INL High-Performance and Sustainable Building Strategy

INL/EXT-10-17808
Revision 3

AUGUST 2024

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Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy

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EXECUTIVE SUMMARY

High-performance buildings are reliable, cost effective, and sustainable structures that minimize energy and water use, reduce solid waste and pollutant emissions, and limit the depletion of natural resources. High-performance buildings also provide a thermally and visually comfortable working environment that increases productivity for building occupants.

As Idaho National Laboratory (INL) is the nation's premier nuclear energy research laboratory, the physical infrastructure requires continual updating and repurposing to help accomplish that mission. INL's infrastructure must incorporate high-performance sustainable design features to be fiscally responsible and reflect an image of innovation to the public and prospective employees.

INL is a large consumer of energy with annual energy costs exceeding $16M. This High-Performance and Sustainable Building Strategy will help engineering and construction project teams design sustainable facilities, reduce life cycle operating costs, and support the INL net-zero plan while providing INL employees with a safe and healthy working environment.

With these goals in mind, the recommendations described in this document are intended to form INL's foundation for sustainable and high-performance building standards. This strategy incorporates the latest federal and Department of Energy (DOE) orders and directives, including DOE Order 436.1A, "Departmental Sustainability," the DOE Sustainability Plan (SP), the INL Site Sustainability Plan (SSP), and Code of Federal Regulations (CFR).

This document identifies the requirements of the "Guiding Principles for Sustainable Federal Buildings" (Guiding Principles) and briefly highlights the Leadership in Energy and Environmental Design (LEED) Gold certification. LEED Gold certification can be used to meet many of the requirements of the Guiding Principles.

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ACRONYMS

ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
CFR	Code of Federal Regulations
CPG	Comprehensive Procurement Guideline
DOE	Department of Energy
DOE-ID	Department of Energy Order Idaho Operations Office
DOE O	Department of Energy Order
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
ESPC	Energy Savings Performance Contract
FAR	Federal Acquisition Regulation
FEMP	Federal Energy Management Program
FY	Fiscal Year
GHG	Greenhouse Gas
GSA	General Services Administration
GSF	gross square feet
HVAC	heating, ventilation, and air conditioning
I2SL	International Institute for Sustainable Laboratories
INL	Idaho National Laboratory
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design
O&M	operations and maintenance
OMB	Office of Management and Budget
PEMP	Performance Evaluation and Measurement Plan
RCRA	Resource Conservation and Recovery Act
SNAP	Significant New Alternative Policy
SPO	Sustainability Performance Office
SP	Sustainability Plan
SSP	Site Sustainability Plan
UESC	Utility Energy Service Contract
USGBC	U.S. Green Building Council

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INL High-Performance and Sustainable Building Strategy

1. INTRODUCTION

Idaho National Laboratory's (INL) mission is to discover, demonstrate, and secure innovative nuclear energy solutions, clean energy options, and critical infrastructure. To achieve this mission, additional state-of-the-art buildings may be required, and modifications to existing buildings will be required.

INL is composed of five campuses that are necessary to achieve the United States Department of Energy (DOE) objectives: Research and Education Campus, Advanced Test Reactor Complex, Materials and Fuels Complex, Specific Manufacturing Capability Complex, and the remaining Sitewide areas, including Central Facilities Area along with various outlying facilities and functions. As INL advances nuclear energy, it is important to showcase INL's innovative and sustainable character. Designing, constructing, and operating sustainable and high-performance buildings will be effective in highlighting INL's commitment to these traits.

Construction of new facilities can be achieved through various funding mechanisms, including private-sector funding, university funding, and government line-item funding; therefore, it is important to clarify INL's high-performance building goals and commitment to sustainability in advance.

The document's goal is to establish the foundation for the design and construction of high-performance buildings at INL. The focus is on the technical and functional requirements that address the operational issues specific to INL's geographical region as well as other economically sustainable practices such as energy efficiency and resource-use minimization. INL can improve the functionality and efficiency of its buildings by committing to sustainability goals that meet applicable codes and regulations while addressing the many requirements in executive and DOE orders.

Revision 3 of this document incorporates the latest federal and DOE orders, including DOE Order (DOE O) 436.1A, "Departmental Sustainability;" the DOE Sustainability Plan (SP); the INL Site Sustainability Plan (SSP); INL Net-Zero Plan; the latest guidelines, trends, and observations in high-performance building construction; and a brief discussion of the Leadership in Energy and Environmental Design (LEED) green building rating system.

