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of Engineers®

ENGINEERING AND CONSTRUCTION BULLETIN

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SUBJECT: Execution and Documentation Requirements for Life Cycle Cost Analyses

CATEGORY: Directive and Policy

1. References:

- a. SemoNOTE #22, USACE, 19 June 2019, subject: Life Cycle Cost Analysis
- b. Memorandum, ASA (IE&E), 17 Jan 2017, subject: Sustainable Design and Development Policy Update. <https://www.wbdg.org/ffc/army-coe/policies-and-guidance-army-design-and-construction/army-sdd-policy-update>
- c. Unified Facilities Criteria 1-200-02, High Performing and Sustainable Buildings. <https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02>
- d. Engineer Regulation 1110-1-8173, Energy Modeling and Life Cycle Cost Analysis. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-1-8173.pdf
- e. Code of Federal Regulations, Title 10 Part 433 Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings. <https://www.wbdg.org/ffc/fed/code-federal-regulations/10-cfr-part-433>
- f. NIST Handbook 135, Life-Cycle Costing Manual for the Federal Energy Management Program. <https://www.wbdg.org/ffc/nist/criteria/nist-handbook-135>

2. Background. The Chief of Engineers SemoNOTE #22 (Reference a) directs Project Delivery Teams to demonstrate their facilities are cost-effective and efficient by conducting proper Life Cycle Cost Analyses (LCCA) on at least three alternative *whole-building* design solutions. Headquarters Army audits of USACE projects to determine compliance with the Army's Sustainable Design and Development (SDD) Policy (reference b) have repeatedly found a lack of proper design methods being reflected in the project documentation. To date, some improvements have been made in some Districts, but senior level attention across the Corps is required to ensure all teams are exercising, and documenting, due-diligence in design.

3. Applicability. This ECB applies to all US Army funded Military Construction, Restoration and Modernization projects for which energy optimization and LCCA is required in accordance with the policy, regulations, and criteria referenced herein. This ECB also applies to Energy Resilience and Conservation Investment Program (ERCIP) projects to the extent practicable based on project scope. This directive and guidance is effective immediately. Army Projects in design without a LCCA must be updated to reflect the results of a LCCA as described above. Under no circumstances will an Army project be authorized for release without an LCCA as prescribed herein, or advanced coordination with HQUSACE for a waiver completed.

4. **Guidance.** The Army plans, designs, builds, and operates facilities to achieve the highest performing sustainable design to meet and sustain the mission. This directive and guidance stresses adherence to the policy and engineer regulations referenced herein. This ECB is also intended to reinforce the systematic steps necessary to achieve compliance with energy conservation requirements, including the associated documentation, by setting forth the following common approach:

a. Execute Military Design and Construction as required by the Army SDD Policy (reference b), UFC 1-200-02 (reference c), and ER 1110-1-8173 (reference d) to achieve building designs with the highest energy efficiency that is life cycle cost effective and within approved Program Amounts (PA).

b. Execute Life Cycle Cost Analysis (LCCA) by following the NIST Handbook 135 (reference f) and utilizing the Building Life Cycle Costing (BLCC) software program as outlined in UFC 1-200-02.

c. Steps to an energy efficient, life cycle cost effective design:

(1) Comply with the requirements of UFC 1-200-02 regarding integrated design, prioritizing passive energy conservation strategies, including building massing, orientation, daylighting and passive solar potential as a part of the design charrette effort. Include related discussion points and outcomes in the charrette report or meeting minutes and include in the project design analysis.

(2) The design must comply with the energy efficiency standards of ASHRAE 90.1 at a minimum. If compliance with ASHRAE Standard 90.1 cannot be achieved then a waiver of the SDD Policy (ref. b) and UFC 1-200-02 (ref. c) is required.

(3) Perform the energy optimization and LCCA in accordance with Attachment A.

(4) For Military Construction, Army (MCA) projects, as early as possible, perform the energy optimization and LCCA. Energy optimization and LCCA must be performed during the Code 2 validation and 35% design process. The goal of the Code 2 is to validate the scope and cost in the DD1391, prior to project budget (PA) lock. During this phase, identify energy enhancements that are life-cycle cost effective and supported by the LCCA to meet energy efficiency requirements. Where such enhancements increase costs, additional funds should be requested for the project prior to budget lock. After budget lock, the project must remain within the programmed amount and primary scope indicated on the DD 1391.

(5) The references describe the requirements for new buildings or renovations to achieve energy consumption reduction from an ASHRAE 90.1, Appendix G baseline if life-cycle cost effective. Design teams should strive toward the highest efficiency that is life-cycle cost effective and within PA, in accordance with Army policy (Ref. b). The design teams must perform energy modeling to identify the highest efficiency building systems/feature alternatives from those that are feasible. LCCA must be performed to determine which alternatives are life-cycle cost effective. At least three alternatives to the baseline must be considered (to the extent that feasible alternatives are available). When appropriate, design teams should consider

additional alternatives. Exercise good engineering judgment and use past experience in identifying the best alternatives for analysis. Document all alternatives considered.

