UFC 1-200-02
01 DECEMBER 2020
Change 03, 08 JULY 2025

UNIFIED FACILITIES CRITERIA (UFC)

HIGH PERFORMANCE AND SUSTAINABLE BUILDING REQUIREMENTS

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HIGH PERFORMANCE AND SUSTAINABLE BUILDING REQUIREMENTS

Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING **\1** SYSTEMS **/1/** COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

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

Change No.	Date	Location
01	03 Jan 2022	Replaced “renovation” with “comprehensive replacement” or “SRM” as appropriate, defined; minor changes Table 1-1; revised “Component” and “Service” throughout, defined; Metering policy updates to paras 2-3.3, 2-4.4, 3-4.2.2, 2-4.3, 3-3.3, 3-4.2, 3-4.3.2, 3-4.4, updated Reference; replaced “compounds” with “substances” paras 2-6.1.3 and 3-6.1.3; App A added sentence to 1st para and replaced flowchart.
02	01 June 2022	Minor changes para 1.1 and 1.2; language change for ASHRAE 90.1-2019 and IECC 2021 in paras 2-2.2, 2-3; addressed CCRs.
03	08 July 2025	Aligned Applicability para with UFC 1-300-01; changed threshold for full compliance to ≥25,000GSF; updated LCCA process and moved to Ch 4; removed climate change/adaptation language; addressed CCRs; updated weblinks.

This change supersedes UFC 1-200-02 Change 02, 01 JUNE 2022

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 **\3** , its territories, and possessions **/3/** 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 most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFCs are living documents and will be periodically reviewed, updated, and made available to users as part of the **\3** Military Department's **/3/** responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering **\1** Systems **/1/** Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. **\3** Technical content of UFC is the responsibility of the cognizant DoD working group**. /3/** Defense Agencies should contact the **\3** respective DoD Working Group **/3/** for document interpretation and improvements. **\3\ /3/** Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site 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://www.wbdg.org/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

The Energy Policy Act of 2005, Energy Independence Security Act of 2007, **\3** and Energy Policy Act of 2020, **/3/ \2\ \3\ /3/ /2/** require Federal agencies to **\3** lead by example and **/3/** increase efficiency, optimize **\3** sustainable **/3/** performance, eliminate unnecessary use of resources, **\3** create safe indoor air quality, **/3/** and protect the environment. **\3\ /3/** Consistent with UFC program requirements, this UFC integrates DoD requirements (DoDI 4170.11 and other DoD Policies) with **\3**: Federal sustainability, energy and water laws, regulations, policies and mandates; the Federal requirements, collectively referred to as **/3/** High Performance and Sustainable Building (HPSB) Guiding Principles **\3** (detailed in *Guiding Principles for Sustainable Federal Buildings and Associated Instructions*, February 2016); **/3/** and industry standards **\3**, to establish minimum requirements **/3/** for high performance and sustainable buildings. **\3**[1]

1-2 REISSUES AND CANCELS

This UFC Change 03 supersedes UFC 1-200-02, Change 02, dated June 2022. **/3/**

1-3 PURPOSE AND SCOPE.

This UFC **\3** is a compliance document, providing the backbone for other criteria document to further define technical requirements. This UFC provides minimum requirements of laws, regulations, orders, mandates, industry standards, and Federal tracking and reporting requirements for sustainability. **/3/** This UFC is organized around the HPSB Guiding Principles. Per *Department of Defense Sustainable Buildings Policy*, when a building meets the requirements of this UFC, it is considered compliant with the HPSB Guiding Principles.

\2\ /2/ \1\ /1/ This UFC incorporates the sections of the **\2** International Green Construction Code (IgCC) **/2/** mentioned herein when appropriate and determined to be life cycle cost effective. Where the provisions of the IgCC meet the intent of the HPSB Guiding Principles, the provisions of the IgCC are referenced in this UFC as a means of compliance or provided as an alternative compliance pathway. These requirements are applicable to each new **\3** building, addition **/3/ \1**, comprehensive replacement, and sustainment, restoration, and modernization (SRM) **/1/** projects, regardless of building type or configuration.

[1] **\3** Upon initial publication of this UFC, the Congressional NDAA Committee stated, "We commend the Department [of Defense] for formalizing its new sustainable design criteria [UFC 1-200-02] and policy [DOD Sustainable Building Policy, 2014] governing investments in energy and water efficiency initiatives…" **/3/**

1-4 ORGANIZATION.

- CHAPTER 1 introduces the scope of this document and overall requirements
- CHAPTER 2 provides requirements for building design and construction activities.
- CHAPTER 3 details Federal HPSB Guiding Principles Existing Building Assessment requirements that must be met in order for an existing building to be reported as a High Performance and Sustainable Building (HPSB).
- CHAPTER 4 details the energy optimization and LCCA process.
- CHAPTER 5 defines HPSB compliance and details tracking and reporting.
- APPENDIX A contains preferred methods of execution for cited topics.
- APPENDIX B contains project requirements impacted by historic buildings, historic districts and those near historic facilities, \1\ /1/ and other designated cultural resources.
- APPENDIX C contains acronyms, abbreviations, and terms.
- APPENDIX D contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

1-5 APPLICABILITY.

This UFC **\3** follows the same applicability as UFC 1-200-01, paragraph 1-3, except this UFC does not apply to **/3/**

- Buildings to be demolished or deconstructed, except for demolition waste diversion reporting
- Buildings that have a status of Report of Excess (ROE) submitted, ROE accepted, or Determination to Dispose
- **\3\ /3/** Structures and linear construction that do not meet the definition of a building.

Comply with Table 1-1:

Table 1-1 Building \3\ /3/ Requirements and Thresholds

Requirements	Thresholds \1\ (Refer to each chapter's "Overview" for details) /1/
Chapter 1	**\3** Each building as applicable.
Chapter 2	Each planning, design, construction, and O/M activity. **/3/**
Chapter 3	Assessments of existing building assets **\3** ≥25,000 GSF (2323 GSM). **/3/**
Chapter 4	**\3** Each building that meets statutory threshold.[2] **/3/**
Chapter 5 For **\1**Service**/1/** policy and guidance documents, refer to paragraph titled **\3**"Service Specific Policy."**/3/**	HPSB Guiding Principles Compliance Tracking and Reporting (use Service HPSB Checklist[3] **\3** for each building, beginning in the planning stage in order to determine the extent of compliance, and updated throughout the design and construction execution **/3/**): 1. For Army and Navy, new building or stand-alone addition **\3** ≥25,000 GSF (2323 GSM) **/3/**; for Air Force, all new buildings or stand-alone additions. 2. Comprehensive replacement in an existing building that is **\3** >25,000 GSF (2323 GSM) **/3/**, with total cost **\3** >$4M **/3/** and 50% or more Estimated Replacement Cost (ERC) 3. Assessments of existing building assets **\3** ≥25,000 GSF (2323 GSM) **/3/** **\1\ /1/** Addition of **\2** Third-Party **/2/** Certification: 1. New building or stand-alone addition **\3** ≥25,000 GSF (2323 GSM) **/3/**, with construction cost **\3** >$4M **/3/** 2. Comprehensive replacement in an existing building that is **\3** ≥25,000 GSF (2323 GSM) **/3/**, with total cost greater than **\3** $4M **/3/** and 50% or more ERC.
\3\ Appendices A, B, C, and D	Each building as applicable. **/3/**
\1\ All Chapters and Appendices	New building or additions **\3** <25,000 GSF (2323 GSM) **/3/**, sustainment, modernization, and restoration building improvements must comply with UFC requirements relevant to the scope of the project/work, as determined by the Project Delivery Team as early as possible during project process. Comprehensive replacement to a building includes significant opportunities for improvement in: energy and water efficiency (such as HVAC, lighting, building envelope, and other building components); indoor air quality; other requirements in this UFC; and additions that are part of the comprehensive replacement. Total cost for comprehensive replacement includes addition, **\3** sustainment, and associated restoration. **/3/ /1/**

[2] In addition to the new building requirements, each existing building large capital energy investments (each project for which the cost of the systems that impact energy consumption exceeds \3\ $1,000,000 /3/, which constitutes a capital investment, per National Defense Authorization Act) are to employ the most energy efficient designs, systems, equipment, and controls that are life cycle cost effective.

[3] **\3** For building scopes that do not meet the minimum requirements or thresholds as cited by Table 1-1, ensure the PDT completes the initial HPSB Checklist for each building in the project, to determine the crosswalk of scope items with criteria in this UFC. Refer to Chapter 5 for Service-specific HPSB Checklist location. **/3/**

1-6 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-7 LIFE-CYCLE COST ANALYSIS (LCCA).

\3 The purpose of the LCCA methodology as detailed in 10 CFR Part 436 Subpart A is to identify and compare life-cycle cost (LCC) of building systems that impact energy and water consumption, including passive strategies, that will in total achieve the energy and water requirements stated in this document. Perform LCCA, including a thorough and systematic evaluation of alternatives, as early as possible in the planning and design process in order to evaluate important and applicable choices to reduce life cycle costs (LCC), thus improving the total ownership costs over the life of the building. Investigate all feasible alternatives in accordance with the scope of work, so the project delivery team can determine the best investment decisions that align with the Installation plans, goals and objectives. Refer to Chapter 4 for requirements.

Prior to starting the LCCA process on the active, energy-consuming building systems, ensure passive design strategies have been identified, analyzed, and optimized. Refer to paragraph title "EMPLOY INTEGRATED DESIGN PRINCIPLES". **/3/**

\3\ /3/

1-8 CYBERSECURITY.

All **\2** facility **/2/** control systems (including systems separate from **\2** a utility-monitoring and **/2/** control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by individual Service Implementation Policy.

CHAPTER 2 BUILDING DESIGN AND CONSTRUCTION

2-1 OVERVIEW.

The requirements of this chapter apply to **\3** planning, design and construction for **/3/** each building within a project. Refer to Table 1-1 "Building Requirements **\3\ /3/** and Thresholds" to determine applicability of this chapter to each building within a project. Refer to Chapter 4 for additional requirements.

2-1.1 New Construction and \1\ Comprehensive Replacement /1/.

New construction and **\1** comprehensive replacement **/1/** must comply with each requirement; or must clearly identify and provide justification when requirements are not applicable or fully achievable. Refer to paragraph titled "Compliance with Federal Requirements" for additional guidance and requirement applicability.

2-1.2 Work in Existing Buildings.

In some of the paragraphs that follow, there are specific requirements provided for **\1** sustainment, restoration, and modernization (SRM) projects **/1/**. For existing building **\1** SRM **/1/**, the goal is to improve the performance of the existing building inventory with every investment. The systems and components included in the scope of the project must meet the requirements of this UFC, by providing the most resource-efficient solutions. This UFC does not apply to systems and components not included in the scope of the project. The intent is not to expand the scope of the project.

2-2 EMPLOY INTEGRATED DESIGN PRINCIPLES.

Integrated design is the most important requirement in achieving a high performance **\3** and sustainable **/3/** building. A design team must have strong, consistent representation from each stakeholder throughout the project phases to maximize opportunities to improve building performance and to realize increased savings potential.

2-2.1 Integrated Design.

Incorporate the following planning and evaluation into the integrated design, as described in IgCC F101.1.1 (F1.1.1) *Charrette Process*.

Exception: subparagraph b. does not apply.

2-2.1.1 Integrated Planning.

Use a collaborative, integrated planning and design team composed of users, government support staff, and appropriate professionals, to identify requirements and to establish performance goals for siting, energy, water, materials, indoor environmental quality, and other comprehensive design goals. Ensure incorporation of these goals throughout design and construction.

2-2.1.2 Evaluation for Design Strategies

Evaluate the site and building components to determine whether passive and natural design strategies and features are cost effectively incorporated before designing the active and mechanical systems. Incorporate these features where applicable.

Take into account site attributes, including climate and local and regional context, which impact the design of the building.

2-2.1.3 Evaluation of the Site.

During the site selection process, comply with the requirements of UFC 2-100-01.

2-2.1.4 Site Integration and Design of the Building.

Use the following site development considerations and passive strategies:

- Meet the requirements of UFC 3-201-02.
- Site design elements that ensure safe and convenient pedestrian access.
- Incorporate results of site analysis in order to design the building, focusing on orientation, configuration, and massing.
- Orient building to maximize energy efficiency, passive solar, and daylighting potential.
- Select, design, and integrate into the overall building, high performance and sustainable systems (examples: HVAC, plumbing, water heating systems, lighting systems, control systems, elevators, building envelope, and fire protection systems).
- Consider opportunities for occupants to voluntarily increase physical activity early in the design process. Refer to Appendix A "Best Practice" for examples.

