

CHAPTER 10

Sustainable Design & Energy Conservation

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10.1 GENERAL

This chapter provides design criteria and guidance for sustainable design and energy conservation. Discipline specific chapters of the LDMDG may also contain additional requirements related to sustainable design and energy conservation or provide additional clarification. Bring any conflicts to the attention of the USACE PE/A for determination of the appropriate requirement for the project. Additional requirements may also be in the AE contract.

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10.2 CRITERIA

The sustainable design and energy conservation requirements vary with each using/funding agency, type of project, and funding/fiscal year. UFC 1-200-02 High Performance and Sustainable Building Requirements applies to all Department of Defense agencies and includes requirements for new construction and major and minor renovations. Each agency may have additional requirements. Confirm sustainable design and energy conservation requirements with the USACE PE/A for each project. Relevant Engineering & Construction Bulletins (ECB), Engineering Regulations and Technical Letters and other criteria may apply to specific project types. Review current ECB, ER, and ETL for applicable criteria on Whole Building Design Guide (www.wbdg.org).

Relevant Army Policy may be found at <http://www.wbdg.org/ffc/army-coe/policies-and-guidance-army-design-and-construction>.

Relevant Air Force Policy may be found at <http://www.wbdg.org/ffc/af-afcec/sustainable-design-development-sdd>.

ECBs may be found at <http://www.wbdg.org/ffc/dod/engineering-and-construction-bulletins-ecb>.

Compliance with ASHRAE 90.1 shall be through mandatory and prescriptive compliance paths. The Chapter 11 Energy Cost Budget Method is not permitted as a compliance path.

Refer to the other technical discipline chapters of this Guide for additional sustainability requirements.

10.3 ENERGY/WATER OPTIMIZATION

10.3.1 ANALYSES/REQUIREMENTS

The goal for most projects is to achieve the highest energy or water efficiency that is life-cycle cost effective within project funds. Projects with energy and water optimization requirements shall comply with the below requirements which apply to the presolicitation stages of both design-bid-build and design-build projects. Refer to UFC 1-200-02 and agency policy for project parameters that require energy/water optimization. Additional requirements may also be in the AE contract. Refer also to Engineering Regulation 1110-1-8173 Energy Modeling and Life Cycle Cost Analysis for additional requirements.

The building envelope, interior and exterior lighting, HVAC, plumbing, and renewable energy systems for the project shall be based on the results of life-cycle cost analyses prepared in accordance with applicable criteria. The systems and features for the building shall be selected during the concept phase of design for design-bid-build projects and during pre-solicitation/RFP development for design-build projects.

Systems to be analyzed and reductions in number of alternatives analyzed shall be approved by the USACE PE/A prior to analysis. The minimum number of systems/features to analyze shall be as follows:

1. Baseline and three alternatives for each of the wall systems, roof systems, lighting systems, and domestic hot water systems.

2. Baseline and two alternatives for windows.
3. Baseline and four alternatives for HVAC systems.

Where separate systems would be used for different areas of the building or different buildings in the project, each area or building shall be evaluated separately. Example: Area A and Area B will have separate HVAC systems; each area will have four alternatives analyzed. Analyze geo-exchange or ground source heat pump systems when such are technically feasible and affordable within project funding constraints. In any case where geo-exchange or ground source heat pump systems will be analyzed, both full and hybrid systems shall be analyzed. The number of alternatives to analyze may be reduced at the sole discretion of USACE. The systems/features to be analyzed must be sufficiently varied to ensure that a wide-range of installed costs, maintenance costs, energy savings, etc. are considered; however, the systems/features selected for analysis must also be available within the project funding. For HVAC systems, the analysis must consider air system alternatives in addition to hydronic system alternatives. Four alternatives involving only chilled and heating water variations is insufficient.

Propose systems/features for analysis based on project stakeholder input (maintenance capability, available utilities, functional requirements, aesthetics, anti-terrorism/force-protection, etc.), preferences, design guides, etc. The AE shall provide brief narratives describing the reasoning used to determine the systems/features proposed for analysis. Systems that are not desired by the stakeholders must only be analyzed if there are insufficient alternatives to meet the minimum requirement for analysis.