(6) The alternatives that have the highest energy efficiency out of the set of alternatives that are life-cycle cost effective (and available within PA) will be selected as the proposed design for the project. Refer to Attachment B for example selection process. When the design chosen does not meet this criteria, provide a justification in the documentation. Such a justification may relate to mission requirements, sensitivity/uncertainty in the analysis, resiliency requirements, or operation and maintenance considerations not quantitatively included in the LCCA.

(a) Increases in energy efficiency must be balanced by operating and maintenance (O&M) costs and initial costs, including any necessary training of O&M personnel. Life-cycle cost effective means that the proposed design solutions have a lower life-cycle cost than the life-cycle cost of the baseline. In other words, the calculated total cost of ownership for the design must not be greater than the total cost of ownership for the baseline.

(b) For existing buildings, the LCCA baseline for the building envelope is the existing building envelope system type with ASHRAE 90.1 Section 5 compliant U-factors, etc. Example: if an existing building has masonry wall construction, the baseline envelope will have masonry wall construction with the associated U-factors from ASHRAE 90.1 Section 5. The ASHRAE 90.1 Appendix G requirement to for steel-framed wall will not be used for the baseline for LCCA in this example. The proposed building envelope for the project will be used in the HVAC system LCCA across all alternatives.

(c) In selecting alternatives for analysis, give preference to features and systems with lower complexity and maintenance burden. Do not include alternatives for which it is clear, prior to LCCA that the cost exceeds the potential savings based on historic information or engineering judgment. Where such alternatives were considered, but not analyzed, identify those alternatives and provide an explanation. When there are less than three feasible alternatives for the project, include a justification in the documentation. LED and high-intensity RF Induction lighting systems, when included in the design, do not require LCCAs be performed on them because their long life, efficiency, and environmental sustainability is inherent in these technologies.

(d) Some installations have preferred systems or systems that they prohibit. Installation preferences do not supersede Army policy or Unified Facilities Criteria without an approved Exemption from the Chief, Engineering & Construction Division in accordance with MIL-STD-3007. Incorporate operational and maintenance considerations into the LCCA. When non-quantitative considerations may impact alternatives selected, provide justification as noted above.

(e) Where the DD Form 1391 for the project requires a particular feature or system, such feature or system must be included in the design. In such cases, a LCCA for that feature or system is not required during design. Include a statement in the documentation regarding this. Example: Where funding has been identified for solar photovoltaic systems or ground source heat pump systems in the DD Form 1391, they will be included in the project without LCCA. Where connection to a central energy plant is required in the 1391, LCCA for the central

heating/cooling plants for a building is not required but a LCCA for the air systems will be included.

(7) Quality Assurance. District architect and engineering subject matter experts (SME) will review and approve alternatives proposed for analysis, prior to the start of LCCA, in order to ensure that a sufficient number and variation of alternatives is analyzed for the project and that alternatives that are not acceptable are not included. Include a statement that the proposed alternatives have been reviewed and are approved, signed by the SME(s), in the project design analysis. The results of the LCCA are used to establish the features/systems for the project; therefore, District SMEs will review the 35% submittal to ensure compliance with energy optimization/LCCA requirements prior to design progression to 65%. Include a statement that the 35% submittal has been reviewed for compliance with sustainability criteria, signed by the SME(s), in the project design analysis. Update and include the statement as part of any required review documentation (including the BCOES reviews.)

(8) Complete the documentation of the energy optimization/LCCA, including the associated energy modeling, no later than the parametric design phase (5-35%). Place all documentation in the design analysis and make it readily available for a third party review. The LCCA documentation forms a part of the Energy Compliance Analysis required for the project in accordance with UFC 1-200-02. Provide documentation in accordance with Attachment C Energy Optimization & LCCA Documentation.

(9) Design Build. Design Bid Build (DBB) and Design Build (DB) projects follow the exact same procedures described above. In DB, the LCCA is prepared during the development of the solicitation package (request for proposal). The resulting system/feature selections will be incorporated as requirements the DB contract. DB selection criteria must require that betterments provided by the offeror that significantly affect energy efficiency be supported by a LCCA. Acceptance of such a betterment must take the life-cycle cost into consideration.

(10) Any changes to the project scope beyond initial design that impact energy savings (more than 30% of building total consumption) or project cost (more than 30% of program amount) require an update to the LCCA.

(11) The architect and mechanical, electrical, and cost engineers are generally responsible for execution of the LCCA. The PDT Technical Lead has the responsibility to ensure that the LCCA is performed and fully documented, including options not selected, in the Design Analysis. The PDT will employ integrated design principles, as a team in accordance with UFC 1-200-02, to incorporate feasible alternatives into the analysis in order to achieve the highest energy performing design that is life-cycle cost effective, available within PA, and meets mission requirements.

5. Update. This guidance contained herein is reflected in the referenced documents and will be reflected in future updates as well.

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6. **Point[s] of Contact.** The Headquarters USACE point of contact for this ECB is Eric Mucklow, CECW-EC, (202) 761-0522.

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Encl.

