

## A.6 LIFE CYCLE COST ANALYSIS REQUIREMENTS

### A.6.1 LCCA GENERAL REQUIREMENTS

#### A.6.1.1 LCCA LEGISLATION REQUIREMENTS

Subpart A of [Title 10 Code of Federal Regulations \(CFR\) Part 436](#) establishes Methodology and Procedures for determining the life cycle cost effectiveness of new buildings alternatives and existing building modernizations, retrofits and replacement alternatives.

Alternative building designs for new Federal buildings and existing building modernizations, retrofits and replacements must be evaluated on the basis of life cycle costs. The alternative design which results in the lowest life cycle costs shall be deemed the most cost-effective. Life cycle cost-effective means that the proposed building or alternative has a lower life-cycle cost than the life-cycle costs of the baseline building or baseline alternative, as described by 10 CFR 436.19.

Section 433.100 (5)(ii) of [Title 10 Code of Federal Regulations \(CFR\) Part 433](#) requires the life cycle cost of Federal design alternatives and proposed systems to be lower than the life cycle cost of the ASHRAE 90.1 2019 baseline building and systems.

$$\text{Life Cycle Cost} = \text{Initial Investment} + \text{Energy} + \text{Water} + \text{OM\&R} + \text{Replacement} - \text{Residual Value}$$

where: All costs are converted to present values by discounting

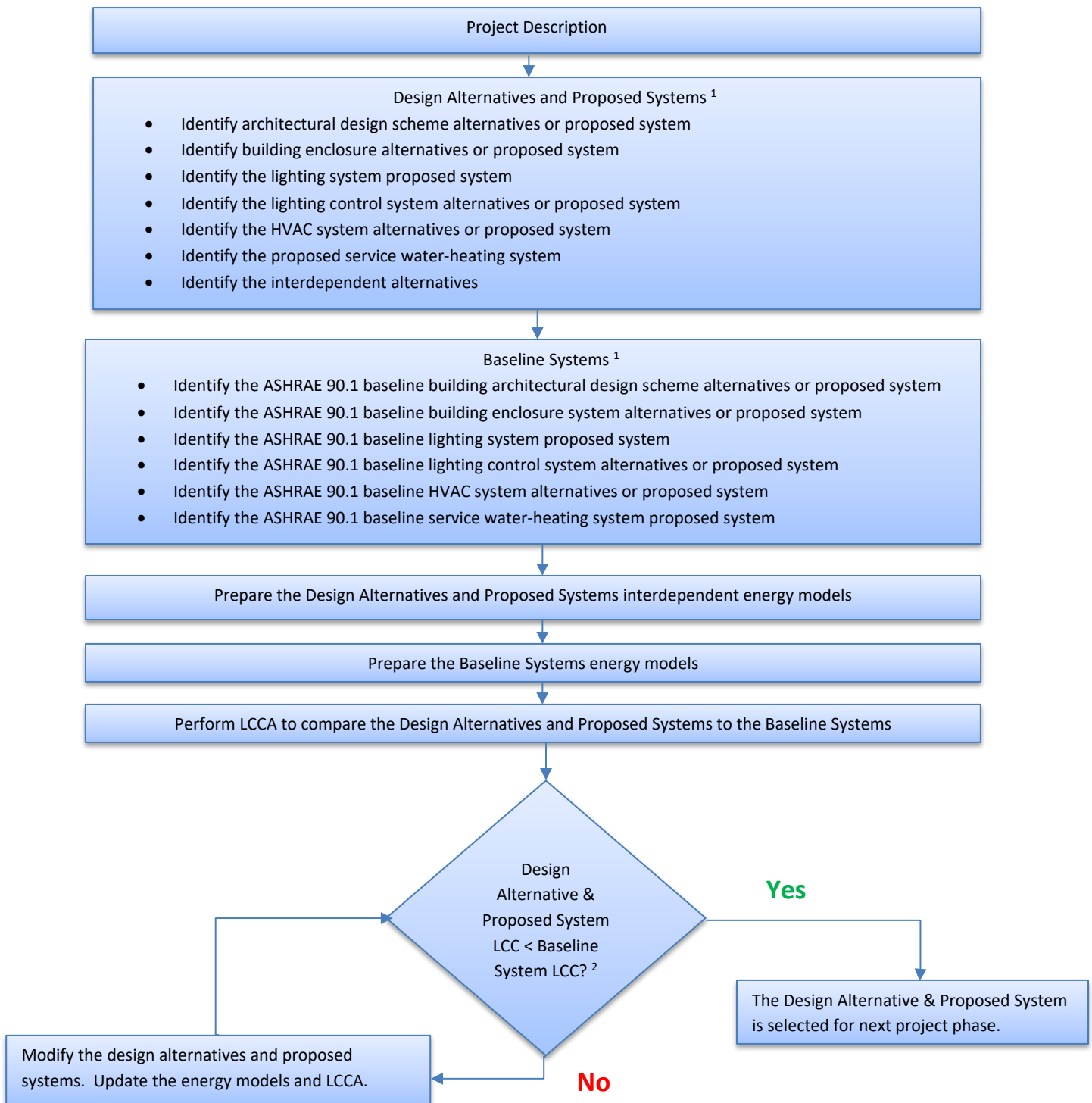
The LCCA study period is generally the expected life of the retrofit, replacement, modernization, new building, or 40 years, whichever is shorter. See 10CFR436 for the LCCA study period requirements.

