UFC 4-030-01
21 December 2007

UNIFIED FACILITIES CRITERIA (UFC)

SUSTAINABLE DEVELOPMENT

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SUSTAINABLE DEVELOPMENT

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 4-030-01
Superseding: None.

Description: This UFC describes the DoD requirements to comply with the sustainable related Federal Mandates including: Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*; *Energy Policy Act* of 2005; *National Environmental Policy Act* (1969); *Clean Air Act* of 1990 (as amended in 1997); *Clean Water Act* of 1973; and *National Energy Conservation Policy Act*.

Reasons for Document: With the government focus on reducing energy costs and facility maintenance and operation costs, sustainable development is growing more important. This document describes the requirements for including sustainable development in DoD projects.

Impact: Properly executed sustainable design projects can:

- reduce energy costs;
- reduce maintenance and operation costs; and
- reduce the negative impact on resources.

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CHAPTER 1 INTRODUCTION

1-1 GENERAL.

This UFC provides instruction, requirements and references to reduce the total cost of ownership of DoD facilities while minimizing negative impacts on the environment, and promoting productivity, health, and comfort of building occupants by implementing sustainable development principles and strategies using an integrated approach.

1-2 PURPOSE.

This UFC provides instruction, requirements and references for customers, DoD facility professionals—including planners, programmers, designers, and maintenance personnel—and architect/engineer and construction contractors to apply sustainable development principles and strategies consistently in DoD facilities throughout their life cycle: from planning to programming and securing of funds, to site selection, design and construction, to documentation and operations and maintenance, and to reuse, or deconstruction and removal. This UFC will help DoD services produce and maintain facilities that comply with existing service policies and federal mandates for sustainable design, energy efficiency, and green procurement of environmentally preferable materials.

This UFC provides the sustainable policies of the Military Departments to satisfy the Office of Management and Budget (OMB) Energy Management Scorecard requirement to demonstrate comprehensive implementation of a sustainability program for green buildings that at a minimum requires sustainability design principles on all new construction and major renovations and is consistent with EPACT 2005 and EO 13123, and/or is implementing the Memorandum of Understanding (MOU) on Federal Leadership in High Performance and Sustainable Buildings (1/24/06) or equivalent.

1-3 SCOPE.

This UFC applies to all new facility projects regardless of funding source, scope or method of accomplishment. The technical requirements recommended herein may not be applicable for projects outside the United States. Requirements in requests for proposals (RFP) and bid documents for such projects should be based on the appropriate ICAO, NATO, ASCC and National criteria to assure a project can be constructed using local materials, products and techniques.

1-4 DEFINITION OF SUSTAINABLE DEVELOPMENT.

In April 1987, the United Nations World Commission on Environment and Development (also known as the Brundtland Commission) defined Sustainable Development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Applied to the built environment, Sustainable Development means to plan, program, site, design, construct, renovate, operate, maintain, deconstruct, and remove facilities in ways that: efficiently use energy, water, and materials; improve and protect built and natural environments; and provide

long-term benefits for occupant health, productivity, and comfort. Within the building industry, Sustainable Development is also known by such terms as “green,” “high performance,” or “environmentally friendly.”

From a military perspective, “sustainability” is the capacity to continue the mission without compromise. It is the ability to operate into the future without decline – either in the mission or the natural and man-made systems that support it.

1-4.1 **Principles**.

Sustainable Development in the built environment includes six fundamental principles:

a. Optimize Site Potential

b. Optimize Energy Use

c. Protect and Conserve Water

d. Use Environmentally Preferable Products and Practices

e. Enhance Indoor Environmental Quality (IEQ)

f. Optimize Operational and Maintenance Practices

1-4.2 **Sustainable Development**.

Sustainable Development incorporates the broadest consideration of environmental and long-term financial impacts of choices and decisions made throughout the facility life cycle. Designing and building sustainably:

a. requires the repair and restoration of past damage to a selected site (Installation Restoration Program [IRP]);

b. minimizes environmental damage of new construction to the site (*Endangered Species Act* [ESA], Environmental Impact Analysis in accordance with *National Environmental Policy Act* [NEPA]);

c. employs conservation of materials and resources (including green procurement) in the design and construction, and during the occupation and use of the project’s areas (*Resource Conservation and Recovery Act* of 1976 [RCRA], Comprehensive Procurement Guidelines [CPG]) and DOD Green Procurement Strategy;

d. assures projects provide a physically and emotionally healthy living and working environment (*Clean Water Act* [CWA], *Clean Air Act* [CAA]); and

e. considers the costs of operating and maintaining the project areas over their projected life both in terms of price and in costs to the environment (Life-Cycle Cost Analysis [LCCA]).

This results in an optimal balance of cost, environmental, societal, and human benefits while meeting the mission and functions of the intended facility or infrastructure.

1-5 **INTEGRATED DESIGN APPROACH**.

The key to providing a sustainable facility is the integrated design process. The integrated design, or "whole building," approach involves interaction between all issues, objectives and life-cycle requirements, as well as between the customer, user, designer, consultants, and contractor early on (in the project planning stage) and throughout the project development process. This fosters a multidisciplinary project team and allows them to develop creative solutions that yield multiple benefits. For a more detailed discussion of the integrated design approach, see *Engage the Integrated Design Process (*http://www.wbdg.org/design/engage_process.php*)* and *Integrated Design* (http://www.wbdg.org/sustainableEO/mou_id.php) and *Appendix H*.

1-6 **SUSTAINABLE DEVELOPMENT TEAM**.

A successful, integrated, multidisciplinary project team for Sustainable Development should include, but are not limited to, these members:

1-6.1 **Customer**, to identify project needs, requirements, and final operating objectives. Ideally, the customer representative should have a broader perspective, as well as responsibility for long-term operations, maintenance, and budgets for the facility and program.

1-6.2 **Planning and Programming Staff**, to provide guidance regarding broad goals and objectives for facility development, including site selection, master planning, and facility space planning. They are involved in identifying and documenting the requirements of a project and getting the funds necessary to award it. Sustainable development features shall be incorporated in DD Form 1391 per paragraph 3-2.3.

1-6.3 **Project Manager**, to provide overall leadership that ensures competing interests are properly balanced and goals ultimately achieved. Attention is paid to quality, schedule, and budget. The Project Manager should be involved in the project in the planning and programming stages, through design, contract award, and construction, and stay with it until completion of the one-year warranty period.

1-6.4 **Sustainability Champion**, who understands sustainability principles and concepts, and how to successfully integrate them into the project. Use of a LEED® Accredited Professional as the sustainability champion (or any primary team members) will meet the requirement for LEED Version 2.2, Innovation and Design Process Credit 2, LEED® Accredited Professional.

1-6.5 **Contracting Representative**, to advise on acquisition related issues, particularly ensuring that architects/engineers and construction contractors with sustainability experience on similar projects are solicited and selected.

1-6.6 **Cost Engineer**, to provide accurate cost data, including sustainable development features, during the programming phase, and throughout the project development process.

1-6.7 **Architects, Engineers, and Designers (A/E)**, including in-house and contractor members to develop plans and specifications that respond to the customer's needs, comply with requirements and regulations, and integrate sustainable development strategies.

1-6.8 **Operations and Maintenance Personnel**, to address long-term operations and maintenance requirements for the facility, and to share and capture maintenance lessons learned. During occupancy, they ensure that facility operations and maintenance are optimized for occupant comfort and health, and resource efficiency.

1-6.9 **Safety and Security Representatives**, to ensure appropriate measures are taken to safeguard people and property. Together with the A/Es and the sustainability champion, they can develop solutions that meet both security and sustainability goals.

1-6.10 **Environmental and Energy Managers**, to help identify targets for energy and environmental consumption, and to ensure projects support meeting or exceeding mandates for their programs.

1-6.11 **Construction Manager**, to advise on constructability related issues and oversee the overall construction process, including deconstruction, reuse and recycling.

1-6.12 **Commissioning Authority (CA)**, to ensure that operation of the final constructed facility meets the customer's project requirements. The CA is involved from planning through design, construction, turnover, and the one-year warranty period. They will also be involved in any re-commissioning activities.

1-6.13 **Construction Contractor**, to build the facility as designed and specified, ensuring quality construction practices (including subcontractors' performance), and proper installation of sustainable development features.

1-7 COMPANION SUSTAINABLE DEVELOPMENT UFC.

Sustainable development involves more than just the design of individual buildings. It is a critical component in the layout of military bases and in the repair of facilities after a disaster. Two UFCs that will incorporate sustainable development principles into Installations and disaster recovery are under development and will be available soon.

1-7.1 UFC 4-030-02, Sustainable Installations: this concise companion UFC will provide DoD planners, designers, contractors, and facility managers with instruction, requirements and references to integrate sustainable development at the installation level. This guide will identify the sustainable opportunities, synergies, strategies,

features and benefits of sustainable installations throughout the life cycle of the facilities, the infrastructure and the installation.

1-7.2 UFC 4-030-03, Sustainable Disaster Recovery Design Guide: this concise companion UFC will provide DoD planners, designers, contractors, and facility managers with instruction, requirements and references to integrate sustainable development into the rebuilding process of facilities and installations after disasters. This UFC will identify the sustainable opportunities, synergies, strategies, features and benefits to improve the facilities and installations rather than simply replacing. It will address the topic as it applies to the programming and design for repairs and new construction, including temporary relief strategies and cleanup of vegetative and construction debris.

CHAPTER 2 DOD SUSTAINABILITY REQUIREMENTS AND MANDATES

2-1 RELEVANT EXECUTIVE ORDERS AND REGULATIONS.

2-1.1 Relevant Executive Orders.

a. Executive Order 13006 of 21 May 1996, *Locating Federal Facilities on Historic Properties in Our Nation's Central Cities*.

b. Executive Order 13150 of 21 April 2000, *Federal Workforce Transportation*.

c. Executive Order 13221 of 31 July 2001, *Energy-Efficient Standby Power Devices*.

d. Executive Order 13327 of 04 February 2003, *Federal Real Property Asset Management*.

e. Executive Order 13423 of 27 January 2007, *Strengthening Federal Environmental, Energy, and Transportation Management* (revokes Executive Orders 13101, 13123, 13134, 13148, and 13149).

f. Executive Orders http://www.wbdg.org/references/exec_orders.php

2-1.2 Relevant Legislation and Regulations.

a. *Energy Policy Act of 2005* amends the *Energy Policy Act of 1992* and provides new requirements for design of new Federal buildings.

b. *Energy Policy Act* of 1992 (EPAct) – Along with its amendments to the National Energy Conservation Policy Act, formed the statutory basis of Federal energy management activities. Subtitle F of the act focused on Federal agency energy management.

c. *National Environmental Policy Act* (NEPA) of 1969, as amended.

d. *Endangered Species Act* of 1973, as amended.

e. *Clean Air Act* of 1990 as amended in 1997.

f. *Clean Water Act* of 1977, as amended.

g. *Resource Conservation and Recovery Act* (RCRA) of 21 October 1976.

h. 10 CFR Part 434 – *Energy Code for New Federal Commercial and Multifamily High-Rise Residential Buildings*.

i. 10 CFR Part 435 – *Energy Efficiency Standards for New Low-Rise Residential Buildings*.

j. 10 CFR Part 436 – *Federal Energy Management and Planning Programs*.

k. *Energy Conservation and Production Act*, as amended.

l. FAR 41 – *Acquisition of Utility Services*.

m. FAR 23.704 – *Application to Government-Owned or -Leased Facilities*.

n. *National Energy Conservation Policy Act* (NECPA):

- NECPA Title VIII, "Incentives for Agencies" (as amended by EPAct)
- NECPA Title VIII, Sections 801 to 804 "Energy Savings Performance Contracts."

2-2 DOD POLICY.

Each of the following memorandums and instruction outlines the manner in which the respective DoD service shall meet sustainable goals. Host Nation and NATO funded projects are exempt from these criteria. Memorandums and instruction are included herein.

2-2.1 Army.

Army Memorandum: *Sustainable Design and Development Policy Update*, 05 January 2006. Signatory: Joseph W. Whitaker, Deputy Assistant Secretary of the Army (Installations and Housing) OASA (I&E) https://eko.usace.army.mil/_kd/Items/actions.cfm?action=Show&item_id=15147&destination=ShowItem .

The Army will transition from SPiRiT (Sustainable Project Rating Tool) to the USGBC LEED® rating system effective with the FY 08 Military Construction Program. All military vertical building construction projects starting with the FY 08 military construction program will achieve the Silver level of LEED-NC (New Construction). This includes all new construction projects regardless of fund source. Horizontal construction, such as ranges, roads and airfield, will continue to incorporate sustainable design and development features to the maximum extent possible. The installation Director of Public Works or the Reserve Component equivalent, supporting Engineer District, designer and constructor will jointly certify the final LEED score and rating. Projects prior to the FY 08 program will continue to use SPiRiT and achieve the Gold level. Projects under the Residential Communities Initiative will continue to meet the Gold SPiRiT rating until LEED Homes is released by USGBC, then Army will adopt LEED Homes for scoring residential housing

2-2.2 Navy and Marine Corps.

NAVFAC Instruction 9830.1, 09 June 2003
(https://portal.navfac.navy.mil/pls/portal/docs/PAGE/DOCS/DOC_STORE_PUB/9830_1.PDF)

NAVFAC Engineering & Construction Bulletin (ECB) No. 2007-05, 26 January 2007
(https://portal.navfac.navy.mil/pls/portal/docs/PAGE/DOCS/DOC_STORE_PUB/ECB2007-05.PDF)

2-2.2.1 For all new construction and renovation building projects over $750K, reduce the life-cycle cost of shore facilities by incorporating sustainable concepts, strategies and features and meet the required LEED level rating, consistent with mission, budget and client requirements. For projects under $750K and projects not covered by LEED for New Construction such as horizontal construction of roadways, runways and piers, incorporate sustainable concepts, strategies and features to the fullest extent possible.

2-2.2.2 The FY07 and prior year projects are funded without any programmed amount for compliance with EPAct 2005. For projects with design starts and RFP preparations started prior to 3 January 2007 follow energy performance requirements as defined in current contracts and criteria to meet ASHRAE 90.1 - 2004 as the minimum energy performance target. LEED Certified-level rating is the minimum goal for applicable projects.

2-2.2.3 The FY08 projects are funded without any programmed amount for compliance with EPAct 2005. For FY08 and all other projects with design starts and RFP preparations started on or after 3 January 2007 comply with EPAct 2005 as codified under US Code 10 CFR 433 & 435 requirements for all new buildings regardless of fund source. If the project funding or life-cycle cost-effectiveness will not achieve the maximum energy efficiency goal of EPAct 2005, evaluate alternative designs at successive decrements below 30% to the optimal level that is life-cycle cost-effective. Do not decrease scope. Include energy analysis compliance statements in contract documents as described in ECB 2007-05, Enlocure (4). LEED Certified-level rating is the minimum goal for applicable projects. To encourage higher levels of performance, include the following in Requests for Proposals:

a. Design-Build projects: Include a technical evaluation factor for providing a facility that achieves a LEED Silver-level rating performance.

b. Design-Bid-Build projects: Include achieving a LEED Silver-level rating performance as an additive bid item or option.

2-2.2.4 The FY09 and beyond projects for new buildings must comply with EPAct 2005 as codified under US Code 10 CFR 433 & 435 requirements regardless of fund source. Projects must also comply with the Executive Order 13423, *Strengthening Federal Environmental, Energy and Transportation Managemen*t that incorporates the *Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding* for establishing sustainable development goals. ECB 2007-05,

Enclosure (2) describes LEED credits as minimum measures that conform to the requirements above. LEED Silver-level rating is the minimum goal for applicable projects. The project team will determine if this goal is attainable based on project attributes such as facility type and site constraints.

Building systems and features required for meeting the EPAct and sustainable development requirements will be included in the DD 1391 in accordance with guidance provided in ECB 2007-05, Enclosure (3). For new buildings procured by reimbursable or Special Project funding, ensure there is adequate funding for meeting the mandatory energy performance levels.

During RFP development, include energy analysis compliance statements to contract documents as indicated in ECB 2007-05, Enclosure (4).

2-2.3 **Air Force**.

Air Force Memorandum: *Air Force Sustainable Design and Development (SDD) Policy*, 31 July 2007. Signatory: Maj Gen Del Eulberg, USAF, The Civil Engineer, DCS/Logistics, Installations & Mission Support, http://www.afcee.brooks.af.mil/eq/programs/progpage.asp?PID=27

2-2.3.1 Beginning in FY09, all MILCON vertical construction projects, with climate control, will be designed to be able to achieve LEED Silver certification. All other MILCON projects will incorporate sustainable principles to the maximum extent possible and achieve the benchmark levels indicated in the Air Force SDD Policy memorandum.

a. Projects not selected for LEED registration/certification will be reviewed by a LEED Accredited Professional (AP) and found to be compliance with the Air Force SDD Policy.

b. Sustainment, restoration and modernization projects will consider incorporation of sustainable principles when financially feasible.

2-2.3.2 New buildings and major renovations must comply with EPAct 2005 as codified under US Code 10 CFR 433 & 435 requirements regardless of fund source. Projects must also comply with the Executive Order 13423, *Strengthening Federal Environmental, Energy and Transportation Managemen*t that incorporates the *Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding* and *Guiding Principles* for establishing sustainable development goals. The Air Force SDD Policy memorandum provides guidance as to LEED credits as minimum measures that conform to the requirements above.

2-2.3.3 Status of the implementation of the policy will be monitored by a LEED AP through the phases of the project. Reporting of status will be, at a minimum, at the programming/customer concept document, design charette, final design, and beneficial occupancy phases of the project. The sustainable development and implementation process will continue throughout the life of the facilities.

2-2.4 **USGBC LEED Certification**.

The Army does not require their projects to be registered with USGBC and have the LEED submittal documentation certified by USGBC to meet the required LEED rating. The Air Force requires 5% (by project cost) of FY09 MILCON vertical construction (with climate control) and 10% of FY10 and beyond be registered with USGBC and have the LEED submittal documentation certified by USGBC to meet the required LEED rating. The Navy requires their FY 09 and beyond new construction and renovation building projects over $750K to be registered with USGBC and have the LEED submittal documentation certified by USGBC to meet the required LEED rating.

2-2.5 For a detailed description of LEED® and SPiRiT refer to Appendix B.

2-3 **OTHER RELEVANT DOD DOCUMENTS**.

a. Tri-Services Memorandum of Agreement (MOA) on "Criteria/Standards for Economic Analyses/Life-Cycle Costing for MILCON Design" of 1991.

b. Memo on New DoD Pollution Prevention Measures of Merit of 13 May 1998.

c. Memo establishing DoD Green Procurement Program, 27 Aug 2004.

2-4 **FEDERAL DOCUMENTS**.

a. Executive Order 13423 Technical Guidance for Implementing the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings http://www.wbdg.org/sustainableEO/ .

2-5 **DOD AND OTHER SUSTAINABLE DEVELOPMENT WEB SITES**.

a. Whole Building Design Guide http://www.wbdg.org .

b. NAVFAC Engineering Programs Office http://www.wbdg.org/references/pa_dod_cieng.php .

c. USACE Sustainable Design and Development http://www.cecer.army.mil/sustdesign/ .

d. AFCEE Center for Environmental Excellence http://www.afcee.brooks.af.mil/ .

e. DOE/FEMP

- http://www.eere.energy.gov/
- http://www.eere.energy.gov/femp/

f. GSA Sustainable Design Program

- http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_OVERVIEW&contentId=8154&noc=T

CHAPTER 3 DOD SUSTAINABLE PROJECT DEVELOPMENT PROCESS

3-1 THE DOD PROJECT DEVELOPMENT PROCESS.

This Chapter describes sustainable requirements for each stage of the project development process. While there will be variations in the project development process based on the specific project and Military Department, this UFC refers to the major project stages: Planning and Programming, Design, Construction, Operation/Maintenance and Deactivation.

3-2 IMPLEMENTING SUSTAINABILITY IN THE PLANNING AND PROGRAMMING STAGE.

Project planning and programming is the first stage of the facility development process. Decisions made during this stage set the project tone and direction, and have the greatest impact upon facility life-cycle costs. Establishing project sustainable development goals, defining the process to achieve them, and developing a clear understanding of the expected results will enable project success.

3-2.1 Documentation.

Sustainable development principles should be taken into consideration in developing the project documentation during this stage. This includes the DD Form 1391 (see paragraph 3-2.3 for more information), a parametric cost estimate, site plans, an environmental impact statement and a LEED project checklist. For Air Force projects, a Certificate of Compliance certifying that required planning actions have been accomplished, including a statement that sustainable goals and design strategies were considered, is also required.

3-2.2 Sustainable Development-Related Action Items.

These actions must take place early in the project development process using an Integrated Team approach.

3-2.2.1 **Define Responsibilities and Procedures**. Within the sustainable development team identified in paragraph 1.8, assign responsibilities for managing the project and the sustainability program. Use formal or informal partnering within the team to ensure early buy-in, commitment, and understanding of project sustainability goals. At an initial meeting, the team should discuss procedures used to exchange information throughout the life of the project.

3-2.2.2 **Conduct a Project Planning/Programming Charrette.** A planning/programming charrette (or scoping and programming charrette) is conducted in the formative stage for future projects. The purpose is to identify and resolve issues of standardization, functionality, location, scope, and cost which might otherwise affect execution of the project. Sustainable development should be one of the issues addressed during the planning charrette. The objective deliverable of the planning/programming charrette is the Department of Defense (DD) Form 1391.

Planning charrettes do not eliminate a need for the much more detailed Design Charrette conducted with Planning and Design funding later in the project.

3-2.2.2.1 **Applicability**. Planning/programming charrettes should be conducted by all services to address all issues related to the execution of a project, including sustainability.

3-2.2.2.2 **Funding**. Identify the need for a planning charrette far enough in advance to ensure that approvals and O&M funding to conduct them are in place by the beginning of the Fiscal Year.