Attachment A – Energy Optimization and LCCA Process

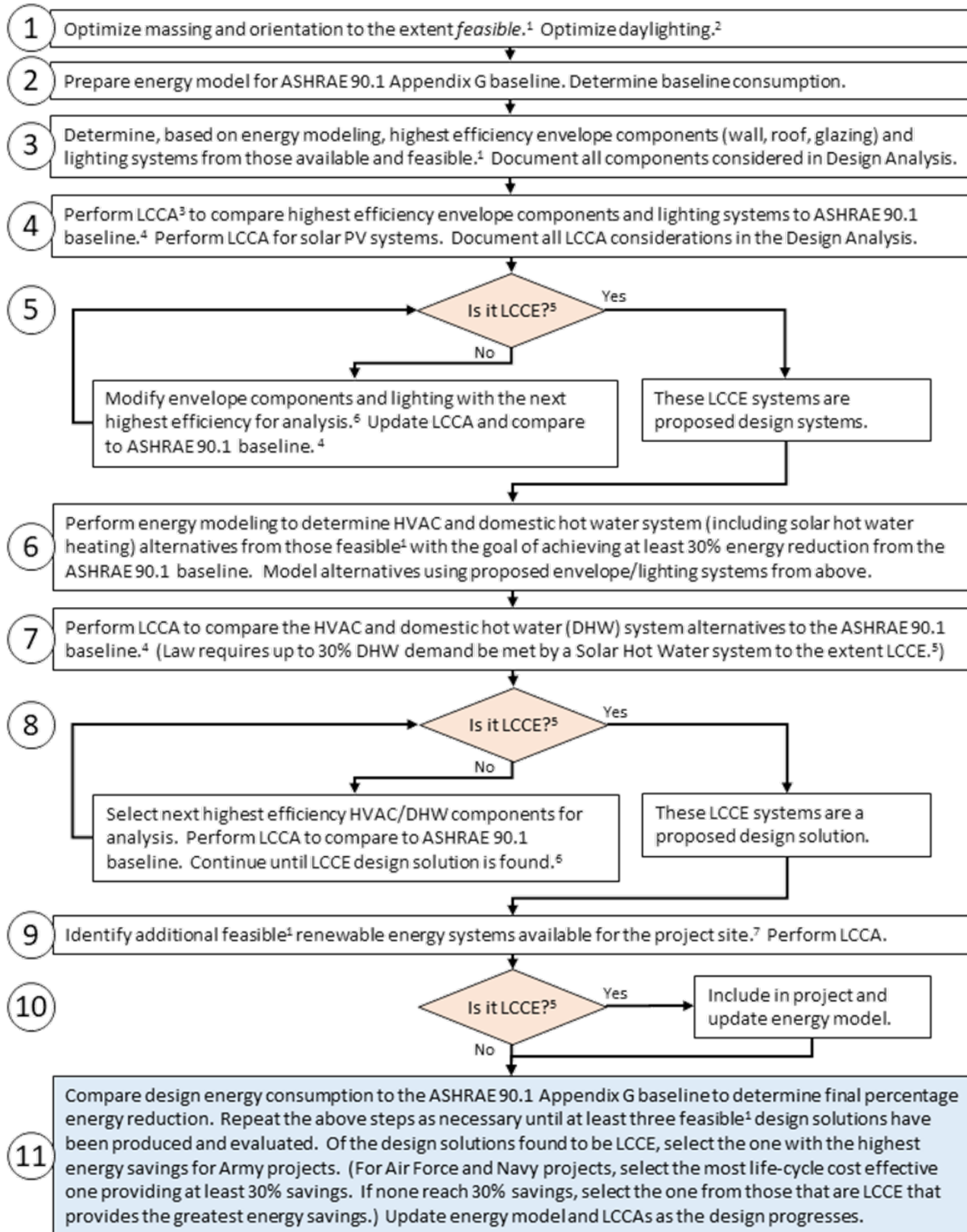
Attachment B – Example Selection Process

Attachment C – Energy Optimization & LCCA Documentation

Attachment D – AE Technical Scope of Work (AESOW)

ATTACHMENT A:

Energy Optimization and LCCA Process



FOOTNOTES:

1. The term “feasible” throughout the flow chart means technically viable and affordable (within PA) alternatives which are available in the project market and meet mission/functional requirements, and comply with Federal Laws and applicable Government regulations, policy, codes and criteria (UFCs, AT/FP) and that can be economically maintained by the facility operation and maintenance staff or contractors. Design solutions that are found to not be “feasible” must be documented in the Design Analysis for the record.
2. Optimize daylighting is meant to improve occupant environmental quality as well as provide opportunity to save energy through automatic electronic light dimming. This should be optimized to the extent feasible as noted in Note 1. Consider the extent of energy savings available based on most likely lighting system to be used.
3. Life-Cycle Cost Analysis (LCCA) is performed in accordance with 10 CFR 436 and the NIST Handbook 135 using present-value method. Only include maintenance costs for work that would actually be performed. LCCA for lighting systems is not required when LED or high-intensity RF induction (cathodeless) lighting is used due to inherent long-life, efficiency, and environmental sustainability.
4. ASHRAE 90.1 Appendix G prescribed baseline systems in accordance with UFC 1-200-02 High Performance and Sustainable Building Requirements.
5. Life-Cycle Cost Effective (LCCE), as determined by an LCCA, is defined in 10 CFR 433.
6. A minimum of three feasible alternatives to the baseline is required for a complete analysis. Consider any additional alternatives available that may yield better results.
7. The consideration of solar energy systems is required by mandate, but there are other forms of renewable energy that can enhance the performance and resiliency of the facility. Ensure the current utility costs for the site are used. Evaluate the project location for alternative renewable energy sources available in the area. Some locations may have significant wind, waste heat recovery, microhydro, biomass, cogeneration, or other options that may be included economically as a package. Whenever feasible, design these systems to supplement critical power circuits to reduce fuel consumption by back-up generators during service disruptions.