#### A.6.1.2 LCCA SUMMARY FLOWCHART

Flowchart A.6.1.2.1 provides a summary of the life cycle cost analysis process. Section A.6.1.3 LCCA DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE REQUIREMENTS tables A.6.1, A.6.2 and A.6.3 identify the LCCA requirements for each project phase for the four project delivery methods and funding codes.

## APPENDIX

### A.6.1.2.1 LCCA PROCESS SUMMARY



#### Footnotes

1. See Section A.6.1.3 LCCA DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE REQUIREMENTS tables A.6.1, A.6.2 and A.6.3 for the LCCA requirements for each project phase for the four project delivery methods and funding codes.
2. Life cycle cost of design alternatives and proposed systems are less than the life cycle cost of the baseline building and systems.

## APPENDIX

### A.6.1.3 LCCA DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE REQUIREMENTS

**Table A.6.1 Delivery Method: Design Bid Build; Design Build Bridging; Construction Manager as Constructor**

Funding Code: BA51 New Construction, BA55 Major Repair and Alterations			
Project Phase <sup>3</sup>			
Preliminary Concept	Concept Development	Final Concept	Design Development 100%
Proposed Design and Alternatives			
<ul style="list-style-type: none"> <li>Three distinctly different architectural design schemes</li> <li>One proposed proven life cycle cost effective building enclosure system</li> <li>One proposed lighting system for each architectural design scheme</li> <li>One proposed ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system for each architectural design scheme<sup>1,2</sup></li> <li>One proposed ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system for each architectural design scheme<sup>1,2</sup></li> <li>One proposed service water-heating system for each architectural design scheme</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>Three proposed building enclosure system alternatives<sup>2</sup></li> <li>One proposed lighting system</li> <li>Three proposed lighting control system alternatives<sup>2</sup></li> <li>Three proposed HVAC system alternatives<sup>2</sup></li> <li>One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>One proposed building enclosure system</li> <li>One proposed lighting system</li> <li>One proposed lighting control system</li> <li>One proposed HVAC system</li> <li>One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>One proposed building enclosure system</li> <li>One proposed lighting system</li> <li>One proposed lighting control system</li> <li>One proposed HVAC system</li> <li>One proposed service water-heating system</li> </ul>
Baseline Systems			
<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building for each architectural design scheme</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system for each architectural design scheme</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system for each architectural design scheme</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system for each architectural design scheme</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system for each architectural design scheme</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system for each architectural design scheme</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>

#### Footnotes

- The proposed system must be the ASHRAE 90.1-2019 Appendix G PRM baseline system for the Preliminary Concept phase.
- If the project scope of work is not a new building or retrofit of the existing architectural design scheme, then provide three proposed building enclosure system alternatives, three proposed HVAC system alternatives and three proposed lighting control system alternatives in the Preliminary Concept phase instead of the Concept Development phase.
- Update the LCCA as the design progresses for the CD 65%, CD 95%, and CD Final project phase submissions.