The AE shall evaluate the following HVAC system features where such features are not required by criteria and where such features are technically feasible: air and water energy recovery and air and water economizers. The following renewable energy and water reclaim/harvesting systems shall be analyzed where such technologies are technically feasible: solar photovoltaic, wind power, solar hot water heating, condensate reclaim, grey water reclaim, and rainwater harvesting.

As an alternative to performing some of these energy and life-cycle cost analyses, data from previous energy and life-cycle cost analyses may be used for similar building types, sizes, occupancy/usage patterns, internal heat gains, utility rates, and climate at the sole discretion of USACE. Coordinate with USACE PE/A for approval.

The information resulting from the analyses including installed costs, utility costs, operation and maintenance costs, and salvage value along with any other advantages and disadvantages to the systems/features analyzed shall be presented to the project stakeholders for discussion and final selection for incorporation into design. The AE shall retain documentation of approval of the systems/features selected.

Energy simulations shall be performed using Trane Trace, Carrier HAP, or EQuest. Other energy simulation software must be approved in advance by the Contracting Officer. Energy simulations shall be performed using a computer program or programs that integrate architectural features with air-conditioning, heating, lighting, and other energy producing or consuming systems. These programs shall be capable of simulating the features, systems, and thermal loads used in the design. The energy savings and parasitic energy loads associated with the utilization of renewable or waste heat applications shall be included. The program will perform 8,760 hourly calculations. Software must comply with software requirements described in ASHRAE 90.1, Appendix G.

Life-cycle cost analyses shall follow methodology in Subpart A of Title 10 of the Code of Federal Regulations Part 436. Life-cycle cost analyses shall be performed using the Building Life-Cycle Cost (BLCC) program, which incorporates required factors and complies with 10 CFR Part 436 and is provided for free at:

http://www1.eere.energy.gov/femp/information/download_blcc.html

10.3.2 CHARRETTE DOCUMENT/CONCEPT DESIGN SUBMITTAL

The energy models, water calculations, cost analyses, and life-cycle cost analyses shall be provided in the charrette document or concept design submittal. The documentation shall include a matrix showing each system or feature evaluated, the associated energy consumption, utility costs, installation costs, maintenance costs, and salvage value. Narratives describing the reasoning used to establish the analyzed alternatives and how the final selections for the

project were made shall be included. The input/output reports from the energy models and life-cycle cost analyses shall be provided. The cost analyses, including maintenance costs, shall include a description of the source of data used.

Energy model input and output shall be organized such that each space, zone, system, item of equipment, building component, etc. is correlated with identifiers on design plans and easily identifiable. Examples: Conference Room #244 is identified at conference room #244 on input/output documents; AHU-2-4 is identified as AHU-2-4 on input/output documents; Zone 3-4 on the input/output files is associated with VAV 3-4.

10.3.3 DESIGN-BUILD REQUEST FOR PROPOSAL

Design-build requests for proposal shall not require life-cycle cost analyses from the design-build contractor, and the request for proposal shall not provide means for the design-build contractor to use life-cycle cost as justification to lower performance during construction. Example: Do not reference Energy Policy Act of 2005; negate the language in UFC 1-200-02 regarding life cycle cost; etc. The design-build contractor must still be required to develop an energy compliance analysis as described in the Energy Compliance Analysis paragraph below. For design-build projects, the systems and features determined to be incorporated shall be prescriptively required in the request for proposal. Care must be taken to ensure that the prescriptive requirements do not conflict with any other requirements of the request for proposal. The request for proposal must require bidders to propose the prescribed systems; however, bidders may be allowed to submit betterments as alternatives provided that life-cycle cost analyses are submitted with the proposal. Documentation required for submission during Request for Proposal development shall be the same as required for the charrette document or concept design submittal as required in paragraph CHARRETTE DOCUMENT/CONCEPT DESIGN SUBMITTAL.

10.4 ENERGY COMPLIANCE ANALYSIS

Comply with UFC 1-200-02 High Performance and Sustainable Building Requirements energy modeling requirements. Provide an Energy Compliance Analysis complying with UFC 1-200-02 with the final design submittal. Refer also to Engineering Regulation 1110-1-8173 Energy Modeling and Life Cycle Cost Analysis for additional requirements. In addition to the requirements of UFC 1-200-02, include the following in the narratives:

1. A listing of all energy conservation criteria that applies to the project.
2. Identification of the software used to prepare the calculations including the vendor and version.
3. Summary table showing the baseline and proposed building annual energy consumption, energy costs, and calculated maintenance costs. The table shall show the energy consumption reduction percentage calculated and the energy cost reduction percentage calculated in accordance with LEED requirements.
4. Description of each energy conservation feature and strategy designed for the project. Include rationale for selected systems to model. Provide a description of how the design limited any maintenance cost increases caused by the energy conservation features and strategies.
5. Provide a chart demonstrating the annual energy consumption and energy cost attributed to each end energy use including, but not limited to, lighting, space cooling, space heating, ventilation, receptacle/process loads, and hot water heating.
6. Provide a report showing the monthly electricity and natural gas consumption for 12 consecutive months.