3-2.2.2.3 **Participants.** As a minimum, the Customer (User), Engineering representatives (LEED accredited or knowledgeable with LEED or SPiRiT), operations and maintenance personnel from the appropriate shops (electrical, mechanical, etc), and the Acquisition Agent (Corps of Engineers or NAVFAC) must reach agreement on a design strategy for sustainable development and for incorporating green procurement requirements. For both design-bid-build and design-build contracts, construction authority should also be represented. Representatives for data and telecommunication, security, force protection, fire department, transportation management, and others relevant to the project type should be included whenever possible. Contracting personnel would be helpful for identification of current green procurement issues.

3-2.2.2.4 **References**.

3-2.2.2.4.1 **Army**. DD Form 1391 Preparation Planning Charrette Process (Text and Appendix A - E), ECB No. 2003-8, 06 November 2003.
http://www.wbdg.org/ccb/browse_cat.php?o=31&c=214

3-2.2.2.4.2 **Navy**. NAVFAC employs the Functional Analysis Concept Development (FACD) process
https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NAVFACLANT_PP/LANT_BL/LANT_CI/LANT_CI4/TAB54857/VE_FACD_CHARETTE.PDF. It starts with the identification of required functions and proceeds through identification of design alternatives (concept design), risk analysis, development, presentation, and approval. The process is iterative and follows the Plan, Do, Check, Act process. The FACD workshop includes the designers, occupants or users of the facility, and owner (major claimant). At the end of the workshop, all stakeholders sign off on the concept design, providing the architect with clear direction to proceed to the next stage of design

3-2.2.2.4.3 **Air Force.** USAF Project Manager's Guide for Design and Construction, Chapter 5 – Project Definition and Contract Development, June 1, 2000. Air Force Sustainable Facilities Guide http://www.afcee.brooks.af.mil/dc/dcd/arch/rfg/index.html
Air Force Institute of Technology (AFIT) Civil Engineering Services School Courses
http://cess.afit.edu/

3-2.2.2.4.4 **Whole Building Design Guide.** Engage the Integrated Design Process Planning and Conducting Integrated Design (ID) Charrettes http://www.wbdg.org/design/charrettes.php?r=engage_process-i

3-2.2.3 **Determine Project Requirements Based on User Input and Develop Project Sustainability Goals.** Identify and describe the project's sustainability goals as part of the project requirements. The project requirements will dictate how aggressively each sustainable development principle can be pursued. In particular, the environmental needs of each space (e.g. the desirability of daylighting, specific temperature/humidity conditions, acoustical requirements, etc.) must be considered. Sustainability goals should consider the maintenance strategy for the project, as well as safety and security considerations. Where practical, the goals should include measurable results (i.e., degree of energy consumption), which can be measured once the facility is completed. The goals should address:

a. environmental impacts;

b. energy and water conservation;

c. use of renewable energy sources;

d. use of environmentally preferable materials;

e. use of recycled materials;

f. life-cycle costs;

g. indoor environmental quality;

h. employee safety and security;

i. operations and maintenance considerations including availability, ease of maintenance, access, and safety;

j. commissioning;

k. construction and demolition waste management; and

l. deconstruction and disposal.

3-2.2.4 **Identify Certification Goals.** Specify the LEED® or SPiRiT rating level desired, and identify if the project will be registered with USGBC and the LEED documentation submitted for certification. NAVFAC and Air Force housing projects must be submitted for ENERGY STAR® certification.

3-2.2.5 **Develop Evaluation Criterion for Professional Services.** Establish an evaluation criterion that ensures architect-engineers, design-builders, construction

contractors, commissioning agents, and other consultants are selected based upon their experience and proven success with sustainability concepts on similar projects.

3-2.2.6 **Establish the Sustainability Budget.** Set the project budget based on the design alternatives with the lowest total life-cycle cost. Identify the budget requirements to achieve the sustainability goals. Some sustainability concepts may increase the first costs of the project. The project team should conduct a life-cycle cost analysis to demonstrate the merit for incurring these additional first costs. See paragraph 3-2.3 for information on how to include sustainability in DD Form 1391 for project funds.

3-2.2.7 **Establish the Commissioning Plan.** The commissioning plan captures important decisions about commissioning and ensures that everyone understands their responsibilities. The commissioning plan should incorporate or reference the project requirements; identify the project's commissioning goals; identify the Commissioning Authority (CA) and commissioning team members and their roles; establish the scope of commissioning in terms of systems and equipment; outline the major commissioning steps during design, construction, activation and operation; and discusses lines of communication and authority. Identify acquisition strategy for commissioning. For large and/or high risk projects, the CA should be hired directly by the government. For lower risk projects, the CA may be hired through the prime contractor. Small, low risk projects may use the contractors Quality Control Manager as the CA.

3-2.2.8 **Evaluate Siting Alternatives.** Identify and evaluate possible siting alternatives, considering: building reuse; storm water and erosion; building footprint, orientation, massing, form, and height; existing landscaping; access to public transportation; natural habitat; solar gain; local and/or renewable resources; and security. The impact on the existing community should also be considered when siting a project.

3-2.2.9 **Conduct a Preliminary Energy Analysis.** The conceptual design should be energy modeled (using O&M Funding), cost modeled, and then revised to ensure the optimum design and cost solution for the project. Cost models can help balance project costs by identifying potential trade-offs where necessary to bring overall project cost in line with DoD cost criteria.

3-2.2.10 **Determine the Overall Maintenance Philosophy.** The maintenance philosophy considers an appropriate mix of reactive, preventive, predictive, and proactive maintenance strategies. Customers and facility managers should address reliability and availability issues, which may affect sustainable development decisions. Final disposal should also be considered in maintenance requirement assessment.

3-2.3 **DD Form 1391**.

Responding to E.O. 13123, in 2003 the Joint Services stated that sustainable development (SD) is a requirement for MILCON projects. How to prepare the DD Form 1391 to include sustainable development is rapidly evolving. The greatest progress has

happened since all services have begun to charrette the development of the 1391 package as discussed in paragraph 3-2.2.2. The final 1391 documentation differs slightly from service to service, but all the same elements get included. New instructions for DD 1391 preparation will likely result from the issuance of Executive Order 13423 of January 2007 which revoked E.O. 13123. The Navy has issued direction for 1391 development in Enclosure 3 of the NAVFAC Capital Improvements Engineering & Construction Bulletin (ECB) No. 2007-05 dated 26 January 2007.

3-2.3.1 **Language in DD Form 1391.** The DD Form 1391 submittal process is the Defense Department's process for project planning and programming. In writing 1391s for (MILCON, MCA) projects, highlighting an aspect of a project as "sustainable" could be construed to mean that only that aspect will be sustainable versus the entire project. Also, the term "sustainable development", whether correct or not, is associated with the cause of additional costs. Therefore, use of "sustainable" or "sustainability" or other similar language is not acceptable and should not be used in Blocks 1-9 of the 1391.

Per NAVFAC ECB No. 2007-05, in Block 9 for FY09 projects include a line item titled "EPAct 2005 & LEED® Silver Compliance". In Block 10 of DD 1391, explanation of sustainable design features may be added. Each sustainable line item should be broken out in the Budget Estimate Summary Sheet. For an overview of the DD Form 1391 Process, see Appendix I.

3-2.3.2 **Cost Accounting for Sustainable Development in DD Form 1391.** Competition for funding begins at the installation level, and proceeds through Headquarters to Pentagon level. There has been no restructuring of Federal or DoD cost estimating programs to accommodate special or higher overall project costs whether attributable to sustainable development or any other including Anti-Terrorist Force Protection (ATFP). Since all Services compete for the same limited federal funding, approving authorities will reject 1391s showing cost additions for the design (A/E services) or construction of a sustainably developed project that are out of line with the published scope and cost criteria for the region where the project is to occur. To integrate sustainable development into a project without significantly impacting design or construction costs, all Services have developed programs to charrette the writing of the DD Form 1391. By using an integrated "whole building" design approach, programmers are keeping costs in alignment with existing cost criteria.

During the planning and programming of DD Form 1391, decisions are made for the preferred project development process: Design-Bid-Build or Design-Build. Sustainable strategies following LEED or SPiRiT criteria are formulated based on which process is identified. For example, in a design-bid-build scenario, the team may indicate specifics of how criteria are to be met: on-site grey water reuse, retention pond, percentage of daylight, energy costs, etc. In a design-build scenario, performance within budget will be specified in a Request for Proposal, such as "Meet SPiRiT Gold" or "Meet LEED Silver"—without detail or specifics of how to achieve it. Respondents will each specify how they intend to meet the criteria.

3-2.3.3 **Specific Sustainable Development Requirements in DD Form 1391.**

3-2.3.3.1 **Army and Army Corps of Engineers.** Per Department of the Army Memorandum dated 27 April 2007 on *Sustainable Design and Development Policy Update*, paragraph 3.d. Programming requires the following. Documenting sustainable design and development (SDD), EPAct05, and EO 13423 costs on DD Form 1391,Military Construction Project Data, in accordance with DoDI 4170.11, will commence beginning with the FY)(Military Construction Program. Under the primary facilities cost, a separate line item will be added labeled "SDD & EPAct05" (under DD Form category code 00005). The cost will include the actual costs associated with achieving this policy. If the costs are undetermined at the time the DD Form 1391 is developed, they will be programmed at 2 percent of the primary facility cost (facilities with climate control systems only) until they are determined. When the costs exceed 2 percent, an explanation will be provided in the description of the proposed construction under block 10 of the DD Form 1391 describing the SDD, EPAct05 and/or EO 13423 features (such as distributed generation systems including renewable systems, solar electric, solar lighting, geo (or ground coupled) thermal, wind turbines, biomass, as well as other generation systems suich as fuel cell, cogeneration, or highly efficient alternatives) included in the design. For DD Forms 1391 with multiple facilities, the SDD & EPAct05 primary line item will include sub-line items for each facility's SDD and EPAct05 costs.

3-2.3.3.2 **Navy.** NAVFACINST 11010.45 is the programming instruction for the Navy. The Navy refers to initial developments in the 1391 process as Scoping (vice charrette), which is the process of establishing facility size (i.e. scope). It is during this earliest portion of the process where strategies for identifying LEED requirements that can be reasonably applied to a project are discussed. The overall cost of the facility must remain in accord with the DoD Pricing Guide criteria in order to remain competitive. The NAVFAC Capital Improvements Engineering and Construction Bulletin, No. 2007-05 dated 26 January 2007 provides guidance for incorporating energy efficiency measures into a project that exceed the Primary Facility Cost.

3-2.3.3.3 **Air Force.** Military Construction Programming is covered in AFI 32-1021. In the Certificate of Compliance checklist (found in Chapter 2 of AFI 32-1021), which is attached to the complete 1391 package as 1391C, is checklist item 32, "Sustainable Design and Development." Item 32 contains three statements:

a. Project includes sustainable development concepts.

b. Project will qualify for LEED® certification.

c. Project does not include sustainable development concepts.

The applicable statements must be checked before the Base Engineer and Installation Commander sign off.

Per the Air Force SDD Policy memorandum signed 31 Jul 07. costs associated with the SDD strategy for projects will be documented as a separate line item, identified as "SDD

& EPAct05", under primary facility costs, on the DD Form 1391 and will be no more than 2% of the primary facility cost unless detailed costs are determined. When the costs exceed 2%, an explanation will be provided in block 10 of the 1391.

3-3 IMPLEMENTING SUSTAINABILITY IN THE DESIGN STAGE.

The design stage begins with selecting Architect-Engineer or Design-Builder and Commissioning Authority (if separate entity) with proven sustainability experience. During the design stage, the team creates a basis of design document and a specific design with project plans and specifications that forms the basis for construction (for design-build projects) or a construction contract award (for design-bid-build projects). Decisions made during this stage regarding materials, technologies, and systems for the project will significantly affect its degree of sustainability. Once the design proceeds toward completion, opportunities to impact the life-cycle costs for the facility diminish rapidly.

3-3.1 **Documentation**.

When products are detailed into a drawing, a cut-sheet of each product including all of its properties relating to sustainable development (e.g., percentage recycled content; level of volatile organic compounds, etc.) should be added to a file, which can be used by the specification writer and later by the commissioning agents. At the end of this stage, the project team must ensure that sustainable development goals and selected strategies are incorporated and clearly articulated in the project documentation, including final designs (with sustainable development goal narratives and updated LEED® or SPiRiT project checklist), specifications (see Appendix K for information on green specifications), adjusted cost estimates, and refined commissioning plan.

3-3.2 **Sustainable Development-Related Action Items**.

3-3.2.1 **Select an Architect-Engineer or Design-Builder, Commissioning Authority, and Other Consultants with Sustainability Experience**. Three actions are required to ensure the selection of architects-engineers, design-builders, and consultants with sustainable development experience:

a. Include sustainable development experience in the selection criteria published in the FedBizOpps advertisement.

b. Make sustainable development experience a deciding factor in the selection by "weighting" it appropriately (when compared to the other selection criteria used in the process).

c. Assist personnel on the selection board in understanding the basics of sustainable development, so they can interpret and evaluate the proposals effectively.

3-3.2.1.1 **References**.

a. Executive Order 13423 Technical Guidance: Selecting A/E Contractors http://www.wbdg.org/sustainableEO/mou_sc.php

b. Air Force Sustainable Development website: http://www.afcee.brooks.af.mil/eq/programs/progpage.asp?PID=27

c. WBDG

- Select Appropriate Design Professionals http://www.wbdg.org/design/select_professionals.php

d. UFC/Other DoD Criteria

http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 1-300-09N Design Procedures
- UFC 3-100-10N Design: General Architectural and Interior Design Requirements
- UFC 3-200-10N Design: General Civil/ Geotechnical/ Landscape
- UFC 3-500-10N Design: General Electrical Requirements
- NAVFAC Design Build Master, http://www.wbdg.org/ndbm/DesignGuid/DesignGuid.html?Tab=DesignGuid

3-3.2.2 **Conduct a Design Charrette.** The design charrette is an intensive process where designers, users, and installation decision-makers team together to gather information, define the project requirements both in written and visual form, and focus their input on the design of the project. It is an extremely effective tool for selecting the optimal alternative among the options identified during the planning and programming stage. The design charrette will ensure appropriate options are reviewed; allow debate regarding competing project priorities; ensure a good project cost estimate base is established; and bring the team into alignment prior to moving forward in the project development process. The LEED or SPiRiT project checklist can be used to structure discussions related to sustainable development during the design charrette and throughout the design process.

3-3.2.2.1 **Applicability**. Design charrettes are recommended for all services. The duration of the design charrette can vary from three days to two weeks, depending on the complexity of the project.

3-3.2.2.2 **Funding**. Planning and Design funding may be used to conduct a design charrette.

3-3.2.2.3 **Topics.** The broad topics covered in the design charrette related to sustainable development include: the building's location and microclimate; orientation and envelope; interior spaces; fenestration, daylighting, and lighting; energy and water needs; heating, ventilating, and air-conditioning (HVAC) equipment; landscaping and exterior spaces; and monitoring equipment and controls, if applicable.

3-3.2.2.4 **Participants.** The design charrette is led by the Architect/ Engineer contractor (A/E) or Design/Builder (D/B) and attended by the full project team (e.g., customers, engineers, planners, environmental specialist, facility managers) and all other design consultants.

3-3.2.2.5 **References.**

a. **WBDG**. Planning and Conducting Integrated Design Charrettes http://www.wbdg.org/design/charrettes.php

b. **Army.** Design Charrette Guidance for Army Military Construction (MILCON) Programs, ECB No. 2002-13. http://www.wbdg.org/ccb/browse_cat.php?o=31&c=214

c. **U.S. Department of Energy, Building Technologies Program.** Design Charrette. http://www.eere.energy.gov/buildings/info/design/wholebuilding/conductdesign.html

d. **Navy.** Functional Analysis Concept Development (FACD) process https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NAVFACLANT_PP/LANT_BL/LANT_CI/LANT_CI4/TAB54857/VE_FACD_CHARETTE.PDF.

3-3.2.3 **Select Sustainable Development Strategies to Meet Project Goals.** Consider sustainable development strategies, technologies, and materials to maximize site potential, minimize energy consumption, protect and conserve water, have environmentally preferable characteristics, enhance indoor environmental quality, and facilitate effective and efficient maintenance and operations, as well as meet other project goals such as aesthetics and security. The design team should use energy modeling and daylighting analysis to refine the design, and life-cycle cost analysis to provide a primary basis for decision making. See Appendix C for information on specific sustainable development strategies, technologies, and materials. Assign a project team member responsible for each of the LEED credits being pursued.

3-3.2.4 **Document Design Decisions.** The project team should have established a process for recording information about project decisions at its initial planning meeting. It is very important to document decisions made throughout the project development process, especially where trade-offs must be made between competing priorities. The LEED or SPiRiT scorecard and narrative, updated periodically throughout the design process, should be used to track strategies and progress towards achieving the desired sustainable development goals.

3-3.2.5 **Conduct Design Reviews.** The design process typically includes project reviews at predetermined stages in the preparation of design development/construction documents. During these reviews the project team should assess whether sustainability enhancements and considerations have been properly applied throughout the design process.

3-3.2.6 **Continue the Building Commissioning Process.** At the beginning of the design phase the Commissioning Authority guides the project team in updating and completing the project commissioning plan. The commissioning plan includes actions required to achieve the owner's project requirements. As the requirements are translated into design documents, the designers create a "basis of design documentation" to convey the assumptions made while completing the design. Commissioning specifications detail the construction contractor's responsibilities for commissioning work, including documentation, testing, and final acceptance.

Projects using the commissioning process require additional design generated documents beyond the traditional plans and specifications. The design team shall create one-line diagrams of all systems (similar to electrical one-line diagrams), control logic diagrams (piping & instrumentation diagrams (P&ID)) for control systems, interface wiring diagrams of communication links between systems, basis of design documentation, and design calculations. The design team shall also ensure appropriate commissioning specifications are developed for: appropriate accommodations for testing and monitoring data collection; and the ability of selected equipment and systems to operate under all loads and conditions.

3-3.2.7 **Update Cost Estimates.** Check projected costs against project budget to ensure that the design, including the sustainability features, falls within the budget. Sustainable projects that exceed budget are not acceptable.

3-4 IMPLEMENTING SUSTAINABILITY IN THE CONSTRUCTION STAGE.

During the construction stage many opportunities to stray from a solid, sustainable design will present themselves. To keep on course, ensure contractors (or design/builders) and subcontractors with proven sustainability experience are selected. To do so, ensure language in the solicitation and contractor qualifications are properly worded to require contractors to demonstrate their sustainable development experience. During construction, the building commissioning aspect of sustainability moves to the forefront, as the team attempts to convert plans and specifications into a fully functioning and sustainable facility with the ultimate goal of meeting the defined project goals and requirements. Important sustainable development issues to address in the construction phase include:

a. Procurement;

b. Site/Environment;

c. Material Selection;

d. Waste Prevention;

e. Recycling;

f. Energy;

g. Building and Material Reuse;

h. Construction Technologies;

i. Health and Safety; and

j. Indoor Environmental Quality.

Refer to the Pentagon Renovation and Construction Office's Field Guide to Sustainable Construction http://renovation.pentagon.mil/sustainfieldguide.htm.

3-4.1 **Documentation**.

Prior to construction, the construction contractor should submit a Construction Waste Management Plan, an Indoor Environmental Quality Plan for construction and prior to occupancy, and updated cost data for materials/products/assemblies. Once the project is awarded for construction, the construction contractor should be obligated to present submittals of all products, equipment, and processes. Products and processes should be documented for future certification purposes. Where substitutions are made, new data sheets should be added to the growing file to prove the case for LEED, SPiRiT, and/or ENERGY STAR certification. At construction completion, the construction contractor should submit final documentation for LEED, SPiRiT, and/or ENERGY STAR certification.

3-4.2 **Sustainable Development-Related Action Items**.

3-4.2.1 **Conduct a Pre-Bid Conference.** The Architect/Engineer contractor (A/E) and the Project Manager (PM) should hold a pre-bid conference for all interested bidders. In that conference key aspects of the design and unusual features are described. This meeting should be used to present the sustainable design goals to the bidders, and to introduce any unusual sustainable design strategies, so that pricing will be more accurate. The pre-bid conference could also encourage sustainability innovation by the bidding contractors with a separate section (in the pricing schedule) offering these innovations and cost reductions. These need to be separated to avoid disparity between tenders but could be a major factor in bidder selection.

3-4.2.2 **Hire Construction Contractors with Sustainability Experience.** Many construction contracts are awarded to the lowest responsive, responsible bidder in a firm, fixed priced, sealed bid approach. If permissible, the team should consider an award based upon best value, considering price, past performance and experience, and other technical factors as the basis for award. If a best value process is used, one technical criterion to include in the evaluation process is the contractor's experience and

understanding of sustainable development, maintainable design, and the building commissioning process.

3-4.2.3 **Conduct a Pre-Construction Partnering Session.** The partnering session provides an opportunity to bring the newly selected construction contractor onto the sustainability team, and to establish working relationships and project expectations. All team members will begin to understand the project objectives. Process issues should be discussed, including submittal and shop drawing reviews and approvals, conduct and timing of functional performance testing, access to the project site by operations and maintenance (O&M) personnel for orientation visits, and other required building commissioning efforts.

3-4.2.4 **Require an Indoor Environmental Quality Plan.** To reduce negative impact on the building and building occupants, especially during renovation projects, require an Indoor Environmental Quality Plan. With regard to construction, the IEQ plan should include requirements for protecting the building materials, sequencing material installation, ventilation requirements, and keeping the site clean and hazard free.

3-4.2.4.1 **References**.

a. Field Guide for Sustainable Construction, Pentagon Renovation and Construction Program Office http://renovation.pentagon.mil/sustainfieldguide.htm .

b. Executive Order 13423 Technical Guidance Protecting IAQ During Construction http://www.wbdg.org/sustainableEO/mou_iaq.php.

c. Sheet Metal and Air-Conditioning Contractors Association. IAQ Guidelines for Occupied Buildings under Construction. http://www.smacna.org/bookstore/ .

3-4.2.5 **Require Site Conservation Practices.** The construction contract should require the contractor to preserve the integrity of the site and existing habitat. Enforcement of these requirements (erosion control, tree protection and cutting, etc.) is important to sustaining the existing site.