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**Table A.6.2 Delivery Method: Design Build**

Funding Code: BA51 New Construction, BA55 Major Repair and Alterations			
Project Phase <sup>2</sup>			
Pre-Award Concept (min 3 offerors)	Post-Award Concept	Final Concept	Design Development 100%
Proposed Design and Alternatives			
<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>One proposed proven life cycle cost effective building enclosure system</li> <li>One proposed lighting system</li> <li>One proposed ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system <sup>1</sup></li> <li>One proposed HVAC system</li> <li>One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>Three proposed building enclosure system alternatives</li> <li>One proposed lighting system</li> <li>Three proposed lighting control system alternatives</li> <li>Three proposed HVAC system alternatives</li> <li>One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>One proposed building enclosure system</li> <li>One proposed lighting system</li> <li>One proposed lighting control system</li> <li>One proposed HVAC system</li> <li>One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One proposed architectural design scheme</li> <li>One proposed building enclosure system</li> <li>One proposed lighting system</li> <li>One proposed lighting control system</li> <li>One proposed HVAC system</li> <li>One proposed service water-heating system</li> </ul>
Baseline Systems			
<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>

**Footnotes**

1. The proposed system must be the ASHRAE 90.1-2019 Appendix G PRM baseline system for the Preliminary Concept phase.
2. Update the LCCA as the design progresses for the CD 65%, CD 95%, and CD Final project phase submissions.

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**Table A.6.3 Delivery Method: Design Bid Build; Design Build Bridging; Construction Manager as Constructor**

Funding Code: BA80 Reimbursable Work Authorization, ESPC			
Project Phase <sup>3</sup>			
Final Concept	Design Development 100%	CD 65%	CD 95%
Proposed Design and Alternatives			
<ul style="list-style-type: none"> <li>• Three distinctly different architectural design schemes</li> <li>• One proposed proven life cycle cost effective building enclosure system</li> <li>• One proposed lighting system for each architectural design scheme</li> <li>• One proposed ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system for each architectural design scheme <sup>1,2</sup></li> <li>• One proposed ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system for each architectural design scheme <sup>1,2</sup></li> <li>• One proposed service water-heating system for each architectural design scheme</li> </ul>	<ul style="list-style-type: none"> <li>• One proposed architectural design scheme</li> <li>• Three proposed building enclosure system alternatives <sup>2</sup></li> <li>• One proposed lighting system</li> <li>• Three proposed lighting control system alternatives <sup>2</sup></li> <li>• Three proposed HVAC system alternatives <sup>2</sup></li> <li>• One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>• One proposed architectural design scheme</li> <li>• One proposed building enclosure system</li> <li>• One proposed lighting system</li> <li>• One proposed lighting control system</li> <li>• One proposed HVAC system</li> <li>• One proposed service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>• One proposed architectural design scheme</li> <li>• One proposed building enclosure system</li> <li>• One proposed lighting system</li> <li>• One proposed lighting control system</li> <li>• One proposed HVAC system</li> <li>• One proposed service water-heating system</li> </ul>
Baseline Systems			
<ul style="list-style-type: none"> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building for each architectural design scheme</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system for each architectural design scheme</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system for each architectural design scheme</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system for each architectural design scheme</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system for each architectural design scheme</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system for each architectural design scheme</li> </ul>	<ul style="list-style-type: none"> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>	<ul style="list-style-type: none"> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline building enclosure system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline lighting control system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline HVAC system</li> <li>• One ASHRAE 90.1-2019 Appendix G PRM baseline service water-heating system</li> </ul>

**Footnotes**

1. The proposed system must be the ASHRAE 90.1-2019 Appendix G PRM baseline system for the Preliminary Concept phase.
2. If the project scope of work is not a new building or retrofit of the existing architectural design scheme, then provide three proposed building enclosure system alternatives, three proposed HVAC system alternatives and three proposed lighting control system alternatives in the Preliminary Concept phase instead of the Concept Development phase.
3. Update the LCCA as the design progresses for the CD 65%, CD 95%, and CD Final project phase submissions.