Input and output reports in excess of 100 pages may be provided electronically via CD or DVD. In addition to required reports, provide native files for computer generated calculations and simulations. Required reports include:

1. Energy Simulation outputs and inputs for all spaces, systems, plants, schedules. Include reports showing how ventilation was handled in the simulation.
2. LEED Summary Output Report.

Load analysis and energy model input and output shall be organized such that each space, zone, system, item of equipment, building component, etc. is correlated with identifiers on design plans and easily identifiable. Examples: Conference Room #244 is identified as Conf Rm #244 on input/output documents; AHU-2-4 is identified as AHU-2-4 on input/output documents; Zone 3-4 on the input/output files is associated w/ VAV 3-4.

All calculations provided in worksheet format shall be clear with respect to method of calculation or include description of how the calculations were performed.

10.5 THIRD PARTY CERTIFICATION (TPC)

Requirements for third party certification of compliance with sustainability criteria vary with each agency and project type, funding, and size. Confirm TPC requirements with the USACE PE/A for each project. See UFC 1-200-02 paragraph COMPLIANCE WITH FEDERAL REQUIREMENTS and agency policy for project applicability.

10.5.1 ARMY - LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

Army projects that include a TPC requirement and meet LEED Minimum Program Requirements (established by USGBC) must achieve LEED version 4 Silver Certification. Current projects shall be registered in LEED version 4.

Projects that are incapable of achieving a required LEED certification level must pursue a waiver. Coordinate with the USACE PE/A to determine waiver requirements. Waiver authority is with the Assistant Secretary of the Army for Installations, Energy & Environment and must be coordinated through HQ USACE.

Projects must generally be registered by the AE for design-bid-build projects and by the design-build contractor for design-build projects. Registration requirements are as follows. Alert the USACE PE/A of any problems encountered in the registration process:

1. **Project Name:** Contact the Contracting Officer for the correct Project Name. For information only, the Project Name will begin with the using agency (Army, AF, DLA, etc.), followed by the project number (PNXXXXXX), project name, and building.
2. **Project Address:** Contact the Contracting Officer for the correct Project Address. For information only, the first line includes the facility number, street address, block number, etc. The second line includes the base identification code, category code, and real property unique identification code (RPUID). Project Real Property Unique Identification Code (RPUID) may not be available until near the end of construction. Coordinate with the Contracting Officer to obtain the RPUID as soon as possible.
3. **Project City:** Include the name of the installation. Example: Fort Campbell or Scott Air Force Base. If the project is not on an installation, include the nearest town or city.
4. **Project Confidential:** Contact the Contracting Officer for the correct designation. Generally, the project is not confidential unless the project has security sensitivity.
5. **Notification of Local Chapter:** Indicate NO.
6. **Project Owner:** Contact the Contracting Officer for the correct Project Owner. Generally, the project owner will be the USACE Project Manager through project construction. Immediately prior to occupancy and prior to acceptance of the LEED certification from GBCI, the owner must change to the Department of Public Works or Base Civil Engineer. Contact the Contracting Officer prior to final submission to GBCI for the correct Project Owner information.
7. **Owner Organization:** U.S. Army Corps of Engineers, Louisville District
8. **May we publish Owner information:** Indicate NO.
9. **Owner Type:** Federal Government

The construction contract must require that the second line of the Project Address in the Project Information section in LEED Online be updated with the base identification code, category code, and real property unique identification code (RPUID) prior to final submission of the project to GBCI for certification. The information will be obtained from the Contracting Officer's Representative.

Federal energy performance requirements use a baseline and energy modeling methodology from ASHRAE 90.1-2013. LEED version 4 energy baseline and modeling methodology is based on ASHRAE 90.1-2010; however, a LEED Interpretation allows the use of ASHRAE 90.1-2013 along with an adjustment to percentage energy savings for Minimum Energy Performance and Optimize Energy Performance credits.