ATTACHMENT B: EXAMPLE SELECTION PROCESS

These examples are over-simplified in order to provide clear examples of alternative selection.

The requirement for compliance with the Energy Policy Act of 2005 is to achieve at least 30% energy reduction from an ASHRAE 90.1 baseline, if life-cycle cost effective. If 30% energy reduction is not life-cycle cost effective, achieve the highest efficiency that is life-cycle cost effective. The Army policy requires achieving the highest efficiency that is life-cycle cost effective within the project’s programmed amount. Life-cycle cost efficiency is measured against the LCCA Baseline of ASHRAE 90.1 Appendix G.

Example 1: Refer to Table 1 for LCCA comparison of multiple alternatives. Assume the alternatives are all electric source and energy cost is proportional to energy consumption. Assume that up to \$1,000,000 is available within the project amount. Assume that the Baseline energy consumption for this example is equal to the ASHRAE 90.1 Appendix G energy modeling baseline energy consumption. For the case reflected in Table 1, all alternatives save energy compared to the Baseline. Of the alternatives, Alternative 1 and 3 are not life-cycle cost effective and will not be selected. Alternative 4 saves more energy than Alternative 2 and has an equal or lower life-cycle cost than the LCCA Baseline. In this example, Alternative 4 is chosen. Alternative 4 has the highest energy efficiency that is life-cycle cost effective and is available within Project Amount.

After selecting alternative 4 (and any subsequent systems selections by following the flowchart in Attachment A), the energy consumption percent reduction is calculated based on the proposed features/systems versus the ASHRAE 90.1 Appendix G energy modeling baseline.

Additional observations:

- a. Alternative 4 has a higher first cost than Alternative 2; however it will be selected anyway if the funds are available. If only \$900,000 were available within the project amount, Alternative 4 will not be selected. In such a case, Alternative 2 would be selected.
- b. Alternative 2 has a lower life-cycle cost than Alternative 4; however, it has higher energy efficiency and the life-cycle cost is no higher than the Baseline.

TABLE 1 - LCCA COMPARISON TABLE

	LCCA Baseline	Alternative 1	Alternative 2	Alternative 3	Alternative 4
First Cost	\$750,000	\$1,000,000	\$700,000	\$900,000	\$1,000,000
Energy Cost/yr	\$25,000	\$23,000	\$21,000	\$20,000	\$15,000
Total Energy Cost	\$250,000	\$230,000	\$210,000	\$200,000	\$150,000
Maintenance Cost	\$400,000	\$350,000	\$400,000	\$400,000	\$250,000
LCC (NPV)	\$1,400,000	\$1,580,000	\$1,310,000	\$1,500,000	\$1,400,000

Example 2: Refer to Table 2 for LCCA comparison of multiple alternatives. Assume the alternatives are all electric source and energy cost is proportional to energy consumption. Assume that up to \$1,000,000 is available within the project amount. Assume that the Baseline energy consumption for this example is equal to the ASHRAE 90.1 Appendix G energy modeling baseline energy consumption. For the case reflected in Table 2, all alternatives save energy compared to the Baseline. Of the alternatives, none have a lower life-cycle cost than the LCC Baseline. In this example, the LCCA Baseline would be chosen based purely on the rules because it has the highest energy efficiency that is life-cycle cost effective relative to the LCCA Baseline.

Notice that difference in the LCC for the Baseline and Alternative 2 is negligible (0.7%). The energy cost for Alternative 2 is lower, but the maintenance costs are much higher. The first costs are lower. Alternative 2 may be selected for the project depending on stakeholder preferences regarding first costs, energy cost savings, and maintenance costs.

TABLE 2 - LCCA COMPARISON TABLE

	Base	Alternative 1	Alternative 2	Alternative 3	Alternative 4
First Cost	\$750,000	\$1,000,000	\$700,000	\$900,000	\$1,000,000
Energy Cost/yr	\$25,000	\$23,000	\$21,000	\$20,000	\$15,000
Total Energy Cost	\$250,000	\$230,000	\$210,000	\$200,000	\$150,000
Maintenance Cost	\$400,000	\$350,000	\$500,000	\$400,000	\$350,000
LCC (NPV)	\$1,400,000	\$1,580,000	\$1,410,000	\$1,500,000	\$1,500,000

Example 3: Refer to table 3 for LCCA comparison of multiple alternatives. Assume the alternatives are all electric source and energy cost is proportional to energy consumption. Assume that up to \$1,000,000 is available within the project amount. Assume that the Baseline energy consumption for this example is equal to the ASHRAE 90.1 Appendix G energy modeling baseline energy consumption. For the case reflected in Table 3, all alternatives save energy compared to the Baseline. Of the alternatives, Alternative 2 and 3 have an equal or lower life-cycle cost than the LCC Baseline. For Army projects, in this example, Alternative 3 would be chosen because it has the highest energy efficiency that is life-cycle cost effective relative to the LCCA Baseline.