2-2.2 Commissioning.

In order to verify design and performance, and ensure that the Government requirements are met, employ commissioning practices appropriate to the size and complexity of the building and its system components. This must include an experienced commissioning provider, who should be independent of the project design and construction team, and from the operations team. The choice of either contracted services or Government personnel to serve as the commissioning provider will be determined at project level. **\3** Refer to UFGS 01 91 00.15 Building Commissioning and related documents for commissioning requirements. **/3/**

\2 To the extent practicable, based on LCCA and DoD policy[4], **\3** each building with conditioned space greater than 10,000 SF (929 SM): **/2/**

- Meet the requirements of ASHRAE 90.1-2019.
- For buildings and systems that are less complex, commissioning may be tailored as determined by the DoD Service AHJ. The Project Delivery Team must determine the extent of commissioning activities required.
- "Schematic design" is the design charrette or similar conceptual design activity prior to completion of 35% design.

\2\ /2/ /3/

For Medical Treatment Facilities, refer to UFC 4-510-01 *Medical Military Facilities* for commissioning requirements. **\3\ /3/ \1\ /1/**

2-3 OPTIMIZE ENERGY PERFORMANCE.

Base energy efficiency design decisions on LCCA, as indicated in Chapter 4. The LCCA includes a minimum of three energy efficient alternatives to the baseline standard (such as ASHRAE 90.1 or IECC.) **\3\ /3/**

2-3.1 Energy Efficiency.

\3 Comply with the following paragraphs, based on the applicable standard: **/3/**

2-3.1.1 Commercial and Multi-Family High-Rise Residential Buildings

\2\ \3 For buildings to which this standard applies, and **/3/** to the extent practicable, based on LCCA and DoD policy[5], meet the following: **/2/**

- Meet the requirements of ASHRAE 90.1 **\3** -2019 for each building. **/3/ \2\ /2/**
- Design the building to achieve at least 30% energy consumption reduction from ASHRAE 90.1 baseline.
- If a 30% reduction is not LCCE, modify the design of the proposed building to achieve an energy consumption level at the highest level of energy efficiency that is LCCE.
- **\2\ /2/ \3\ /3/** Determine energy consumption levels for both the ASHRAE baseline building and proposed building alternatives by using the

[4] \2\ Includes DoD policies that relate to commissioning. /2/
[5] \2\ Includes DoD policies that relate to energy. /2/

Performance Rating Method found in Appendix G of ASHRAE 90.1-2019[6].
\2 The formula for determining the percentage improvement is:

Percentage Improvement = 100 x (1-PCI/PCIt)

Where

PCI = Performance Cost Index calculated in accordance with section G1.2 of ASHRAE 90.1-2019

PCIt = Performance Cost Index Target calculated by formula in section 4.2.1.1 of ASHRAE 90.1-2019 **/2/**

\3 Utilize ASHRAE 90.1-2019 Addendum ch to determine the energy consumption reduction value. **/3/**

2-3.1.2 Low-Rise Residential Buildings

\2\ \3 For each building for which this standard applies, and **/3/** to the extent practicable based on LCCA and DoD policy[7], meet the following: **/2/**

- Meet the requirements of International Energy Conservation Code (IECC) **\2\ \3** 2021 for each building.**/3/ /2/**
- Design the building to achieve at least 30% energy consumption reduction from the IECC baseline using the Simulated Performance Alternative found in Section 405 of the IECC.
- If a 30% reduction is not LCCE, modify the design of the proposed building alternatives to achieve an energy consumption level at the highest level of energy efficiency that is LCCE.

2-3.1.3 \1\ Comprehensive Replacement and SRM /1/.

\2 To the extent practicable based on LCCA and DoD policy[9], meet the following: **/2/**

- **\1\ /1/ \3** Each building within a project **/3/** that replaces everything above the foundation **\1** (comprehensive replacement) **/1/** must apply either paragraph "Commercial and Multi-Family High-Rise Residential Buildings" or "Low-Rise Residential Buildings".
- **\1** SRM projects **/1/** choose one of the following options:

[6] \2\ Energy consumption \3\ calculation methodology (formulas) for the purpose of determining the 30 percent savings requirement is found in 10 CFR Part 433, and /3/ shall include the building envelope and energy consuming systems normally specified as part of the building design by ASHRAE 90.1-2019 such as space heating, space cooling, ventilation, service water heating, and lighting, and each process and receptacle load, except for energy-intensive process loads that are driven by mission and operational requirements, not necessarily buildings, and not influenced by conventional building energy conservation measures.
[7] Includes any DoD policies that relate to energy. /2/

- Reduce measured building energy use by at least 30%, below FY 2003, or earlier, energy use baseline[8].
- Reduce measured building energy use by at least 20% below FY 2015 energy use baseline.
- Reduce modeled energy use (from each source including renewable energy) by 30% compared to the ASHRAE 90.1 baseline building design for Commercial or Multi-Family High-Rise Residential Buildings, or the IECC baseline (using the Simulated Performance Alternative found in Section 405 of the IECC) for Low-Rise Residential buildings. (Refer to paragraph "Commercial and Multi-Family High-Rise Residential Buildings" for calculation of energy consumption reduction.)**\3**
- Ensure the building has an ENERGY STAR score of 75 or higher. For building types not eligible to receive an ENERGY STAR score and where adequate benchmarking data exists, demonstrate that the building is in the top quartile of energy performance for its building type. **/3/**

If none of the reduction choices is life-cycle cost effective, modify the design of the proposed building system(s) to achieve an energy consumption level at the highest level of energy efficiency that is life-cycle cost effective

2-3.2 Energy Efficient Products.

Per EISA 2007 Section 525, acquire products that are ENERGY STAR® **\3** certified by the EPA or meet or exceed the efficiency standard designated by FEMP Energy-Efficient Products requirements in each covered product category. **/3/**

2-3.2.1 Standby Power Devices.

Per EISA 2007 Section 524, provide commercially available, off-the-shelf products that use no more than 1 watt in their standby mode, provided it is life-cycle cost effective, practicable, and performance is not compromised.

2-3.3 \3\ Renewable Energy. /3/

2-3.3.1 \3\ On-Site Renewable Energy. /3/

Provide on-site renewable energy systems in accordance with IgCC 701.4.1.1 (7.4.1.1) *On-Site Renewable Energy Systems* and UFC 3-440-01 where LCCE, considering climate, infrastructure condition, mission compatibility, and effects on base-wide electrical system (grid) power quality. When available, utilize Installation-specific studies

[8] **\2** Consult with Installation Energy Manager to determine if building metered data is available. If it isn't, this option cannot be pursued. **/2/**

to determine LCCE renewable energy systems. Studies must be dated within five years of project design start.

- For Army projects, if not LCCE, utilize IgCC **\2** 701.3.2 ((7.3.2) **/2/** *On-Site Renewable Energy Systems* for future installation of on-site renewable energy systems.
- Services may choose LCCE centralized or Installation-wide renewable energy development, in lieu of building-by-building application. Meet the requirements of **\3** UFC 3-540-08 **/3/**.

Exception: Do not use purchase of renewable energy certificates (RECs) as a substitute for IgCC 701.4.1.1 **\2** (7.4.1.1) **/2/** new building requirement.

2-3.3.2 Solar Domestic Hot Water (SDHW).

Per EISA 2007 Section 523, meet at least 30% of the annual domestic hot water requirement through the installation of solar water heating unless SDHW is not LCCE.

2-3.4 Metering.

\1 Provide meters as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

2-4 PROTECT AND CONSERVE WATER.

Base water efficiency design decisions on life-cycle cost as indicated in **\3** CHAPTER 4. **/3/**

- Meet the requirements of **\3** IgCC 601.3.2.1 (6.3.2.1) *Plumbing Fixtures and fittings* **/3/**, which incorporates EPA WaterSense-labeled products. Water closet replacements **\1\ /1/** may have a flush value of up to 1.6 GPF (6.1 LPF) to accommodate existing plumbing infrastructure. Fixtures used for sanitizing potential biohazards are exempt from low-flow and WaterSense labeling requirements.**\3**

For Navy and Air Force, **/3/**paragraph 601.3.2.1.j is not mandatory, but encouraged.

2-4.1.1 Indoor Water Metering.

\1\ Provide meters to monitor building indoor water consumption, as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter

configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy.

2-4.2 Outdoor Water.

\3 Comply with UFC 3-201-02. **/3/**

2-4.2.1 Landscaping.

- In accordance with DoD Memo *Water Use for Landscape Architecture on Department of Defense Installations/Sites*, potable water use is prohibited for irrigating new landscaping, other than for plant establishment.
- For existing systems, if a building has a single water meter, reduce combined indoor and outdoor potable water use by at least 20% compared to building water use in 2007. Compare results to a baseline building, using the EPA WaterSense landscape water budget tool version 1.01 or later, or a Service approved tool.
- Show preference for irrigation contractors who are certified through a WaterSense labeled program, or other industry-recognized credentialing programs. **\3\ /3/**

2-4.2.2 Outdoor Water Metering.

\1 Where LCCE, provide meters to monitor existing irrigation systems serving more than 25,000 square feet **\3** (2323 SM) **/3/** of landscape, as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

For all other existing irrigation systems using potable water, meters are encouraged.

2-4.3 Alternative Water.

Where life-cycle cost-effective and permitted by state and local laws and regulations, use alternative water sources for non-potable applications.**\1** Where LCCE, provide meters to monitor alternative water consumption, as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

2-4.4 Stormwater Management.

Meet the requirements of UFC 3-210-10.

2-5 ENHANCE INDOOR ENVIRONMENTAL QUALITY.

2-5.1 Ventilation and Thermal Comfort.

Comply with UFC 3-410-01 for ventilation and thermal comfort criteria. Consider the use of passive (non-mechanical) thermal comfort methods as described in paragraph entitled, “Integrated Design” in this UFC.

\3\ /3/ For Medical Treatment Facilities, refer to UFC 4-510-01 *Medical Military Facilities* for ventilation and thermal comfort criteria.

2-5.2 Daylighting and Lighting Controls.

Locate all employee work areas, such as classrooms and offices, on exterior walls or other locations where it is feasible to maximize daylighting. Maximize daylighting in break rooms and other gathering areas where feasible. **\1** For those spaces on the exterior of the building where it is feasible to maximize daylighting, meet **/1/** the requirements of IgCC 801.4.1.2 (8.4.1.2) *Minimum Sidelighting Effective Aperture for Office Spaces and Classrooms*. Provide automated lighting, including daylighting, controls in accordance with UFC 3-530-01. For Medical Treatment Facilities, refer to UFC 4-510-01 Medical Military Facilities for additional daylighting criteria.

Exceptions: Under IgCC 801.4.1.2, Exceptions: Number 2, “for more than four daytime hours per day” does not apply.

2-5.3 Indoor Air Quality.

2-5.3.1 Moisture Control.

Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture. **\3** In addition to complying with the IAQ construction management plan, meet the requirements of UFC 3-410-01. **/3/** Refer to Appendix A “Best Practices” for Protect Indoor Air Quality.

2-5.3.2 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials).

Specify materials and products with low or no pollutant emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings. Meet the requirements of IgCC 801.4.2 (8.4.2) *Materials*.

Exception: Exclude compliance with the first sentence.

2-5.3.3 Protect Indoor Air Quality during Construction.

For new construction and for **\1** work in **/1/** an existing building that will be unoccupied during construction, develop and implement an IAQ construction management plan that complies with IgCC 1001.3.1.5 (10.3.1.4) *Indoor Air Quality (IAQ) Construction*

Management, with maximum outdoor air consistent with achieving relative humidity no greater than 60%.

For **\1** work in **/1/** an existing building that will be occupied during construction, comply with **\3** IgCC 1001.4.4 (10.4.4) Construction Activity Pollution Prevention: Protection of Occupied Areas **/3/**. Refer to Appendix A "Best Practices" for "Protect Indoor Air Quality."

2-5.3.4 Environmental Tobacco Smoke Control.

Prohibit smoking[9] within the building and within a minimum of 50 feet (15.24 meters) of all building entrances, operable windows, and building ventilation intakes. **\3** Ensure signage is installed as appropriate. **/3/** Verify if more stringent facility criteria or Installation policy applies.

2-5.4 Occupant Health and Wellness.