10.5.2 AIR FORCE – GUIDING PRINCIPLE CERTIFICATION/ASSESSMENT

Air Force projects that include a TPC requirement must certify the project through USGBC/GBCI Guiding Principles Assessment or GBI Guiding Principles Compliance programs. The project team determines which system will be used for the project.

10.6 COMPLIANCE REPORTING

Reporting requirements vary with each agency. See UFC 1-200-02 paragraph COMPLIANCE WITH FEDERAL REQUIREMENTS for project applicability. The Energy & Sustainability Report Card is required to be completed for Army projects at final design. The card is available on the Whole Building Design Guide at <http://www.wbdg.org/ffc/army-coe/policies-and-guidance-army-design-and-construction>. Coordinate with the USACE PE/A regarding due dates and any issues. The Air Force MILCON Sustainability Requirements Scoresheet, GP version, shall be completed for Air Force projects at the at final design. The scoresheet is available on the Whole Building Design Guide at <http://www.wbdg.org/ffc/af-afccc/sustainable-design-development-sdd/sustainability-tracking-reporting>.

Construction and design-build contractors shall be required by contract to complete the appropriate reporting document at the post-award milestones indicated in ECB 2013-25. See Attachment 1 of this document for instructions regarding the Energy & Sustainability Record Card. Refer questions to the USACE PE/A.

ATTACHMENT 1: ENERGY & SUSTAINABLE RECORD CARD INSTRUCTIONS

Record Card File Naming Convention:
 LRL_MCA_PN76365_GSTB_#_YYYYMMDD.xls

is associated with a step in a reporting process:

- Design Completion, # = 4 (Submit Record Card with Final Design Submission)
- Initial Beneficial Occupancy Date, # = 5 (Submit Record Card with Interim DD 1354)
- Final Turnover, # = 6 (Submit Record Card with Final DD 1354)

YYYYMMDD is the date with Year first, followed by month, and finally day. Date will be the date of completion of the Record Card for each submittal.

Many fields in the E&S Record Card are straight-forward with respect to the data to insert; however, a number of field and requirements are confusing. The below instructions are intended to address the specific fields to limit confusion. In the event the Contractor needs guidance regarding specific fields, contact the Contracting Officer for guidance.

Worksheet Guidance: Building Data Worksheet

1. BUILDING DATA
 - a. D2 = RPUID = DD1354, Block 10
 - b. D3 = Project Number = DD1391 PN, DD1354, Block 3
 - c. D4 = Installation Code = DD1354, Block 6
 - d. F2 = Certification = LEED rating system used on project
 - i. NC/MR 2009 – New Construction/Major Renovation Version 2009
 - e. F4 = Registration Number = N/A
2. ANNUAL ENERGY DEMAND
 - a. C14 = Base on contract option awarded.
3. ANNUAL ENERGY CONSUMPTION BY SOURCE
 - a. C17 = Enter applicable ASHRAE code to which design complies
 - i. Assume C17 = 90.1-2010 for all new starts
 - b. Baseline and design energy use information shall be calculated using computerized simulation software which meets ASHRE 90.1 Appendix G requirements
 - i. Find baseline and design case data in LEED EAcl documentation
 - ii. Design energy use shall be updated with each record card submission if significant items have changed that would impact energy modeling results
 - iii. Metered/Actual blocks (Column E) will remain blank throughout life of facility
 - c. Fossil-fuel derived electric grid
 - d. Pending further guidance from NWD and HQUSACE, enter all electricity used at the facility as Fossil-Fuel Derived Electric Grid, Cell C19
 - e. C28 = Enter the appropriate percentage based on the FY of the project using the table below

FY	EISA Fossil Fuel Reduction Requirement
FY10 – FY14	55%
FY15 – FY19	65%
FY20 – FY24	80%
FY25 – FY29	90%
FY30 and beyond	100%