3-4.2.6 **Require a Waste Management Plan.** The construction contract must emphasize minimizing wastes generated during the construction process. This is reflected in the construction contractor's Construction Waste Management Plan and submitted to the Project Manager for approval. The design and subsequent construction should emphasize source reduction, materials reuse, and waste recycling. Source reduction is most relevant to new construction and large renovation projects and involves reduced "waste factors" on materials ordering, tighter contract language assigning waste management responsibilities among trade contractors, and value-engineering of building design and components. During renovation and demolition, building components that still have functional value can be reemployed on the current project, stored for use on a future project, or sold on the salvage market. Recycling of materials can be accomplished whenever sufficient quantities can be collected and

markets are readily available. Management and minimization of hazardous materials disposal is also very important. In accordance with DoD Measures of Merit (MoM) for solid waste reduction, construction contractors must be required to track and report the amount of solid waste that is recycled and the amount that is disposed. This information is reported to the installation environmental management office for reporting to higher headquarters. Refer to the DoD and Air Force MoMs at http://www.afcee.brooks.af.mil/eq/debris/mom/index.asp . Also refer to Construction Waste Management http://www.wbdg.org/design/cwm.php and Executive Order 13423 Construction Waste http://www.wbdg.org/sustainableEO/mou_cw.php

3-4.2.7 **Establish a Submittal Review and Approval Process.** Requiring the contractor to provide materials that comply with project specifications and support project sustainability requirements is critical. The project team should have a clearly established review and approval process to ensure the appropriate team members participate in the review and approval process, without unduly delaying the construction contractor. Depending upon the material, various members of the team may wish to participate in the review, including O&M staff, the Commissioning Authority, energy, safety, security or environmental representatives. Materials should be evaluated to ensure they meet environmentally preferable product requirements, energy consumption requirements, maintainability requirements (standardization, complexity, maintainability), and functional requirements, and are not replaced with inferior alternates. Where appropriate, the Installation may have a preferred supplier list or request proprietary items to support overall maintainability or environmental objectives.

3-4.2.8 **Update LEED or SPiRiT Project Checklists.** The LEED or SPiRiT project checklist and narrative should be updated and reviewed periodically throughout the construction process to ensure the desired rating level will be achieved.

3-4.2.9 **Schedule Periodic Site Walk-Throughs.** Coordinate periodic site walk-throughs to familiarize O&M personnel with the facility during construction and before components become hidden by wall, ceiling, or floor coverings. Special attention should be paid to accessibility and maintainability issues. A walk-through during the final acceptance of punch list items should include the facility O&M team to ensure operational questions have been asked of the construction contractor.

3-4.2.10 **Perform Building Commissioning During Construction.** Commissioning activities during construction include scheduling and coordinating designated submittal reviews, functional performance testing, finalizing functional performance test procedures and data forms for later use, observing construction for commissioning-related issues (such as location and sizing of control components), performing static tests, and beginning operator training. This sets the stage for energizing and functionally testing systems prior to occupancy. The construction contractor is responsible for conducting the tests, and the commissioning authority verifies and documents the results. Ultimately, the commissioning authority must certify that building equipment and systems meet the customer's performance requirements.

3-4.2.11 **Develop the Operations and Maintenance Program.** Throughout the construction phase the sustainability team should be tailoring the O&M program to support the installation's maintenance philosophy. The construction contractor is required to provide O&M manuals and information from their equipment suppliers. Contractors must provide information electronically, and with enough detail to support interface with the Installation's building automation system/environmental management system (BAS/EMS). Manufacturer warranty information and manuals should be compiled for easy access and interface with the BAS/EMS system.

3-4.2.12 **Conduct Operations and Maintenance Staff Training.** O&M training must take place during construction to ensure the O&M staff and custodial contractors understand building systems and proper procedures and use of sustainable development features such as operable windows and lighting controls, and are ready to operate the facility upon final completion. Designers, contractors, and the commissioning authority participate in training to convey the knowledge each of them has gathered during the project. Review training materials and the qualifications of trainers to ensure effective delivery. Videotape formal training sessions for future use. Insure participation from maintenance personnel.

3-4.2.13 **Establish O&M Baselines.** Establish a baseline of operating parameters for the operations and maintenance program. Consult metrics and lessons learned from previous projects, as well as, industry norms and manufacturer specifications. Use this baseline to assess facility degradation during the life of the facility, and to trigger appropriate maintenance or repair activities in the future.

3-5 IMPLEMENTING SUSTAINABILITY IN THE OCCUPANCY STAGE.

No matter how sustainable a building may have been in its planning, design, and construction, it can only remain so if it is operated responsibly and maintained properly. The use of toxic cleaning products can deteriorate indoor environmental quality; failure to test sensor control points can compromise energy efficiency; and poor training can lead to early system failures. Buildings must be operated and maintained with the security, health, comfort, and productivity of their occupants in mind, and with an understanding of the next generation's need to adapt, reuse and recycle buildings and building components.

3-5.1 Documentation.

At a minimum, the following should be provided to the Customer and to the Engineering and Maintenance/Operations staff at the beginning of the Occupancy Stage: Building Operations and Maintenance Plan, including specifications for non-toxic, environmentally preferable cleaning products, and operations recycling plan; and complete documentation for all products and systems incorporated into the facility. Facility performance evaluations should be conducted ten to eleven months after full occupancy to gauge user satisfaction and to identify and resolve latent defects within the one year warranty period. Data from the facility's building automation

system/environmental management system should be recorded and used to fine-tune equipment operations.

3-5.2 **Sustainable Development-Related Action Items**.

3.5.2.1 **Register Projects and Obtain Certification.** Ensure projects registered with USGBC, SPiRiT and Energy Star and certifications have been received for projects submitted for LEED, SPiRiT, and/or ENERGY STAR certification.

3-5.2.2 **Implement the Building Operations and Maintenance Plan.** Operate and maintain the facility as specified in the Building Operations and Maintenance Plan. Adjust plan and procedures appropriately based upon actual experience. Collect data regarding equipment failures and causes, and perform appropriate failure analyses to determine required adjustments to existing O&M programs. Use condition feedback data and lessons learned as well.

3-5.2.3 **Optimize Sustainable O&M Practices.** Protect and conserve water by using environmentally friendly landscaping practices; planting native species to minimize irrigation, fertilization, and pest control requirements; and using gray water systems for irrigation. Use environmentally preferable products for O&M and user requirements, as mandated by the Green Procurement Program (see paragraph 3-2.7.) Use cleaning products and supplies that are resource-efficient and non-toxic. Ensure reuse and recycling programs are properly implemented to eliminate off-site waste disposal. Enhance indoor environmental quality (IEQ) by using properly sealed vacuum cleaners, regularly cleaning HVAC ducts and filters, and if installed, using air quality monitors to assess IEQ. Enhance energy conservation by insuring that energy conservation systems and procedures are operating optimally. Verify that scheduling of lighting and equipment is coordinated with actual building and occupant schedules.

3-5.2.4 **Perform Measurement and Verification (M&V).** M&V should be performed periodically by the Facility Manager working in coordination with the Environmental group. The Facility Manager should evaluate energy, daylighting, indoor air quality, and water conservation solutions using the M&V protocol established by the rating organization, to enable a comparison of actual performance against baseline performance metrics. M&V should be coordinated with a continuous commissioning plan to ensure optimal performance.

3-5.2.5 **Conduct User Training and Satisfaction Interviews.** Similar to trainings for O&M staff, building occupants should be trained on sustainable development principles and the sustainability features of their building, and made aware of the ripple effect of their actions within the building. Facility Performance Evaluations (FPEs) or Post-Occupancy Evaluations (POEs) are used to systematically evaluate the performance and/or effectiveness of the building for their occupants approximately 1 year after occupancy. In its evaluation, the FPE focuses primarily on the requirements of the users, including accessibility, aesthetics, cost-effectiveness, functionality, productivity, safety and security, and sustainable development factors.

3-5.2.6 **Ensure O&M Staff is Well-Trained.** Educate new O&M staff about the project sustainable design goals, and any specific design strategies and/or materials used that may be unfamiliar to them. Current O&M personnel should periodically review this information also.

3-5.3 **References**

d. Executive Order 13423 Technical Guidance:

- Measurement & Verification
  http://www.wbdg.org/sustainableEO/mou_mv.php
- Operations & Maintenance
  http://www.wbdg.org/sustainableEO/mou_om.php

3-6 **IMPLEMENTING SUSTAINABILITY IN THE DEACTIVATION STAGE**.

The Deactivation Stage brings attention to the opportunities to continue sustainable development principles through the full facility life cycle. Properly planned, designed, and constructed facilities can save resources as they transition from one use to another. The final disposition of the facility should minimize impacts to the environment.

3-6.1 **Documentation**.

If a building is to be deconstructed, ensure the deconstruction contractor submits a deconstruction plan prior to initiating work. The plan should identify the components that can be easily salvaged for reuse or made available for recycling (i.e., high value items like antique brick, hardwood flooring, large structural timbers, modern mechanical equipment, and specialty masonry, woodwork, or metalwork).

3-6.2 **References**.

a. Deconstruction Guide for Military Installations
http://www.kppc.org/resources/DoD%20Deconstruction/Presentations/DECON_guide%20(final%2011-03-03).pdf

b. UFC 1-900-01 Design: Selection Methods for the Reduction, Reuse and Recycling of Demolition Waste
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

3-6.3 Sustainable Development-Related Action Items.

3-6.3.1 **Evaluate Buildings for Adaptive Reuse or Appropriate Disposal.** When a building or space reaches the end of its useful life, converting the structure for an alternate use should be considered an option in addition to demolition. Adaptive reuse is defined as adapting old structures for new purposes. In cases where the facility is excess to the service's or DoD requirements, options including transfer to other services/agencies or lease/reuse to other entities should be considered.

3-6.3.2 **Deconstruct Rather Than Demolish.** Deconstruction—the process of taking apart a facility with the primary goal of preserving the value of all useful building materials, so that they may be reused or recycled—should be considered when adaptive reuse is not an option. Deconstruction minimizes demolition landfill materials and reduces material costs for the converted facility. Salvage and reuse of low efficiency equipment should be avoided. Also, hazardous materials should be properly identified and disposed in accordance with applicable laws and regulations.

3-7 IMPLEMENTING SUSTAINABILITY IN THE DISASTER RECOVERY STAGE.

In rebuilding after a natural disaster, the first reaction is to reconstruct the damaged or destroyed facilities as quickly as possible using the same materials and methods employed in the design and construction of the existing facilities. Instead, consider the sustainable development opportunities afforded in the repairing or rebuilding of these facilities. The long-term benefits of taking a sustainable approach to repairing and rebuilding can far outweigh the small additional costs associated with the design effort and material costs. For example, replacing the roof of a damaged building with an Energy Star® cool roof or a green roof can yield energy savings that pay back quickly and reduce energy costs for the life of the building. Additionally, consider replacing existing materials, products and systems with those that are durable, recyclable, resource efficient, and non-toxic.

3-7.1 References.

a. *Rebuilding for the Future.... Guide to Sustainable Redevelopment for Disaster-Affected Communities*, U.S. Department of Energy September 1994 http://www.smartcommunities.ncat.org/articles/RFTF2.shtml#ref7

b. *Using Sustainable Technology to Recover from Disaster, Operation Fresh Start*, National Center for Appropriate Technology (NCAT) http://www.freshstart.ncat.org/

c. *Holistic Disaster Recovery: Ideas for Building Local Sustainability After a Natural Disaster*, Natural Hazards Center, University of Colorado-Boulder. http://www.colorado.edu/hazards/holistic_recovery/

APPENDIX A SUPPORTING DOCUMENTATION

A-1. BACKGROUND: THE FEDERAL MOVEMENT TOWARDS SUSTAINABLE DEVELOPMENT.

In 1993, the President issued Executive Order 12873, *Federal Acquisition, Waste Prevention, and Recycling*, which created the position of the Federal Environmental Executive (designated by the President), as well as Agency Environmental Executives. These positions were specifically intended to bolster support for recycling and the procurement of recycled-content products. Today, the Office of the Federal Environmental Executive (OFEE) promotes sustainable environmental stewardship and works with agencies to increase good environmental practices, including compliance with these federal mandates.

In 1999, the President signed Executive Order 13123, *Greening the Government Through Efficient Energy Management*, requiring efficient energy management by the federal government, including specific goals and timelines for doing so. In that same year, the U.S. Army Engineer Research and Development Center (ERDC) released the 1.4.1 version of the Sustainable Project Rating Tool (SPiRiT), currently based upon LEED™ Version 2.0, to more directly address the unique requirements of the military. Army will transition to LEED in FY 2008.

In 2002, OMB Circular A-11, “Preparation, Submission and Execution of the Budget,” guidance known to and used by Programmers from all services, was revised. Specifically, Chapter 55 – Energy and Transportation Efficiency Management was modified to encourage Federal agencies to incorporate Energy Star® or LEED™ into up front design concepts for new construction and/or building renovations.

Between 2001 and 2003, all branches of the Armed Services issued policies requiring incorporation of sustainable development principles into new facility projects by following LEED™ or SPiRiT.

In August 2005, the new Energy Policy Act was signed into law by the President. Key sections of EPAct 2005 that affect DoD buildings include:

a. Section 102, "Energy Management Requirements," establishes new energy efficiency goals for all Federal agencies – annual two percent reduction in energy use per gross square foot of buildings, starting in 2006, culminating in a 20 percent reduction in fiscal year (FY) 2015 – from a new baseline of 2003.

b. Section 103, "Energy Use Measurement and Accountability," directs that all Federal buildings be metered by October 1, 2012.

c. Section 109, "Federal Building Performance Standards," requires buildings to be designed to be 30 percent below ASHRAE standard 90.1-2004 or the *International Energy Code*, if life cycle cost effective and

requires the application of sustainable design principles. http://www.wbdg.org/pdfs/epact2005.pdf (full text)

In January 2006, the *Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding* (MOU) was signed by senior officials from 17 federal agencies committing them to leading the federal sector in the design, construction, and operation of buildings by:

a. Reducing the total ownership costs of facilities;

b. Improving energy efficiency and water conservation;

c. Providing safe, healthy, and productive built environments; and,

d. Promoting sustainable environmental stewardship.

To date, 19 federal agencies, representing more than 95% of the total federal facility square footage, have joined the MOU. The Interagency Sustainability Working Group has developed technical guidance to assist the signatory agencies in meeting their MOU commitments. Throughout this UFC, the "Technical Guidance for Implementing the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding" will be referred to as the "Executive Order 13423 Technical Guidance." http://www.wbdg.org/sustainableEO/

On August 4, 2006, B.J. Penn, the Assistant Secretary of the Navy for Installations and Environment, issued a memorandum directing Navy and Marine Corps Commanders to immediately take action to plan, program and budget for and meet the requirements of the *Energy Policy Act* of 2005, the *Memorandum of Understanding on Federal Leadership in High Performance and Sustainable Buildings* and achieve at least LEED Silver-level rating performance in new and replacement buildings.

In January 2007, the President issued Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* which promotes sustainable environmental stewardship throughout the Federal Government. This executive order consolidates and strengthens five executive orders and two memorandums of understanding and establishes new and updated goals, practices, and reporting requirements for environmental, energy, and transportation performance and accountability.

Some of the building related highlights from the new Executive Order include:

a. Energy Efficiency and Greenhouse Gases: improve energy efficiency and reduce greenhouse gas emissions through reduction of energy intensity by 3 percent annually through the end of FY 2015 or 30 percent by the end of FY 2015, relative to the baseline of the agency's energy use in FY 2003.

b. Renewable Power: at least 50 percent of the statutorily required renewable energy consumed by the agency must come from new renewable energy sources.

c. Building Performance: new construction and major renovation of agency buildings must comply with the Guiding Principles for Leadership in High Performance and Sustainable Buildings set forth in the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding and 15 percent of the existing Federal capital asset building inventory of the agency as of the end of fiscal year 2015 incorporates the sustainable practices in the Guiding Principles.

d. Water Conservation: reduce water consumption intensity by 2 percent annually through 2015.

Executive Order 13423 revokes executive orders: 13101, 13123, 13134, 13148 and 13149.

The first set of Instructions for Implementing E.O. 13423 (http://www.wbdg.org/pdfs/eo13423_instructions.pdf) was issued by the Council on Environmental Quality on March 29, 2007. The purpose of this document is to define agency requirements for implementing E.O. 13423 and to define broad strategies for achieving them. In order to ensure effective and efficient implementation, and to meet the goals and objectives of the E.O., it is mandatory that executive departments and agencies implement the activities described in these instructions in accordance with Sections 1, 2, 3, and 4(b) of the E.O.

A-2. **BUSINESS CASE FOR SUSTAINABILITY**.

Application of Sustainable Development principles improves the balance between cost and performance which is the ultimate objective of sound business and design practice. There are significant Economic, Societal and Environmental benefits to be gained by incorporating sustainable development into DoD projects. A matrix of those benefits is found in the Department of Energy publication, *The Business Case for Sustainable Design in Federal Facilities*
http://www.eere.energy.gov/femp/technologies/sustainable_federalfacilities.cfm.

Business case studies illustrate that while the long-term effect of developing sustainably will be healthier natural and built environments, the financial rewards, namely the reduced total cost of ownership, are tangible, and more easily achieved and measured. A list of business case studies is included:

a. GSA LEED® Cost Study
http://www.wbdg.org/newsevents/news_040105.php.

b. *The Federal Commitment to Green Building: Experience and Expectations*
http://www.ofee.gov/sb/fgb_report.html.

c. *The Costs and Financial Benefits of Green Buildings* http://www.cap-e.com/spotlight/index.cfm?Page=1&NewsID=25770.

d. GSA Report: *The Integrated Workplace* http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_DOCUMENT&contentId=14156.

e. Judith Heerwagen: "Sustainable Design Can Be an Asset to the Bottom Line," Environmental Design and Construction, July 2002. http://www.edcmag.com/CDA/Archives/936335f1c9697010VgnVCM100000f932a8c0____.

f. Costing Green: A Comprehensive Cost Database and Budgeting Methodology http://www.davislangdon.com/pdf/USA/2004CostingGreen.pdf.

A-2.1 **National Security**.

Developing sustainable facilities can enhance national security by increasing DoD's energy reliability, and improve the image and reputation of DoD as a steward of environmental resources. For example, strategically located storm water retention ponds can serve as barrier between roadways and key DoD facilities. Incorporating renewable energy technologies and distributed energy generation into projects can provide highly reliable on-site power while limiting peak demand charges.

A-2.2 **Examples of Success**.

DoD's and other federal agencies' application of sustainability principles is not new. In 2002, reports showed that Federal standard (non-industrial/laboratory) buildings—including DoD—reduced energy consumption by 23 percent compared to the 1985 baseline. This improved efficiency helped reduce utility bills for these buildings by 31.3 percent from the 1985 baseline, to $3.6 billion, and also contributed to a reduction of total carbon emissions to 9.8 million metric tons of carbon equivalent (MMTCE)—a reduction of more than 20 percent from the 1990 baseline. Purchasing data collected from seven agencies (DoD, DOE, GSA, NASA, HHS, VA, and USPS) indicated that 42 percent of the concrete purchased by these agencies in FY 2001 contained fly ash from coal combustion, while 42 percent of the insulation purchased also contained recycled content. To date, more than ten military bases have used "deconstruction," the disassembly of old buildings for reuse or recycling of their valuable components and more installations are planning to do so.

APPENDIX B SUSTAINABLE DEVELOPMENT-RELATED CONCEPTS

B-1. RATING SYSTEMS.

Each DoD service has adopted an industry-based sustainable building rating system(s), which shall be used throughout the planning, design, and construction stages to guide the project towards a sustainable solution as well as to score and rate the resulting facility. Rating systems used by the DoD services are:

a. LEED (Leadership in Energy and Environmental Design) Green Building Rating System® – Used by Navy and Air Force http://www.usgbc.org/DisplayPage.aspx?CategoryID=19

b. SPiRiT (Sustainable Project Rating Tool) – Used by Army prior to FY 08 program

c. ENERGY STAR® Label Homes Program – Used by Army, Navy and Air Force http://www.energystar.gov/index.cfm?c=new_homes.hm_index

B-1.1 Status of Certification.

Currently, only the Navy is funding the USGBC registration and certification process for LEED® or ENERGY STAR®. The other DoD services rely upon internal project management during programming and design, and the construction agents during construction and commissioning, to monitor all project phases to ensure certification level criteria are met.

B-1.2 LEED (Leadership in Energy and Environmental Design) Green Building Rating System®.

Created by the U.S. Green Building Council in 1998, LEED is a national sustainable facility performance standard. It is a self-evaluating, self-documenting, feature-oriented system where credits are earned for satisfying each criterion. Criteria categories include sustainable sites, water efficiency, energy and-atmosphere, materials and resources, and indoor environmental quality. The LEED system has varying levels of certification: Certified, Silver, Gold and Platinum levels.

B-1.2.1 **Types of LEED Standards**. Several LEED standards are currently available or under development for various project types:

B-1.2.1.1 **LEED for New Construction (LEED-NC)** – For new commercial construction and major renovation projects, including hotels and residential buildings of four or more habitable stories.

B-1.2.1.2 **LEED for Existing Buildings (LEED-EB)** – Covers the operations of existing buildings, including systems upgrades where the majority of interior or exterior surfaces remain unchanged. LEED-EB is applicable to existing buildings that are

seeking LEED Certification for the first time as well as projects previously certified under LEED standards for new construction.

B-1.2.1.3 **LEED for Commercial Interiors (LEED-CI)** – For commercial interiors, or tenant improvement, projects. LEED -CI is currently under pilot testing. Together with LEED-CS, LEED-CI will establish green building criteria for commercial office real estate for use by developers, designers, and tenants.

B-1.2.1.4 **LEED for Core and Shell (LEED-CS)** – For new core and shell construction—including base building elements, such as the structure, envelope and building-level systems, such as central HVAC, etc.—where the owner does not control the interior design and fit-out. LEED-CS is currently under pilot testing.