Promote opportunities for occupants to voluntarily increase physical activity, as part of the Integrated Design Process. **\1** Refer to Appendix A "Best Practices" for examples. **/1/**

2-6 REDUCE ENVIRONMENTAL IMPACT OF MATERIALS.

2-6.1 Environmentally Preferable Products.

The following paragraphs require procurement of construction materials and building supplies that have a lesser or reduced effect on human health and the environment over their lifecycle, when compared with competing products or services that serve the same purpose.

2-6.1.1 Recycled Content.

Use RCRA Section 6002**\3** and 42 U.S.C. § 6962 **/3/** compliant products that meet or exceed EPA's recycled content recommendations, available on EPA's Comprehensive Procurement Guideline (CPG) Program.

2-6.1.2 Biologically-Based Products.

Per Section 9002 of the Farm Security and Rural Investment Act, **\3** and in accordance with 7 U.S.C. § 8102, **/3/** specify products composed of the highest percentage of biobased content consistent with the USDA BioPreferred Program, if products meet performance requirements and are available at a reasonable cost. Document deviation from using biobased product procurement. Include a preference for purchasing products with the highest biobased content per USDA recommendations for designated product

[9] Refer to Service-specific policies (may need to copy and paste hyperlink in Browser): Army: ARMY HEALTH PROMOTION Navy: NAVY AND MARINE CORPS TOBACCO POLICY Air Force: AIR FORCE INSTRUCTION 40-102

categories in all applicable solicitations. USDA's biobased product designations and biobased content (which includes certified sustainably-harvested and rapidly renewable resources) recommendations are available on USDA BioPreferred website.

2-6.1.3 Ozone-Depleting \1\ Substances /1/.

Do not use ozone-depleting **\1** substances **/1/** and high global warming potential (GWP) chemicals where EPAs Significant New Alternatives Policy (SNAP) Program has identified acceptable substitutes or where other environmentally preferable products are available for use in construction, repair or end-of-life replacements.

\3\ /3/

2-6.2 Waste and Materials Management.

2-6.2.1 Storage and Collection of Recyclables.

Meet the requirements of IgCC 901.3.4.1 (9.3.4.1) *Recyclables*, where markets or onsite recycling exist.

2-6.2.2 Waste Diversion.

Divert a minimum of 60% of the nonhazardous construction and demolition waste material from landfills.

2-7 ADDRESS \3\ /3/ RISK.

Provide building design solutions responsive to any Government-provided **\3\ /3/** determination of acceptable risk, typically evaluated and documented in the planning process.

See UFC 2-100-01 and UFC 3-201-01 for potential **\3\ /3/** risk considerations and requirements for work on existing buildings.

CHAPTER 3 EXISTING BUILDINGS HPSB COMPLIANCE ASSESSMENT

3-1 OVERVIEW.

3-1.1 Federal Guiding Principles Assessment.

Use this chapter when assessing the HPSB Guiding Principles compliance of an existing building, independent of design and construction activities. The assessment is used to assist in identifying opportunities to increase performance of the building until it reaches full compliance. This assessment can also be used to inform future design and construction activities in the building. Some HPSB Guiding Principles can be addressed at the Installation, Service, or DoD Agency level, versus the building level (example: no smoking policy). Align DoD Service programs that target building energy and water efficiency improvements with the requirements of this UFC. Include consideration of whole building, maintainability, and energy and water efficient solutions. Refer to Table 1-1 for requirements for compliance. HPSB tracking and reporting procedures are covered in Chapter 4, paragraph entitled, "Building Compliance Tracking" and "Building Compliance Reporting".

3-1.2 Assessment Requirements.

Use the following questions-based assessment elements to assess Guiding Principles compliance of an existing building. Each element has two designations noted under the element title: 1) "Required" or "Additional" and 2) "Installation-wide" or "Building-specific". Designation definitions are:

- "Required" means the element must be met to be in compliance.
- "Additional" means the element is an optional part of the assessment. Forty percent of these elements must be met to be in compliance.
- "Installation-wide" means the element can be met through Installation policy/specifications/contracts (where the building is located.)
- "Building-specific" means the element must be met at the building level.

3-2 EMPLOY INTEGRATED ASSESSMENT, OPERATION, AND MANAGEMENT PRINCIPLES.

3-2.1 Integrated Assessment, Operation, and Management.

(Required; Installation-wide)

a. Are sustainable operations and maintenance practices incorporated into the Installation Environmental Management System (EMS)?

Through an integrated process and team, identify and implement operations and maintenance policies that improve building environmental performance; protect natural,

historic, and cultural resources; support occupant health and wellness; and improve the resilience of facilities and operations.

b. Has there been an assessment of existing conditions and operational procedures of the building and/or major building systems, and have areas been identified for improvement?

Assess existing condition and operational procedures of the building and major building systems. Consider electric vehicle charging infrastructure and appropriate energy resilience measures, in accordance with applicable laws and regulations. Identify areas for improvement.

c. Are there established operational performance goals for energy, water, material use, recycling, and indoor environmental quality; and is incorporation of the goals ensured throughout the lifecycle of the building?

Establish: operational performance goals for energy and water; product compliance goals for material use, recycling, and indoor environmental quality; and ensure goals are incorporated throughout the remaining life cycle of the building, including a verification process.

d. Is there a building management plan to ensure that operating decisions and user/tenant education are carried out with regard to integrated, sustainable building operations and maintenance?

Incorporate goals into building management to ensure that operating decisions and tenant education are carried out with regard to integrated building operations and maintenance.

e. In addition to the work order program/Facilities Managers, are building operations and maintenance augmented as needed, using Building Manager/occupant/user feedback on workspace satisfaction?

Engage building occupants with building environmental performance information. Augment building operations and maintenance as needed using occupant feedback on workspace satisfaction.

3-2.2 ReCommissioning and RetroCommissioning.

(Required; Building-specific)

Has the building been commissioned, recommissioned, or retrocommissioned within the last four years?

In order to verify performance and ensure that the Government requirements are met, employ retrocommissioning and recommissioning activities, tailored to the size and complexity of the existing building and its system components **\3** to each building

>10,000 SF (929 SM.) **/3/** Recommissioning must be led by an experienced commissioning agent, who should be independent of the facility operations team.

\3 Tailor commissioning activities to the size and complexity of the buildings and systems. For Air Force and Navy assessments, the Assessment Team must determine the level of commissioning activities required. For Navy projects, comply with FC 3-401-02N.

For Medical Treatment Facilities, refer to UFC 4-510-01 Design: Military Medical Facilities for additional commissioning requirements. **/3/**

3-3 OPTIMIZE ENERGY PERFORMANCE.

3-3.1 Energy Efficiency.

3-3.1.1 Commercial and Multi-Family High-Rise Residential Buildings or Low-Rise Residential.

(Required; Building-specific)

\1 When LCCE, h **/1/** as energy usage met one of the following performance options?

- Reduce measured building energy use by at least 30% below the FY 2003, or earlier, energy use baseline[10].
- Reduce modeled building energy use (from all sources including renewable energy) by at least 20% below the FY 2015 energy use baseline.
- Reduce modeled building energy use (from all sources including renewable energy) by at least 30% below ASHRAE 90.1 standard. (Refer to paragraph "Commercial and Multi-Family High-Rise Residential Buildings" for calculation of energy consumption reduction.)
- Reduce modeled building energy use (from all sources including renewable energy) by at least 30% below IECC standard.**\3**
- Ensure the building has an ENERGY STAR score of 75 or higher. For building types not eligible to receive an ENERGY STAR score and where adequate benchmarking data exists, demonstrate that the building is in the top quartile of energy performance for its building type.

If none of the performance options were met, has the maximum performance that is LCCE been achieved? **/3/**

[10] **\2** Consult with Installation Energy Manager to determine if building metered data is available. If it isn't, this option cannot be pursued. **/2/**

3-3.1.2 Energy Efficient Products.

(Required; Installation-wide)

Do acquisition documents require the purchase of **\1** ENERGY STAR® **/1/** and/or FEMP-designated Energy Efficient products?

Per EISA 2007 Section 525, acquire products that are ENERGY STAR® **\3** certified by the EPA, or meet or exceed the efficiency standard designated by FEMP Energy-Efficient Products requirements in all covered product category. **/3/**

3-3.2 On-Site Renewable Energy.

(Additional; Building-specific or Installation-wide)

a. Has building-level or centralized renewable energy generation been evaluated?

b. When found to be LCCE, has renewable energy generation been implemented or planned for implementation?

Implement renewable energy generation projects on agency property for agency use, where lifecycle cost effective and when there are no adverse effects on base-wide electrical system (grid) power quality or mission. Implementation must comply with the requirements in UFC 3-440-01. When available, utilize Installation-specific studies to determine LCCE of renewable sources. Studies must be dated within five years of project design start.

Services may choose centralized renewable energy development in lieu of building-by-building application. Meet the requirements of UFC 3-540-08.

3-3.3 Metering.

(Additional; Building-specific)

a. **\3** For buildings that use electricity, **/3/** is there a building meter for electricity?

b. **\3** For buildings that use gas, **/3/** is there a building meter for gas?

c. **\3** For buildings that use steam, **/3/** is there a building meter for steam?

\1 Provide meters as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

3-3.4 \1\ /1/ Benchmarking (Verification).

(Additional; Building-specific)

a. **\3** For buildings that use electricity and have a meter, **/3/** is electric metered data gathered on a monthly basis?

   If Yes: Is the data analyzed?

b. **\3** For buildings that use gas and have a meter, **/3/** is gas metered data gathered on a monthly basis?

   If Yes: Is the data analyzed?

c. **\3** For buildings that use steam and have a meter, **/3/** is steam metered data gathered on a monthly basis?

   If Yes: Is the data analyzed?

\3 Benchmark building performance at least annually and regularly monitor building energy performance against historical performance data and peer buildings, where feasible. **/3/**

3-4 PROTECT AND CONSERVE WATER

3-4.1 Indoor Water.

(Required; Building-specific or Installation-wide)

Do acquisition documents require the purchase of water-conserving products (ex: EPA's WaterSense-labeled products where available for toilets, showers, urinals, faucets)?

3-4.2 Indoor Water Metering

(Required; Building-specific)

a. Is there a building meter for potable water sources?

b. Is there a measured 20% reduction in water usage from 2007 baseline; OR has a 20% reduction in water usage been determined by a Service approved method; OR has an analysis been conducted of water use, leaks been identified and repaired, single pass cooling been eliminated, cooling tower operations optimized, and water efficient products installed?

\1 Provide meters to monitor building indoor water consumption, as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation’s advanced metering protocols. Meter

configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy **/1/**

3-4.3 Outdoor Water.

3-4.3.1 Water for landscaping.

(Additional; Building-specific)

> If potable water is used for existing irrigation, has 20% reduction been demonstrated by metered data or modeling (such as the EPA WaterSense Landscape Water Budget Tool, version 1.01 or later, or a Service approved tool) OR is water efficient landscaping used?

\3 In accordance with DoD Memo Water Use for Landscape Architecture on Department of Defense Installations/Sites, potable water use is prohibited for irrigating new landscaping, other than for plant establishment. Evaluate and implement, as applicable, water efficient landscaping best practices that incorporate native, non-invasive, drought tolerant, and low maintenance plant species. Comply with UFC 3-201-02 for additional requirements. **/3/**

3-4.3.2 Outdoor Water Metering

(Additional; Building-specific)

> For irrigation systems serving more than 25,000 SF **\3** (2323 SM) **/3/** of landscaping, is an outdoor water meter installed?

\1 Where LCCE, provide meters to monitor existing irrigation systems serving more than 25,000 **\3** SF (2323 SM) **/3/** of landscape, as required by DoDI 4170.11, and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation’s advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

3-4.4 Alternative Water.

(Additional; Building-specific or Installation-wide)

a. Have building-level or centralized alternative water sources been evaluated?

b. When found to be LCCE, have alternative water sources been implemented or planned for implementation?

Where life-cycle cost-effective and permitted by state and local laws and regulations, use alternative water sources for non-potable applications.**\1** Where LCCE, provide meters to monitor building alternative water consumption, as required by DoDI 4170.11,

and as amended by DoD Utilities Meter Policy, in the standard units of measure. Where base-wide energy and utility monitoring and control systems exist, meters must be connected using the installation's advanced metering protocols. Meter configuration must comply with the requirements of UFC 4-010-06, and as required by individual Service's meter implementation policy. **/1/**

3-4.5 Stormwater Management.