Air Force or other services may only require meeting the Federal mandate for 30% energy reduction, if LCC effective, or the highest energy reduction that is LCC effective if that is not possible. Often such services do not want to expend further project funding than is required. Always verify with stakeholder. In such cases, once beyond 30% energy reduction, no further funds are required to be spent. In the example, Alternative 2 achieves a 44% energy reduction and Alternative 3 achieves a 60% energy reduction. Alternative 3 has a higher first cost than Alternative 2. In this case, Alternative 2 may be selected for some Federal services depending on their preferences or rules.

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TABLE 3 - LCCA COMPARISON TABLE

	Base	Alternative 1	Alternative 2	Alternative 3	Alternative 4
First Cost	\$750,000	\$1,000,000	\$700,000	\$900,000	\$1,000,000
Energy Cost/yr	\$25,000	\$16,000	\$14,000	\$10,000	\$13,000
Total Energy Cost	\$250,000	\$160,000	\$140,000	\$100,000	\$130,000
Maintenance Cost	\$400,000	\$350,000	\$500,000	\$400,000	\$350,000
LCC (NPV)	\$1,400,000	\$1,510,000	\$1,340,000	\$1,400,000	\$1,480,000

ATTACHMENT C: Energy Optimization & LCCA Documentation

Refer to Energy Compliance Analysis (ECA) and ECA Narrative requirements in UFC 1-200-02 High Performance and Sustainable Building Requirements. Life Cycle Cost Analysis/Energy Optimization documentation is to be detailed enough to provide sufficient information for the analysis to be auditable or repeatable by a third party.) At a minimum, the document must include the following to the extent applicable:

- Narrative
 - Identify applicable criteria
 - Documentation of any exemptions approved by higher headquarters.
 - Identify the proposed design resulting from the analysis and include thorough description of process/reasoning for selection. If the alternative selected is not the most energy efficiency alternative that is LCC effective, provide justification (maintainability, base preference, initial cost, etc.).
 - Summary description of each alternative analyzed including assumptions and references used to determine each parameter. Include summary of base-case.
 - List any alternatives considered but not selected for analysis and reasoning. Include description of installation/stakeholder preferences and restrictions or DD Form 1391 requirements that influenced selection of alternatives.
 - Provide a table comparing alternatives for each feature/system (wall-to-wall, roof-to-roof, HVAC-to-HVAC) that shows current year initial cost, annual energy consumption, annual energy cost, maintenance/replacement costs, other operating costs (if applicable), salvage/residual costs, and present-value life-cycle cost. Provide the same information for renewable energy, waste heat recovery, and alternative water system analyses. Refer to Table 1 for an example table.
 - Describe results of sensitivity analysis and any impact on selection for proposed design.
 - Identify software used for energy modeling and LCCA
 - Identify sources of information for initial costs, maintenance/removal costs, service life, residual/salvage value, energy/water utility data, etc.
 - List utility rate data and explain how utility rate structure was applied.
 - Confirm/identify source of discount and escalation rates for the LCCA.
 - Statement that alternatives proposed for analysis were reviewed and approved prior to beginning LCCA, signed by the reviewing SME(s).
 - At 65%, provide statement that the energy optimization/LCCA was reviewed during the 35% submittal review, signed by the reviewing SME(s).
- Analysis Documentation
 - Provide cost analysis for initial costs and maintenance/operational costs.
 - Provide input/output reports from software (BLCC) for the LCCA for each system/feature.
 - Provide input/output reports from energy modeling software for each alternative included in the LCCA.
 - In the electronic submission (PDF), bookmark locations for energy analysis, cost analysis, and LCCA separately. Subdivide by alternative/base-case and book mark. The intent is for reviewer to quickly find the modeling, cost, or LCCA information relevant to a particular alternative.

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TABLE 1 – EXAMPLE WALL LCCA COMPARISON TABLE

DESIGN SOLUTION:	<u>BASELINE</u> ASHRAE 90.1 APPENDIX G	<u>ALT #1</u> INSULATED CONCRETE FORM, R-20 C.I., BRICK	<u>ALT #2</u> CONCRETE MASONARY UNIT, RW INSUL R-28, BRICK	<u>ALT #3</u> MASS TIMBER FRAME, SPF INSUL R-18, RIGID INSUL R- 5 C.I. BRICK
<i>First Cost</i>				
<i>Annual Energy Consumption (Kbtu)</i>				
<i>Annual Energy Utility Cost</i>				
<i>Energy Utility Cost (Over 40 Years)</i>				
<i>Annual Preventative Maintenance Cost</i>				
<i>Maintenance Cost (Over 40 Years)</i>				
<i>Replacement Costs (Over 40 Years)</i>				
<i>Salvage/Residual Value (After 40 Years)</i>				
<i>Other Costs (Utility, Operation, Etc.)</i>				
<i>Net Present Value LCC</i>				