## APPENDIX

### A.6.2 DOCUMENTATION REQUIREMENTS

LCC studies, whether small or large, need to be carefully and clearly documented to keep track of the evaluation process, create a decision record, and have information easily accessible for future studies. The format should be simple and easy to understand. The extent of the documentation should be related to the complexity of the decision and in proper proportion to the scale of the overall project. The LCCA report must include the following:

#### A.6.2.1 PROJECT DESCRIPTION AND SCOPE

1. General information
2. Types of decisions to be made
3. Constraints

#### A.6.2.2 COMMON PARAMETERS

1. General information
2. Study period
3. Base date
4. Discount rate
5. Inflation
6. Operational assumptions
7. Local utility energy and water cost rates/schedules

#### A.6.2.3 DESIGN ALTERNATIVES, PROPOSED SYSTEMS AND BASELINE SYSTEMS

A list of design alternatives, proposed systems and baseline systems must be provided in accordance with the requirements for each project phase. The list of design alternatives, proposed systems and baseline systems must be arranged by building system type and include the architectural design schemes, building enclosure systems, lighting systems, lighting control systems, HVAC systems, and service water-heating systems. Provide a table identifying each combination of interdependent design alternatives. Provide the following;

1. Narrative for each alternative and baseline
2. Technical criteria and design features
3. Rationale for including alternatives in the LCCA
4. Rationale for excluding alternatives from the LCCA
5. Non-monetary considerations

When a chosen design alternative or proposed system is not the lowest life cycle cost, provide a justification in the narrative. 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.

When selecting design alternatives and proposed systems, give preference for equipment and materials with lower complexity and OM&R requirements. Do not include alternatives and proposed system with known costs prior to the LCCA that exceed the potential savings based on historical information and engineering judgment. When such alternatives and proposed systems are considered but not included in the LCCA, identify those alternatives and proposed systems, and provide an explanation.

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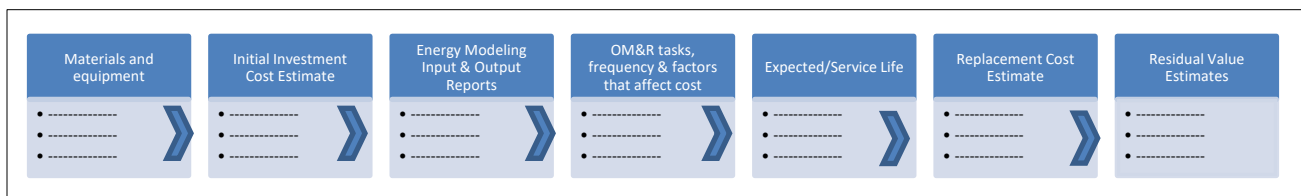
### A.6.2.3.1 MATERIALS AND EQUIPMENT

Materials and equipment lists must be provided for each design alternative, proposed system, and the baseline system. The materials and equipment list must include a description, size, type, quantity, R value, efficiency, manufacturer, model number, etc. Sufficient information must be included to document the data entered in the cost estimates and energy modeling input and output reports. The materials and equipment names/labels must be consistent in all the LCCA documents:

- Initial investment cost estimates
- Energy modeling input and output reports
- OM&R tasks, frequency and factors that affect cost
- Materials and equipment expected/service life
- Replacement cost estimates
- Residual value estimates

If different material and equipment names/labels are used within the LCCA documents, then a matrix must be provided identifying the materials and equipment names/labels and the equivalent names/labels used within the other documents.

Figure #: A.6.1 LCCA Documentation Name/Label Consistency



### A.6.2.4 INITIAL INVESTMENT COSTS

An initial investment cost estimate must be provided for each design alternative, proposed system, and baseline system list of materials, equipment, and specifications. Provide a narrative explaining how the material, equipment and specification list was used to develop the cost estimate. Provide a matrix listing the material, equipment, and specifications and the corresponding initial investment cost estimate line-item data.

The initial investment cost estimate must meet GSA P120 requirements; Planning & Concept – Unit Costs – UNIFORMAT, Design Development/DiD – Unit Costs – UNIFORMAT, Construction Drawings – Labor, Material & Equipment Breakout – Masterformat – Level 5/6, Level 3 Summary. The basis for the unit costs and quotes must be well documented and included in the supporting data of the cost estimate. Quotes for material and equipment may be obtained from local suppliers or contractors. The same initial investment cost estimate data set must be used to develop the initial investment cost estimate for each design alternative to get consistent and comparable results.