(Additional; Building-specific or Installation-wide)

Are the requirements of UFC 3-210-10 incorporated into projects that include **\3** buildings: and expansion of the footprint of one or more existing buildings, and/or site **/3/** disturbance of greater than 5000 SF?

3-5 ENHANCE INDOOR ENVIRONMENTAL QUALITY.

3-5.1 Ventilation and Thermal Comfort.

(Required; Building-specific)

Does the building comply with the ventilation and thermal requirements of UFC 3-410-01?

3-5.2 Daylighting and Lighting Controls.

(Additional; Building-specific)

Are automated lighting controls, including occupancy/vacancy sensors with manual-off capability and daylighting controls, provided for appropriate spaces in accordance with UFC 3-530-01? (Appropriate spaces include: restrooms, conference and meeting rooms, employee lunch and break rooms, training classrooms, and offices.)

\3 Maximize the use of automatic dimming controls in regularly occupied spaces. **/3/** Provide automated lighting controls in accordance with UFC 3-530-01.

3-5.3 Indoor Air Quality.

3-5.3.1 Moisture Control.

(Additional; Installation-wide)

Is there a policy or specification requiring moisture control strategy for moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture?

Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.

3-5.3.2 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials).

(Additional; Installation-wide)

a. Is there a policy or **\3** purchasing procedures **/3/** requiring low emitting materials (low Volatile Organic Compounds (VOCs)) for building repairs/modifications?

b. Is there a policy or **\3** purchasing procedures **/3/** requiring the use of low emitting materials (low Volatile Organic Compounds (VOCs)) for cleaning?

Use reduced volatile organic compounds (VOC) (low emitting materials) for building modifications, maintenance, and cleaning. In particular, specify the following materials and products to have low or no pollutant emissions: composite wood products, **\3** wall panel, insulation, adhesives, sealants, solvents, interior paints and finishes, solvents, carpet systems, janitorial supplies, and furnishings. Refer to EPA's Volatile Organic Compounds' Impact on Indoor Air Quality resources for information on low-emitting products. **/3/**

3-5.3.3 Integrated Pest Management.

(Additional; Installation-wide)

Is there an Integrated Pest Management Plan (IPMP) in place?

Use integrated pest management techniques as appropriate to minimize pesticide usage. When pesticides are needed, only use EPA-registered pesticides, **\3** and as required by DoDM 4150.07. **/3/**

3-5.3.4 Environmental Tobacco Smoke Control.

(Additional; Installation-wide)

Do all smoking structures comply with Service policy to be 50 feet from openings?

Prohibit smoking[11] within the building and within a minimum of 50 feet (15.24 meters) of all building entrances, operable windows, and building ventilation intakes. Verify if more stringent facility criteria or Installation policy applies.

[11] Refer to Service-specific policies (may need to copy and paste hyperlink in Browser): Army: ARMY HEALTH PROMOTION Navy: NAVY AND MARINE CORPS TOBACCO POLICY Air Force: AIR FORCE INSTRUCTION 40-102

3-5.4 Occupant Health and Wellness.

(Additional; Installation-wide)

Do occupants have access to infrastructure, buildings, and interior attributes that promote voluntary increased physical movement?

Promote opportunities for occupants to voluntarily increase physical movement. Refer to Appendix A "Best Practice" for examples.

3-6 REDUCE ENVIRONMENTAL IMPACT OF MATERIALS.

3-6.1 Environmentally Preferable Products.

The following paragraphs require procurement of construction materials and building supplies that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose.

3-6.1.1 Recycled Content.

(Required; Installation-wide)

Is there a policy or **\3** procedure **/3/** requiring products to meet or exceed EPA's recycled content recommendations for all building repairs/modifications?

Use RCRA Section 6002 compliant products that meet or exceed EPA's recycled content recommendations, available on EPA's Comprehensive Procurement Guideline (CPG) Program.

Encourage reuse of building materials, components, and furnishings that are in refurbishable condition and meet the quality standards of the government.

3-6.1.2 Biologically-Based Products.

(Required; Installation-wide)

Is there a policy or **\3** procedure **/3/** requiring use of products listed by USDA's biobased content site?

Per Section 9002 of the Farm Security and Rural Investment Act, specify products composed of the highest percentage of biobased content consistent with the USDA BioPreferred Program, if products meet performance requirements and are available at a reasonable cost. Document deviation from using biobased product procurement. Include a preference for purchasing products with the highest biobased content per USDA recommendations for designated product categories in all applicable solicitations for building modifications, operations and maintenance, and cleaning. USDA's biobased product designations and biobased content (which includes certified sustainably-

harvested wood products and rapidly renewable resources) recommendations are available on USDA BioPreferred website.

3-6.1.3 Ozone-Depleting \1\ Substances /1/.

(Required; Installation-wide)

> Is there a **\3\ /3/** management plan that includes reducing Ozone-Depleting **\1** Substances **/1/**?
>
> If Yes: does the plan include a phase out of ODCs, or have CFCs, **\3** HCFCs and HFCs **/3/** already been phased out?

Eliminate the use of ozone-depleting **\1** substances **/1/** and high global warming potential (GWP) chemicals where EPAs Significant New Alternatives Policy (SNAP) Program has identified acceptable substitutes or where other environmentally preferable products are available for use in construction, repair or end-of-life replacements. **\3\ /3/**

3-6.2 Waste and Materials Management.

3-6.2.1 Storage and Collection of Recyclables.

(Required; Installation-wide)

a. Is there reuse or recycling service for building occupants?

b. Is there policy **\3** or procedure **/3/** requiring salvage, reuse, or recycling services for waste generated from building operations and maintenance**\3\ /3/**?

Provide salvage, reuse and recycling services for waste generated from building operations, maintenance, repair and **\1** SRM projects **/1/**, where markets or on-site recycling exist.

3-6.2.2 Waste Diversion.

(Additional; Installation-wide)

> Is there policy**\3** or procedure **/3/** requiring salvage, reuse, or recycling services for waste generated from **\3** building operations and maintenance **/3/ \1\ /1/**?

\3 Verify a waste management and recycling policy, program, or procedures are in place. Conduct an analysis or verify one has been done of non-hazardous, non-construction waste and develop a waste management plan or industry equivalent to increase waste diversion rate. Include in or ensure that the plan estimates waste types and amounts as well as goals for waste diversion to minimize waste sent to landfill. **/3/**

3-7 ADDRESS \3\ /3/ RISK.

(Required; Building-specific or Installation-wide)

Where **\3\ /3/** risk factors have been identified, is there a process to implement associated actions?

Provide building design solutions responsive to any Government-provided projections of **\3\ /3/** determination of acceptable risk (typically determined, evaluated and documented in the planning process.)**\3\ /3/**

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CHAPTER 4 ENERGY OPTIMIZATION, \3\ MODELING, /3/ AND LCCA PROCESS INTEGRATION

\3 Execute LCCA by following the NIST Handbook 135 and utilizing the BLCC software program. **\1** DOE COMcheck-web or COMcheck desktop programs might be useful to improve energy efficiency, reduce energy cost, and comply with IECC and ASHRAE 90.1. **/1/** The LCCA process requires the input of Architects, Mechanical Engineers, Electrical Engineers, Cost Engineers, and Energy Modelers (when part of the team.) Each professional must participate, in order to achieve overall optimization.

4-1 \3\ PROCESS. /3/

\3 LCCA is an integral part of energy optimization, resulting in balancing energy performance with other resources. An LCCA is required for the following:

1. Systems contributing to the energy footprint of the building including, but not limited to, HVAC, domestic hot water, lighting, thermal storage, and the building envelope[12]

2. Renewable energy generating systems (example: photovoltaic panels)

3. When life-cycle cost effectiveness (LCCE) is selected as the reason a requirement of this document is “Partially compliant” or “Not Applicable” (reference paragraph “Tracking Compliance”).

4. As required in the ENERGY OPTIMIZATION, MODELING AND LCCA PROCESS CHART at the end of this chapter, and when life-cycle cost analysis (LCCA) is required by law or policy.

The LCCA methodology may also be used to evaluate multiple options, such as selecting the building construction type and comparing compliant materials; and is at the discretion of the project team. **/3/**

4-1.1 \3\ LCCA Format. /3/

\3 Prepare the LCCA in accordance with 10 CFR Part 436, Subpart A and NIST Handbook 135 Life-Cycle Costing Manual for the Federal Energy Management Program. The LCCA must be prepared using the Building Life-Cycle Costing (BLCC) program, available from the National Institute of Standards and Technology. The implied long-term inflation rate and discount rates identified in the Annual Supplement to NIST Handbook 135 must be used. A link to BLCC can also be found at the Department of Energy’s building energy tools web site: Building Life Cycle Cost Programs. The NIST handbook focuses on determining an LCCA for each design alternative modeled

[12] **\3** In addition to the new building requirements, each existing building large capital energy investments (each project for which the cost of the systems that impact energy consumption exceeds $1,000,000, which constitutes a capital investment, per National Defense Authorization Act) are to employ the most energy efficient designs, systems, equipment, and controls that are life cycle cost effective. **/3/**

by acceptable software. In order to be fully acceptable, the selected design alternative must also comply with federally-mandated ASHRAE 90.1, and meet the performance goals in paragraph titled “Energy Efficiency”. LCCE means that the proposed design solutions have a lower life-cycle cost than the life-cycle cost of the baseline. **/3/**

4-1.2 \3\ LCCA Building-Level (Whole Building) Analysis. /3/

\3 Each building-level LCCA must be calculated using a 40-year study period (expectant life.) Individual components or systems life expectancies must be reflected by inclusion of appropriate replacement and salvage values in the appropriate year of this analysis. **/3/**

4-1.3 \3\ LCCA Individual Component or System Alternatives Analysis. /3/

\3 LCCAs comparing at least three individual component or system alternatives must use a study period (or life expectancy) of 40 years from the beginning of beneficial use. All alternatives, along with their sub-systems, must meet all functional needs of the project and meet all applicable laws, regulations, policies, UFC, codes, and standards. Utilize the appropriate replacement and salvage values for each of the alternatives. Acceptable alternatives must not degrade the overall building performance. They must be sound technical alternatives that are user comfort-compatible, reliable, locally serviceable, user friendly, ensure safety, and at a minimum are neutral with regard to occupant productivity and design aesthetics.

Perform this analysis based on the actual conditions expected over the life of the building including anticipated occupancies, scheduled hours of operation, and process loads. Use real data from installations, when available in usable form and appropriate for analysis of all alternatives. If not available, use standard industry data sources. Also use modeled energy usage and efficiencies; realistic O/M, repair and replacement costs; and all costs or savings associated with recovered energy, solar heat, solar photovoltaic energy and other renewable or waste heat applications. Credit alternative funding such as rebates in the LCCA. **/3/**

4-1.4 LCCA Process Integration Steps.

Use the Process flowchart “ENERGY OPTIMIZATION, MODELING AND LCCA PROCESS CHART” **\3** when performing the Energy Optimization, Modeling and LCCA to meet Federal requirements. Additional processes may be necessary, to meet service agency requirements that exceed minimum Federal requirements.

For buildings that must include energy modeling and LCCA (refer to Table 1-1), **/3/** perform energy optimization, modeling and LCCA during parametric design process to 35% Design or earlier. Identify energy enhancements that are life-cycle cost effective (LCCE) and supported by the LCCA to meet energy efficiency requirements. Where such enhancements increase costs, request additional funds for the project prior to budget lock. Ensure that all processes, decisions, and the resultant recommended course of action are properly documented.

4-1.5 Identify Alternatives.

Identify the highest efficiency building systems and features from those that are feasible. Perform energy modeling on at least three alternative sets of building envelope, and mechanical, and electrical design solutions[13]. Exercise sound engineering practices in identifying the best alternatives for analysis for a given building. This includes balancing increases in energy efficiency against operating and maintenance (O&M) costs and initial costs. Perform LCCA to determine which alternatives are LCCE. When appropriate, consider additional alternatives. Document all alternatives considered in the Design Analysis for the record, including those that were not pursued.

- For Navy and Air Force **\3** buildings, select a strategy that provides at least 30% energy savings from ASHRAE 90.1 baseline, if LCCE relative to the ASHRAE 90.1 baseline. If multiple alternative strategies that provide 30% energy savings are LCCE relative to the ASHRAE 90.1 baseline, select the most LCCE of these alternatives. If there are no strategies that achieve at least 30% energy savings that are LCCE relative to the ASHRAE 90.1 baseline, select the alternative that provides the highest energy savings that is LCCE relative to the ASHRAE 90.1 baseline. **/3/** Refer to Chapter 2, paragraph titled “Energy Efficiency” for calculation methodology.
- For Army buildings, select the alternative that provides the highest energy efficiency that is LCCE, relative to the ASHRAE 90.1 baseline, as the proposed design solution for the building.