This revised High-Performance and Sustainable Building Strategy is aligned with the DOE SP and is based on the criteria set forth in the "Guiding Principles for Sustainable Federal Buildings and Associated Instructions" (Guiding Principles), which was published in December 2020 by the Council on Environmental Quality. The Guiding Principles are divided into two sections: one for new construction and major renovations and the other for existing buildings.

Members of the Sustainable INL team are subject matter experts and available to assist design engineers in the sustainable building design process. The Sustainable INL should be contacted early in the design process and can assist with the following:

- Design reviews to ensure the building design meets federal sustainability requirements
- Review sustainability-related vendor data submittals
- Gather documentation to show sustainable building compliance.

2. BACKGROUND, CONTACTS, AND REGULATORY DRIVERS

In the U.S., commercial and residential buildings consume 38% of energy in general and 75% of all electricity (Energy Information Administration) and accounts for 12% of all greenhouse gas (GHG) emissions (Environmental Protection Agency [EPA]). The goal of a high-performance building design is to use a holistic approach to lessen a building's impact on the environment and operational funding needs.

High-performance buildings offer several benefits that address these significant energy and environmental issues:

- Reduced energy and water consumption and their associated utility costs
- Reduced waste materials going to landfills
- Reliable, healthy, and comfortable environment that promotes productivity and employee retention.

A significant component of INL's vision is to be a leading laboratory for sustainability performance in the U.S. and globally. Achieving sustainability means simultaneous consideration of economic prosperity, environmental quality, and social equity.

The Sustainable INL program was established in September 2007 and is committed to improving energy and resource efficiency, responsible environmental stewardship, and fiscal responsibility. The Sustainable INL program relies heavily on management and employee participation to achieve its goals.

Information on the Sustainable INL program is available on the internal INL website at https://inl.sharepoint.com/sites/nz-sustainability or via these contacts:

- Scott Stultz, INL Senior Energy and Sustainability Analyst, 208-526-4265, (scott.stultz@inl.gov)
- Trevor Terrill, INL Energy Manager, 208-881-3999, (trevor.terrill@inl.gov)
- Caitlin Nate, Sustainability Analyst, (caitlin.nate@inl.gov)
- Maryl Fisher, Sustainable INL Program Manager, 208-526-8340, (maryl.fisher@inl.gov).

The requestor and project manager for a new, leased, or existing INL building project are responsible for ensuring that the requirements in the Guiding Principles are addressed during project design and construction. The Guiding Principles are a compilation of sustainability-related requirements, as outlined in applicable federal regulations along with Executive and DOE orders.

2.1. Energy Policy Flow Down to INL

Federal sustainability requirements are distributed to INL operations through DOE O 436.1A, "Departmental Sustainability."

DOE O 436.1A connects the federal standards, orders, and directives to DOE and outlines the implementation path. Although executive and DOE orders are regularly updated and superseded, DOE O 436.1A and its objectives remain in the INL contract until a new order is issued and incorporated into the contract. The most recent version of DOE O 436.1A was approved on April 25, 2023. Design teams are encouraged to review the full text of contractor requirements document in DOE O 436.1A found at the link in the References section for this document.

DOE O 436.1A requires DOE to prepare an annual SP with accompanying guidance and direction. INL implements the SP through the INL SSP and INL procedures and standards. Critical outcomes and performance measures are reported in the INL Performance Evaluation and Measurement Plan (PEMP).

The SP goals and requirements applicable to the INL Site were developed to ensure that DOE meets the sustainability goals in the regulations and orders. These goals are summarized for reference in Table 1. INL reports on these goals to the DOE Idaho Operations Office (DOE-ID) annually, and the goals are included in INL's PEMP.

Table 1. SP goals and metrics.

Goal	Metric
Facility Energy Efficiency	Reduce building energy intensity (Btu/ft²)
Efficiency Measures/Investments	Buildings evaluated for efficiency opportunities

Goal	Metric
Renewable Energy Use	Renewable electricity used as a percent of electricity use
Water Efficiency	Reduce potable water intensity (gal/ft²)
High-Performance Sustainable Buildings	Percent of DOE owned buildings meeting the "Guiding Principles for Sustainable Federal Buildings" (Guiding Principles)
Transportation/Fleet Management	Reduction in petroleum fuel
Sustainable Acquisition	Purchase products per Federal Acquisition Regulation (FAR)

2.2. Federal Sustainability

Section 2 briefly describes the main drivers on federal sustainability. See Section 10. ADDITIONAL RESOURCES for other sustainability guidance and resources.