Only design alternative initial investment costs that are relevant and significant to the outcome of the LCCA decision should be included in the initial investment cost estimate. Costs are relevant if the initial investment costs change from alternative to alternative. If initial investment costs are approximately the same for each design alternative, then the initial investment costs can be eliminated from the LCCA. Costs are significant when they are large enough to make a credible difference in the LCCA of a design alternative. Identify design alternative nonrelevant and insignificant initial investment costs that do not affect the LCCA decision and are excluded from the initial investment cost estimate.

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### A.6.2.5 ENERGY MODELING

Energy modeling must be provided for each design alternative, proposed system, and baseline system for each combination of interdependent design alternatives, proposed systems, and baseline systems. As per NIST Handbook 135, section 7.4: *Determining the optimal design or energy efficiency for several interdependent systems within a facility generally requires a simultaneous energy analysis to properly account for the interaction among the systems. This interaction occurs when the use of one system affects the energy use of other systems in the same facility.*

For each design alternative, proposed system and baseline system determine the effect on building energy use and building water use by completing energy modeling and water use calculations. Each alternative proposed system and baseline system should be evaluated and identified if the alternative affects energy use or water use. If a design alternative does not affect building energy use, then the alternative does not have to be included in the energy model and the water use calculations. Individual building subsystem alternatives for example, interior finishes, that do not affect a building's energy use, can be evaluated independently.

The energy modeling must be completed in accordance with ASHRAE 90.1 2019 Appendix G, Performance Rating Method energy modeling requirements. Energy modeling input and output documentation must be provided in accordance with ASHRAE 90.1 2019 section G.1.3.2 Application Documentation items a through q. A summary table must be provided showing the annual energy use by type and total energy use from the energy modeling calculations for each mutually exclusive design alternative including the ASHRAE baseline systems. Energy modeling calculations are not required for proposed systems and design alternatives that do not significantly influence the cost of energy consumed.

### A.6.2.6 WATER USAGE AND DISPOSAL CALCULATIONS

Water usage and disposal/treatment calculations must be provided for each combination of interdependent proposed systems, design alternatives, and baseline systems. A table showing the annual water usage and disposal/treatment for each combination of interdependent proposed system, design alternative and baseline systems must be provided.

### A.6.2.7 OM&R COSTS

The design alternatives, proposed systems, and baseline systems equipment and materials manufacturers OM&R manuals must be used to determine the OM&R tasks and frequency. The following ASHRAE 2019 Applications Handbook Chapter 38 Owning and Operating Costs, Section 3, Factors Affecting Maintenance Costs must be evaluated and documented for each OM&R task:

1. Quantity and type of equipment
2. Equipment location (height above floor/grade, above ceiling) and access (including access restrictions)
3. System run time
4. Critical systems
5. System complexity
6. Local conditions
7. Geographical location
8. Equipment age
9. Available infrastructure



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OM&R costs must be determined from contractor and vendor quotes provided for the OM&R list of tasks, frequency and the ASHRAE Factors Affecting Maintenance Costs. Applying simple cost per unit of building floor area is unreliable, does not address the factors that affect OM&R costs and must not be used as the basis to determine OM&R costs. The following OM&R cost documents must be provided for the design alternatives, proposed systems, and baseline systems.

1. Table listing the materials, equipment, and specifications data and the corresponding manufacturers OM&R manual name, equipment/material name and model number.
2. Copies of the manufacturer's OM&R manual pages showing the manual name, material/equipment name and model number and the OM&R tasks and frequency.
3. Table listing the materials, equipment, and specifications data (size, type, quantity, etc.), the OM&R tasks, and frequency from the OM&R manuals and the ASHRAE Factors Affecting OM&R Costs.
4. Contractor and vendor quotes for each item listed in the materials, equipment, and specifications OM&R task, frequency and ASHRAE Factors Affecting Costs list.
5. Table listing the materials, equipment, and specifications data (size, type, quantity, etc.), the OM&R tasks, and frequency from the OM&R manuals, the ASHRAE Factors Affecting OM&R costs and the contractor/vendor quoted cost.

If other accurate and reliable OM&R cost data sources, other than vendor quotes, would like to be considered for use as the OM&R cost data, then submit the OM&R cost data information to GSA for review and approval. The OM&R cost data must account for the OM&R maintenance tasks and the ASHRAE factors affecting OM&R cost.