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TABLE 2 - EXAMPLE HVAC LCCA COMPARISON TABLE

<i>DESIGN SOLUTION:</i>	<u>BASELINE:</u> ASHRAE 90.1 APPENDIX G COMPLIANT	<u>ALT #1</u> HIGH-EFF AC CHILLER W/ HEAT RECOVERY FOR DHW. HIGH-EFF CONDENSING BOILER. VAV REHEAT	<u>ALT #2</u> DISTRIBUTED WSHP SYSTEM W/ DOAS.	<u>ALT #3</u> DISTRIBUTED GSHP SYSTEM W/ DOAS.
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<i>First Cost</i>				
<i>Annual Energy Consumption (Kbtu)</i>				
<i>Annual Energy Utility Cost</i>				
<i>Energy Utility Cost (Over 40 Years)</i>				
<i>Annual Preventative Maintenance Cost</i>				
<i>Maintenance Cost (Over 40 Years)</i>				
<i>Replacement Costs (Over 40 Years)</i>				
<i>Salvage/Residual Value (After 40 Years)</i>				
<i>Other Costs (Utility, Operation, Etc.)</i>				
<i>Net Present Value LCC</i>				

ATTACHMENT D:

**1 - AE Technical Scope of Work (AESOW)
*Design-Build Request for Proposal***

x.0 Sustainable Design and Development Scope

NOTE: This example AE scope of work applies to projects wherein the AE prepares a technical scope for a request for proposal for a design-build project. It is recommended that the AESOW preparer engage a subject matter expert, as needed, to complete the scope language. The intent of the scope language is to identify expectations for the project and submittals that may not be covered elsewhere. Redundancy with applicable criteria should be limited to that needed to emphasize critical or routinely-missed criteria.

x.1 General

Note: AESOW preparer identifies the specific criteria that applies to the project. General reference to UFC, ER, ECB, etc. here or in another section of the scope may be sufficient to cover most criteria references. List additional criteria not covered elsewhere. Often, policy documents, installation documents, etc. need explicit references. Add path or link to AESOW for WBDG.org, USACE Publications, and other document sources.

Incorporate Federal, DoD, and [Agency][Army] sustainable design and development requirements into the project in accordance with the following applicable criteria:

- Unified Facilities Criteria (UFC) 1-200-02 High Performance and Sustainable Building Requirements
- [ASA (IEE) SDD Policy Update - Assistant Secretary of the Army for Installations, Energy, and Environment) Memo: Sustainable Design and Development (SDD) Policy Update]
- [Engineering Regulation 1110-1-8173 Energy Modeling and Life Cycle Cost Analysis]
- [Engineering Regulation 1110-345-723 Total Building Commissioning Procedures]
- [Applicable ECB][ECB 20xx-xx]
- [Other agency/installation sustainable requirement criteria]

In the event a conflict is discovered, immediately notify the Contracting Officer's Representative.

Immediately upon discovery that a criteria document requirement or [Third Party Certification][LEED] requirement cannot be met, notify the Contracting Officer's Representative and, as requested, provide the technical documentation necessary to support the associated exception or waiver requests.

x.2 Sustainability and Design-Build

NOTE: The DB RFP preparer is responsible for ensuring that the requirements of the project can be met within the available funds and other project constraints. This will require some level of conceptual design and analysis.

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The AE is responsible for incorporation of the project sustainability and energy/water efficiency requirements into the project. While much of the responsibility for compliance with the sustainability requirements will be transferred to the design-build (DB) contractor, the AE must validate that such requirements can be met and perform sufficient conceptual design to develop a cost estimate for the project.

x.3 Kick-off/Charrette

NOTE: Because the project technical requirements, budget, and schedule are influenced by sustainability requirements for the project, the integrated design requirements for the project must be addressed during RFP preparation. This is in addition to addressing integrated design in the post-award design charrette led by the DB contractor.

Incorporate the requirements of UFC 1-200-02, paragraph Employ Integrated Design Principles into the kick-off or charrette. Address each requirement of the applicable criteria to the extent they impact the project design concept, budget, and schedule. [In addition, address the project [Third Party Certification][LEED] requirements.] Demonstrate compliance through the charrette documentation including a description of the integrated design process that occurred at the charrette, identification of the building and site sustainability strategies and features considered and discussed, and identification of the decisions made during the charrette or further evaluation that must be performed. Ensure that sufficient information is gathered for preparation of the Owner's Project Requirements required by UFC 1-200-02, paragraph Commissioning and ER 1110-345-723.

x.4 Request for Proposal Technical Scope Development

Incorporate the energy and water efficiency and life-cycle cost analysis requirements of UFC 1-200-02, ER 1110-1-8173, [and]ASA (IEE) SDD Policy Update 2017, [and ECB 20xx-xx] into the development of the technical scope for the DB request for proposal (RFP). The requirement to achieve energy efficiency to the extent life-cycle cost effective requires energy optimization including energy modeling and life-cycle cost analysis (LCCA). In accordance with ER 1110-1-8173, the AE will perform these analyses during preparation of the technical scope for the DB RFP.