2.2.1. DOE Order 436.1A, "Departmental Sustainability"

DOE Order 436.1A approved April 25, 2023, supersedes DOE O 436.1, May 2, 2011, and covers eight topic areas encompassing 60 clauses:

1. Planning, Budgeting, and Funds Management
2. Acquisition and Supply Chain Management
3. Fleet Management
4. Environmental Stewardship, Waste Minimization, and Environmental Justice
5. Facility, Energy, Water, and Utilities Management
6. Climate Adaptation and Resilience
7. Land and Resource Management
8. Performance Management and Reporting

Sustainable high-performance buildings are covered in Section 5 of the order.

5.a Incorporate the principles of sustainability early in the project planning and design process equivalent to Critical Decision 1 or earlier in accordance with DOE O 413.3, "Program and Project Management for the Acquisition of Capital Assets," current version.

5.b Incorporate location-specific resilience design criteria for new construction and major renovations.

5.c Design new construction projects to meet 10 CFR 433 or, if applicable, the requirements of the latest ANSI/ASHRAE/IES Standard 90.1 and, if life-cycle cost effective, achieve energy savings levels that are at least 30% below the Standard 90.1 baseline.

5.d Design new construction, renovation, and modernization projects, greater than 25,000 ft^2 in accordance with the Guiding Principles.

5.e Design new construction and modernization (NC&M) projects greater than 25,000 GSF to be net-zero emission by 2030.

5.f Consider implementing renewable distributed energy systems in new construction or retrofit projects, where life-cycle cost effective and/or when such a system enhances energy reliability,

resilience, or security.

5.g Ensure the sustainable and equitable siting of new and leased facilities to promote local infrastructure, public transportation, and equitable economic development.

5.h Protect water resources by reducing stormwater runoff from development projects.

5.i Analyze the life-cycle cost effectiveness of identified energy and water conservation opportunities and propose potential projects as either stand-alone projects or bundled projects to be accomplished either through direct funding or performance contracts, e.g. Energy Savings Performance Contract (ESPCs) and Utility Energy Service Contract (UESCs).

5.j Evaluate existing facilities for compliance with the Guiding Principles as required and report in the Sustainability Dashboard.

5.k Ensure covered metered facilities are benchmarked, preferably using ENERGYSTAR® Portfolio Manager.

5.l Implement Federal Building Metering Guidance, including (1) meter all buildings for electricity, water, natural gas, and steam except for allowed exclusions; (2) ensure all meters are advanced meters to the maximum extent practicable; (3) input metering data into the DOE Sustainability Dashboard; (4) ensure all advanced meter operations meet site and DOE cybersecurity standards; and (5) ensure compliance with DOE metering plan and relevant instructions.

2.2.2. Code of Federal Regulations Title 10, Part 433

Energy efficiency standards for federal buildings are addressed in the CFR. The CFR identifies the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 90.1 as the threshold of measurement for building energy efficiency. ASHRAE 90.1 is updated periodically, and the CFR should be checked during construction design to confirm the appropriate version of ASHRAE 90.1 is used for the project. Below is a summary from Title 10, Part 433 of the CFR:

Title 10: Energy

PART 433—ENERGY EFFICIENCY STANDARDS FOR THE DESIGN AND CONSTRUCTION OF NEW FEDERAL COMMERCIAL AND MULTI-FAMILY HIGH-RISE RESIDENTIAL BUILDINGS

Subpart A - Energy Efficiency Performance

Source: *79 FR 61569, Oct. 14, 2014, unless otherwise noted.*

§ 433.100 Energy efficiency performance standard.

(5) All Federal agencies shall design new Federal buildings that are commercial and multi-family high-rise residential buildings, for which design for construction began on or after April 7, 2023, to:

(i) Meet ASHRAE 90.1-2019, (incorporated by reference, see § 433.3); and

(ii) If LCC effective, achieve energy consumption levels, calculated consistent with paragraph (b) of this section, that are at least 30 percent below the levels of the ASHRAE Baseline Building 2019.