### A.6.2.8 REPLACEMENT COSTS

A replacement cost estimate must be provided for each design alternative, proposed system, and baseline system list of materials, equipment, and specifications with an expected/service life less than the LCCA study period. Provide copies of the materials, equipment, and specifications manufacturers data or industry technical data identifying the expected /service life. Provide a table listing the expected/service life of the materials, equipment, specifications for each proposed system, design alternative and the baseline systems. Provide a narrative explaining how the material, equipment and specification list was used to develop the replacement cost estimate. Provide a matrix listing the material, equipment, and specifications, the expected/service life, and the corresponding replacement cost estimate line-item data.

The replacement cost estimate must meet GSA P120 unit-price cost estimate requirements. The basis for the unit costs must be well documented and included in the supporting data of the initial cost estimate. Quotes for material and equipment may be obtained from local suppliers or contractors. The basis for the quotes must be well documented and included in the supporting data for the initial cost estimate. The same replacement cost estimate data set must be used to develop the replacement cost estimate for each design alternative in order to get consistent and comparable results.

Only design alternative replacement costs that are relevant and significant to the outcome of the LCCA decision should be included in the replacement cost estimate. Costs are relevant if the replacement costs change from alternative to alternative or if the expected/service life is different from alternative to alternative. If replacement costs are approximately the same for each design alternative and the expected/service life is approximately the same for each design alternative, then the replacement costs can be eliminated from the LCCA. Replacement costs are significant when they are large enough to make a credible difference in the LCCA of a design alternative.

Identify design alternative nonrelevant and insignificant replacement costs that do not affect the LCCA decision and are excluded from the initial cost estimate.

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### A.6.2.9 RESIDUAL VALUE

Provide a table listing the residual value, net of any disposal costs of the design alternatives, proposed systems, and baseline systems from the list of materials, equipment, and specifications with an expected/service life longer than the LCCA study period.

The residual value of a system (or component) is its remaining value at the end of the study period, or at the time that it is replaced during the study period. Residual values can be based on value in place, resale value, salvage value, or scrap value, net of any selling, conversion, or disposal costs. The residual value of a system at the end of its expected useful life is likely to be small or even negative (due to removal or disposal costs) if the system needs complete replacement or the facility is being demolished. However, for systems with expected lives extending beyond the end of the study period, the residual value should be based on their value in place, not on their "salvage" value as if they were to be removed from the building at that point. A facility system that is functioning in place adds significant value to the building and this value should be reflected in its residual value. There are numerous methods in estimating this value that may be appropriate depending on the application. It is recommended that you consider values that can be quantified using market-based data.

### A.6.2.10 NIST BUILDING LIFE CYCLE COST (BLCC) PROGRAM

The most recent version of the NIST BLCC program must be used to perform the life cycle cost analysis calculations. If the purpose of an LCC analysis is primarily to evaluate the energy savings for a particular building or building system, the analysis must be conducted using the FEMP LCC criteria according to 10 CFR 436A. However, if a project involves energy usage and the energy-related and non-energy-related parts of the investment cannot be broken out, then the analyst must submit a recommendation for approval to GSA whether to use OMB Analysis criteria or FEMP Analysis criteria.

FEMP Analysis, Energy Project: The criteria used as defaults in this module follow FEMP's life cycle costing rules according to 10 CFR 436A as they apply to energy and water conservation and renewable energy projects funded by agencies from direct appropriations.

OMB Analysis, Non-Energy Project: This OMB module is designated to perform life-cycle cost analyses subject to OMB Circular A-94, when the purpose of the evaluation is not primarily to assess energy-related savings. This module supports analyses that are subject to the life cycle costing guidelines of OMB Circular A-94 for the following types of projects: (a) cost-effectiveness, lease-purchase, internal government investment, and asset sales, and (b) public investment and regulatory analyses.

Water resource projects are subject to Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.

The BLCC *Input Data Listing*, *Detailed LCC Analysis*, *Cash Flow Analysis*, *Summary LCC*, *Lowest LCC*, and *Comparative Analysis* reports must be included as part of the LCCA documentation for each design alternative, proposed system, and ASHRAE 90.1 baseline building and systems.

### A.6.2.11 INTERPRETATIONS

Provide narratives and tables presenting the data for the baseline and each alternative for the following: 1) LCCA comparisons, 2) Sensitivity analysis, and 3) Uncertainty assessment.