The energy optimization must include building envelope, lighting, HVAC, domestic hot water, renewable energy, and solar hot water systems. Include evaluation of passive strategies and energy recovery and waste heat strategies, when such technologies are feasible. In addition, evaluate the life-cycle cost of alternative water systems such as water reclaim and harvesting systems. Systems and features selected as alternatives for modeling and analysis must be in compliance with agency and Federal government criteria and regulations, meet mission requirements, and be technically feasible.

Coordinate with the Contracting Officer's Representative for approval of alternative systems and features prior to performing the analysis. Include system/feature approval for analysis correspondence in the project design analysis.

Coordinate with the Contracting Officer's Representatives and project stakeholders for selection

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and approval of the systems and features for the projects based on the results of the energy optimization and life-cycle cost analyses prior to continuing with design of those systems and features. Include system/feature approval for design correspondence with the project design analysis.

Energy optimization and alternative water evaluation including energy modeling and LCCA must be provided as a separable volume of the design analysis. Provide documentation described in Attachment [A][____].

NOTE: The requirement below to prescribe systems and features applies to fix-priced DB projects. Energy optimization may not be deferred to the DB contractor. The cost of the project and level of performance (energy efficiency and maintainability) must be known prior to contract award.

Incorporate the requirements for the selected systems and features into the DB RFP technical scope. The technical scope will not include a requirement for the DB contractor to provide additional energy optimization or life-cycle cost analyses. The DB contractor must be required to complete an energy model, based on the final design, to report energy reductions in accordance with the applicable criteria. The DB RFP must require that proposals that offer betterments that impact energy efficiency be supported by a life-cycle cost analysis.

Perform storm water management analyses to the extent necessary to assure that compliance with the applicable criteria is feasible. Provide associated documentation including narratives and modeling.

Include a completed [Army E&S Record Card][AF MILCON Sustainability Requirements Scoresheet][____] and [Third Party Certification][LEED] Project Checklist in the design analysis based on the information available at the end of this phase.

Ensure that the DB RFP fully and clearly outline the responsibilities of the construction contractor in complying with the sustainability and associated documentation requirements for the project including [Third Party Certification][LEED certification].

[x.5 [Third Party Certification][LEED] Registration

NOTE: It is recommended that the AE preparing the DB RFP be responsible for initially registering the project including paying the associated fees. Doing this pre-award locks the project into the current version of the certification system and avoids additional contract actions, to pay registration fees, beyond the AE contract. The administration roles may be transferred to the DB contractor after award.

The AE is responsible for registration of the project [with the certifying organization for the selected Third Party Certification][in LEED Online in the appropriate LEED Rating System] including all associated fees. [Refer to applicable criteria for instructions regarding project details for the registration process.][Coordinate with the Contracting Officer's Representative for the appropriate information to include in the registration process.]]

2 - AE Technical Scope of Work (AESOW) *Design-Bid-Build*

x.0 Sustainable Design and Development Scope

NOTE: This example AE scope of work applies to projects wherein the AE prepares a full design for a design-bid-build project. It is recommended that the AESOW preparer engage a subject matter expert, as needed, to complete the scope language. The intent of the scope language is to identify expectations for the project and submittals that may not be covered elsewhere. Redundancy with applicable criteria should be limited to that needed to emphasize critical or routinely-missed criteria.

x.1 General

Note: AESOW preparer identifies the specific criteria that applies to the project. General reference to UFC, ER, ECB, etc. here or in another section of the scope may be sufficient to cover most criteria references. List additional criteria not covered elsewhere. Often, policy documents, installation documents, etc. need explicit references. Add path or link to AESOW for WBDG.org, USACE Publications, and other document sources.

Incorporate Federal, DoD, and [Agency][Army] sustainable design and development requirements into the project in accordance with the following applicable criteria:

- Unified Facilities Criteria (UFC) 1-200-02 High Performance and Sustainable Building Requirements
- [ASA (IEE) SDD Policy Update 2017 - Assistant Secretary of the Army for Installations, Energy, and Environment) Memo: Sustainable Design and Development (SDD) Policy Update, January 17, 2017]
- [Engineering Regulation 1110-1-8173 Energy Modeling and Life Cycle Cost Analysis]
- [Engineering Regulation 1110-345-723 Total Building Commissioning Procedures]
- [USACE Army – Sustainable Design Program Implementation Guide][USACE Army LEED Implementation Guide]
- [Applicable ECB][ECB 20xx-xx]
- [Other agency/installation sustainable requirement criteria]

In the event a conflict is discovered, immediately notify the Contracting Officer's Representative.

Immediately upon discovery that a criteria document requirement or [Third Party Certification][LEED] requirement cannot be met, notify the Contracting Officer's Representative and, as requested, provide the technical documentation necessary to support the associated exception or waiver requests.