(b) If a 30 percent reduction is not LCC effective, the design of the proposed building shall be modified so as to achieve an energy consumption level at or better than the maximum level of energy efficiency that is LCC effective, but at a minimum complies with paragraph (a) of this section.

2.2.3. Sustainable Acquisition

Federal laws and DOE orders establish the basis for procurement of sustainable products. The INL General Provisions incorporate these requirements for purchasing. Design teams should incorporate the most recent contract requirements and terms and conditions to ensure that federal sustainable acquisition is met. The following resources are available to assist with understanding federal sustainable acquisition requirements.

Federal Energy Management Program (FEMP) energy efficient products: https://www.energy.gov/femp/search-energy-efficient-products

Recycled-content products: https://sftool.gov/greenprocurement/

Bio-based products: https://www.biopreferred.gov/

Non-ozone depleting alternative products: https://www.epa.gov/ozone/strathome.html

Water-efficient plumbing products: https://epa.gov/watersense

3. GUIDING PRINCIPLES FOR SUSTAINABLE FEDERAL BUILDINGS

Buildings larger than 25,000 ft^2, including new construction and major renovations, are required to meet the criteria outlined in the Guiding Principles.

While the Guiding Principles documentation is required for new construction buildings >25,000 ft^2, smaller buildings and existing buildings may also be evaluated and receive recognition.

> *Since 2002, the Federal Government has outlined its intent to advance sustainable building principles and practices throughout its portfolio established through a number of statutory and executive policies that every Federal agency has integrated and utilized. These sustainable principles and practices have been incorporated into six Guiding Principles for sustainable Federal buildings (Guiding Principles).*

The Guiding Principles are the basis for INL sustainable design and construction. The Guiding Principles were developed to align with the definition of a high-performance green building, encompassing six areas for both new construction and existing buildings:

1. Employ Integrated Design Principles
2. Optimize Energy Performance
3. Protect and Conserve Water
4. Enhance the Indoor Environment
5. Reduce the Environmental Impact of Materials
6. Assess and Consider Building Resilience

This document summarizes the requirements for the Guiding Principles in Sections 3.2 and 3.3 and provides guidance specific to INL in meeting the requirements. The full text of the Guiding Principles can be found at:
https://www.sustainability.gov/pdfs/guiding_principles_for_sustainable_federal_buildings.pdf.

3.1. Documentation of the Guiding Principles

The Sustainable INL team will use design documents, construction documents, and vendor data submittals to establish compliance with the Guiding Principles. It is recommended that design teams meet with Sustainable INL early and throughout design and construction process to ensure that proper documentation is developed and recorded.

3.2. New Construction and Major Renovation

All new construction and major renovation projects for buildings greater than 25,000 ft² must follow the Guiding Principles. New construction and major renovations less than 25,000 ft² must implement energy, water, and waste reduction technologies to the maximum extent practical using the Guiding Principles as a framework to achieve net-zero goals.

Table 2 summarizes the new construction building requirements for the Guiding Principles dated December 2020. The table has been adapted from the Guiding Principles specifically for INL with the most likely compliance path for each metric and identification of the responsible INL party. Design teams are encouraged to review the full text of the Guiding Principles found at the link in the References section for this document.

CFR Title 10, Part 433, defines the current version of ASHRAE referenced in Table 2: Criteria 2.1. Energy Efficiency.

The NC&M checklist summary in Table 2 highlights the 30 criteria to assess whether the building meets the policy outlined in the Guiding Principles. All criteria should be considered during the initial assessment process and throughout the design and construction of the project.

Core Criteria: Eighteen core criteria, supported by statutory and regulatory requirements and green building industry standards, are considered fundamental principles for any federal high-performance green building. To qualify as a sustainable federal building under the Guiding Principles, the building must meet all 18 of the core criteria.

Non-Core Criteria: For the remaining 12 criteria that are not indicated as core criteria, agencies must meet a minimum of 75 percent (9 of 12).

Table 2. Guiding Principles summary for new construction and major renovation.