4-1.6 Chosen Alternative Justification.

When the LCCA process does not identify an LCCE solution that meets or exceeds 30% below baseline, provide an explanation in the Design Analysis file. For example, justification may relate to unique mission requirements, historic building requirements, resilience requirements, or operation and maintenance **\3** costs. Refine the LCCA at each design submittal, as well as during construction if there are significant changes to the system. **/3/**

4-1.6.1 \3\ Existing /3/ Building Envelope.

For existing buildings, the LCCA baseline for the building envelope is the existing building envelope system type modified to comply with ASHRAE 90.1 prescriptive path envelope performance requirements. Example: if an existing building has masonry wall construction, the baseline envelope will have masonry wall construction with the

[13] **\3** For Army, perform LCCAs on a minimum of three substantially differing integrated design configurations utilize ER 1110-1-8173 “Energy Modeling and Life Cycle Cost Analysis”. Conduct and document life-cycle cost analyses consistent with ER 1110-1-8173 “Energy Modeling and Life Cycle Cost Analysis.” **/3/**

associated U-factors from ASHRAE 90.1 Section 5. Do not use the ASHRAE 90.1 Appendix G requirement for steel-framed wall for the baseline for LCCA in this example.

4-1.6.2 Preferred Features.

In selecting alternatives for analysis, give preference to durable features and systems with lower complexity and maintenance burden. Where alternatives were considered, but not analyzed, identify those alternatives and provide an explanation in the Design Analysis. When there are less than three feasible alternatives for the building, include a justification in the documentation.

4-1.6.3 Lighting Systems.

When included in the design, LED and high-intensity RF Induction lighting systems do not require LCCAs because long life, efficiency, and environmental sustainment is inherent in these technologies.

4-1.6.4 Installation Preferences.

Installation preferences do not supersede service policies or this UFC without an approved exemption in accordance with MIL-STD-3007. Incorporate realistic operational and maintenance costs into the LCCA.**\3\ /3/**

4-1.6.5 Funding of Features and Systems.

Where the DD Form 1391 for a Congressionally-approved project requires a particular feature or system, such feature or system must be included in the design. In such cases, an LCCA for that feature or system is not required during design. Cite the reason for no LCCA in the Design Analysis. Example: Where funding is identified for solar photovoltaic systems or ground source heat pump systems in the DD Form 1391, they will be included in the project without the need for an additional LCCA, since a required LCCA was completed in order for those systems to be added to the DD form 1391. Where connection to a central energy plant is required in the DD form 1391, LCCA for the central heating/cooling plants for a building is not required. However, an LCCA for the building-level systems is required. When central plant data is available, energy optimization, modeling and LCCA calculations should be conducted and documented in the design analysis.

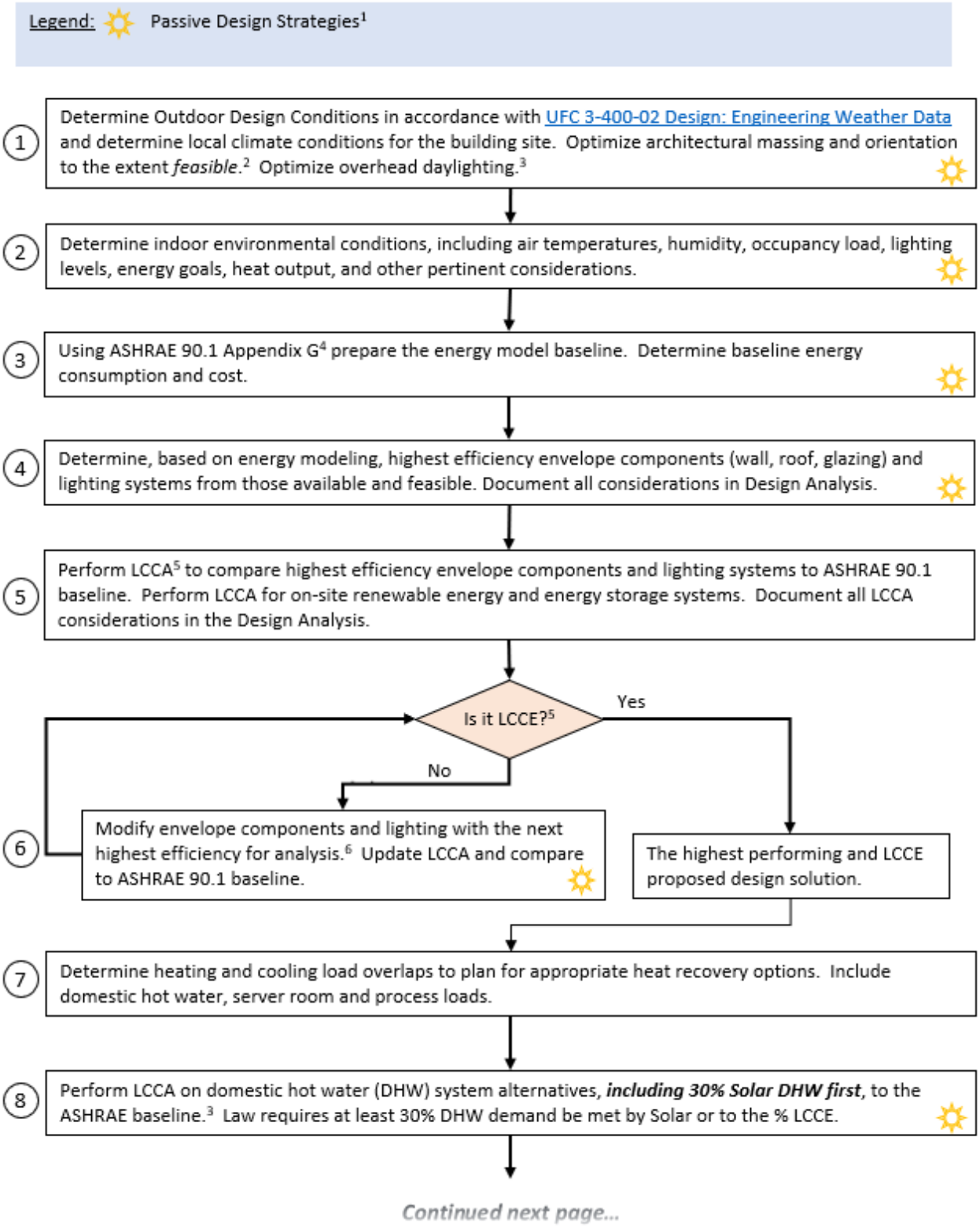
4-1.7 Energy Modeling.

Complete the documentation of the energy optimization, modeling and LCCA no later than the parametric design phase (5-35%). Significant changes to the building scope beyond initial design that impact energy savings or building cost require an updated LCCA and energy model. Place all documentation in the Design Analysis and keep it readily available for a third-party review. The LCCA documentation forms a part of the Energy Compliance Analysis required for the building.

4-2 DESIGN BUILD PROJECTS.

In Design Build (DB) projects, the LCCA is prepared **\3** for each building in the project **/3/** during the development of the solicitation package, or Request for Proposal (RFP). The resulting system and feature selections are incorporated as requirements in the DB RFP. The DB selection criteria must require that a deviation provided by the offeror that increases energy efficiency is supported by an energy optimization, **\3** modeling and LCCA documentation. **/3/** Deviations that decrease the energy efficiency are not acceptable. **\3** The DB RFP must include the requirement for refining the LCCA at each design submittal, as well as during construction if there are significant changes to the system. **/3/**

4-3 ENERGY OPTIMIZATION, MODELING AND LCCA PROCESS CHART



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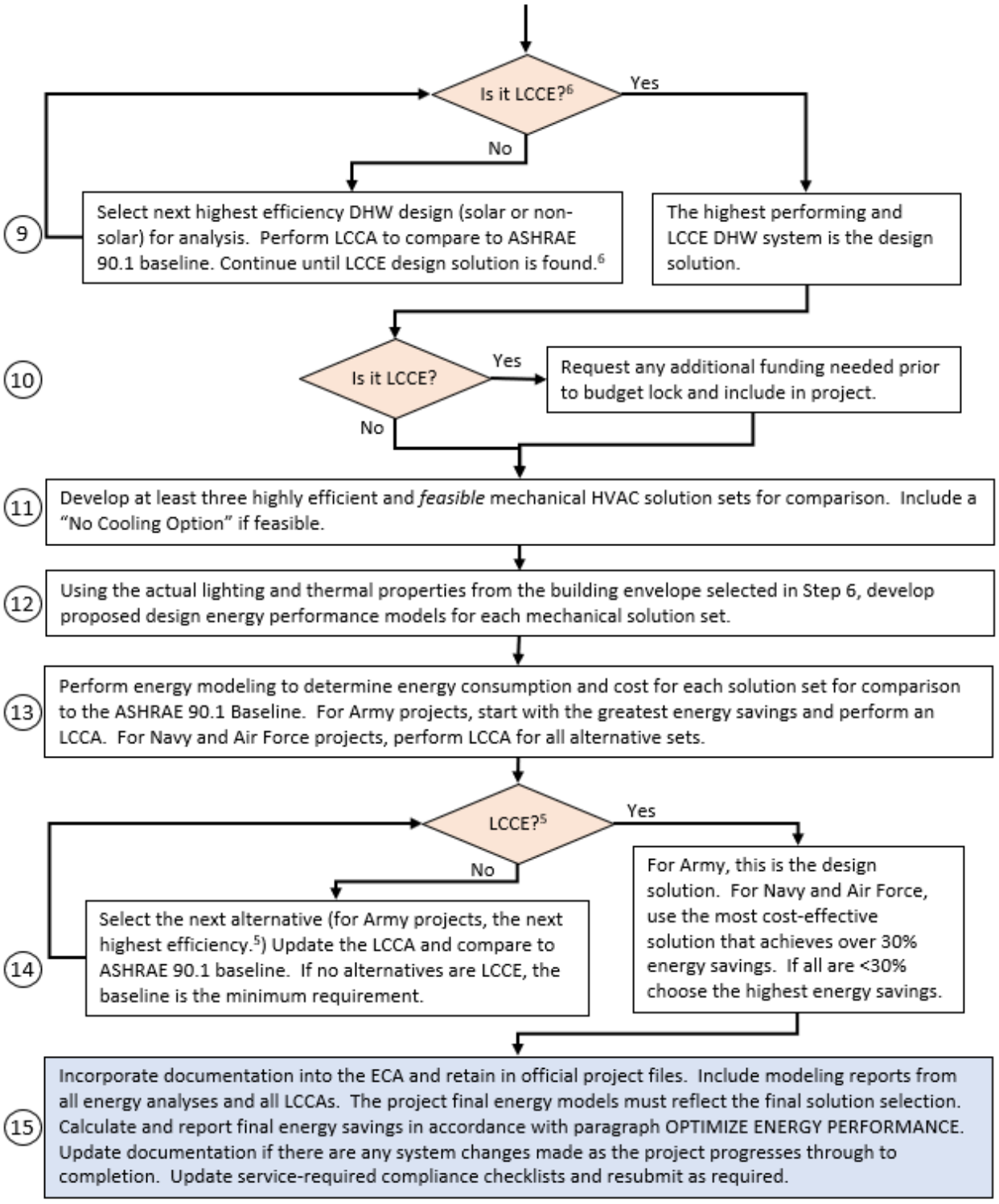

Flowchart Footnotes:

1. **\3** Passive design strategies maximize natural light, heat and air movement, based on local site conditions, in order to create a comfortable interior environment that reduces the need for energy. Evaluate and incorporate passive design strategies before initiating design or LCCA. Refer to paragraph “EMPLOY INTEGRATED DESIGN PRINCIPLES” for requirements. **/3/**
2. The term “feasible” throughout the flow chart means technically viable alternatives that are: 1) available in the project market; meet mission/functional requirements; 2) comply with Federal Laws and applicable Government regulations, policy, codes, and criteria (UFCs, AT/FP, etc.); and 3) realistically and economically maintainable by local facility operation and maintenance staff or contractors. Justify design solutions found to be “not feasible” in the Design Analysis for the record with documentation.
3. “Optimize daylighting” means improvement to user environmental quality, as well as providing opportunity to save energy through instantaneous automatic electronic light dimming. Optimize to the extent feasible per Footnote 1. Consider the extent of energy savings available based on most likely selected lighting system alternative.**\3\ /3/** Refer to UFC 3-101-01, Architecture for guidance on Daylighting.
4. **\3** Baseline must be based on ASHRAE 90.1 Appendix G (the process is similar for use with the IECC for low-rise residential buildings to the extent applicable). All Federal facilities are required to achieve at least 30% energy savings from this baseline, if LCCA. Refer to paragraphs 2-3.1.1 or 3-3.1.1. **/3/**
5. Perform **\3** LCCA **/3/** using present-value method. Include realistic maintenance costs, based on Installation O&M capabilities.
6. **\3\ /3/** A minimum of three alternative solutions to the baseline is required for a complete analysis. If none of the alternative solutions with savings beyond the baseline are LCCE, then the baseline is the design solution.
7. The consideration of solar energy systems is required by mandate. **\3** To the extent such information is available, **/3/** use the current, local Installation utility costs, including savings attributable to demand and time-of-day charge reductions from the inclusion of renewable energy and energy storage. **\3** To enhance performance and resilience based on location, consider other forms of renewable energy, such as waste heat recovery, microhydro, biomass, cogeneration, or other options that may be included economically as a package. Evaluate energy storage systems, when feasible. Consider enhancing resilience with systems to supplement critical power circuits to reduce fuel consumption by backup generators during service disruptions. Prior to DD1391 enactment, request additional funding for a line item that was not included or underestimated. Document funding request approvals and disapprovals in the Design Analysis. **/3/ /1/**

CHAPTER 5 HPSB COMPLIANCE TRACKING, REPORTING, AND POLICIES

5-1 OVERVIEW.