4. ANNUAL ENERGY HARVEST
 - a. Unless renewable energy is produced as a result of the facility, all cells C45 – C60 shall be 0
 - b. If solar water heating or other non-electric renewable energy is installed on the facility it shall be entered in cells C64 – C69
5. WATER
 - a. C78 = Enter applicable code to which design complies
 - i. Assume C78 = IPC 2006
 - b. Baseline water use information shall be calculated per code guidelines
 - i. Find baseline and design case data in LEED Wec3 documentation
 - c. C91 = 20% unless facility is targeting high water savings
 - i. Justification: LEED2009 prerequisite requires minimum 20% domestic potable water reduction
6. RECYCLED MATERIALS
 - a. Waste calculations shall only apply to waste associated with new construction; do not include metrics associated with any demolition included in the project
 - i. If a project includes demolition the team may choose to include waste diversion metrics associated with demolition if it is included consistently throughout all calculations
 - b. Waste recycled/diverted
 - i. Target – assume buildings create 4.34 lbs per square foot of construction and on average 75% is recycled/diverted
 - ii. Target = square footage * 4.34 lbs * (1 ton/2,000 lbs) * .75 = Tons recycled/diverted
 1. *Justification: Calculations are based on EPA 2009 study*
 - c. Waste disposed to landfill
 - i. Target – assume buildings create 4.34 lbs per square foot of construction and on average 25% goes to the landfill
 - ii. Target = square footage * 4.34 lbs * (1 ton/2,000 lbs) * .25 = Tons disposed to landfill
 1. *Justification: Calculations are based on EPA 2009 study*
 - d. Waste Diverted and Waste to Landfill Current
 - i. Fill out cells D96 – D98 with Initial BOD submittal
 - e. Waste Diverted and Waste to Landfill Actual
 - i. Fill out cells E96 – E98 with Final Turnover submittal
 - ii. Cells D96 – D98 and E96 – E98 shall match on Final Turnover submittal
 - f. Scroll down to the bottom of the page and enter Project Manager’s name and contact information in green box

Mandates Worksheet

7. Provide 0 – 100 answer for each green box
 - a. 0 = Not compliant
 - b. 100 = Fully compliant
8. D9 – Assume 100% compliance
 - a. *Justification: New Corps executed projects have minimal impact on total agency energy intensity footprint given the significant stock of existing buildings in the agency*
9. B13 – Enter 100% unless non-compliant with contracted award option
10. D13 – Enter 100% if compliant with EISA Fossil Fuel Reduction Requirement in table below
 - a. Enter pro-rated % if Reduction Requirement as not been met
 - b. Example: Facility in FY16 project achieves 32.5% EISA fossil fuel reduction; this facility would report 50% in this block

FY	EISA Fossil Fuel Reduction Requirement
FY10 – FY14	55%
FY15 – FY19	65%
FY20 – FY24	80%
FY25 – FY29	90%

FY30 and beyond	100%
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11. B16 – NA for our projects; enter 100
 - a. *Justification: Deadline for implementation has sunset (2010) and each agency has responsibility for counting renewable energy produced on Federal lands used at Federal facilities*
12. B21 – NA for our projects, enter 100
 - a. *Justification: Renewable energy purchase requirement is a Federal Government target and is centrally managed by agencies*
13. D21 – Enter 100%
14. D23 – Enter 100%
15. B27 – Enter 100%
16. D27 – Enter 100%
17. B30 – Enter 100%, smart meters required by contract
18. D30 – NA for our projects, enter 100%
19. B36 – Enter 100%, required by contract
20. D36 – Enter 100%, required by contract

HPSB Guiding Principles Worksheet

21. A13 – Default is yes
 - a. *Justification: Corps standard operating principles require collaborative and integrated project delivery teams*
22. A14 – Default is yes
 - a. *Justification: Corps standard operating principles incorporate commissioning into contracts*
23. D18 – Enter energy savings for facility. Change baseline listed to ASHRAE 90.1-2010.
24. A29 – Default is yes
 - a. *Justification: USACE contract language has been updated to include ENERGY STAR and FEMP requirements*
 - b. Change to “no” if ENERGY STAR and FEMP requirements have not been incorporated
25. A62 – Default is no unless specifications are updated to require Water Sense qualified irrigation contractors
 - a. Assume yes if no irrigation is installed for the facility
 - b. Assume yes if the requirement is not applicable to the facility
26. A67 – Default is yes
 - a. *Justification: Corps air barrier requirements and standard architectural designs combined with construction quality control efforts meet the identified moisture control requirements*
 - b. Change to “no” if Corps air barrier requirements were not implemented

----END OF SECTION----