B-1.2.1.5 **LEED for Neighborhood Developments** – This rating system will integrate the principles of smart growth, urbanism, and green building for neighborhood design. LEED for Neighborhood Developments is currently under development and currently in pilot phase.

B-1.2.1.6 **LEED for Schools** – Recognizes the unique nature of the design and construction of K-12 schools. Based on LEED for New Construction, it addresses issues such as classroom acoustics, master planning, and mold prevention. A draft rating system is currently available with expected launch in 2007.

B-1.2.1.7 **LEED for Homes (LEED-H)** – Promotes the design and construction of high performance “green” homes. An updated pilot rating system is available with launch expected in Summer 2007.

B-1.2.1.8 **LEED Retail for New Construction** – This rating system is currently under development.

B-1.2.1.9 **LEED Guide for Multiple Buildings and On-Campus Building Projects** – This rating system provides direction in applying LEED-NC to projects in a campus or multi-building setting, such as corporate campuses, college campuses, and government installations.

B-1.2.1.10 **LEED Project Submission** – Projects applying for LEED certification can now submit 100 percent of their documentation on-line at LEED Online http://www.usgbc.org/DisplayPage.aspx?CMSPageID=277& . Per USGBC, LEED-Online “enables project team members to upload credit templates, track Credit Interpretation Requests (CIRs), manage key project details, contact customer service, and communicate with reviewers throughout the design and construction reviews. With LEED-Online, all LEED information, resources, and support are accessible in a centralized location.”

B-1.2.1.11 **Cost of LEED Certification.** If the project will be officially registered with the USGBC and submitted for certification, following are estimated additional project costs—which varies based on the project type, complexity, and size, and experience of the project team:

a. LEED project registration: $450 – 600

b. LEED project certification: $1,750 – 22,500

c. LEED project documentation: $10,000 – 70,000

B-1.2.1.12 **Resources**

a. LEED for New Construction Version 2.2 Reference Guide www.usgbc.org

B-1.2.2 **Other Rating Systems.** As other rating systems become available, DoD will evaluate them for adoption. The newest rating system is GreenGlobes from the Green Building Initiative. For more information on rating systems see *Utilizing Rating Systems & Standards*.

a. Green Globes http://www.thegbi.com/greenglobes/

b. Executive Order 13423 Technical Guidance: Utilizing Rating Systems & Standards http://www.wbdg.org/sustainableEO/mou_rss.php

B-1.3 **SPiRiT (Sustainable Project Rating Tool)**.

Based on LEED-NC, the U.S. Army Engineer Research and Development Center (ERDC) developed SPiRiT for the Army to reflect the unique nature of military installation planning, design, and construction. SPiRiT provides guidance to support the consideration of sustainable design and development principles in Army installation planning decisions and infrastructure projects to the fullest extent possible, within the context of funding constraints and customer requirements. For a detailed discussion of SPiRiT refer to http://www.cecer.army.mil/SustDesign/SPiRiT.cfm

B-1.3.1 **Applicability.**

B-1.3.1.1 **Army.** The Army will transition from SPiRiT to the US Green Building Council (USGBC) LEED® rating system effective with the FY08 Military Construction (MILCON) Program, except for Army Family Housing. For details on the transition see DOD Instructions in Chapter 2.

B-1.3.1.2 **SPiRiT Self-Certification.** The Army requires its Project Delivery Teams (PDT) to self evaluate the project and self rate the result. Army may decide to register some projects with USGBC for a formal certification. Army may also form a team of experts and review these ratings.

B-1.4 **ENERGY STAR® Label Homes Program**.

Developed by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, the program defines the standard for an ENERGY STAR qualified three stories or less and are at least 15 percent more energy efficient than homes built to the 2004 International Residential Code (IRC). This includes site-constructed homes,

attached or detached homes, single or low-rise multi-family residential buildings, manufactured homes, systems-built (e.g., SIP or modular) and log homes, existing homes, or retrofitted homes. This translates into a HERS (Home Energy Rating System) score of 86 or less.

B-1.4.1 **Applicability.**

B-1.4.1.1 **Navy.** Effective as of 04 May 2000, Navy Family Housing construction improvement projects as well as public-private ventures shall implement the EPA ENERGY STAR Label Homes Program. Per MOU between EPA and the U.S. Army Corps of Engineers, all Army Family Housing (AFH) units will meet Energy Star requirements. Air Force military family housing projects will implement Energy Star Label homes starting with the FY06 and FY07 MILCON programs.

B-1.4.2 **ENERGY STAR Certification.** The Navy requires single-family and multi-family housing projects to be certified "ENERGY STAR Homes." As such, the energy efficiency of the housing units must be independently verified by an accredited home energy rater.

B-1.4.2.1 **Cost of ENERGY STAR Certification.** The fee for certifying an Energy Star home is estimated between $250 and $1,000 per unit, which should be included in the original project costing documentation.

B-1.4.3 **Resources.**

a. UFC 4-711-01, *Family Housing*
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

B-2 **ALTERNATIVE FINANCING FOR ENERGY EFFICIENCY PROJECTS**.

There are alternatives to DoD funding available for financing Federal energy-efficiency projects that do not require large up-front capital outlays on the part of the services or the Department of Defense. Energy Savings Performance Contracts (ESPC) and Utility Energy-Efficiency Services Contract (UESC) allow energy projects to be paid for out of energy savings at or near no net cost to the service. The U.S. Department of Energy helped develop these strategies to surmount the issues of higher first costs of some of the promising energy saving technologies. These financing alternatives are further discussed in Appendix J.

B-3 **COST ESTIMATING**.

B-3.1 **Programming Cost Estimates**.

Cost estimates are based on quantities and unit prices, historical data, or cost models depending on the level of design information available. Programmers should establish reasonable supportable costs for comparison of alternate designs, which will help provide support for any trade-offs needed during the integrative design process. The *DOD Facilities Pricing Guide (UFC series 3-701 - with the final two numbers indicating*

the FY; http://www.wbdg.org/ccb/browse_cat.php?o=29&c=78), is the primary source for unit costs. The computer program for cost estimating is Tri-Services Automated Cost Engineering System (TRaCES). Both are used in formulating costs in a 1391. However, as familiarity with sustainable products and trends improves, related pricing is beginning to improve. Programmers must ensure they have the latest available cost criteria.

B-3.2 **Following Costs through Design and Construction**.

The total current working estimate must be continuously updated, as the design is refined. The programming cost estimate sets the target during the feasibility phase for managing and controlling project costs. The Project Manager should continuously evaluate costs versus design requirements to maintain a design-to-cost philosophy. A total current working estimate must be prepared by the Cost Engineer at each major milestone in the project development. The cost estimate documentation shall be in the TRaCES format and include the summary sheets for direct costs, indirect costs, and owner costs. Helpful narratives that discuss cost relationships and assumptions made based on the level of design, quantity issues, and unknowns should be included. The narrative should also identify the risks or uncertainties used in the development of contingencies.

B-3.3 **Independent Government Estimates (IGE)**.

A formal, approved construction cost estimate is prepared to support the award of each construction contract. This estimate is required for all contracts of $100,000 or more (based on requirements of FAR 36.203). IGE are not required by the Army.

B-3.4 **Life-Cycle Costing (NIST Handbook 135)**.

Life-Cycle Costing is mandated by law and is defined in 10 CFR, Part 436, Subpart A: Program Rules of the Federal Energy Management Program (FEMP).

B-3.5 **Demonstration Program on Reduction in Long-Term Facility Maintenance Cost**.

B-3.5.1 **Program Authority**. The National Defense Authorization Act for Fiscal Year 2002, Title XXVII – General Provisions; Sec. 2184 (division B; 115 Stat. 1310 U.S.C. 2809 note) authorizes the Secretary of the Army to "…conduct a demonstration program to assess the feasibility and desirability of including facility maintenance requirements in construction contracts for military construction projects for the purpose of determining whether such requirements facilitate reductions in the long-term facility maintenance costs of the military departments." The Act was amended in Public Law 107-314 (FY 2003 National Defense Authorization Act) to include all of the Department of Defense and transferred reporting requirements to the Secretary of Defense.

B-3.5.2 **Goals and Objectives**. Facility life cycle engineering represents the most effective balance of cost to construct; cost to start-up; cost to operate; and (perhaps most importantly) the users' cost to perform the intended function of the facility over its

useful life. The demonstration program fosters true life cycle engineering. Under the demonstration program, MILCON funding included the first five years of maintenance, which virtually eliminated any backlog maintenance and resulted in facilities that more cost effectively meet the users' needs.

B-4 **BUILDING COMMISSIONING**.

B-4.1 **Definition**.

Complementing the integrated design process, Building Commissioning is a quality-assurance process for enhancing the delivery of a project. For DoD facility projects, the process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the performance requirements of the customers. The process ideally extends through all phases of a project, from planning to completion of warranty periods.

B-4.2 **Goals**.

The goals of Building Commissioning are to improve the building delivery process; to provide a safe and healthy facility; to improve energy performance; to reduce operating costs; to provide operations and maintenance staff orientation and training; and to improve systems documentation.

B-4.3 **Applicability**.

While Building Systems Commissioning is both a LEED-NC and a SPiRiT Energy and Atmosphere prerequisite credit, application of the Additional Building Commissioning credit varies among the DoD services.

B-4.3.1 **Army**. Building Commissioning is inherent in Army standard business practices for all new construction facility projects.

B-4.3.2 **Navy**. NAVFAC Instruction 12271.1 of 23 October 2003 https://portal.navfac.navy.mil/pls/portal/docs/PAGE/DOCS/DOC_STORE_PUB/12271_1.PDF is the policy statement for NAVFAC Building Commissioning. t states that Building Commissioning principles shall be applied to the process for executing Navy new construction and rehabilitation projects.

B-4.3.3 **Air Force**. Implementing Building Commissioning is required for all Air Force projects involving new construction or major renovation. Project teams should follow the current American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Guideline 0, The Commissioning Process http://www.ihserc.com/ and Guideline 1 (The HVAC Commissioning Process) http://www.ihserc.com/ , and, where applicable, use the Unified Facilities Guide Specifications (UFGS) for particular systems.

B-4.4 **Commissioning Responsibility**.

The authority responsible for building commissioning varies among the DoD services.

B-4.4.1 **Army**. The U.S. Army Corps of Engineers is the commissioning authority for their customers.

B-4.4.2 **Navy**. The NAVFAC Capital Improvements Business Line Manager shall decide whether to contract out the commissioning work, use a specialty office, or use in-house forces.

B-4.4.3 **Air Force**. The Air Force expects their design and construction agents to integrate commissioning into the project development process. They do not fund, require, or recommend hiring a separate, independent commissioning authority.

B-4.5 **Cost of Commissioning**.

It is estimated that implementing Building Commissioning may cost 0.3 percent to one percent of the construction budget. While the cost of commissioning should not be listed as a line item on the DD 1391, it still needs to be budgeted for when developing the project budget.

B-4.6 **DoD Commissioning Points of Contact**:

- **Army POC** – Gary Bauer
U.S. Army Corps of Engineers
(202) 761-7170
gary.bauer@HQ2.USACE.ARMY.MIL

- **Navy POC** – Clay Dean
NAVFAC
(202) 685-9174
joseph.dean@navy.mil

- **Alternate Navy POC** – Rudy Perkey
NAVFAC
(757) 322-8240
Lenvin.perkey@navy.mil

- **Air Force POC** - K. Quinn Hart
HQ Air Force Civil Engineer Support Agency
(850) 283-6343
Quinn.Hart@tyndall.af.mil

B-4.7 **Commissioning Resources**.

a. Executive Order 13423 *Technical Guidance Commissioning* Commissioning:
http://www.wbdg.org/sustainableEO/mou_commissioning.php

b. Portland Energy Conservation, Inc. (PECI) http://www.peci.org

    - Model Commissioning Plan and Guide Specifications

c. Building Commissioning Association (BCA) http://www.bcxa.org

d. Building Commissioning (WBDG) http://www.wbdg.org/project/buildingcomm.php

e. AABC Commissioning Group (ACG) http://www.commissioning.org/

APPENDIX C SUSTAINABLE DEVELOPMENT STRATEGIES & FEATURES

C-1 OVERVIEW.

This Appendix will elaborate on the strategies and features to achieve a successful sustainable facility. The project team should consider and evaluate these strategies at the planning/programming stage through the occupancy stage to determine a balanced approach to achieving the project's sustainable development goals and other project requirements. The strategies in this Chapter are organized around the Sustainable Development principles defined in Chapter One:

a. Optimize Site Potential

b. Protect and Conserve Water

c. Optimize Energy Use

d. Use Environmentally Preferable Products

e. Enhance Indoor Environmental Quality

f. Optimize Operations and Maintenance Procedures

In January 2006, USGBC issued LEED® Version 2.2 replacing Version 2.1. All references to LEED® in this chapter are to Version 2.2. A useful tool tying LEED® and WBDG together is the LEED® Version 2.1 Credit/WBDG Resource Page Matrix which links each LEED® Version 2.1 credit to the appropriate existing WBDG Resource Pages that provide information on technologies and/or strategies that could be implemented to achieve the credit. http://www.wbdg.org/tools/leed.php?c=1

C-2 OPTIMIZE SITE POTENTIAL.

Sustainable development of a facility begins with selecting an appropriate site, followed by properly developing the site to minimize impacts of the built structure on the environment, to take advantage of natural site features, and to optimize potential for passive solar heating and cooling, daylighting, and natural ventilation.

The key strategies for selecting, planning, and developing sites sustainably include:

a. Select Appropriate Sites (SS-1, SS-2, SS-3);

b. Control Erosion, Sedimentation, and Water Quality (SS-P1);

c. Provide Alternative Transportation (SS-4);

d. Minimize Site and Habitat Disturbance (SS-5, SS-8);

e. Manage Storm Water Runoff (SS-6); and

f. Reduce Heat Islands (SS-7).

Note: SS-1 through SS-8 refers to the LEED® credits for Sustainable Sites. SS-P1 refers to the Sustainable Sites Prerequisite.

C-2.1 **Select Appropriate Sites**.

To optimize site design and minimize site disturbance for a facility within a Base, Installation, or Campus, properly plan for the project and its place in the overall Base or Campus master plan, which gives organized guidance for land development and facility design and operations. Give preference to sites that: do not include sensitive site elements and restrictive land types (e.g., wetlands, prime farmland); were previously occupied (e.g., brownfields, existing buildings); and are located in urban areas, near mass transportation systems or conform to the desired development density.

C-2.1.1 **Sustainable Master/Campus Plans**. Traditionally, master/campus planning initiatives result in a comprehensive long-range plan that sets goals and priorities and provides organized guidance for land development and facility design and operations that will meet evolving mission and program needs. A *sustainable* master plan also focuses on maximizing resource efficiency and minimizing waste. The sustainable master plan charts a course to follow that ensures future development is done in a coordinated and holistic fashion, and provides a context for the siting and design of facilities/bases/campuses that are sustainable and high performance.

The plan looks ahead ten to thirty years, depending on the base/campus projected growth, the need for new facilities, and the long-term goals of the organization. The sustainable master plan must have the flexibility needed to accommodate unanticipated changes that inevitably will occur. Basically, the sustainable master plan consists of several sections, each addressing components critical to the success of the overall plan. The sections of a sustainable master plan include an inventory of existing facilities; land use and circulation; identification of space needs; determination of parking needs to coordinate with space needs; relationship of the base/campus to the surrounding community; consideration of historic preservation of buildings and grounds; evaluation of demolition and new construction versus reuse of existing facilities; impact of base/campus growth on the environment; survey of utilities infrastructure to determine capacity and condition; and proposed means of financing the plan.

Additionally, the master/campus plan incorporates sustainable development principles including: building orientation to optimize solar gain; consideration of renewable energy sources on site or integrated into the buildings; preservation of views and vistas, pedestrian and bicycle friendly travel throughout the base/campus; limiting development footprint; creation of open spaces; maintenance of the natural environment; low impact development; light pollution reduction; minimization of heat island effect; provisions for the storage and collection of recyclables; public transportation access; and water efficient landscaping.

Involve all stakeholders (including base commanders, campus administrators, occupants, maintenances staff, and community representatives) in a series of meetings and workshops to ensure the sustainable master plan is comprehensive and general consensus is achieved.

Coordinate sustainable site design with anti-terrorism/force protection (ATFP) requirements early in the project development process to ensure both project goals are met.

LEED-NC Multiple Buildings and On-Campus Building Projects Application Guide (https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1097) provides direction in applying LEED-NC to projects in a campus or multi-building setting.

UFC 4-030-02 *Sustainable Installation Guide* (placeholder for future document)

C-2.1.2 **Localized Density**. To minimize the development of open spaces, select sites that are located within existing areas of development and conform to the existing or desired level of density. Where feasible, cluster facilities to reduce their impacts on the site and adjacent sites. For small bases with limited space available in existing developed areas, ATFP considerations may limit viable options for new construction in existing developed areas.

C-2.1.2.1 **LEED-NC Version 2.2**. Sustainable Sites Credit 2 – Development Density and Community Connectivity.

C-2.1.3 **Existing Infrastructure and Structures**. Select sites that are located near existing utility corridors to minimize the need to extend the utility infrastructure. Consider retrofitting an existing building instead of constructing a new facility to conserve existing natural areas and undeveloped open spaces as well as to minimize the purchase of new materials. The adaptive reuse of existing buildings can also preserve historic structures and natural habitats.

C-2.1.3.1 **LEED-NC Version 2.2**. Sustainable Sites Credits 5.1 & 5.2, Site Development and Reduced Site Disturbance; Materials & Resources Credits 1.1, 1.2 & 1.3 – Building Reuse.

C-2.1.4 **Degraded Sites/Brownfields.** The cleanup, restoration, and redevelopment of degraded sites, such as brownfield properties (land contaminated from prior uses), is one of the best ways to put unused land back into use. Where feasible, rehabilitate damaged sites to prevent undeveloped, open land from being used as a building site; use existing infrastructure; and increase the existence of healthy habitat for native species.

C-2.1.4.1 **LEED-NC Version 2.2.** Sustainable Sites Credit 3 – Brownfield Redevelopment. Sustainable Sites Credit 1 – Site Selection.

C-2.1.4.2 **Resources.**

a. Websites:

- EPA Brownfields Cleanup and Redevelopment http://www.epa.gov/brownfields/
- National Brownfields Association http://www.brownfieldassociation.org/
- The Brownfields Technology Support Center http://brownfieldstsc.org/
- American Planning Association http://www.planning.org/
- Society for College and University Planning http://www.scup.org/
- GreenInfrastructure.Net http://www.greeninfrastructure.net/
- Smart Growth Online http://www.smartgrowth.org/
- Urban Land Institute http://www.uli.org
- Maryland Department of Environment, Smart Growth and Neighborhood Conservation Initiative http://www.mde.state.md.us/Programs/MultimediaPrograms/Smart_Growth/home/index.asp

b. Design and Analysis Tools:

- GSA Project Planning Tools http://www.projectplanningtools.org/

c. WBDG:

- Project Planning, Management, and Delivery http://www.wbdg.org/project/index.php
- Optimize Site Potential http://www.wbdg.org/design/site_potential.php

d. Executive Order 13423 Technical Guidance: Sustainable Sites/Smart Growth http://www.wbdg.org/sustainableEO/mou_sg.php

e. UFC/Other DOD Criteria:

- http://hq.environmental.usace.army.mil/programs/brownfields/brownfields.html

C-2.2 **Control Erosion, Sedimentation, and Water Quality.**

The erosion of soil caused by precipitation or wind can lead to destruction of vegetation, degradation of property, and sedimentation and pollution of local water bodies as well as unstable building foundations. Develop a site sediment and erosion control plan and a pollution prevention plan to address the above issues. Use Integrated Pest Management http://cipm.ncsu.edu/ to reduce groundwater pollution from pesticides. Eliminate materials that are lead-polluting. Use non-toxic cleaning products http://www.wbdg.org/design/greenproducts.php , especially for bathrooms and kitchens. Use vegetation, grading, and stabilization techniques (e.g., seeding and mulching,

pervious paving, silt fences) to prevent erosion. Use sediment controls (e.g., earth dikes and sediment basins) to retain sediment after erosion has occurred. Prevent hazardous material discharge and petroleum oils and lubricants (POL) discharge into storm water systems by installing water quality ponds or oil grit separators to filter surface water runoff.

C-2.2.1 **LEED-NC Version 2.2.** Sustainable Sites Prerequisite 1 – Construction Activity Pollution Prevention.

C-2.2.2 **Resources.**

a. Websites:

- Erosion Control Technology Council http://www.ectc.org/
- EPA Erosion and Sedimentation Control http://www.epa.gov/owow/nps/ordinance/erosion.htm

b. Design and Analysis Tools:

Watergy A simple spreadsheet model that screens sites for potential water conservation opportunities and illustrates the energy savings that result from water conservation activities. http://www.watergy.org/

c. WBDG:

- Achieving Sustainable Site Design through Low Impact Development Practices, WBDG Resource Page http://www.wbdg.org/design/lidsitedesign.php
- Low Impact Development Technologies, WBDG Resource Page http://www.wbdg.org/design/lidtech.php

d. Executive Order 13423 Technical Guidance Stormwater Run-off Mitigation http://www.wbdg.org/sustainableEO/mou_sw.php

e. UFC/Other DOD Criteria http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-230-19: Design: Water Supply Systems
- UFC 3-210-10: Design: Low Impact Development

C-2.3 **Accommodate Sustainable Transportation Alternatives**.

Standard cars and other vehicles use enormous amounts of fossil fuels and contribute to smog and ground level ozone, which causes human respiratory stress and damages many plants, significantly reducing farm crop yields and the health of trees and other vegetation. As such, site the building or campus with public transportation access in mind and limit on-site parking. Use porous alternatives to traditional paving for roads and walkways. Make provisions for bicycling, walking, carpool parking, and

telecommuting; and provide refueling/recharging facilities for alternative fuel/electric vehicles. For bases in harsh climates and desert environments, bicycling and walking provisions may not be feasible.

C-2.3.1 **LEED-NC Version 2.2.** Sustainable Sites Credits 4.1-4.4 – Alternative Transportation.