[x.2 [Third Party Certification][LEED] Registration

NOTE: It is recommended that the AE be responsible for registering the project including paying the associated fees. The AE needs to maintain responsibility for the project documentation through design. This is also more efficient by avoiding additional contract

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actions, to pay registration fees, beyond the AE contract.

The AE is responsible for registration of the project [with the certifying organization for the selected Third Party Certification][in LEED Online in the appropriate LEED Rating System] including all associated fees. [Refer to applicable criteria for instructions regarding project details for the registration process.][Coordinate with the Contracting Officer's Representative for the appropriate information to include in the registration process.]]

x.3 Design Charrette

NOTE: It is vital that all significant Government stakeholders be included in the design charrette to the extent reasonable. The AE design team performance is influenced by the extent and timeliness of the information they receive.

Incorporate the requirements of UFC 1-200-02, paragraph Employ Integrated Design Principles into the design charrette. Address each requirement of the applicable criteria to the extent they impact the project design concept, budget, and schedule. [In addition, address the project [Third Party Certification][LEED] requirements.] Demonstrate compliance through the charrette documentation including a description of the integrated design process that occurred at the charrette, identification of the building and site sustainability strategies and features considered and discussed, and identification of the decisions made during the charrette or further evaluation that must be performed. Ensure that sufficient information is gathered for preparation of the Owner's Project Requirements required by UFC 1-200-02, paragraph Commissioning and ER 1110-345-723.

x.4 [35%][____][Concept] Design Phase

Incorporate the energy and water efficiency and life-cycle cost analysis requirements of UFC 1-200-02, ER 1110-1-8173, [and]ASA (IEE) SDD Policy Update 2017, [and ECB 20xx-xx] into the development of the [35%][____][concept] design. The requirement to achieve energy efficiency to the extent life-cycle cost effective requires energy optimization including energy modeling and life-cycle cost analysis (LCCA).

The energy optimization must include building envelope, lighting, HVAC, domestic hot water, renewable energy, and solar hot water systems. Include evaluation of passive strategies and energy recovery and waste heat strategies, when such technologies are feasible. In addition, evaluate the life-cycle cost of alternative water systems such as water reclaim and harvesting systems. Systems and features selected as alternatives for modeling and analysis must be in compliance with agency and Federal government criteria and regulations, meet mission requirements, and be technically feasible.

Coordinate with the Contracting Officer's Representative for approval of alternative systems and features prior to performing the analysis. Include system/feature approval for analysis correspondence in the [35%][____] design analysis.

Coordinate with the Contracting Officer's Representatives and project stakeholders for selection and approval of the systems and features for the projects based on the results of the energy

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optimization and life-cycle cost analyses prior to continuing with design of those systems and features. Include system/feature approval for design correspondence with the 35% design analysis.

Energy optimization and alternative water evaluation including energy modeling and LCCA must be provided as a separable volume of the design analysis. Provide documentation described in Attachment [A][__].

Incorporate the storm water management requirements of the applicable criteria into the development of the [35%][__][concept] design. Provide documentation including narratives and modeling and analyses to demonstrate how the concept site design complies with the applicable criteria.

Include a completed [Army E&S Record Card][AF MILCON Sustainability Requirements Scoresheet][__] and [Third Party Certification][LEED] Project Checklist in the [35%][__] design analysis based on the information available at the end of this phase.

x.5 Design

Update the project energy models throughout design as required by the applicable criteria and submit at each design submittal.

Update the life-cycle cost analyses when any changes to the project scope beyond [35%][__][concept] design impact energy savings by more than [5%][__] of building total energy consumption or [10%][__] of project construction cost. Provide any updated LCCA with the design analyses at each design submittal. Immediately notify the Contracting Officer's Representative when an updated LCCA may result in a need to change the design.

Provide compliance documentation, as a separable volume of the design analysis, at each design submittal in accordance with the applicable criteria demonstrating compliance with each sustainability requirement including the associated narratives and analyses. Include the completed [Army E&S Record Card][AF MILCON Sustainability Requirements Scoresheet][__] and [Third Party Certification][LEED] Project Checklist.

Ensure that the construction documents fully and clearly outline the responsibilities of the construction contractor in complying with construction phase sustainability requirements including [Third Party Certification][LEED certification].

[x.6 [Third Party Certification][LEED] Design Phase Certification & Construction Documents

NOTE: It is recommended to require a split review for the project, if the certifying organization allows, to ensure design phase requirements are validated prior to contract award, if possible, and as early as possible otherwise. The Government should be allowed an opportunity to review the documentation prior to submission to the certifying body. This is an ideal situation, project teams must be ready to adjust to specific project circumstances that may impact the indicated timelines.

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For Government review, provide the completed [Third Party Certification][LEED] documentation for the design phase of the project as required to support the project [Third Party Certification][LEED] certification concurrent with the [95%][corrected final][certified final] design submittal.

Initiate the design review by the certifying body [concurrent with][no later than] the [corrected final][certified final] design submittal. The AE is responsible for all associated fees. The goal for the project is to complete the design phase review prior to project award, to the extent possible. Seeking extensions from the certifying body to complete the design review process is only acceptable when the project status affects the certification process. [(Example: award of options impacting LEED credits would be an acceptable reason for delaying design review initiation.)]