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
1.0 - Employ Integrated Design Principles			
1.1 Integrated Design and Management	Core	Establish sustainability goals as part of the project to meet the Guiding Principles and incorporate those goals into the design document and process, such as the Owner's Project Requirements (OPR), Basis of Design (BOD), Conceptual Design Report (CDR), or relevant design documents.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
1.2 Sustainable Siting	Core	Sustainable siting requirements include the following: (1) avoid development of prime farmland; (2) preserve areas with permeable soils; (3) avoid, or if not possible, minimize potential harm to or within the floodplain; (4) protect and conserve existing landscapes, wetlands, forest, and wilderness areas; (5) minimize site disturbance; (6) preserve threatened or endangered species and their habitats, including pollinators' habitats; (7) improve linkages and connections to surrounding destinations and neighborhoods; (8) use historic properties, especially those located in central business districts; and (9) incorporate appropriate security design parameters.	Design team/laboratory planning and policies
1.3 Stormwater Management	Core	For new construction or modernization projects disturbing a surface area of 5,000 ft^2 or more, use planning, design, construction, and maintenance strategies to maintain or restore the predevelopment hydrology of the property in terms of temperature, rate, volume, and duration of flow, in accordance with statutory requirements (42 U.S.C. § 17094). Low impact development (LID) infrastructure solutions can be used to help achieve these criteria.	Design team
1.4 Infrastructure Utilization and Optimization	Non-Core	Evaluate and prioritize transportation strategies and associated infrastructure improvements that promote and support alternative transportation, including walking, cycling, alternative fuel and electric vehicles, and public transit over the life of the building, as feasible and consistent with the mission of the facility.	Design team/ laboratory planning