C-2.3.2 **Resources.**

a. Websites:

- Department of Energy http://www.eere.energy.gov/
- Smart Growth Network http://www.smartgrowth.org/default.asp

b. Executive Order 13423 Technical Guidance: Sustainable Sites/Smart Growth http://www.wbdg.org/sustainableEO/mou_sg.php

c. Design and Analysis Tools:

- Telework Impact Estimation Tool http://greenmfg.me.berkeley.edu/green/SoftwareTools/Telework/

C-2.4 **Minimize Site and Habitat Disturbance**.

A habitat is a place where plants and animals normally live and grow. When planning a project, keep land disturbance to a minimum to allow retention of prime vegetation and the natural habitats of birds and animals. Ways to minimize habitat disturbance include reducing building and paving footprints; limiting site disturbance to a minimal area around the building perimeter; and selecting a site in areas of high density where buildings can be located adjacent to existing infrastructure. Avoid habitat fragmentation and parcelization. When construction must disturb portions of a habitat, provide natural corridors for birds and animals to travel between existing habitats. Plan construction staging areas with the environment in mind.

C-2.4.1 **Appropriate Exterior Lighting/Dark-Sky**. Light pollution occurs when the nighttime use of electric lighting to illuminate building exteriors, walkways, parking lots and roadways lights up the night sky and spills over into areas not intended to be lit. Light pollution is intrusive: it disturbs residents trying to sleep in housing adjacent to parking lots and roadways; and it upsets the nocturnal patterns of both land and sea creatures, and obstructs the view of the stars. Light pollution is energy inefficient: the light lost to sky glow and light trespass is not usable to light the parking lot or roadway, thus requiring more fixtures or higher lamp wattage to achieve the desired coverage. Design the exterior lighting system to light only the desired area. Use full cut-off fixtures that do not shine any light above the horizon line. Cut-off type luminaires reduce glare, thus improving visibility. Follow the requirements of UFC 3-530-01, I*nterior and Exterior Lighting and Controls* http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4 and *IESNA Recommended Practice Manual: Lighting for Exterior Environments*. For parking lots rarely used at night, consider providing a low constant light level supplemented by

occupancy-type sensors to light up the area when a pedestrian or vehicle is detected. Avoid using occupancy-type sensors with low pressure sodium and metal halide fixtures due to start-up delays.

C-2.4.1.1 **LEED-NC Version 2.2**. Sustainable Sites Credit 8 – Light Pollution Reduction.

C-2.4.1.2 **Resources**.

a. IESNA Recommended Practice Manual: Lighting for Exterior Environments. http://www.ihserc.com/

b. Websites:

- USACE Sustainable Design and Development Resources: Sustainable Sites: Light Pollution Reduction http://www.cecer.army.mil/SustDesign/SDRSiteLPR.cfm
- International Dark-Sky Association http://www.darksky.org/

c. UFC/Other DOD Criteria:

- UFC 3-530-01AN, Interior and Exterior Lighting and Controls http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4
- AFI 32-7064, Integrated Natural Resources Management http://www.e-publishing.af.mil/pubfiles/af/32/afi32-7064/afi32-7064.pdf

C-2.4.2 **LEED-NC Version 2.2.** Sustainable Sites Credits 5.1 & 5.2 – Site Development.

C-2.4.2.1 **Resources.**

d. Websites:

- National Wildlife Federation http://www.nwf.org/

C-2.5 **Manage Storm Water Runoff**.

When precipitation rate exceeds infiltration rate or when soil is saturated, water begins to move down slope on ground surface, carrying with it soaps, detergents, oil, antifreeze, fertilizers, pesticides, animal bacteria, and other pollutants. Most of the surface runoff enters streams and rivers and eventually flows back into oceans, contaminating the waterways along the way. Use low impact development (LID) technologies (e.g., bio-retention cells, permeable paving) and natural or man-made site features (e.g., roofs of buildings, parking lots, and other horizontal surfaces) to infiltrate, treat/filter, store, evaporate, and detain runoff close to its source to the maximum extent feasible.

C-2.5.1 **Low Impact Development (LID)**. LID is a sustainable storm water management strategy that controls rainfall and storm water runoff at the source rather than sending it into a system of storm drain pipes and channels that lead to large, costly end-of-pipe facilities located at the bottom of drainage areas for management and treatment. LID practices enable distribution of storm water across a project site in order to replenish groundwater supplies, or collection of storm water for reuse. LID helps to improve the quality of receiving surface waters and to stabilize the flow rates of nearby streams by reducing water pollution and increasing groundwater recharge. LID has also been proven to reduce development and infrastructure costs and minimize operations and maintenance costs. LID technologies include permeable paving, vegetated roofs (see Appendix C 5-2.6.3 on Vegetated Roofs), rainwater harvesting, sand filters, vegetated filter strips, rain gardens, and constructed wetlands.

C-2.5.1.1 **Resources**.

a. Websites:

- EPA Low Impact Development http://www.epa.gov/owow/nps/lid/
- USACE Sustainable Design and Development Resources: Sustainable Sites: Storm Water Management http://www.cecer.army.mil/SustDesign/SDRSite.cfm.
- Low-Impact Development Center http://www.lowimpactdevelopment.org/

b. Design and Analysis Tools:

- Low Impact Development Urban Design Tool http://www.lid-stormwater.net/

c. WBDG:

- Achieving Sustainable Site Design Through Low Impact Development Practices http://www.wbdg.org/design/lidsitedesign.php?r=sustainable-i

d. Executive Order 13423 Technical Guidance: Stormwater Run-off Mitigation http://www.wbdg.org/sustainableEO/mou_sw.php

e. UFC/Other DOD Criteria:

- UFC 3-210-10, *Low Impact Development Manual*. http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

C-2.5.2 **LEED-NC Version 2.2**. Sustainable Sites Credits 6.1 & 6.2 – Stormwater Design.

C-2.5.3 **Resources**.

a. Websites:

- Texas Water Development Board, Rainwater Harvesting
  http://www.twdb.state.tx.us/assistance/conservation/Alternative_technologies/Rainwater_Harvesting/Rain.asp

b. Design and Analysis Tools:

- Surface Water Runoff Modeling
  http://www.shodor.org/master/environmental/water/runoff/
- Peak Discharge and Runoff Calculator
  http://www.lmnoeng.com/Hydrology/hydrology.htm

c. WBDG:

- Protect and Conserve Water
  http://www.wbdg.org/design/conserve_water.php

d. Executive Order 13423 Technical Guidance: Outdoor Water Conservation
http://www.wbdg.org/sustainableEO/mou_ow.php

e. UFC/Other DOD Criteria:

- UFC 3-210-10 *Low Impact Development Manual*
  http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4
- Air Force:
  AFI 32-7041, *Water Quality Compliance;*
  AFCESA Engineering Technical Letter 03-1: "Storm Water Construction;"
  http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125
  and
  AFCESA Engineering Technical Letter 04-6: "Inspection of Drainage Systems."
  http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125

C-2.6 **Reduce Heat Islands**.

Heat islands are domes of elevated temperatures over an urban area caused by the heat absorbed by structures and pavement, which will affect microclimates and natural habitats. Minimize heat islands by minimizing building footprint, reducing paving and walkways, and using landscaping and exterior building design methods, which include cool roofs and vegetated roofs.

C-2.6.1 **Landscaping Methods**. Maximize the use of trees and other vegetation to shade walkways, parking lots, and other open areas, being mindful that landscaping should employ indigenous, drought-tolerant plants. Integrate landforms and

landscaping into the site planning process to enhance resource protection. Ensure that site work and landscaping are integrated with security and safety design.

Consider covering or replacing walkways, parking lots, and other open areas that are paved or made with low reflectivity materials with high reflectivity materials or vegetation to reduce heat absorption. Ensure that shading devices do not block critical ground level sight lines for security.

C-2.6.1.1 **LEED-NC Version 2.2**. Sustainable Sites Credit 7.1 – Heat Island Effect: Non-Roof

C-2.6.1.2 **Resources**.

a. EPA Heat Island Effect http://www.epa.gov/heatisland/

C-2.6.2 **Cool Roofs.** Dark-colored roofs contribute to the heat island effect by heating the air around them. On the other hand, light-colored roofing materials (aka "cool roofs") reduce energy loads and extend the life of the roof, particularly in warm climates. Characteristics of a cool roof include high solar reflectance, high infrared emittance, and good convective heat transfer. Cool roofs come in many colors, not just bright white and may be membranes (e.g., TPO, EPDM, PVC), shingles, tiles, or metal. Factory applied coatings provide better long-term benefits than field applied coatings. While metal roofs contain 25-95 percent recycled content and have low thermal mass, they also have low emissivity (the ability to shed heat). Use a roofing product that meets or exceeds ENERGY STAR® roofing criteria and has an emissivity of at least 0.9.

C-2.6.2.1 **LEED-NC Version 2.2.** Sustainable Sites Credit 7.2 – Heat Island Effect: Roof

C-2.6.2.2 **Resources.**

a. Websites:

- Cool Roofs Rating Council http://www.coolroofs.org/
- Cool Roofing Materials Database http://eetd.lbl.gov/CoolRoofs/
- EPA's Energy Star® Reflective Roof Products http://www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products

b. WBDG Resource Pages:

- Cool Metal Roofing http://www.wbdg.org/design/coolmetalroofing.php

c. UFC/Other DOD Criteria:

- UFC 3-190-04FA, Design: Roofing and Waterproofing http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

C-2.6.3 **Vegetated Roofs**. Vegetated, or green, roofs are effective strategies controlling storm water runoff, mitigating heat-island effects, conserving energy, and prolonging the life of roofing materials. Green roofs can be installed on top of conventional flat roofs or on sloping roofs. The two types of vegetated roofs are extensive (six inches or shallower) and intensive (more than 6 inches). Intensive green roofs are typically used in plaza landscapes with large perennial plants and trees. The most common extensive green roof cover in temperate climates is a single, un-irrigated, 3- to 4-inch layer of lightweight growth media vegetated with succulent plants and herbs. A properly designed 3-inch deep vegetated roof cover provides a durable, low maintenance system with long-lasting benefits. Key components of a well-designed extensive green roof include proper drainage, plant nourishment and support, and protection of the underlying waterproofing system.

Figure 5-1 Green Roof Example

C-2.6.3.1 **LEED-NC Version 2.2.** Sustainable Sites Credit 7.2 – Heat Island Effect: Roof; Sustainable Sites Credit 6.1 – Stormwater Design: Quantity Control.

C-2.6.3.2 **Resources.**

a. Websites:

- USACE Sustainable Design and Development Resource http://www.cecer.army.mil/SustDesign/Index.cfm
- http://www.Greenroofs.com
- Green Roofs for Healthy Cities http://www.greenroofs.org/

b. Design and Analysis Tools:

- http://www.roofmeadow.com

c. Executive Order 13423 Technical Guidance: Security and Sustainability http://www.wbdg.org/sustainableEO/mou_ss.php

d. WBDG:

- Extensive Green Roofs http://www.wbdg.org/design/greenroofs.php
- Balancing Security/Safety and Sustainability Objectives http://www.wbdg.org/design/balancing_objectives.php

C-3 **PROTECT AND CONSERVE WATER**.

The Federal Government uses an estimated 244-256 billion gallons of water annually, which translates into about $0.5 billion to $1 billion for potable water and sewer runs, not including the significant amount spent on maintenance, repair and system upgrades. Consumption of water in many areas of the country exceeds the ability of the supplying aquifer to replenish itself. Because potable water sources are becoming increasingly scarce, previously, both Executive Order 13123 and the *Energy Policy Act* of 1992 required Federal agencies to install cost-effective water conservation measures in their facilities but did not include water conservation goals. Executive Order 13423 requires agencies to reduce water consumption intensity by 2 percent annually through 2015. Each service should develop and implement facility water management plans for their new and existing facilities based on the Federal Energy Management Program's (FEMP) *Facility Water Management Planning Guidelines* and ten Best Management Practices for Water Conservation. Among these, the key strategies for reducing potable water consumption and minimizing the impacts of wastewater systems include:

a. Use Potable Water Efficiently; and

b. Reuse and Recycle Water On-Site.

C-3.1 **Use Potable Water Efficiently**.

Establish a water use baseline; meter water usage; employ measurement and verification methods; comply with the Department of Energy's International Performance Measurement and Verification Protocol (IPMVP) for water use. Eliminate leaks; caulk around pipes and plumbing fixtures; conduct annual checks of hoses and pipes. Leaks may also cause mold, adversely affecting the quality of the indoor environment. Design landscape for water efficiency through xeriscaping or use of native plants tolerant of local soil and rainfall conditions, eliminating the need for permanent irrigation systems.

Use ultra water-efficient plumbing fixtures including dual flush toilets and waterless urinals, and integrate other water-saving devices into the buildings. Install water-conserving cooling towers designed with delimiters to reduce drift and evaporation. Reduce evaporation through scheduled irrigation at dawn and dusk.

C-3.2 **Reuse and Recycle Water On-Site**.

Facilities have water needs that can be met with non-potable water. Non-potable water is either filtered but untreated or, in the case of wastewater (aka black water), treated to meet high standards at on-site mechanical or biological waste treatment facilities. Collect rainwater from roofs with cisterns. Use roof water, groundwater from sump pumps, and non-sewage wastewater for on-site activities such as landscape irrigation, cooling tower make-up and other industrial and processes, fire sprinkler systems, and sewage conveyance. Ensure non-potable water usage is permissible in the city or county in which the base is located.

C-3.3 **LEED-NC Version 2.2**.

Water Efficiency Credits 1.1 & 1.2 – Water Efficient Landscaping; Water Efficiency Credit 2 – Innovative Wastewater Technologies; Water Efficiency Credits 3.1 & 3.2 – Water Use Reduction; Sustainable Sites Credit 6.2 – Stormwater Design: Quality Control.

C-3.4 **Resources**.

a. Websites:

- EPA Water Pages http://www.epa.gov/water/
- EPA WaterSense http://www.epa.gov/watersense/
- FEMP Technologies water efficiency recommendations http://www.eere.energy.gov/femp/technologies/water_efficiency.cfm
- EPA Green Landscaping with Native Plants http://www.epa.gov/greenacres/
- US DOE Measuring Performance (IPMVP) http://www.eere.energy.gov/buildings/info/operate/measuring.html
- National Resource Conservation Services (NRCS) Plants Database, link to landscaping resources http://plants.usda.gov/
- American Waterworks Association http://www.awwa.org/
- The Groundwater Foundation http://www.groundwater.org/

b. WBDG:

- Water Conservation http://www.wbdg.org/design/water_conservation.php

c. Executive Order 13423 Technical Guidance:

- Measurement & Verification
  http://www.wbdg.org/sustainableEO/mou_mv.php
- Indoor Water Conservation
  http://www.wbdg.org/sustainableEO/mou_iw.php

d. UFC/Other DOD Criteria:

- UFC 3-440 O&M: Water Conservation
  http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4
- Air Force Water Conservation Guidebook
  http://www.afcesa.af.mil/ces/cesc/water/cesc_watercons.asp

C-4 **OPTIMIZE ENERGY USE**.

With America's supply of fossil fuels dwindling, concerns for energy security increasing, and the impact of greenhouse gases on world climate rising, it is essential to find ways to reduce load, increase efficiency, and use renewable fuel resources in federal facilities. Executive Order 13423 and the *Energy Policy Act* of 2005 require Federal agencies to install cost-effective energy conservation measures in their facilities. The key strategies for conserving energy, encouraging the use of non-grid source energy and protecting the atmosphere include:

a. Reduce Ozone Depletion,

b. Optimize Energy Performance,

c. Monitor Project Performance, and

d. Use Green Power.

C-4.1 **Reduce Ozone Depletion**.

Ozone that naturally exists in the stratosphere shields the Earth against harmful ultraviolet rays from the sun, and subsequent harmful health effects on humans and the environment. However, depletion of stratospheric ozone by man-made chlorofluorocarbons (CFCs) is a serious global concern due to the potential increase in ultraviolet radiation that may reach the surface of the Earth as a result of stratospheric ozone layer thinning. Therefore, only use heating, ventilating, air-conditioning (HVAC), and refrigerating equipment containing with non-CFC-based refrigerants. Use of HVAC, refrigeration, and fire suppression equipment free of HCFCs and Halons is also recommended. Evaluate alternative refrigerants keeping in mind that refrigeration system efficiencies are also impacted by various refrigerant choices.

C-4.1.1 **LEED-NC Version 2.2**. Energy & Atmosphere Prerequisite 3 – Fundamental Refrigerant Management; Energy & Atmosphere Credit 4 – Enhanced Refrigerant Management.

C-4.1.2 **Resources**.

a. Websites:

- EPA Significant New Alternatives Program (SNAP) http://www.epa.gov/ozone/snap/fact.html

b. Design and Analysis Tools:

- EPA SNAP Alternatives List http://www.epa.gov/ozone/snap/lists/index.html

c. WBDG:

- High Performance HVAC http://www.wbdg.org/design/hvac.php

d. Executive Order 13423 Technical Guidance: Ozone Depleting Compounds http://www.wbdg.org/sustainableEO/mou_odc.php

e. UFC/Other DOD Criteria: http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-400-01, *Energy Conservation*
- UFC 3-440-01N *Active Solar Preheat Systems*
- UFC 3-440-03N *Passive Solar Buildings*
- UFC 3-440-04N *Solar Heating of Buildings and Domestic Hot Water*
- UFC 3-440-06N *Cooling Buildings with Natural Ventilation*
- AFCESA Engineering Technical Letter 06-8, "Energy Savings Performance Contracts (ESPC) http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125

C-4.2 **Optimize Energy Performance**.

Optimal energy performance depends on project team collaboration and an integrated design approach that considers the entire building, not just its subsystems, at the outset and throughout the design and construction stages. For example, the evaluation of a building envelope design must consider its effect on cooling loads and daylighting http://www.wbdg.org/design/daylighting.php. An energy-efficient building envelope, coupled with a state-of-the-art lighting system http://www.wbdg.org/design/efficientlighting.php and efficient, properly-sized HVAC equipment will cost less to purchase and operate than a building whose systems are selected in isolation from each other.

New DoD buildings, except low-rise residential buildings, should meet or exceed the current version of ASHRAE 90.1 (http://www.ihserc.com/). In addition, the *Energy Policy Act* of 2005 requires new Federal buildings to use 30% less energy than ASHRAE 90.1-2004 (or the ICC *International Energy Conservation Code* for low rise residential buildings). The Army Corps of Engineers requires the designer to achieve a

minimum of 30 percent. Fundamental to designing an energy-efficient, high-performance building is integrating the building with the site; using renewable and/or distributed energy resources; optimizing the building envelope; specifying efficient lighting and appliances; specifying correctly-sized heating, ventilating, and air-conditioning (HVAC) systems, recovering waste energy and developing appropriate system control strategies. Employ energy modeling programs http://www.wbdg.org/design/energyanalysis.php early in the design process to guide architectural and engineering decisions to achieve the energy use goals defined in the planning stage.

C-4.2.1 **Integration of Building with Site.** Take advantage of natural site elements, such as vegetation, landforms, solar access, and wind direction to reduce the energy load of the building. Use passive solar design techniques, including passive solar heating, trombe walls, and natural ventilation. Orient and size windows, and locate landscape with solar geometry, predominate wind direction, and building load requirements in mind. Well-designed sun control and shading devices are particularly important in buildings that employ passive solar heating or daylighting. Use fixed overhangs on south-facing glass. Limit east and west glass since it is harder to shade. Shading strategies that work well at one latitude may be completely inappropriate for another site at different latitudes. Use caution in applying shading ideas from one project to another. Consider vertical landscaping for size restricted sites and tall atria.

C-4.2.1.1 **LEED-NC Version 2.2.** Energy & Atmosphere Prerequisite 2 – Minimum Energy Performance; Energy & Atmosphere Credit 1 – Optimize Energy Performance.

C-4.2.1.2 **Resources.**

a. WBDG:

- Sun Control and Shading Devices http://www.wbdg.org/design/suncontrol.php?r=sustainable-i
- Daylighting http://www.wbdg.org/design/daylighting.php?r=sustainable-i
- Energy Efficient Lighting http://www.wbdg.org/design/efficientlighting.php?r=sustainable-i
- Electric Lighting Controls http://www.wbdg.org/design/electriclighting.php?r=sustainable-i
- Energy Analysis Tools http://www.wbdg.org/design/energyanalysis.php?r=sustainable-i

b. Executive Order 13423 Technical Guidance:

- Daylighting (http://www.wbdg.org/sustainableEO/mou_daylight.php),
- Energy Efficiency (http://www.wbdg.org/sustainableEO/mou_ee.php)

c. UFC/Other DOD Criteria:
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-400-01, *Energy Conservation.*

C-4.2.2 **Renewable and/or Distributed Energy Resources.** Renewable and distributed energy systems can be less polluting than grid-source energy created from fossil fuels. Where feasible, consider on-site renewable energy technologies such as solar water heating http://www.wbdg.org/design/swheating.php , stand-alone solar panels, or building integrated photovoltaics), wind turbines, biomass gasifiers, and geothermal plants. Consider other distributed energy systems such as microturbines, fuel cells, waste-to-energy and hybrid systems that combine technologies to improve performance and efficiency (e.g., solid oxide fuel cell combined with a microturbine, or engines combined with energy storage devices such as flywheels). Some distributed energy resources possess combined heat and power capabilities (cogeneration). Other renewable energy technologies that do not generate power, but contribute to the energy efficiency of the building include: geothermal heat pumps and solar water heating.

C-4.2.2.1 **LEED-NC Version 2.2.** Energy and Atmosphere Prerequisite 2 – Minimum Energy Performance; Energy and Atmosphere Credit 1 – Optimize Energy Performance; Energy and Atmosphere Credit 2 – On-Site Renewable Energy.