Federal agencies are required to target and report annual progress toward HPSB Guiding Principles compliance**\3\ /3/**. Refer to Table 1-1 “Building Requirements Compliance and Thresholds” to determine applicability of this chapter to each building within a project.

\3 Guiding Principles Validation (GPV), as used in UFGS 01 33 29, is project delivery team self-assessment of UFC 1-200-02 compliance, which includes meeting Federally-required tracking and reporting requirements. **/3/**

5-2 COMPLIANCE WITH FEDERAL REQUIREMENTS.

The focus of compliance with the HPSB Guiding Principles is to meet the requirements of Table 1-1 "Compliance Requirements/Thresholds." HPSB Checklist requirements are met (marked “YES”) when each requirement demonstrates one of the following:

- Fully compliant – the requirement is in full compliance and is marked “Yes”.
- Partially compliant – the requirement is compliant to the greatest degree possible, based on LCCE (example: SDHW serves only 20% of water use, per LCCE); mission restriction (example: 24/7 operation); location/regional restriction (example: availability of high-efficiency equipment service); locale restriction (example: proximity of existing buildings restricts daylighting), or safety (example: building orientation restriction for anti-terrorism due to existing infrastructure), and is marked “Yes" with justification.
- Not applicable – the requirement is not applicable, based on LCCE (example, LCCE excludes use of Alternative Water); mission exclusion (example, no daylighting in a theater); location/regional exclusion (example, Host Nation Agreement or no local recycling facility); locale exclusion (example, there is no steam to meter), or safety (example, building orientation restriction for AT/FP due to existing infrastructure), and is marked “Not Applicable” with justification.

Per *Department of Defense Sustainable Buildings Policy*, if a newly constructed building or renovated existing building complies with all the requirements of this UFC, it is considered compliant with all federal sustainability requirements.

\2 Guiding Principles Validation (GPV), as used in UFGS 01 33 29, is project delivery team self-assessment of compliance, and required tracking and reporting. **/2/**

5-2.1 Compliance HPSB Checklists.

Use the DoD Service-level HPSB checklists to track and report compliance with the requirements of this UFC, found on the Tri-Services Sustainability Program "Required Tracking – Reporting" page. Additional requirements:

- Air Force –Tracking and reporting includes revising and submitting the Air Force Sustainability Requirements Scoresheet and the design analysis **\3** for each building within a project **/3/** to <AFCEC.CF.SustainableRpt@us.af.mil> at each **\3** request for proposal and **/3/** design submittal and when construction is complete.
- Army – **\3** Tracking and reporting includes revising and submitting the Army HPSB Checklist for each building within a project to Armyleed@USACE.army.mil at each design submittal and when construction is complete. **/3/**
- Navy – Tracking includes revising and submitting the NAVFAC HPSB Checklist **\3** for each building within a project **/3/** with the Final Design Submittal and as a Construction Submittal when all construction HPSB requirements are complete.

Use the Checklist of the Service that will maintain the building asset in their Real Property Record. Check with the user Command for additional requirements.

\3 For all projects with one or more buildings within the scope, ensure the project delivery team completes the initial HPSB Checklist for each building to determine the crosswalk of scope items with criteria in this UFC. **/3/**

5-2.1.1 Compliance Documentation.

Compliance documentation demonstrates appropriate analysis and compliance with each of the HPSB requirements. Examples of compliance documentation are cited in the following paragraphs. Provide and update Compliance documentation in the design phase with each design submittal, preferably consolidated into a "sustainability" chapter in the Basis of Design, Scope of Work, or Design Analysis, and retained in the project folder.

Compliance documentation also includes the "S" submittals. The "S" Submittal is a required specification submittal that proves a particular sustainability requirement has been met by the post-award construction contractor. These submittals support the requirements in UFGS 01 33 29, are part of the electronic organization system called the Sustainability eNotebook, and are also used to obtain required documentation for third-party certifications. Many of the UFGS templates contain the standard language and tagging for the "S" submittals, with notes on how to edit each tagged submittal phrase. "S" submittals appear on the Submittal Register.

5-2.1.1.1 Energy Compliance Analysis (ECA).

In the design analysis, include an ECA that demonstrates compliance with all energy related requirements in this UFC. Identify the specific energy efficiency criteria that apply to the **\3** building **/3/**, the software used to prepare the necessary calculations, a summary of all input to and output from the calculations, and the calculated energy consumption of the baseline and alternatives. Include **\3\ /3/** a completed "Performance Rating **\3** Method Compliance Form" in the ECA, **/3/** as shown for Appendix G in the ASHRAE 90.1 *User's Manual*. Building-level energy consumption calculations **\3\ /3/** must be performed using a computer program or programs that integrate architectural features (such as the building envelope), air-conditioning, heating, lighting, and other energy producing or consuming systems. These programs must be capable of simulating the features, systems, and thermal loads used in the design. Include the energy savings and parasitic energy loads associated with the utilization of recovered energy, solar heat, solar photovoltaic energy and other renewable or waste heat applications. The program must be capable of performing 8,760 hourly calculations. The Department of Energy (DoE) maintains a list of building energy tools for design (such as eQuest).

5-2.1.1.2 ECA Narrative Requirements.

ECA LCCA narratives must be prepared by each of the following individuals: Lead Project Architect, Lead Project Mechanical Engineer, and Lead Project Electrical Engineer. List in each of the three narratives the conservation features considered for that discipline and conservation measures adopted in the design.**\3** Provide supporting LCCA calculations. **/3/**

5-2.2 Existing Buildings, HPSB Assessment.

Existing building assessment is detailed in Chapter 3. Code an existing building meeting the HPSB Guiding Principles (all “Required” and 40% of “Additional” elements) as “Yes (1)”. Indicate the appropriate sustainability status when the asset record is created, assessed, or updated.

For reporting requirements, refer to the paragraph entitled, “Compliance Reporting”.

5-2.3 Building Compliance Tracking.

Refer to Table 1-1 for building compliance tracking thresholds. During the project definition, design, and construction phases of a project, compliance with requirements is tracked using DoD Service HPSB checklist referenced in the paragraph entitled, “Compliance Checklists”. Individual building performance is reported in the Annual Energy Management and Resilience Report to Congress. Refer to each DoD Service for guidance on reporting systems and instructions.

Once the project is complete, track the final status for each building's HPSB Guiding Principles compliance in each Service's reporting system as detailed above.[14] A new building or **\1** comprehensive replacement **/1/** meeting the HPSB Guiding Principles also meets the existing building HPSB Guiding Principles and can be coded as "Yes (1)". Indicate the appropriate sustainability status at the completion of the project when the asset record is created or updated.

5-2.4 Building Compliance Reporting.

Compliance with this UFC is considered compliance with the HPSB Guiding Principles. DoD Services report their building compliance with HPSB Guiding Principles via the Real Property Inventory Submission, as provided in guidance promulgated by the Office of the Assistant Secretary of Defense (OASD) Energy, Installations & Environment (EI&E), Business System Integration Directorate (BSI). View policy regarding this reporting requirement in DoDI 4165.14.

BSI maintains the real property inventory data standards needed for the Enterprise Energy Information Management capability in the Real Property Information Model. The specific data element identified with this reporting requirement is "RPA Sustainability Code".

\3 The data elements should not be reported for:

- Non-building assets,
- Buildings located outside the U.S. and U.S. territories, or
- Buildings that have status indicator ROE submitted (B), ROE accepted (C), Determination to Dispose (F), Cannot Currently Be Disposed (G), Surplus (S) or Disposed (D). **/3/**

The reporting codes are:

- Yes (1) – **\3** building **/3/** has been evaluated and meets HPSB Guiding Principles
- No (2) – **\3** building **/3/** has been evaluated and does not meet HPSB Guiding Principles
- Not Yet Evaluated (3) – asset has not yet been evaluated **\3**
- Not Applicable (4) – All of the following conditions are met:

  /3/

  - Unoccupied: The building is occupied one hour or less per person per day on average;

[14] Buildings greater than \3\ 25,000 GSF (2323 GSM) /3/ are reported to Congress.

Low/No Energy Use: The total building energy consumption **\3** (including receptacle and process loads) **/3/** from all sources is less than 12.7 kBTU / SF/ Yr.;

Low/No Water Use: Annual average water consumption **\3** (including process water) **/3/** is less than 2 gallons per day for the building.

Code existing buildings ≥ **\3** 25,000 GSF (2323 GSM) **/3/** that have not had an HPSB Guiding Principles assessment "Not yet evaluated (3)". Code existing buildings **\3** ≥25,000 GSF (2323 GSM) **/3/** that have had an HPSB Guiding Principles assessment as either "Yes (1)" or "No (2)" using the guidance herein.

5-3 DOD SUSTAINABILITY POLICY REQUIREMENTS.

5-3.1 Office of Secretary of Defense Guidance.

OUSD AT&L Memorandum, *Department of Defense Sustainable Buildings Policy* requires compliance with this UFC, in alignment with Federal policy. The memo also requires the use of auditable processes to track and report this compliance.

5-3.2 Sustainable Third-Party Certification (TPC).

The requirement for TPC is in addition to tracking and reporting HPSB Guiding Principles Compliance in accordance with Table 1-1 "Building **\3\ /3/** Requirements and Thresholds". Per *Department of Defense Sustainable Buildings Policy*, DoD projects must "…include green-building certification of those buildings through any of the systems approved for federal use…" The green-building rating system is also known as Third-Party Certification (TPC), and is an additional requirement to this UFC compliance, tracking, and reporting. TPC is the generic term for a third-party product that provides either certification of the third party's specific product or a validation program by the third party that this UFC's requirements have been met. TPC is required for applicable DoD **\1** Component **/1/** buildings in the US and US territories.**\3\ /3/** Apply TPC to each applicable building in a project. Use the TPC of the supporting Service who will maintain the building asset in their Real Property Record. See guidance for supporting Service in DoD Policy[15].

5-3.2.1 Service-Specific TPC

\1\ /1/ Refer to Component policy for exemption requirements if the following cannot be met:

- Air Force: Project delivery teams may use either Green Business Certification, Inc. (GBCI) "Guiding Principles Assessment for Department of

[15] Memorandum, Department of Defense Supplemental Guidance for Implementing and Operating a Joint Base, April 15, 2008: Facilities Investment Joint Base Supplemental Guidance (CAC with Authentication certificate required)

Defense" program or Green Building Initiative's (GBI) "Department of Defense Guiding Principles Compliance" program.

- Army: Projects must use USGBC's LEED rating system at the minimum Silver level. **\3** Army family housing and privatized housing and lodging must be LEED Certified Silver, regardless of square footage. For additional guidance regarding LEED refer to Army Sustainability Implementation Guide. **/3/**

- Navy: Project delivery teams may use one of the following: Green Business Certification, Inc. (GBCI) "Guiding Principles Assessment for Department of Defense" program; USGBC's "LEED" rating system; Green Building Initiative's (GBI) "Department of Defense Guiding Principles Compliance" program; or GBI's "Green Globes" rating system.