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
1.5 Commissioning	Core	Employ commissioning, as defined per Section 432 of the Energy Independence and Security Act (EISA) of 2007 (42 U.S.C. 8253[f][1][A]) and tailored to the size and complexity of the building. Document through a commissioning process that the building and its commissioned components, assemblies, and systems (including any renewable energy systems, thermal storage, district heating and cooling system, and cooling towers) comply with the OPR. Conduct commissioning in accordance with the FEMP's "Commissioning for Federal Facilities" guidance, using ANSI/ASHRAE/IES Standard 202 or other generally accepted engineering standards, guidelines, and nationally recognized organizations. For less complex buildings, commissioning should be performed with generally accepted engineering standards acceptable to the agency.	Project management team
2.0 - Optimize Energy Performance			
2.1 Energy Efficiency	Core	Ensure compliance with federal energy efficiency performance requirements for new construction in accordance with § 109 of the Energy Policy Act of 2005 [42 U.S.C. § 6834(a)(3)(A)] and DOE's regulations as established under 10 CFR parts 433, Subpart A, and 10 CFR parts 435, Subpart A. Ensure installation of ENERGY STAR and FEMP-designated products in all procurements involving energy-consuming products and services, in accordance with 42 U.S.C § 8259b and 10 CFR § 436.40– 436.43.	Design team
2.2 Energy Metering	Core	Install building-level meters for electricity and advanced meters. Install standard or advanced meters for natural gas and steam to the maximum extent practical.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
2.3 Renewable Energy	Non-Core	Evaluate applicable renewable electric energy strategies related to the project or building that could support, as needed, agency progress toward renewable energy goals where cost effective, per 42 U.S.C. § 15852(a). *(Campus/Installation-wide approach can be used if the agency has assessed and can verify that the building will directly benefit from the renewable energy system. Alternatively, the agency should develop an internal energy accounting or tracking system to apportion renewable energy or attributes to the building to avoid any double counting.)*	Sustainable INL
2.4 Benchmarking	Core	Benchmark building performance at least annually, preferably using ENERGY STAR Portfolio Manager, and regularly monitor the building energy performance against historic performance data and peer buildings.	Sustainable INL
3.0 - Protect and Conserve Water			
3.1 Indoor Water Use	Core	Install WaterSense equipment or equivalent alternatives, where available, for all fixtures that are designed to be used more than once per day on average over a month. For all fixtures and fittings using potable water with planned use of more than once per day, compile a cut sheet or product declarations or plumbing schedule showing the flush or flow rate performance meets WaterSense or equivalent. Eliminate the use of single-pass (also called once-through) cooling equipment using potable water and optimize cooling tower operations to minimize makeup water.	Design team
3.2 Water Metering	Core	Install building-level water meters (standard or advanced) and monitor to ensure optimized management of water use during occupancy, including detection of leaks in accordance with DOE's Federal Building Metering Guidance.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
3.3 Outdoor Water Use	Non-Core	Evaluate and implement, as applicable, water-efficient landscaping best practices that incorporate native, non-invasive, drought-tolerant, and low maintenance plant species. Employ water-efficient irrigation strategies to reduce outdoor potable water consumption. Where installed, demonstrate that the permanent irrigation system uses 50 percent or less of the potable water amount used in conventional practices, assuming typical annual baseline water use. Install water meters for irrigation systems serving more than 25,000 ft^2 of landscaping. If installing landscaping, use xeriscaping techniques or do not irrigate beyond the establishment of plantings.	Design team
3.4 Alternative Water	Non-Core	Not applicable	—
4.0 - Enhance the Indoor Environment			
4.1 Ventilation and Thermal Comfort	Core	Comply with all ventilation and thermal comfort requirements. Use the most current version of ASHRAE, "Ventilation for Acceptable Indoor Air Quality," Standard 62.1 or 62.2 and ASHRAE 55, "Thermal Environmental Conditions for Human Occupancy."	Design team
4.2 Daylighting and Lighting Controls	Non-Core	Design and construct the building to meet and maintain all required illumination levels, in accordance with 41 CFR § 102-74.180 of the Federal Management Regulation and maximize the use of automatic dimming controls or accessible manual controls in regularly occupied spaces. Improve access to and benefits from daylight by ensuring regularly occupied spaces along the exterior wall have fenestration, and control solar gain, daylight transmittance, and glare. If the building cannot achieve adequate daylighting due to mission or security needs, use circadian-effective lighting based on computer analysis or simulation tools to design optimal lighting conditions for the regularly occupied spaces. Evaluate and assess the occupant workplace to allow more open space around windows, except where not appropriate because of building function, work mission, or structural constraints.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
4.3 Low-Emitting Materials and Products	Non-Core	Use low-emitting (low or no volatile organic compound [VOC]) materials on at least 75 percent of interior products by cost or surface area for the following materials and products: composite wood products, flooring and carpet systems, wall panels, insulation, adhesives, sealants, interior paints and finishes, solvents, janitorial supplies, and furnishings. Agencies should refer to EPA's VOCs' Impact on Indoor Air Quality resources for information on low-emitting products.	Design team
4.4 Radon Mitigation	Core	In accordance with 41 CFR § 102-80.20 of the Federal Management Regulation, test for radon and mitigate high levels to maintain a level at or below 4 pCi/L (picocuries/liter).	Project management team/Facility O&M plans
4.5 Moisture and Mold Control	Non-Core	Implement a moisture control strategy (may be part of the operations and maintenance [O&M] protocols) for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.	Facility O&M plans
4.6 Indoor Air Quality During Construction	Non-Core	Develop and implement a plan to protect indoor air quality during construction.	Project management team
4.7 Environmental Smoking Control	Core	In accordance with 41 CFR § 102-74.315 and 102-74.330 of the Federal Management Regulation, prohibit smoking in any form inside buildings and within 25 feet of all building entrances, operable windows, and building ventilation intakes. Ensure signage is installed as appropriate.	Laboratory-wide policies and programs
4.8 Integrated Pest Management	Core	In accordance with 41 CFR § 102-74.35 of the Federal Management Regulation, ensure effective and environmentally sensitive integrated pest management (IPM) services, including the planning, development, operations, and maintenance for pest control, removal, and prevention in both indoor and outdoor spaces. Ensure that pest management contracts are effectively coordinated with the activities of other building service programs that have a bearing on pest activity such as food service, landscaping, child care, waste management, and repairs and operations.	Laboratory-wide policies and programs