C-4.2.2.2 **Resources.**

a. Websites:

- FEMP Technologies
http://www.eere.energy.gov/femp/technologies/technologies.cfm

b. WBDG:

- Building Integrated PV (BIPV)
http://www.wbdg.org/design/bipv.php?r=sustainable-i
- Distributed Energy Resources (DER)
http://www.wbdg.org/design/der.php?r=sustainable-i
- Fuel Cell Technology
http://www.wbdg.org/design/fuelcell.php?r=sustainable-i
- Microturbines
http://www.wbdg.org/design/microturbines.php?r=sustainable-i
- Solar Water Heating
http://www.wbdg.org/design/swheating.php?r=sustainable-i
- Passive Solar Heating
http://www.wbdg.org/design/psheating.php?r=sustainable-i

c. Executive Order 13423 Technical Guidance: Renewable Energy & Green Power http://www.wbdg.org/sustainableEO/mou_regp.php

d. UFC/Other DOD Criteria:
http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-400-01, *Energy Conservation.*

C-4.2.3 **High-Performance Building Envelopes.** The building envelope, or shell, holds the building up, prevents water infiltration, keeps wind out, and controls the transfer of energy (heat) between interior, conditioned spaces and exterior, unconditioned spaces, or the ground. Energy-efficient building envelopes contribute significantly to reducing the energy load of the building. Key building envelope efficiency elements and issues include roofs, walls, floors, glazing (windows and doors), insulation, and moisture control.

C-4.2.3.1 **Roofs/Walls/Floors**. An airtight, waterproof building envelope is critical for buildings of all sizes and uses in nearly all climates. Additionally, a well insulated envelope reduces energy use and enhances occupant comfort. S elect roof, wall, and floor assemblies based on long-term, insulation, and durability requirements.

C-4.2.3.2 **Glazing (Windows and Doors)**. Glazing has the single largest effect on heating, cooling, and lighting among the various building envelope components. The choice of glazing will largely determine the level of solar radiant gain, the degree of daylight transmission and, in conjunction with frame design, the insulating value of a window. Other issues to consider in selecting glazing include daylighting, noise control, security, and durability/moisture control. In recent years, high-performance low-e glass has become readily available and cost-effective. Low-e stands for low emissivity or low emittance. A low-e coating reduces the heat emitted (radiated) from the warm pane to the cool pane. In heating-dominated buildings, consider specifying glass with the low-e coating on the interior pane (on the surface facing the air space), to reduce heat loss in winter. In cooling dominated buildings, normally select glass with the low-e coating on the exterior pane (on the surface facing the air space), to keep the pane, which gets hot in summer, from sending much of its heat inside. A low-e coating decreases the U-value, the shading coefficient, and the daylight transmittance of glazing.

Glazing can provide most of the daytime lighting needs for the interior areas it serves through windows, roof monitors, clerestories, and skylights. The benefits of daylighting go beyond the energy savings accrued from the electric lighting being off much of the day. Extensive studies have shown a significant increase in productivity and a similar decrease in absenteeism in daylit workspaces. Other studies have demonstrated dramatic increases in retail sales in daylit stores and major improvement in student math and reading scores in daylit classrooms.

In some applications, vision glazing must have different characteristics than daylight glazing. Employ reduced visible light transmittance for vision glazing and higher visible light transmittance for daylighting glass. In those cases, use exterior or interior light shelves to direct daylight deep into the space.

Other types of glazing that have applications for DoD buildings are: spectrally selective (allows a large percentage of visible light to be transmitted while remaining largely opaque to the heat-producing, near infrared portion of the spectrum), ceramic-frit (finely ground, colored glass strips that can be selected to alter the shading coefficient of clear glass from 0.36 to 0.60) and translucent panels (fiberglass reinforced plastic sheets that scatter light and eliminate hot spots due to direct sunlight-–for industrial and commercial applications).

C-4.2.3.3 **LEED-NC Version 2.2.** Energy & Atmosphere Prerequisite 2 – Minimum Energy Performance; Energy & Atmosphere Credit 1 – Optimize Energy Performance; Indoor Environmental Quality Credits 8.1 & 8.2 – Daylight and Views.

C-4.2.3.4 **Resources.**

a. Websites:

- Energy Star – Qualified Products http://www.energystar.gov/index.cfm?fuseaction=find_a_product.
- FEMP Energy-Efficient Products Lists http://www.eere.energy.gov/femp/procurement/

b. Design and Analysis Tools: Window 5.2 http://windows.lbl.gov/software/window/window.html

c. WBDG:

- Windows and Glazing http://www.wbdg.org/design/windows.php?r=sustainable-i
- Daylighting http://www.wbdg.org/design/daylighting.php?r=sustainable-i
- Sun Control and Shading Devices http://www.wbdg.org/design/suncontrol.php?r=sustainable-i
- Mold and Moisture Dynamics http://www.wbdg.org/design/moisturedynamics.php?r=sustainable-i
- Air Barrier Systems in Buildings http://www.wbdg.org/design/airbarriers.php

d. Building Envelope Design Guide http://www.wbdg.org/design/envelope.php

e. Executive Order 13423 Technical Guidance: Ventilation & Thermal Comfort http://www.wbdg.org/sustainableEO/mou_vtcomfort.php

f. Executive Order 13423 Technical Guidance Moisture Control http://www.wbdg.org/sustainableEO/mou_mc.php

g. UFC/Other DOD Criteria;

- UFC 3-400-01, *Energy Conservation* http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4; and
- AFCESA Engineering Technical Letter 04-7, "Design Criteria for Prevention of Mold in Air Force Facilities." http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125

C-4.2.4 **Energy-Efficient HVAC, Lighting, Appliances, and Controls.** Approximately 90 percent of the energy consumed in typical commercial buildings is attributed to space and water heating, space cooling, lighting, and appliances. Energy-efficient systems can reduce energy costs by 50 percent.

C-4.2.4.1 **Energy-Efficient HVAC Systems.** To achieve an efficient HVAC design: "right size" HVAC systems to ensure efficient operation; consider part-load performance when selecting equipment; shift or shave electric loads during peak demand periods; plan for expansion, but do not size for it; specify appropriate control systems (e.g., Direct Digital Controls [DDC]); and commission the HVAC systems. Use energy-efficient HVAC equipment and systems that meet or exceed Energy Star® or Department of Energy Federal Energy Management Program (FEMP) recommendations, and the current version of ASHRAE 90.1. Evaluate energy recovery systems that preheat or pre-cool incoming ventilation air in commercial and institutional buildings. Investigate the use of integrated generation and delivery systems, such as cogeneration, fuel cells, and off-peak thermal storage. (See Appendix C 5-4.2.2 for more information).

C-4.2.4.2 **Energy-Efficient Lighting Systems.** High quality energy-efficient lighting systems should integrate lighting and lighting controls to provide comfortable and visually interesting spaces for occupants. Use lighting systems that consume less than 1 watt/square foot for ambient lighting. Use ENERGY STAR® approved lighting and lighting controls or products that meet or exceed Department of Energy Federal Energy Management Program (FEMP) standards. Follow IESNA Standards to optimize light and lighting controls performance and aesthetic qualities provided to occupied spaces.

C-4.2.4.3 **Energy Efficient Appliances.** Use ENERGY STAR® approved products or products that meet or exceed Department of Energy Federal Energy Management Program (FEMP) standards.

C-4.2.4.4 **Electric Motors.** Federal agencies are required by *Energy Policy Act* of 2005 to procure premium efficiency motors. Motors that meet the required efficiency levels carry the NEMA Premium™ label

C-4.2.4.5 **System Controls.** Energy conservation depends greatly on how well building HVAC and lighting systems are controlled to match occupant needs. Use sensors to control loads based on occupancy, schedule, and/or the availability of natural resources such as daylight or natural ventilation. Evaluate the use of Direct Digital Controls. Employ air quality (carbon dioxide) sensors, space temperature sensors installed in various locations, and occupancy sensors that can feed signals back to the central control system in order to control ventilation air quantities based on demand;

reduce reheat energy by automatically resetting supply air temperature; and bring spaces to the desired temperature after a setback period.

C-4.2.4.6 **LEED-NC Version 2.2.** Energy & Atmosphere Prerequisite 2 – Minimum Energy Performance; Energy & Atmosphere Credit 1 – Optimize Energy Performance; Energy & Atmosphere Credit 5 – Measurement & Verification; Indoor Environmental Quality Credit 1 – Outdoor Air Monitoring.

C-4.2.4.7 **Resources.**

a. Websites:

- Energy Star – Qualified Products http://www.energystar.gov/index.cfm?fuseaction=find_a_product. .
- FEMP Energy-Efficient Products Lists http://www.eere.energy.gov/femp/procurement/
- FEMP Energy-Efficient Motors http://www1.eere.energy.gov/femp/procurement/eep_emotors.html

b. WBDG:

- High Performance HVAC http://www.wbdg.org/design/hvac.php
- Energy-Efficient Lighting http://www.wbdg.org/design/efficientlighting.php
- Electric Lighting Controls http://www.wbdg.org/design/electriclighting.php

c. Executive Order 13423 Technical: Energy Efficiency http://www.wbdg.org/sustainableEO/mou_ee.php

d. Executive Order 13423 Technical Guidance: Measurement & Verification http://www.wbdg.org/sustainableEO/mou_mv.php

e. UFC/Other DOD Criteria: http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-400-01, *Energy Conservation*.

C-4.3 **Monitor Project Performance**.

Establish quality assurance plans and procedures for use throughout the life cycle of a building to ensure that the project is designed and built according to defined requirements and performs optimally during occupancy. Quality assurance begins with well-defined project requirements during planning/programming, followed by the design phase which establishes the sequence of operation and the systems parameters that will be measured and verified during the commissioning process, which will be on-going through the construction phase into the occupancy phase. The commissioning phase ensures that the systems are operating as specified. See Appendix B-4 for information

on building commissioning. D uring occupancy, as part of the facility's operations and maintenance program, ongoing monitoring and continuous commissioning (using Building Automation Systems/Energy Management Systems/Direct Digital Controls) of HVAC, ventilation, water, and lighting systems should occur. This allows facility managers to adjust and optimize building system performance. Annual energy and water usage data reporting is required and must be submitted to headquarters level staff for Service-, DoD-, and Federal-wide accounting.

C-4.3.1 **Metering**. Per *Energy Policy Act* of 2005, Federal agencies must have advanced metering capability (hourly measurements of electricity consumption and daily data reports, at a minimum) by October 1, 2012. Metering of gas and water consumption should also be considered.

C-4.3.2 **LEED-NC Version 2.2.** Energy & Atmosphere Prerequisite 1 – Fundamental Commissioning of the Building Energy Systems; Energy & Atmosphere Credit 3 – Enhanced Commissioning; Energy & Atmosphere Credit 5 – Measurement and Verification; possible Innovation & Design Credit 1 for O&M plan.

C-4.3.3 **Resources**.

a. Websites:

- FEMP Purchasing Renewable Power http://www.eere.energy.gov/femp/technologies/renewable_purchasepower.cfm

b. WBDG:

- Building Commissioning http://www.wbdg.org/project/buildingcomm.php
- Total Quality Commissioning http://www.wbdg.org/design/tqc.php
- GSA Project Planning Tools http://www.wbdg.org/tools/ppt.php?u=5

c. Executive Order 13423 Technical Guidance:

- Commissioning http://www.wbdg.org/sustainableEO/mou_commissioning.php
- Energy Efficiency http://www.wbdg.org/sustainableEO/mou_ee.php

d. UFC/Other DOD Criteria: http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-530-01AN *Interior and Exterior Lighting and Controls*;
- UFC 3-400-01, *Energy Conservation*;
- AFCESA Engineering Technical Letter 98-4, "Building Manager Energy Conservation Handbook" http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125; and

- *Air Force Procedures for Accessing Department of Energy FEMP Services*, including renewable power procurement www.afcesa.af.mil/ces/cesm/energy/DOEProc_Atch.pdf.

C-4.4 Use Green Power.

As part of a whole building sustainable design strategy, consider on-site generation of or the purchase of bulk green power—electricity produced by sources that are less harmful to the environment than fossil fuels—to complement building-specific design goals like minimizing electrical load requirements. Green power sources are clean, rapidly renewable (such as wind, solar, geothermal, biomass, and small hydroelectric), and environmentally preferable.

C-4.4.1 **LEED-NC Version 2.2**. Energy & Atmosphere Credit 6 – Green Power.

C-4.4.2 **Resources**.

a. Websites:

- EPA Green Power http://www.epa.gov/greenpower/
- FEMP Purchasing Renewable Power http://www.eere.energy.gov/femp/technologies/renewable_purchasepower.cfm
- Green-e Renewable Electricity Certification Program http://www.green-e.org/

b. WBDG:

- Building Integrated Photovoltaics http://www.wbdg.org/design/bipv.php

c. Executive Order 13423 Technical Guidance: Renewable Energy & Green Power http://www.wbdg.org/sustainableEO/mou_regp.php

d. UFC/Other DOD Criteria: http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

- UFC 3-400-01, *Energy Conservation.*

C-5 **USE ENVIRONMENTALLY PREFERABLE PRODUCTS.**

Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," (http://www.wbdg.org/ccbref/ccbdoc.php?category=eo&docid=11&ref=1) directs Federal agencies to use recycled content (see EPA's Comprehensive Procurement Guidelines (http://www.epa.gov/cpg/products.htm)), biobased products (see USDA's web page), environmentally preferable products (see EPA's EPP database), and reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of

by the agencies. Prior to specifying materials for a project, evaluate their environmental preferability using the cradle-to-cradle, life-cycle assessment (LCA) [http://www.wbdg.org/design/greenproducts.php] approach. Factors to be considered include: raw materials acquisition, manufacturing, transportation, installation, use, recyclability, recycled content, bio-based content, and ultimate disposal related to life-cycle cost http://www.wbdg.org/design/lcca.php , global warming, resource depletion, indoor air quality http://www.wbdg.org/design/ieq.php , and waste prevention. LCA Tools like ATHENA™ http://www.athenasmi.ca/ and BEES® http://www.bfrl.nist.gov/oae/software/bees.html should be used to assist in the selection process. Sustainable performance requirements for materials, equipment, and systems should be carefully documented in the specifications for construction. See Appendix L for information on green specifications.

Other key strategies for reducing the use of new raw materials, limiting waste materials, and reducing environmental impacts of transportation as well as supporting regional economies include:

a. Renovate Existing Facilities;

b. Limit Construction Debris;

c. Reuse Materials, Products, and Equipment;

d. Choose Environmentally Preferable Products;

e. Give Preference to Locally Produced Materials with Low Embodied Energy Content;

f. Use Rapidly Renewable Materials and Certified Wood Products; and

g. Use Recyclable Assemblies and Products.

C-5.1 **Renovate Existing Facilities**.

See Appendix C-2.1.3.

C-5.2 **Limit Construction Debris**.

Consider deconstructing buildings (the systematic dismantling of buildings) rather than demolishing them. In project specifications, incorporate requirements to divert from landfills a high percentage of both construction waste and demolition debris by salvage, recycling, or recovery. Include the development and implementation of a plan for sorting construction waste for recycling. Use products and assemblies that minimize disposable packaging and storage requirements.

C-5.2.1 **LEED-NC Version 2.2**. Materials & Resources Credits 2.1 & 2.2 – Construction Waste Management.

C-5.2.2 **Resources**.

a. Websites:

- The Building Deconstruction Consortium https://www.denix.osd.mil/denix/Public/Library/Sustain/BDC/bdc.html
- The Deconstruction Institute http://www.deconstructioninstitute.com/
- WasteSpec: Model Specifications for Construction Waste Reduction, Reuse, and Recycling by Triangle J Council of Governments http://www.tjcog.dst.nc.us/regplan/wastspec.htm
- Construction Waste Management http://www.toolbase.org/Best-Practices/Construction-Waste/construction-waste-management

b. Executive Order 13423 Technical Guidance: Construction Waste http://www.wbdg.org/sustainableEO/mou_cw.php

c. UFC/Other DOD Criteria:

- AFCEE Construction and Demolition Waste Guide http://www.afcee.brooks.af.mil/eq/programs/progpage.asp?PID=61
- Solid Waste Measures of Merit http://www.afcee.brooks.af.mil/eq/debris/mom/index.asp
- Navy:
  Deconstruction Guide for Military Installations
  http://kppc.org/Resources/DoD%20Deconstruction

d. WBDG:

- Construction Waste Management http://www.wbdg.org/design/cwm.php
- Construction Waste Management Database http://www.wbdg.org/tools/cwm.php?u=5

C-5.3 **Reuse Materials, Products, and Equipment**.

For renovation projects, incorporate as much of the existing non-shell walls, floor coverings, ceilings, and doors as feasible into the design. Prior to deconstruction or demolition, evaluate if components of existing buildings or facilities, such as framing lumber, bricks, windows, or metal door frames, can be incorporated in any new construction. Ensure that the windows and doors meet the new facility's security and energy requirements. Use salvaged and reconditioned products and equipment, such as wood flooring and furniture, whenever economically feasible and resource efficient. Be certain that they are free of hazardous materials such as asbestos, lead, mercury and PCBs. Set aside storage space for salvaged, reusable materials, products, and equipment.

C-5.3.1 **LEED-NC Version 2.2**. Materials & Resources Credit 1.3 – Building Reuse: Maintain 50 Percent of Interior Non-Structural Elements; Materials & Resources Credits 3.1 & 3.2 – Materials Reuse.

C-5.3.2 **Resources**.

a. Websites:

- Building Materials Reuse Association http://www.ubma.org/

b. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php

c. UFC/Other DOD Criteria:

- Army Projects: Deconstruction/Demolition http://www.cecer.army.mil/SustDesign/APDecon.cfm

C-5.4 **Choose Environmentally Preferable Products**.

Use EPA-designated recycled content products (http://www.epa.gov/cpg/products.htm) to the maximum extent practicable—required under the *Resource Conservation and Recovery Act* of 1994, Section 6002 http://www.wbdg.org/references/us_code.php . Purchase environmentally preferable products as described in EPA's Environmentally Preferable Purchasing (EPP) Program (http://www.epa.gov/oppt/epp/), which promotes Federal Government procurement of products and services that have reduced impacts on human health and the environment over their life cycle. Follow the EPA's five guiding principles http://www.epa.gov/oppt/epp/pubs/guidance/fivegp.htm established to help Executive agencies identify and purchase environmentally friendly products and services:

a. Environment + Price + Performance = EPP. Include environmental considerations as part of the normal purchasing process.

b. Pollution Prevention. Emphasize pollution prevention as part of the purchasing process.

c. Life-Cycle Perspective/Multiple Attributes. Examine multiple environmental attributes throughout the product and service's life cycle.

d. Comparison of Environmental Impacts. Compare environmental impacts when selecting products and services.

e. Environmental Performance Information. Collect accurate and meaningful environmental information about environmental performance of products and services.

Consider the recycled content, embodied energy (Appendix C-5.5), biobased content (Appendix C-5.6), VOC content (Appendix C-6.4), and other environmental attributes of the products being considered, then choose the product that provides the overall best value with the least environmental impact.

C-5.4.1 **LEED-NC Version 2.2.** Materials & Resources Credits 4.1 & 4.2 – Recycled Content.

C-5.4.2 **Resources.**

a. Websites:

- AIA Colorado Sustainable Design Resource Guide http://aiacolorado.org/SDRG/home.htm
- OIKOS Green Building Source http://oikos.com/
- EPA EPP Database http://yosemite1.epa.gov/oppt/eppstand2.nsf
- Scientific Certification Systems (SCS) Environmentally Preferable Product Certification Program http://www.scscertified.com
- Green Seal Product Standards and Certification http://www.greenseal.org
- GreenSpec Guideline Specifications and Product Listings http://www.buildinggreen.com/menus/index.cfm

b. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php

c. Federal Green Construction Guide for Specifiers http://www.wbdg.org/design/greenspec.php

d. Executive Order 13423 Technical Guidance :

- Recycled Content http://www.wbdg.org/sustainableEO/mou_rc.php
- Biobased Content http://www.wbdg.org/sustainableEO/mou_bc.php

e. UFC/Other DOD Criteria:

- Air Force ETL 00-1: "EPA Guideline Items in Construction and Other Civil Engineering Specifications," http://www.afcee.brooks.af.mil/eq/ap/ETL00-1.pdf
- Guide to Green Purchasing http://www.afcee.brooks.af.mil/eq/ap/gg/guide.doc

C-5.5 **GIVE PREFERENCE TO LOCALLY PRODUCED MATERIALS WITH LOW EMBODIED ENERGY CONTENT**.

Embodied energy is the energy required to produce and transport materials. In choosing building materials, products, and systems for new construction or major building renovations, give preference to the use of locally produced products to stimulate local economies and reduce transportation burdens. Give preference to the use of materials and assemblies that require minimum "embodied" energy for raw materials acquisition, manufacture, transport, installation, and use where economically feasible.

C-5.5.1 **LEED-NC Version 2.2**. Materials & Resources Credits 5.1 & 5.2 – Regional Materials.

C-5.5.2 **Resources**.

a. Websites:

- AIA Colorado Sustainable Design Resource Guide http://www.aiacolorado.org/SDRG/home.htm
- Forest Stewardship council (FSC) http://www.fscus.org
- Forest Certification Resource Center http://www.certifiedwood.org
- Biobased Manufacturers Association – Biobased Products http://www.biobased.com/
- USDA Biobased Products Preferred Procurement Program http://www.biobased.oce.usda.gov/public/index.cfm

b. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php

C-5.6 **Use Rapidly Renewable Materials and Certified Wood Products**.

Use timber products obtained from sustainably managed forests, certified through third-party agencies such as the Forest Stewardship Council (FSC). Where economically feasible, give preference to rapidly renewable and bio-based materials or products, such as agricultural-fiber sheathing, linoleum, and bamboo flooring, over inert or non-recycled alternatives.

C-5.6.1 **LEED-NC Version 2.2**. Materials & Resources Credit 6 – Rapidly Renewable Materials; Materials & Resources Credit 7 – Certified Wood.

C-5.6.2 **Resources**.

a. Websites:

- Forest Stewardship Council http://www.fsc.org/en/
- Sustainable Forestry Initiative http://www.aboutsfi.org/core.asp
- American Tree Farm System http://www.treefarmsystem.org/index.cfm

b. WBDG:

- Evaluating and Selecting Green Products
  http://www.wbdg.org/design/greenproducts.php

C-5.7 **Use Flexible and Recyclable Assemblies and Products**.