5-3.3 Prohibition of Sharing \3\ Building /3/ Data.

No energy or water usage data sharing with private, sustainable third-party certification vendors is allowed for any DoD project. The DoD has complete exemption from sharing energy or water with third-party certifiers. Some certifiers have specific procedures for registering projects to include waiver language. Contact DoD Service or Third-Party Certification provider for specific procedures.

5-3.4 \3\ Service-Specific /3/ Policy.

DoD and Service-specific implementation requirements and guidance documents may be viewed at Tri-Services Sustainability Program "Policy and Mandates" page.

5-4 \3\ BUILDING STRATEGIC PLAN /3/.

\3 The DoD Building Strategic Plan (BSP) provides an organized approach to meeting requirements, **/3/** including HPSB.

APPENDIX A BEST PRACTICES

A-1 PROMOTE SUSTAINABLE LOCATION AND SITE DEVELOPMENT.

Coordinate with UFC 2-100-01 requirements and guidance.

A-1.1 Mitigation of Heat Island Effect.

- For Site Hardscapes – Consider the use of IgCC 501.3.5.1 (5.3.5.1) *Site Hardscape* for sidewalks, courtyards and POV parking areas
- For Walls – Consider the use of IgCC 501.3.5.2 (5.3.5.2) *Walls*.

A-2 PROTECT INDOOR AIR QUALITY (IAQ).

IAQ is a quality-of-life issue in every enclosed building. Due to lack of good IAQ, occupant absenteeism and poor performance has drawn a lot of attention over the years. In addition to moisture control, IAQ should be of concern in every project.

A-2.1 IAQ for \1\ Work in Existing Buildings /1/.

IAQ is of particular concern in **\1** work **/1/** that occur in occupied buildings.

When **\1** work occurs **/1/** in occupied buildings, include in the sequencing consideration for the occupants who remain in the building during the **\1** work **/1/**.

- **\3** For additional guidance for work in an existing building that will be occupied during construction, refer to ANSI/SMACNA 008-2008, 2nd Edition, SMACNA IAQ Guidelines for Occupied Buildings Under Construction. **/3/**
- Pay additional attention to sealed edges of barriers that prevent escaping dust from the construction area into corridors and other occupied areas
- Require fans and additional ventilation when potential off-gassing materials are installed
- To the greatest degree possible, plan construction activities after business hours or over weekends, for demolition or installation of materials with potential off-gassing or dust-producing properties. Examples: all dust-producing tear-outs; painting; drywall cutting; mixing and application of adhesives, caulking, and other glues; placement of insulation; asphalt (exterior that is near air intake louvers); poured or broadcast floor finishes; or any material that takes hours or days to cure, set, or dry.

A-3 OCCUPANT HEALTH AND WELLNESS.

A-3.1 Sit-Stand Workstations.

Consider the design of office space for either the immediate or future addition of sit-stand workstations for all occupants. Examples:

- Consider systems furniture that allows easy adjustment of work surface height
- Consider overhead cabinet locations, relative to future work surface height changes, or addition of desktop sit-stand equipment
- Work with end users to determine the type of furniture to support sit-stand environment.

A-3.2 Promoting Voluntary Physical Activity.

Include discussion and decisions in project charrettes related to how buildings address voluntary physical activity. No two projects will result in the same decisions. Always consider less mobile occupants during the decision process. The following examples are suggestions and do not comprise a complete list of possible solutions:

- Location of common use zones
- Use of under-utilized spaces as common gathering areas
- Visibility of stair locations
- Corridor locations and lengths
- Proximity and configuration of exterior walkways and bicycle commuter facilities, as promoted by UFC 2-100-01 and UFC 3-201-02.

A-3.3 Connection to Nature

Include discussion and decisions in project charrettes related to design for location for plantings. Consider strategies to extend daylighting and exterior views beyond minimum requirements, Examples:

- Low walls to allow penetration of daylighting
- Occupants’ ability to have proximity to exterior views
- Locations for planters

A-4 DOMESTIC SOLAR HEATING.

Consider implementation of solar heating for domestic hot water in the 60 to 85 percent range, when determined to be life-cycle cost-effective.

A-5 OTHER SUSTAINABLE PRODUCTS.

Purchase products that meet Federally Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing; or are on the Federal Green Procurement Compilation.

A-6 TPC.

For applicable projects, the addition of TPC is required (refer to paragraph Sustainable Third-Party Certification (TPC) and Table 1-1.)

A-6.1 Design Submittal.

It is preferred that each project that applies a TPC requires a design review by the TPC at final design submittal, rather than a combined design and construction review (applies to both design-build and design-bid-build.)

A-6.2 TPC Training.

It is highly recommended that all **\3** planning, designers and construction managers take training offered by the Department of Defense, Department of Energy, White House Committee on Environmental Quality, and other Federal and industry sources, to enhance understanding of sustainable, energy, and resilience policies, targets, and tools. Many sources for such training are cited at: Tri-Services Sustainability Program. **/3/**

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APPENDIX B PROJECTS IMPACTING A HISTORIC BUILDING OR DISTRICT

B-1 APPLICABILITY TO SUSTAINABILITY GOALS.

B-1.1 Applicability.

Many buildings listed in or eligible for listing in the National Register of Historic Places are capable of meeting the HPSB Guiding Principles and should work toward compliance. Following the National Historic Preservation Act of 1966 (NHPA) Section 106 implementing regulations, 36 CFR Part 800, will facilitate the consultation needed to meet sustainability goals in proposed construction/rehabilitation/repair projects. This process will also take into account indirect impacts that the project could have on other cultural resources that could trigger project delays.

B-1.2 Building Analysis.

Sustainably rehabilitating historic buildings conserves the invested-cost of energy and materials as well as encouraging the preservation of these resources and cultural landscapes. The design, materials, type of construction, size, shape, site orientation, surrounding landscape and climate all play a role in how buildings perform. Before implementing any energy conservation measures to enhance the sustainability of a historic building, the existing energy-efficient characteristics of the building should be assessed as historic construction methods and materials often maximized natural sources of heating, lighting, and ventilation to respond to local climate conditions.

B-1.3 Consultation.

For DoD’s historic facilities, certain generic sustainable upgrades may not be the most appropriate solution. To avoid later delays, early inclusion of the DoD Service-specific Installation Cultural Resource Manager and the State Historic Preservation Office (SHPO) ensures meeting the Secretary of Interior Professional Standards. Take into consideration the character-defining features of the buildings during the design process. Historic buildings represent a previous long-term investment of resources and energy and as such these buildings were often constructed using methods and materials that maximized natural sources of heating, lighting, and ventilation to respond to local climatic conditions. Work with the Installation Cultural Resource Manager and SHPO to identify these elements of historic buildings that are functional passive design components, or inherently sustainable in nature.

B-1.4 Daylighting.

If windows, skylights and other elements allowing for daylighting are character-defining features on the historic building, discuss options with the Installation Cultural Resource Manager.

If daylighting principles do not cause an adverse effect to the historic facilities, employ them to the fullest extent practicable.

B-1.5 Cistern Use.

The use of cisterns, either sub-grade or above-ground, was a frequently used mechanism for water storage in many historic buildings and structures and may be an appropriate addition when**\1** executing work in an existing building. **/1/**

If a historic cistern is available at the site, reuse the location and equipment, as practical.

B-1.6 Reclaimed/Salvaged Materials.

When repairing or renovating historic buildings, reclamation of salvaged materials must be used instead of procurement of, or repair to, assets to meet current requirements, when timely and economical to do so (DoDI 4715.16 Paragraph 6.1). Monetary value may not be considered a limitation if reclamation will satisfy critical item requirements, or if new procurement/production is impractical. See DoD 4160.21-M Chapter 13 (Reclamation) for more information.

B-1.7 Historical Landscapes.

Consider historic landscapes when planning water efficient landscapes. Refer to UFC 3-201-02.

APPENDIX C GLOSSARY

C-1 ACRONYMS

≥	greater than or equal to
>	greater than
≤	less than or equal to
<	less than
AFCEC	Air Force Civil Engineer Center
AFARS	Army Federal Acquisition Regulation Supplement
AFFARS	Air Force Federal Acquisition Regulation Supplement
AHJ	Authority Having Jurisdiction
APF	Appropriated Funding
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASTM	American Society of Testing and Materials
BEAP	Base Exterior Architecture Plan
BSI	Business Systems Integration Directorate (EI&E Office)
CF	Cubic Feet
CFR	Code of Federal Regulations
CONUS	Continental United States
DFARS	Defense Federal Acquisition Regulation Supplement
DOE	Department of Energy
DoD	Department of Defense
DoDI	Department of Defense Instruction
ECA	Energy Compliance Analysis
EEIM	Enterprise Energy Information Management
EISA	Energy Independence and Security Act

EMS Environmental Management System

\3\ /3/

EPA Environmental Protection Agency

EPAct Energy Policy Act

EPEAT Electronic Product Environmental Assessment Tool

ERC Estimated Replacement Cost

FAR Federal Acquisition Regulation

FEMP Federal Energy Management Program

GBCI Green Business Certification Incorporated

GBI Green Building Initiative

GPF Gallons per Flush

GSA General Services Administration

GSF Gross Square Feet

GSM Gross Square Meters

HPSB High Performance Sustainable Building

HQUSACE Headquarters, U.S. Army Corps of Engineers

HVAC Heating, Ventilation and Air Conditioning

IAQ Indoor Air Quality

ICC International Code Council

IECC International Energy Conservation Code

IESNA Illuminating Engineering Society of North America

KWh Kilowatt Hour

LCC Life-Cycle Cost

LCCA Life-Cycle Cost Analysis

LCCE Life-Cycle Cost Effective

LEED	Leadership in Energy and Environmental Design
LPF	Liters per Flush
MIL-STD	Military Standard
MOU	Memorandum of Understanding
NAF	Non-Appropriated Funding
NAVFAC	Naval Facilities Engineering **\1** Systems **/1/** Command
NIST	National Institute of Standards and Technology
NMCARS	Navy Marine Corps Acquisition Regulation Supplement
OCONUS	Outside Continental United States
ODS	Ozone Depleting Substances
O/M	Operations and Maintenance
OMB	Office of Management and Budget
PL	Public Law
RCRA	Resource Conservation and Recovery Act
RPA	Real Property Accountability
SDHW	Solar Domestic Hot Water
\1 SF	Square Foot **/1/**
SHPO	State Historic Preservation Office
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SNAP	Significant New Alternatives Policy
TPC	Third-Party Certification
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
USGBC	U.S. Green Building Council
US	United States

USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDA	United States Department of Agriculture
WBDG	Whole Building Design Guide

C-2 DEFINITION OF TERMS

Acquisition: A multidisciplinary 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, DFARS, and AFFARS, AFARS, or NMCARS) 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.

Alternative Water Sources: Non-potable water from sources such as harvested rainwater (refer to UFC 3-210-10), treated wastewater, air handler condensate capture, grey water, or reclaimed water. The use of alternative water sources must comply with applicable codes and standards.

Authority Having Jurisdiction (AHJ): The term "Authority Having Jurisdiction" (AHJ) as used in the codes and standards referenced in this UFC means the **\1** Service **/1/** office of responsibility, i.e., U.S. Army, HQ USACE/CECW-CE; U.S. Navy, NAVFACENGCOM HQ Code CHE; U.S. Marine Corps, HQMC Code LFF-1; and U.S. Air Force, AFCEC. The enforcement of the codes and standards as they pertain to facility projects can be delegated to the local **\1** Service **/1/** Office's Chief Engineer's Technical Representative at the discretion of the **\1** Service's **/1/** aforementioned office.

Building: Per UFC 1-300-08, "A roofed and floored facility enclosed by exterior walls and consisting of one or more levels that is suitable for single or multiple functions."

Charrette: 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 create 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.

\3\ /3/

Commercial and Multi-Family High-Rise Residential Buildings: All buildings, other than low-rise residential buildings.

Commissioning: **\3** Per ASHRAE 90.1-2019: Quality-focused process for enhancing the delivery of a project for verifying and documenting that the building and its systems, controls, and building envelope are planned, designed, installed, tested, and include plans for operation and maintenance to meet specified requirements. **/3/**

\1\ Component: One of the Military Departments, Defense Agencies, or DoD Field Activities, per USD (AT&L) Memorandum dated 29 May 2002.