To the maximum extent feasible, use flexible and modular components, such as access floors, carpet tile, and moveable partitions, to reduce the labor and materials costs related to operations and maintenance, "churn"/reconfiguration, and future renovations. Raised access floors used to distribute air also contribute to energy efficiency and occupant comfort. Within acceptable levels of performance, give preference to the use of de-mountable or de-constructible products and assemblies for easy disassembly, and deconstruction and recycling after its useful life. Avoid composite materials, which are usually not recyclable.

C-5.7.1 **LEED-NC Version 2.2**. Materials & Resources Credit 1.3 – Building Reuse: Maintain 50 percent of Interior Non-Structural Elements.

C-5.7.2 **Resources**.

a. Executive Order 13423 Technical Guidance: Meeting Needs with Space Optimization and Alternative Workplace Arrangements
http://www.wbdg.org/sustainableEO/mou_so.php

b. WBDG:

- Selecting and Evaluating Green Products
  http://www.wbdg.org/design/greenproducts.php
- Design for the Changing Nature of Work
  http://www.wbdg.org/design/design_change.php

C-6 **ENHANCE INDOOR ENVIRONMENTAL QUALITY**.

The ultimate success or failure of a project rests on its indoor environmental quality (IEQ). Invariably, healthy and comfortable environments will enable occupants to better perform assignments to meet their service's mission. At a minimum, meet the requirements of ASHRAE 62-1999, *Ventilation for Acceptable Indoor Air Quality* and approved Addenda. http://www.ihserc.com/

Key strategies for creating and maintaining a healthy and productive indoor environment include:

a. Supply and Maintain Adequate Levels of Ventilation;

b. Minimize Construction Impacts on Indoor Air Quality;

c. Avoid the Use of Materials High in Pollutants;

d. Control Disturbing Odors and Contaminants

e. Provide Thermal Comfort and Occupant Control of Environment;

f. Optimize Daylighting, Aesthetics, and Views; and

g. Assure Acoustical Privacy and Comfort.

C-6.1 **Supply and Maintain Adequate Levels of Ventilation**.

Where feasible, design mechanical ventilation systems to comply with the recommended design approaches in ASHRAE 2001 *Fundamentals* http://www.ihserc.com/ Chapter 32, "Space Air Diffusion" and achieve an air change effectiveness (E) greater than or equal to 0.9 as determined by ASHRAE 129-1997. Protect ventilation systems during construction. Prior to initial occupancy, test to assure that adequate ventilation rates can be achieved. Investigate the use of separate outside air and conditioned air distribution networks. Design ventilation system to assure fresh air intakes are located away from loading areas, exhaust fans, and other contamination points. Prohibit smoking in all areas of the building. Where feasible, use a permanent air quality (carbon dioxide) monitoring system to provide feedback on ventilation performance for operational adjustments. Coordinate ventilation and air filtration with chemical, biological, and radiological concerns and locate outside air intakes so they do not conflict with physical security requirements.

C-6.1.1 **LEED-NC Version 2.2.** Indoor Environmental Quality Prerequisite 1 – Minimum IAQ Performance; Indoor Environmental Quality Prerequisite 2 – Environmental Tobacco Smoke (ETS) Control; Indoor Environmental Quality Credit 1 – Outdoor Air Delivery Monitoring; Indoor Environmental Quality Credit 2 – Increased Ventilation; Indoor Environmental Quality Credits 3.1 & 3.2 – Construction IAQ Management Plan.

C-6.1.2 **Resources.**

a. Websites:

- EPA Ventilation and Air Quality in Offices http://www.epa.gov/iedweb00/pubs/ventilat.html

b. Executive Order 13423 Technical Guidance:

- Protecting IAQ During Construction http://www.wbdg.org/sustainableEO/mou_iaq.php
- Low-Emitting Materials http://www.wbdg.org/sustainableEO/mou_lem.php

c. WBDG:

- High Performance HVAC http://www.wbdg.org/design/hvac.php
- Natural Ventilation http://www.wbdg.org/design/naturalventilation.php

C-6.2 **Minimize Construction Impacts on Indoor Air Quality**.

To sustain the comfort and well-being of construction workers and building occupants, implement an indoor air quality (IAQ) management program throughout the construction process. Components of the IAQ program, defined in an IAQ plan, should consist of the following:

a. General. During construction, meet or exceed the minimum requirements of the Sheet Metal and Air-Conditioning National Contractors Associations (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995.

b. HVAC Protection. HVAC supply duct shall be kept clean, and free of dust and debris during storage and handling. In cases where air handlers must be used during construction, filtration media with Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill. Replace all filtration media immediately prior to occupancy—filtration media shall have a MERV of 13 as determined by ASHRAE 52.2-1999.

c. Source Control. Use low-emitting paints and other finishes, sealants, adhesives, and carpeting. See Appendix C-6.3 for more information. Provide maximum 100 percent outside air ventilation during the installation of strong emitting materials. “Bake-out” or “super-heating” of spaces to accelerate the release of gaseous emissions should not be permitted. Consider local humidity levels before deciding to use 100 percent outside air.

d. Housekeeping. Clean daily to remove construction dust and debris. Use HEPA-filter vacuum at least for the final cleaning. Use least toxic and lowest-emitting spot removers and cleaning agents where practical.

e. Pathway Interruption. Ventilate using 100 percent outside air during installation of VOC-emitting materials. Erect physical barriers, such as plastic sheeting and sticky mats, between work areas and non-work areas.

f. Scheduling. Protect absorptive materials from exposure to moisture and high VOC materials during product delivery, storage, and handling. Control sequence of construction to minimize the absorption of VOCs by other building materials.

C-6.2.1 **LEED-NC Version 2.2.** Indoor Environmental Quality Credits 3.1 & 3.2 – Construction IAQ Management Plan.

C-6.2.2 **Resources.**

a. Websites:

- EPA Indoor Air Quality Building Education and Assessment Model (I-BEAM) http://www.epa.gov/iaq/largebldgs/ibeam_page.htm

b. WBDG:

- Enhance Indoor Environmental Quality http://www.wbdg.org/design/ieq.php

c. Executive Order 13423 Technical Guidance:

- Protecting IAQ During Construction http://www.wbdg.org/sustainableEO/mou_iaq.php

d. UFC/Other DOD Criteria:

- AFCESA Engineering Technical Letter 07-4, "Air Force Carpet Standard" http://www.wbdg.org/ccb/browse_cat.php?o=33&c=125

C-6.3 **Avoid the Use of Materials High in Pollutants**.

Limit the use of products high in volatile organic compounds (VOCs), such as paints, sealants, coatings, and adhesives. Avoid specifying building materials and products containing formaldehyde. When renovating buildings, remove asbestos-containing material or contain it in a manner that precludes the possibility of future exposure. In areas where it is prevalent, include measures to control and mitigate radon buildup. When designing facilities, create safe, convenient, and secure storage spaces for housekeeping chemicals.

C-6.3.1 **LEED-NC Version 2.2.** Indoor Environmental Quality Credits 4.1-4.4 – Low-Emitting Materials.

C-6.3.2 **Resources.**

a. Websites:

- GREENGUARD Environmental Institute Certification Program www.greenguard.org.
- EPA EPP Database http://yosemite1.epa.gov/oppt/eppstand2.nsf
- OIKOS Green Building Source http://oikos.com/.
- GreenSpec Guideline Specifications and Product Listings http://www.buildinggreen.com/menus/index.cfm (note: requires a fee for service).
- Carpet and Rug Institute http://www.carpet-rug.com.

b. Executive Order 13423 Technical: Low-Emitting Materials.

c. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php.
- Sustainable O&M Practices http://www.wbdg.org/design/sustainableom.php.

C-6.4 **Control Disturbing Odors and Contaminants**.

Implement a construction IAQ program (see Appendix C-6.2 for more information). Select low-emitting building materials and finishes (see Appendix C-6.3 for more information). Minimize the use of fibrous materials such as insulation and carpeting, that can emit, absorb, and re-emit contaminants. Physically isolate and install dedicated exhaust systems in high-polluting or odor-causing spaces such as bathrooms, janitorial closets, and intensive copy/printing rooms. Install permanent architectural floor grilles at entryways to prevent dirt and dust from entering the building interior. After occupancy, minimize disturbing odors through contaminant isolation and selection of non-toxic cleaning products that contain no dyes or perfume and are free of ammonia. Inspect ventilation system ducts to ensure moisture, dust and mold are not present. Avoid placing garbage bins near building air intake vents. Locate composting areas downwind of occupied buildings. Consider flushing buildings at night to remove odors generated in the building during working hours.

C-6.4.1 **LEED-NC Version 2.2**. Indoor Environmental Quality Credits 3.1 & 3.2 – Construction IAQ Management Plan; Indoor Environmental Quality Credits 4.1-4.4 – Low-Emitting Materials; Indoor Environmental Quality Credit 5 – Indoor Chemical & Pollutant Source Control.

C-6.4.2 **Resources.**

a. Websites: EPA Cleaning Products Pilot Project http://www.epa.gov/epp/pubs/cleaner.pdf.

b. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php.
- Sustainable O&M Practices http://www.wbdg.org/design/sustainableom.php.

c. UFC/Other DOD Criteria:

- Air Force Pest Management Program http://www.afcesa.af.mil/ces/cesm/pest/cesm_pestmgt.asp.

C-6.5 **Provide Thermal Comfort and Occupant Control of Environment**.

Physical comfort is critical to workplace productivity and satisfaction. Thermal comfort, along with a superior acoustic environment and a high quality visual environment, lead to greater job satisfaction, higher productivity, lower absenteeism and lower employee

turnover. Keep in mind thermal comfort, durability, and energy efficiency when selecting wall, roof, and window assemblies. Evaluate the benefit of specifying high-performance windows http://www.wbdg.org/design/windows.php to increase mean radiant temperature (MRT). Provide as much individual control over an employee's own thermal (temperature and humidity), ventilation, and luminous environment as reasonable and cost-effective. Incorporate temperature and humidity monitoring into buildings to maintain optimum thermal conditions. Use ASHRAE 55 http://www.ihserc.com/ as the basis for thermal comfort. Evaluate the use of access floors with displacement ventilation for flexibility, personal comfort control, and energy savings.

C-6.5.1 **LEED-NC Version 2.2**. Indoor Environmental Quality Credits 6.1 & 6.2 – Controllability of Systems; Indoor Environmental Quality Credits 7.1 & 7.2 – Thermal Comfort.

C-6.5.2 **Resources**.

a. WBDG:

- High Performance HVAC http://www.wbdg.org/design/hvac.php.
- Productive—Provide Comfortable Environments http://www.wbdg.org/design/provide_comfort.php.

b. Executive Order 13423 Technical Guidance: Ventilation & Thermal Comfort http://www.wbdg.org/sustainableEO/mou_vtcomfort.php.

c. UFC/Other DOD Criteria http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4:

- UFC 3-410-01FA, *Heating, Ventilating, and Air Conditioning*.
- UFC 3-410-02N, *Heating, Ventilating, Air Conditioning and Dehumidifying Systems*.

C-6.6 **Optimize Daylighting and Views**.

C-6.6.1 **Daylighting**. Incorporate daylighting into office buildings, schools, warehouses, and other building types as appropriate. Bring daylight into the building, but not the heat and glare of the sun. Daylight use saves energy by reducing electric lighting and HVAC loads. Peak demand is lower because daylight is brightest at the time of day cooling loads would be highest. Daylighting improves workers' productivity and satisfaction with their environment. Increasing productivity yields a greater return than energy savings. Studies have shown significant improvement in students' math and reading scores in daylit schools.

C-6.6.1.1 **LEED-NC Version 2.2**. Indoor Environmental Quality Credits 8.1 & 8.2 – Daylight & Views.

C-6.6.1.2 **Resources**.

a. Websites:

- [Heschong-Mahone daylighting studies http://www.h-m-g.com/projects/daylighting/projects-PIER.htm.
- USACE Sustainable Design and Development Resources: Daylight and Views http://www.cecer.army.mil/sustdesign/HowSD.cfm.

b. WBDG:

- Daylighting http://www.wbdg.org/design/daylighting.php.
- Sun Control and Shading Devices http://www.wbdg.org/design/suncontrol.php.
- Electric Lighting Controls http://www.wbdg.org/design/electriclighting.php.

c. Executive Order 13423 Technical Guidance: Daylighting http://www.wbdg.org/sustainableEO/mou_daylight.php.

d. UFC/Other DOD Criteria http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4:

- UFC 3-530-01AN *Interior and Exterior Lighting and Controls*.

C-6.6.2 **Views.** Windows are important (http://www.wbdg.org/design/windows.php) in occupied spaces for views and natural ventilation (http://www.wbdg.org/design/naturalventilation.php).

C-6.6.2.1 **LEED-NC Version 2.2.** Indoor Environmental Quality Credits 8.1 & 8.2 Daylight & Views.

C-6.6.2.2 **Resources.**

a. WBDG:

- Aesthetics http://www.wbdg.org/design/aesthetics.php.
- Productive—Promote Health and Well-Being http://www.wbdg.org/design/promote_health.php.
- Sustainable—Optimize Site Potential http://www.wbdg.org/design/site_potential.php.

C-6.7 **Assure Acoustical Privacy and Comfort**.

Noise from both indoor and outdoor sources can be distracting and annoying. While acoustics is one of the most overlooked elements of building design, it plays a key roll in building occupants' comfort and productivity.

C-6.7.1 **Acoustical Privacy**. Acoustical privacy provides for an environment where critical information is shared only by those intentionally involved in the discussion and blocks other coworkers and outsiders from hearing the discussion.

C-6.7.2 **Acoustical Comfort**. Just as people function better in a comfortable thermal environment, they do also in an environment where the ambient sound level is suitable for the tasks they perform. Noise generated both inside and outside the building makes it difficult to concentrate on the task at hand. Sound reflects off lighting fixtures, monitor screens, partitions, floors, and windows. Sound passes through lightweight partitions, suspended ceilings, and air return registers.

C-6.7.2.1 **LEED-NC Version 2.2**. Possible Innovation & Design Process Credit 1 for superior acoustic performance.

C-6.7.2.2 **Resources**.

a. Websites:

- USACE Sustainable Design and Development Resources: Acoustic Environment/Noise Control http://www.cecer.army.mil/sustdesign/SDRIEQAcoustic.cfm.
- Architectural Graphic Standards http://www.wiley.com.

b. WBDG:

- Acoustic Comfort http://www.wbdg.org/design/acoustic.php.
- Productive—Provide Comfortable Environments http://www.wbdg.org/design/provide_comfort.php.
- Sustainable—Enhance Indoor Environmental Quality (IEQ) http://www.wbdg.org/design/ieq.php.

c. Executive Order 13423 Technical Guidance: Interior Noise http://www.wbdg.org/sustainableEO/mou_in.php.

d. UFC/Other DOD Criteria:

- UFC 3-120-10, *Interior Design* http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4.
- U.S. Army Corps of Engineers *Design Guide for Interiors* DG 1110-3-122 http://www.usace.army.mil/publications/design-guides/dg1110-3-122/

C-7 **OPTIMIZE OPERATIONS AND MAINTENANCE PROCEDURES**.

Much of the sustainability designed into a project can be lost unless a rigorous operations and maintenance program is instituted. Components of the plan should address procedures for maintaining a healthy and productive indoor and outdoor

environment. This includes monitoring project performance. See Appendix C-4.3 for more information. Other key strategies of the O&M program include:

a. Train Building Occupants and O&M Staff;

b. Practice Green Housekeeping;

c. Reduce, Reuse, Recycle; and

d. Support Tele-Work Opportunities.

C-7.1 **Train Building Occupants and O&M Staff**.

Much of the sustainability designed into a project can be lost unless the building occupants, facility managers, and maintenance staff have been trained and practice sustainability principles and methods. Energy saving controls may be disabled if occupants and maintenance staff do not understand how they work or why they were incorporated into the design. Unless maintenance personnel understand that they must replace lamps and ballasts with the same energy conserving units designed into the project, energy savings will be lost and replacement costs can rise due to product incompatibility. Include building occupants, facilities managers, and maintenance staff in charrettes and project meetings to get their input and to educate them on the types of sustainable products and systems being designed into the building.

C-7.1.1 **LEED-NC Version 2.2.** Possible Innovation & Design Process Credit 1 for user education plan.

C-7.1.2 **Resources.**

a. Websites:

- LEED® for Existing Buildings http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221&.

b. Executive Order 13423 Technical Guidance: Operations & Maintenance http://www.wbdg.org/sustainableEO/mou_om.php.

c. WBDG:

- Sustainable O&M Practices http://www.wbdg.org/design/sustainableom.php.
- Reliability-Centered Maintenance (RCM) http://www.wbdg.org/design/rcm.php.

C-7.2 **Practice Green Housekeeping**.

The housekeeping plan of the O&M program should address cleaning products and pest control. The cleaning products and pest control products used in and around

buildings can be harmful to both people and the environment. Follow these guidelines to ensure cleaning products, fertilizers, and pesticides are resource-efficient and non-toxic.

a. Use cleaners that biodegrade rapidly.

b. Use non-toxic outdoor fertilizers and pesticides; landscape with native plants; minimize site disturbance.

c. Look for products that are concentrated, using less packaging for more power.

d. Use non-toxic pest control and integrated pest management practices for indoor spaces and plants.

e. Keep air ducts clean and free of microorganisms through a structured program of preventive maintenance.

C-7.2.1 **LEED-NC Version 2.2.** Possible Innovation & Design Process Credit 1 for Green Housekeeping/O&M Plan.

C-7.2.2 **Resources.**

a. Websites:

- EPA Cleaning Products – Purchasing Decision Wizards http://www.epa.gov/epp/pubs/cleaner.pdf.
- National Resource Conservation Service (NRCS) Plants Database, Link to Landscaping Resources http://plants.usda.gov/.

b. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php.

c. UFC/Other DOD Criteria:

- Air Force Pest Management Program http://www.afcesa.af.mil/ces/cesm/pest/cesm_pestmgt.asp.

C-7.3 **Reduce, Reuse, Recycle**.

Reduce waste through source reduction and recycling to eliminate disposal off-site. Ensure the design provides space and bins for collection and storage of occupants' recyclables. Establish a waste management plan in cooperation with users to encourage recycling. Consider providing occupant incentives for recycling. Compost organic materials on-site. Locate composting areas downwind of occupied buildings to prevent odors from affecting occupants. Adopt green meeting practices, which

minimize the negative impacts on the environment of conducting meetings and conferences.

C-7.3.1 **LEED-NC Version 2.2**. Materials & Resources Prerequisite 1 – Storage & Collection of Recyclables; possible Innovation & Design Process Credit 1 for Green Housekeeping/O&M Plan.

C-7.3.2 **Resources**.

d. Websites:

- EPA Green Meetings http://www.epa.gov/oppt/greenmeetings/index.htm.

e. WBDG:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php.
- Sustainable O&M Practices http://www.wbdg.org/design/sustainableom.php.

f. UFC/Other DOD Criteria:

- Air Force Recycling Program http://www.afcee.brooks.af.mil/eq/programs/progpage.asp?PID=14.

C-7.4 **Support Tele-Work Opportunities**.

Minimize travel by supporting telecommuting programs and enabling teleconferencing. Develop a telecommuting program. Support teleconferencing/video conferencing to avoid unnecessary air travel.

C-7.4.1 **Resources**.

a. Websites:

- Public Law 106-346, Section 359—Congressional Federal Tele-Work Mandate 2001 (Part of the Department of Transportation Appropriations Act of 2001), 23 October 2000. http://www.wbdg.org/references/public_laws.php.
- Interagency Telework/Telecommuting website (http://www.telework.gov/), GSA/OPM.
- International Telework Association & Council (ITAC) http://www.workingfromanywhere.org/.

b. Design and Analysis Tools:

- Teleworking Impact Estimation Tool (http://greenmfg.me.berkeley.edu/green/SoftwareTools/Telework/) from the Consortium on Green Design and Manufacturing, University of California, Berkeley.

C-8 RELATIONSHIP OF SUSTAINABILITY TO OTHER DESIGN OBJECTIVES.

A truly successful project is one where project goals are identified early on and where the interdependencies of all building systems are coordinated concurrently from the planning and programming phase. Further, all design objectives identified in WBDG: accessible, aesthetics, cost effective, functional/operational, historic preservation, productive, secure/safe, and sustainable and their interrelationships must be understood, evaluated, and appropriately applied. Though each design objective is significantly important, it is just one aspect of what it takes to achieve a successful project. (http://www.wbdg.org/design/designobjectives.php)

C-8.1 Balancing Security/Safety and Sustainability Objectives.

On the surface, it may appear that secure/safe design has little relationship to sustainable design. Yet, security and safety measures, such as those for anti-terrorism and force protection (ATFP), must be considered within a total project context, including impacts on occupants and the environment, regardless of the level of protection deemed appropriate.

Designers must have an understanding of the interaction between security/safety and sustainability objectives. By employing the 'whole building' or integrated design process, identifying areas of synergy and potential conflicts between sustainable and security/safety approaches, and highlighting sustainability opportunities within certain security/safety strategies designers can successfully incorporate both security/safe and sustainability design objectives into their projects.

C-8.2 Resources.

a. Anti-Terrorism/Force Protection Requirements:

- UFC 4-010-01, *DoD Minimum Antiterrorism Standards* http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4.

b. Accessibility for Disabled Persons:

- U.S. Access Board http://www.access-board.gov/.

c. WBDG:

- Balancing Security/Safety & Sustainability Objectives http://www.wbdg.org/design/balancing_objectives.php.

- LEED-DoD Antiterrorsim Standards Tool http://www.wbdg.org/tools/leed_atfp.php?u=7.
- Provide Equal Access http://www.wbdg.org/design/equal_access.php.