Comprehensive Replacement: Comprehensive replacement to a building includes significant opportunities for improvement in: energy and water efficiency (such as HVAC, lighting, building envelope and other building components); indoor air quality; other requirements in this UFC; and additions that are part of the comprehensive replacement. **/1/**

DD Form 1391: A programming document used by the Department of Defense to submit requirements and justifications in support of funding requests for military construction to Congress.

Employee Work Areas: Per International Building Code 2015: “All or any portion of a space use by employees and only for work. Corridors, toilet rooms, kitchenettes and break rooms are not employee work areas.”

Energy Compliance Analysis (ECA): The ECA must identify specific energy conservation criteria that applies to the project, the software used to prepare the necessary calculations, a summary of all input to and output from the calculations, and the calculated energy consumption of the proposed design.

Energy Modeling: The process by which conceptual designs, including size; material choices; factors such as site and solar 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.

\3\ Energy Optimization: The process of evaluating strategies to comply with Federal, DoD, and service component energy requirements. The process is an element of integrated design and includes strategy identification, energy modeling, LCCA, and strategy selection based on results. **/3/**

Energy Resilience: Per DoDI 4170.11, “The ability to prepare for and recover from energy disruptions that impact mission assurance on military installations.”

Environmental Management System (EMS): A framework that helps to achieve environmental goals through consistent control of operations. The assumption is that this increased control will improve environmental performance.

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.

Estimated Replacement Cost (ERC): ERC is the cost listed in the project's DD1391 "Economic Analysis." ERC is the cost of replacing the current physical plant with modern facilities built at today's construction costs using today's construction standards.

Facility: Per UFC 1-300-08, a building, structure, or linear structure out to an imaginary line surrounding a facility at a distance of five feet from the foundation that, barring specific direction to the contrary such as a utility privatization agreement, denotes what is included in the basic record for the facility (examples: landscaping, sidewalks, utility connections). This imaginary line is commonly referred to as the "five-foot line."

Historic Properties: Properties that are included in the National Register of Historic Places or that meet the criteria for the National Register.

\3\ Life Expectancy: The terms life expectancy and study period are used interchangeably for LCCA in 10 CFR 436, EISA 2007, and NIST Handbook 135. Per 10 CFR 436 "study period is the expected life of the retrofit or new building." **/3/**

Life-Cycle Costing (LCC): 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 cost alternatives for a 40-year period. As applied to building design energy conservations measures, the process is mandated by law and is defined in 10 CFR Part 436, Subpart A: *Methodology and Procedures for Life-Cycle Cost Analysis*. The National Institute of Standards and Technology 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.

Life-Cycle Cost Analysis (LCCA): Assessment of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span. LCCA considers all costs (capital, operating, and decommissioning expenses for the duration of a project) for various alternative approaches, including inflation and discount rates.

Life-Cycle Cost Effectiveness (LCCE): **\3** LCCE is a state of having a LCC that is equal to or lower than a baseline OR having a lower LCC than all alternatives, depending on the applicable criteria. This includes **/3/** a documented statement of costs to be incurred to complete all stages of a project from planning through acquisition, maintenance, operation, remediation, disposition, long-term stewardship, and disposal. The results of a LCCA.

Low-Rise Residential Buildings: All buildings three stories or less in height above grade that include sleeping accommodations where the occupants are primarily permanent in nature (30 days or more).

Planning: Initiated 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 fiscal year or alternatively, be dropped altogether.

Process load: The load on a building resulting from energy consumed in support of a manufacturing, industrial, or commercial process. Process loads do not include energy consumed maintaining comfort and amenities for the occupants of the building (including space conditioning for human comfort).

Programming: 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 Installation-level 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, cost, and mission of a project. With historical data on facilities for various missions, experienced programmers will formulate the conceptual design for the DD Form 1391 based upon the required size of a facility to accommodate mission functions. Once the scope for a project has been enacted by Congress, changing the scope of a project will delay a project until the revision has been justified and approved. This is true whether or not the costs have also changed. Reductions of project scope (by no more than 25%) will require Congressional notification, review, and authorization before proceeding. Increasing the project scope is not authorized without reprogramming. See USC Title 10 Section 2853 for more information.

Real Property Asset: An individual building, structure, linear structure or land parcel, owned by the Department of Defense.

Receptacle Load: The load on a building resulting from energy consumed by all equipment plugged into electrical outlets.

Recommissioning: Per DOE Guidance 42 USC 8253(f), “The process of commissioning a previously commissioned facility or system after expiration of the

project development and warranty phase. The primary goal of recommissioning is to optimize facility performance, in accordance with design or operating needs, over the useful life of the facility."

Resilience: The ability to prepare for and recover from disruptions that impact mission assurance on military installations.

Resource-efficient solutions: Solutions that minimize energy, water, natural, and human resources required.

Retrocommissioning: Per DOE Guidance 42 USC 8253(f), "The retroactive commissioning of equipment or a system that was not commissioned at the time of installation or during the warranty phase. Typically, retrocommissioning is performed long after the facility is constructed and placed into service."

\1\ Service: When used to describe a DoD entity, one of the three Military Departments under the DoD, per USD (AT&L) Memorandum dated 29 May 2002. **/1/**

Stand-Alone Additions: Stand-alone additions are scoped to function like stand-alone new buildings. Although the addition is attached to an existing building, all of its new systems operate separately from the existing building.

Structure: Per UFC 1-300-08, a facility, other than a building or linear structure (road, fence, etc.), that is constructed on or in the land.

Sustainable Site: Based on the selection process, a site is considered sustainable when it uses less energy, water, and natural resources, generates less waste, and minimizes the impact on land compared to conventional design, construction, and maintenance techniques.

\1\ Sustainment, Restoration, and Modernization (SRM): Per the Office of the Assistant Secretary of Defense for Sustainment, Construction:

- Sustainment activities include scheduled and unscheduled inspection, maintenance and repair to ensure facilities remain in good working order throughout their service lives.
- Restoration activities include repair and replacement efforts to renovate facilities damaged by inadequate sustainment, excessive age, natural disaster, fire, accident, or other causes.
- Modernization activities include implementation of new or higher standards; accommodating new functions; or replacing building components that typically last more than 50 years. **/1/**

Third-Party Certification (TPC): TPC is the generic term for a third-party product that provides either certification of the third-party vendor's proprietary product requirements (examples: LEED, Green Globes), or a validation program by the third-party vendor that

this UFC's requirements have been met (examples: Guiding Principles Assessment, Guiding Principles Compliance.)

Total Ownership Cost (TOC): Total of all direct and indirect costs associated with an asset or acquisition over its entire life cycle.

Tracking: Method by which each Service internally validates HPSB Guiding Principles compliance, with the use of HPSB Checklist.

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APPENDIX D REFERENCES

(Note: If a web link does not work the first time, close Internet and try again. Also try a different internet platform. This is a persistent issue with Government devices.)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

https://www.ashrae.org/

NOTE: Include all references Errata, except Errata for Addenda. Include Interpretations, except Interpretations for Addenda. Do not include Addenda. **\3** Exception: include ASHRAE 90.1-2019 Addendum ch for energy consumption reduction value as cited in paragraph titled "Commercial and Multi-Family High-Rise Residential Buildings." **/3/**

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\2 ANSI/ASHRAE/IESNA Standard 90.1-2019 (ASHRAE 90.1), Energy Standards for Buildings Except Low Rise Residential Buildings, 2019 **/2/**

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INTERNATIONAL CODE COUNCIL

https://codes.iccsafe.org/search/

International Energy Conservation Code (IECC), 2015

International Green Construction Code (IgCC), 2018

\2 International Energy Conservation Code (IECC), 2021 **/2/**

MILITARY STANDARDS

MIL-STD-3007G Standard Practice Unified Facilities Criteria, Facilities Criteria And Unified Facilities Guide Specifications, 2019
https://www.wbdg.org/FFC/FEDMIL/milstd3007g.pdf

NATIONAL INSTITUTE OF BUILDING SCIENCES (NIBS)

Whole Building Design Guide website
https://www.wbdg.org/

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

https://www.wbdg.org/nist/criteria

NIST Handbook 135, Life-Cycle Costing Manual for the Federal Energy Management Program

The Annual Supplement to NIST Handbook 135 and SP 709, Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis

SHEET METAL AND AIR CONDITIONING CONTRACTOR'S NATIONAL ASSOCIATION (SMACNA)

https://www.smacna.org/

SMACNA *Indoor Air Quality (IAQ) Guidelines for Occupied Buildings Under Construction*, 2nd Edition, 2008

UNITED STATES CODE

https://www.govinfo.gov/app/collection/uscode

USC Title 10 Section 2853, *ADMINISTRATION OF MILITARY CONSTRUCTION AND MILITARY FAMILY HOUSING – Authorized Cost and Scope of Work Variations*

USC Title 16 Section 106, *National Historic Preservation Act*

\3 42 U.S.C. § 6962, Federal Procurement **/3/**

UNITED STATES CODE OF FEDERAL REGULATIONS

https://www.govinfo.gov/collection/cfr-index

10 CFR Part 433, *Energy Efficiency Standards for New Federal Commercial and Multi-Family High-Rise Residential Buildings*

10 CFR Part 436, Subpart A: *Methodology and Procedures for Life-Cycle Cost Analysis*

36 CFR Part 800, *Protection of Historic Properties*

UNITED STATES DEPARTMENT OF AGRICULTURE

BioPreferred Program
http://www.biopreferred.gov/

UNITED STATES DEPARTMENT OF DEFENSE

http://www.esd.whs.mil/dd/

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DoD 4160.21-M, *Defense Materiel Disposition Manual*, 28 May 2004

DoDI 4165.14, *Real Property Inventory (RPI) and Forecasting*, 17 January 2014

DoDI 4170.11, *Installation Energy Management*, 31 August 2018

DoDI 4715.16, *Cultural Resources Management*, 18 September 2008

DoD Memo, *Water Use for Landscape Architecture on Department of Defense Installations/Sites*, 10 March 2017

DoD *Utilities Meter Policy*, **\1** 14 January 2021 https://www.acq.osd.mil/eie/Downloads/IE/DoD%20Utilities%20Meter%20Policy%2014%20Jan%202021.pdf **/1/**

Department of Defense *Sustainable Buildings Policy*, 10 November 2013 https://www.denix.osd.mil/sustainability/dodpolicy/unassigned/dod-sustainable-buildings-policy-current-as-of-nov-2013/DoD-Sustainable_Buildings_Policy_-10-Nov-2013.pdf

Memorandum, Department of Defense Supplemental Guidance for Implementing and Operating a Joint Base, April 15, 2008

\1 Office of the Assistant Secretary of Defense for Sustainment, Construction https://www.acq.osd.mil/eie/FIM/FIM_Program_Areas.html **/1/**

UNITED STATES DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA PROGRAM

https://www.wbdg.org/dod/ufc

UFC 1-200-01, *DoD Building Code*

\3\ /3/

UFC 1-300-08, *Criteria for Transfer and Acceptance of DoD Real Property*

UFC 2-100-01, *Installation Master Planning*

UFC 3-101-01, *Architecture*

UFC 3-201-01, *Civil Engineering*

UFC 3-201-02, *Landscape Architecture*

UFC 3-210-10, *Low Impact Development*

UFC 3-410-01, *Heating, Ventilation, and Air Conditioning Systems*

UFC 3-440-01, *Renewable Energy Systems – Facility*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 3-540-08, *Utility-Scale Renewable Energy Systems*

\3\ /3/

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UFC 4-510-01, *Design: Military Medical Facilities*

UNITED STATES DEPARTMENT OF ENERGY

Federal Energy Management Program (FEMP)
https://energy.gov/eere/femp/federal-energy-management-program

\3\ UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Comprehensive Procurement Guideline (CPG) Program
https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program

Energy Independence and Security Act (EISA), 19 December 2007
https://www.epa.gov/laws-regulations/summary-energy-independence-and-security-act

Energy Policy Act of 2005 (EPAct 2005)
https://www.epa.gov/laws-regulations/summary-energy-policy-act

ENERGY STAR®, http://www.energystar.gov/Resource Conservation and Recovery Act (RCRA), 21 October 1976
https://www.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act

WaterSense Program
https://www.epa.gov/watersense **/3/**

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WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY

Guiding Principles for Sustainable Federal Buildings and Associated Instructions (February 2016)
https://www.sustainability.gov/pdfs/guiding_principles_for_sustainable_federal_buildings-2016.pdf **/3/**

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