APPENDIX D DEFINITIONS

Acquisition is a multi-disciplinary process encompassing a variety of functions that involve all facets of life cycle management including determination of need, planning; design; construction, lease, or purchase; sustainment, modernization and disposal of military installations and facilities as well as other goods and services. Acquiring supplies and services is a process governed by Federal, Defense, and service branch specific Acquisition Regulations (FAR, DFAR, and AFFAR, AFAR, or NAVFAR) and Public Law (PL). Together there are more than 4,000 documents controlling the acquisition process. The acquisition process depends upon: (1) who the customer is, (2) the source of the item to be acquired, and (3) what type of funds are to be used, Appropriated (APF) or Non-Appropriated (NAF). In general, the Military Construction Program process is funded by Appropriated Funds. However, projects for Non-Appropriated Funds activities (commissaries, bowling centers, etc.) use NAF funds for building construction, upgrades, special equipment, and furnishings. APF funding is used most typically for demolition and environmental work on NAF activity sites. A combination of APF and NAF funds may be used sometimes.

Baseline Building - Low-Rise Residential. New DoD low-rise residential building that is otherwise identical to the proposed building but is designed to meet but not exceed the energy efficiency specifications in the ICC IECC, 2004 Supplement Edition, January 2005.

Charrette. Charrette has come to describe an intensive creative work session in which a design team focuses on a particular design problem and arrives at a collaborative solution with stakeholders from the project area.

A charrette can be a breakthrough event that helps creates a meaningful master plan or facility design. Properly executed, this technique can produce a master plan or facility design that is more useful, better understood, and more quickly produced than one formed by any other method.

From the Public Involvement Techniques, publication no. FHWA-PD-96-031 HEP-30/9-96/(4M)QE

Commissioning. (This process is not funded as a program line item.) Commissioning ensures that a facility and its components will perform as designed and intended.

Optimally the commissioning process starts during planning and programming prior to design. It continues during design with review of design information, performance data in specifications, and evaluation of submissions. During construction the commissioning process includes setup of pre-construction cause and effect schedules, tests and test data, and establishes record documentation requirements.

Commissioning includes witnessing field tests, adherence to specified performance criteria such as cleaning of ducts, performance of equipment, and training of facility

maintenance personnel. Commissioning of building systems is critical to ensuring their expected operation. Thorough documentation allows a much more cost effective certification process for attaining mandated SPiRiT or LEED ratings.

DD Form 1391 is a programming document used by the Department of Defense to submit requirements and justifications in support of funding requests for military construction to Congress. See Appendix I for information on the DD Form 1391 process.

Energy Modeling. The process by which conceptual designs, including size, material choices, factors such as site, solar, and wind orientations, daylighting percentages, and energy system choices (solar water heat, underfloor vs. overhead air distribution systems) are analyzed to show how to optimize these factors for efficient building operation and resource consumption. Energy modeling done during the DD Form 1391 charrette process is typically funded from Operations and Maintenance resources as the future year O&M budgets for the modeled building can be accurately projected from the study results.

Environmentally Preferable Products. Products or services having a lesser or reduced effect on human health and the environment when compared with competing products or services serving the same purpose. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or product or service disposal.

Green Procurement. The DoD Green Procurement Policy requires the services to have preferential purchasing programs for EPA recycled content products designated in the Comprehensive Procurement Guidelines (CPG), USDA biobased products; DOE Energy Star products; FEMP Energy Efficient Standby Power Devices; DOE Water Conserving products; California Low VOV products; EPA Asbestos Alternative products; products that reduce EPA priority chemicals (cadmium, lead, PCB, mercury and naphthalene); and any other products that are environmentally preferable according to EPA criteria. These products must be included in all projects whether accomplished by contract or in-house. The Guide to Green Purchasing at http://www.afcee.brooks.af.mil/eq/ap/gg/guide.doc is an Internet-based resource for further details.

Indoor Environmental Quality (IEQ) refers to the condition or state of the indoor built environment. Aspects of IEQ include: light quality, acoustic quality, and air quality.

Life-Cycle Costing is an important economic analysis used in the selection of alternatives that impact both pending and future costs. It compares initial investment options and identifies the least cost alternatives for a twenty-year period. As applied to building design energy conservations measures, the process is mandated by law and is defined in the Code of Federal Regulations (CFR), Title 10 Part 426, Subpart A: Program Rules of the Federal Energy Management Program (NIST Handbook 135). The National Institute of Standards and Technology (NIST) has established the Building Life-Cycle Cost (BLCC) computer program to perform LCC analyses. The program

incorporates user entered data for and compares the following: Sunk Costs, First Costs, Salvage Value, Future Investment, Residual Value, Annually Recurring Fixed Costs, Annually Recurring Escalating Costs, and Energy (Fuel Costs) Escalation Rates.

Low-Rise Residential. Any building three stories or less in height above grade that includes sleeping accommodations where the occupants are primarily permanent in nature (30 days or more).

Operational Performance aspects include: durability, maintainability, energy efficiency, and water efficiency.

Planning is begun by a using entity whose facility needs are driven by mission requirements. The insertion of facility projects into the official budget is based on the requirement for mission support. As mission priorities change, projects can be moved ahead of their initial scheduled FY or alternately, be dropped altogether.

Programming refers to the data collection process done by the military project management team in order to achieve a conceptual design in enough detail to prepare a viable cost estimate. Programming data is reported on DD Form 1391 for design-bid-build and design-build projects, and is scrutinized from base level up through the Office of Management and Budget (OMB), Congress, and signed by the President before it is approved as a project.

Project Definition. As the military programming process often predates actual design by two to five years or more, when the design services portion of a project is funded, the project design team, must validate stated project requirements and personnel assignments based upon updated mission criteria. This process is sometimes referred to as Project Definition to distinguish it from the usual private sector A/E reference to “programming”.

Project Scope refers to the physical size of a project. With historical data on facilities for various missions, experienced programmers will formulate the conceptual design for the 1391 based upon the expected size of a facility to accommodate mission functions. Once the “scope” for a project has been established, altering the physical size of a project by as little as 10% (larger or smaller) will bring the project to a halt until the change in scope has been justified and approved. This is true whether or not the costs have also changed. Changes of 25% may require Congressional level review and authorization before proceeding.

Recovered Materials Advisory Notices (RMANs). EPA also issues guidance on buying recycled-content products in RMANs. The RMANs recommend recycled-content ranges for products based on current information on commercially available recycled-content products, RMAN levels are updated as marketplace conditions change.

APPENDIX E ABBREVIATIONS AND ACRONYMS

AFCEE	Air Force Center for Environmental Excellence
AFCESA	Air Force Center
ATFP	Anti-terrorism/Force Protection
CPG	Comprehensive Procurement Guidelines
CWA	Clean Water Act
DOE	Department of Energy
DoD	Department of Defense
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
EPP	Environmentally Preferable Products
ESA	Endangered Species Act
FAR	Federal Acquisition Regulation
FEMP	Federal Energy Management Program
GSA	General Services Administration
IAQ	Indoor Air Quality
ICC	International Code Council
IECC	International Energy Code
IEQ	Indoor Environmental Quality
IRC	International Residential Code
IRP	Installation Restoration Program
LCA	Life Cycle Assessment
LCCA	Life Cycle Cost Analysis
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
M & V	Measurement and Verification
MILCON	Military Construction
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NASA	National Air and Space Administration
NAVFAC	Naval Facilities Engineering Command
NEPA	National Environmental Policy Act
OMB	Office of Management and Budget
PL	Public Law
SPiRiT	Sustainable Project Rating Tool
SSD	Sustainable Design and Development
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGBC	U.S. Green Building Council
VA	Veterans Administration
WBDG	Whole Building Design Guide

APPENDIX F CASE STUDIES/LESSONS LEARNED/DESIGN EXAMPLES

High Performance Federal Buildings Database
http://www.eere.energy.gov/femp/technologies/sustainable_casestudies.cfm
(Also links to Federal LEED® Certified and Registered Projects)

Whole Building Design Guide Case Studies
http://www.wbdg.org/references/casestudies.php

Environmental Protection Agency Campus, Research Triangle Park, NC
http://www.eere.energy.gov/buildings/database/overview.cfm?ProjectID=30

EPA New England Regional Laboratory
http://www.wbdg.org/references/cs_nerlab.php

Bremerton BEQ Building 1044
http://www.eere.energy.gov/buildings/database/overview.cfm?ProjectID=498

Naval Base Ventura County – Building 850, Port Hueneme, CA
http://www.eere.energy.gov/buildings/database/overview.cfm?ProjectID=51

NAVFAC Building 33 – Washington Navy Yard
http://www.wbdg.org/references/cs_bldg33.php

Pentagon Renovation Program
http://renovation.pentagon.mil/sustainabledesign.htm

APPENDIX G TRAINING RESOURCES

- DOD Training
  U.S. Army Corps of Engineers Sustainable Design and Development
  https://eko.usace.army.mil/_kd/go.cfm?destination=page&pge_id=1379

- Federal Government Training
  FEMP Sustainable Design & Operations
  http://www.eere.energy.gov/femp/technologies/sustainable_training.cfm

- Commercial Training
  Sustainable Buildings Industry Council's *Design Strategies for Low-Energy, Sustainable, Secure Buildings*
  http://www.sbicouncil.org/workshops_lowen.htm
  US Green Building Council (USGBC) LEED® Workshops
  http://www.usgbc.org

- Online Training
  High Performance School Design Online Training
  http://www.hpschooldesigntraining.com
  US Green Building Council (USGBC) Online Training
  http://www.usgbc.org
  NAVFAC Sustainable Development Online Training
  http://www.wbdg.org/

APPENDIX H INTEGRATED DESIGN

The Integrated Design Approach is further described in "Whole Building Design" http://www.wbdg.org/wbdg_approach.php

See also the Executive Order 13423 Technical Guidance: Integrated Design http://www.wbdg.org/sustainableEO/mou_id.php

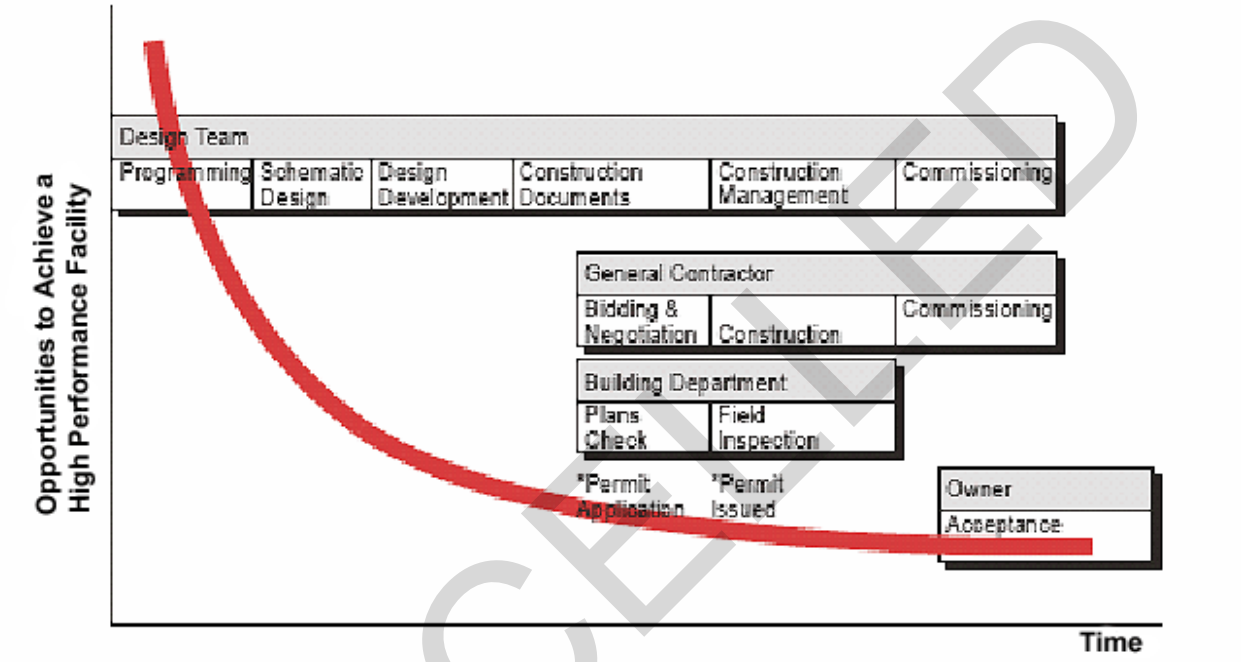

Figure H -1 - Opportunities in the Design Process

Integrated Design is the consideration and design of all building systems and components together. An Integrated Design Process includes all members of the project team: from the user, the designers and engineers, energy and financial analysts, constructors and system installers, to the facility maintenance personnel. *The largest savings impact for sustainable design occurs in the programming stage, therefore, the earlier sustainable concepts are incorporated into the process, the greater the chances for cost-effective and successful solutions.*

Whether this team is writing a DD Form 1391 or formulating an RFP for design-build after a 1391 is funded, the broader the spectrum of team members working collaboratively versus in isolation, the greater the chance for integrated design success.

APPENDIX I OVERVIEW OF PLANNING AND PROGRAMMING (DD FORM 1391 PROCESS)

I-1 OVERVIEW OF PLANNING AND PROGRAMMING (DD FORM 1391 PROCESS)

I-1.1 **Project Initiation**.

Project planning begins with the request from a Customer's Plans and Programs office based upon their mission requirements. Through various mechanisms (regulations, instructions, facility utilization boards which consider requested projects for approval, assigns existing facilities or identifies a new project, the user's budget and mission planners, etc.) a project becomes defined. The scope (size in meters and square feet) and budget based on uniform cost criterion (TRi-services Automated Cost Engineering System [TRACES]) are defined. Users are asked to ensure Process Improvement has been considered to maximize efficiency of their proposed project.

I-1.2 **Project Programming (DD Form 1391)**.

Projects are documented by installation programming offices in a DD 1391 package and are submitted to Headquarters (HQ). Project scope and budget are compared at Headquarters against similar requests from all installations within the Headquarters approval. For projects with scope and budget required to be approved by a higher authority, Headquarters programmers will compare it to similar facilities across the respective branch of service. If a facility is unusually large or small in scope or budget compared to all similar projects, Headquarters will return the package to the installation for revisions.

I-1.3 **Project Priority**.

Design and Construction DD 1391 packages are prepared at least one fiscal year in advance and up to 5 or 10 years ahead of the projected need for the project. Each project then competes against other projects within an installation for its priority. If a higher-priority project surfaces, projects will be realigned to accommodate it, causing lesser priority projects to "slip" into another fiscal year. The prioritization process occurs at least once each fiscal year, but can happen whenever the need arises.

After the project is prioritized at the installation, it is compared to other projects under that installation's higher Headquarters (MAJCOM, MACOM, Major Claimant) purview and is re-prioritized within that project listing. Installation priority order is kept, but those projects will be stacked in the order perceived by HQ to represent the highest needs first. An installation's number 1 priority may wind up being the higher Headquarters' number 10 priority when compared against all other projects. Depending upon project scope and costs, often only the top few priority projects of a Headquarters are funded.

I-1.4 **Final Project Review and Acceptance for Funding**:

At the Pentagon, Programmers will review the project package (DD 1391) again to ensure it will survive all scrutiny. Programmers may request additional information from Headquarters or installations to bolster weak 1391s for high priority or mission critical projects.

In the next and final step, the OSD (Office of the Secretary of Defense) reviewer looks for weak or poorly supported packages to cut, to allow the greatest number of worthy projects to receive funding. Once a package has been cut, it is removed from the program. That project package will essentially need to be completely re-accomplished by the installation and go through the 5-year long priority chain all over again.

APPENDIX J ENERGY SAVINGS PERFORMANCE CONTRACTS (ESPC) AND UTILITY ENERGY-EFFICIENCY SERVICES CONTRACT (UESC)

J-1 **ENERGY SAVINGS PERFORMANCE CONTRACTS (ESPC)** The ESPC financing option allows Federal facilities to purchase energy efficiency, renewable energy, and water conservation technologies and services from private vendors through a shared savings approach. Under the ESPC method, the selected energy services company (ESCO) incurs the costs of implementing energy savings measures, including the cost of energy audits; project design; acquiring, installing, operating, and maintaining equipment; and training O&M personnel. The ESCO is given a share of the energy savings resulting directly from implementing such measures during the multiyear term of the contract (usually 25 years). After paying the ESCO, the remaining savings are shared equally between the agency and the United States Department of the Treasury (USDT), as shown in *Figure J-1*.

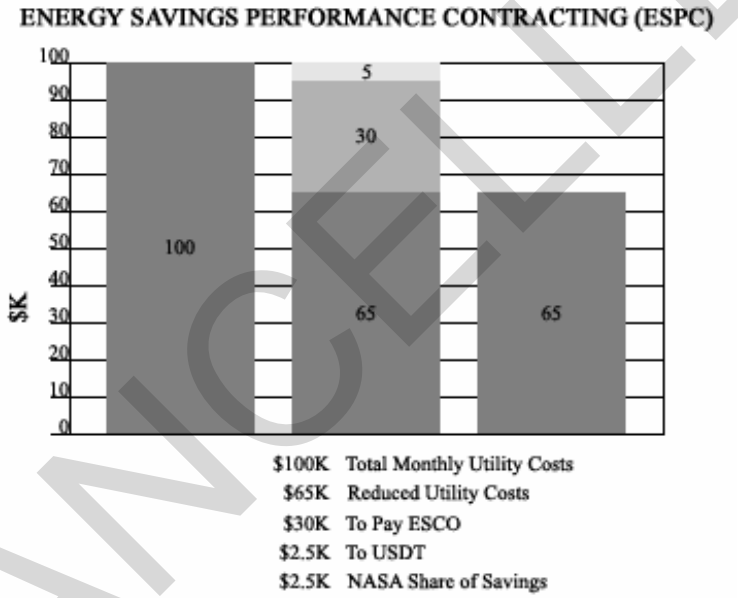

Figure J-1 – ESPC Example

The key benefits of ESPC are that it:

a. Reduces energy consumption;

b. Improves Federal energy efficiency and helps meet the Federal energy savings requirements;

c. Reduces the maintenance and repair costs associated with aging or obsolete energy-consuming equipment;

d. Places O&M responsibilities on the contractor; and

e. Stimulates the economy by allowing ESCOs to profit from their up-front investments in federally-owned buildings by receiving a share of the utility bill savings.

J-2 UTILITY ENERGY-EFFICIENCY SERVICES CONTRACTS (UESC).

In addition to ESPC, EPACT authorizes UESC as another alternative financing method for Federal energy-efficiency and water conservation projects. These programs range from rebates on a piece of equipment all the way to delivering a complete turnkey project. Anticipate some new information on the use of UESC resulting from the issuance of Executive Order 13423, which revokes E.O. 13123.

Services provided for a project can range anywhere from auditing to installation and commissioning, including financing the entire project. Utilities may cover the capital costs of the project in consideration of the energy savings the retrofits will produce. In this arrangement, the net cost to the Federal agency remains the same or less than the status quo, and the agency saves time and resources by using the "one-stop shopping" provided by the utility.

Many utilities offer their customers a wide range of products and services related to the implementation of energy efficiency and/or renewable energy projects. Typical offerings include: financing, financial incentives, rebates, and various technical services such as audits, engineering design, billing analysis, equipment procurement and installation, operation and maintenance, and M&V.

Typically, utility programs are site-specific and customized to the needs of a particular agency or facility. Negotiating the terms of the agreement with the utility can be time consuming. Contacting the utility is the best way to determine the programs that are available in a given region or to a given facility.

Additional information on utility partnership opportunities can be obtained directly from FEMP or the local utility.

For **Air Force Projects**: Air Force Installations should contact AFCESA/CESM for assistance with FEMP or local utility services. See the MOU on Air Force Procedures for Accessing DOE/FEMP Services at
http://www.afcesa.af.mil/ces/cesm/energy/cesm_energy.asp

APPENDIX K GREEN SPECIFICATIONS AND GREEN PRODUCT CERTIFICATIONS

DOD has been undergoing the process of greening the Unified Facilities Guide Specifications (UFGS). Green products are ones that are reduced, reused, or recycled; have post-consumer recycled content; contain post-industrial recycled content; are made from agricultural waste material; are biodegradable; contain low or no volatile organic compounds (VOC); are water conserving or energy efficient, yet have durability, quality, cost, and functionality equal to or better than standard products. To qualify as green, products should also be manufactured in a way that causes minimal pollution and impact on the environment. Certified or sustainability harvested wood is also considered a green product.

Now available through the Whole Building Design Guide (WBDG) website is the *Federal Green Construction Guide for Specifiers*, http://www.wbdg.org/design/greenspec.php which is intended to assist federal building project managers in meeting various mandates as established by statute and Executive Orders. The *Federal Green Construction Guide for Specifiers* provides model language that is intended to assist users in achieving green building goals as may be determined by the individual agency and project. The guidance provided addresses only green performance requirements. These green performance requirements are intended to supplement other project requirements for materials, products, and systems. T hese green performance requirements are NOT intended to diminish or replace the functional requirements, aesthetic requirements, cost requirements, or other project requirements for materials, products, and systems that are already well documented in the UFGS.

Resources

a. Websites:

- EPA Environmentally Preferable Purchasing http://www.epa.gov/opptintr/epp/index.htm.
- Federal Green Construction Guide for Specifiers http://www.wbdg.org/design/greenspec.php.
- Green Seal http://www.greenseal.org/.
- GreenSpec from BuildingGreen.com http://www.buildinggreen.com/menus/index.cfm.
- Oikos Green Building Source http://www.oikos.com/.
- Design and Analysis Tools: ATHENA™ environmental assessment tool http://www.athenasmi.ca/.
- BEES (Building for Environmental and Economic Sustainability) software for selecting cost-effective green building products http://www.bfrl.nist.gov/oae/software/bees.html.
- DoD Green Procurement Program https://www.denix.osd.mil/denix/Public/ES-Programs/Pollution/Procurement/GPP/gpp-intro.html.

b. WBDG Resource Pages:

- Evaluating and Selecting Green Products http://www.wbdg.org/design/greenproducts.php?r=env_preferable_products-i.

c. UFC/UFGS/Other DOD Criteria:

- Unified Facilities Guide Specifications http://www.wbdg.org/ccb/browse_org.php?o=70.
- Unified Facilities Criteria http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4.