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
4.9 Occupant Health and Wellness	Core	Implement an occupant health and wellness program. Fitness center availability in the building either onsite or on campus. Provide desks with adjustable heights for 25 percent of regular occupants. Provide water bottle refill stations, establish a plan to test water quality, and ensure proper maintenance of the stations.	Laboratory-wide policies and programs
5.0 - Reduce the Environmental Impact of Materials			
5.1 Materials - Recycled Content	Core	Use Resource Conservation and Recovery Act (RCRA) Section 6002 compliant products that meet or exceed EPA's comprehensive procurement guideline (CPG) program, which provides recycled content recommendations for building construction, modifications, operations, and maintenance, in accordance with 42 U.S.C. § 6962, et seq.	Laboratory policies/Design team/Project management team/Pollution Prevention team
5.2 Materials - Biobased Content	Core	Use U.S. Department of Agriculture (USDA) BioPreferred products, which are designated products with the highest content level per USDA's biobased content recommendations, in accordance with 7 U.S.C. § 8102.	Laboratory policies/Design team/Project management team/Pollution Prevention team
5.3 Products	Non-Core	Use construction products and building supplies recommended under EPA's Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing, as appropriate and applicable.	Laboratory policies/Design team/Project management team/Pollution Prevention team
5.4 Ozone Depleting Substances	Core	Ensure compliance with 42 U.S.C. § 7671k and 42 U.S.C. § 7671l, concerning the procurement of safe alternatives for ozone depleting substances. Maximize the use of safe alternatives, where EPA's Significant New Alternative Policy (SNAP) program has identified acceptable substitutes and alternatives. Refer to EPA's SNAP regulations, 40 CFR Part 82, which list substitutes that have been determined as unacceptable, acceptable to use conditions, and acceptable subject to narrowed use limits.	Laboratory policies/Design team/Project management team/Pollution Prevention team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
5.5 Hazardous Waste	Core	Ensure compliance with all relevant hazardous waste construction or operational activities that are covered by RCRA, Subtitle C and Subtitle I, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), per 42 U.S.C. § 9601, et seq., and its implementing regulations at 40 CFR Parts 239-282. This criterion is achieved so long as it can be demonstrated that the building has a program and procedure to manage hazardous waste or the building does not generate, store, treat, or dispose of hazardous waste (40 CFR §§ 260.10 and 261.3).	Laboratory policies/Design team/Project management team/Pollution Prevention team
5.6 Solid Waste Management	Non-Core	Develop and implement a construction and demolition waste management plan. Where markets exist, divert at least 50 percent of construction and demolition materials from landfills and non-energy generating incinerations, as defined by and in alignment with EPA's waste management hierarchy. Design the building to incorporate appropriate space, equipment, and transport accommodations for collection, storage, and staging of recyclables and, as appropriate, compostable materials.	Laboratory policies/project management team/pollution prevention team
6.0 - Assess and Consider Building Resilience			
6.1 Risk Assessment	Non-Core	Ensure the building and any planned mission critical activities housed in the building have been evaluated and integrated as part of a recent agency, facility, installation, or campus resilience or adaptation assessment. This can include any resilience and adaptation assessment activities associated with installation master plans, climate adaptation plans, or equivalent agency, installation, or campus resilience or adaptation plans.	Laboratory policies/design team/project management team/sustainable INL

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
6.2 Building Resilience and Adaptation	Non-Core	Use the risk assessment to determine and prioritize design parameters that should be incorporated to ensure resilient building design and operations over the intended service life of the building, considering mission criticality, cost, and security. Ensure the implementation of no cost and cost effective climate resilience measures and, where feasible, implement solutions that focus on operations. Consider in the operation plans of the building, facility, campus, or installation, the adaptive capacity of the building to cope with stressors and mitigate based on mission criticality and cost. Identify and implement measures, where appropriate, that support passive survivability and functionality during emergencies.	Laboratory policies/design team/project management team/sustainable INL

3.3. Existing Buildings

Sustainable INL typically selects existing buildings most likely to meet the Guiding Principles and develops project upgrades as needed. This requirement can also be met by taking the Guiding Principles into consideration when upgrading a building for a new purpose or when simply upgrading/replacing operational equipment. Facilities management and engineering should notify and work with Sustainable INL to ensure these types of upgrades are consistent with the Guiding Principles.

Table 3 summarizes the existing buildings requirements from the Guiding Principles dated December 2020. The table has been adapted from the Guiding Principles specifically for INL with the most likely compliance path for each metric and responsible INL party. Design teams are encouraged to review the full text of the Guiding Principles found at the link in the References section of this document. Full implementation of the Guiding Principles for existing buildings may require upgrade projects to improve performance or enhance operations.

> **Core Criteria:** Twelve core criteria supported by statutory and regulatory requirements and green building industry standards are considered fundamental principles for any federal high-performance green building. To qualify as a sustainable federal building under the Guiding Principles, the building must meet all 12 of the core criteria.
>
> **Non-Core Criteria:** For the remaining 18 criteria that are not indicated as core criteria, agencies must meet a minimum of 50 percent (9 of 18). Agencies have flexibility to focus on the criteria that are most applicable to the building and account for life-cycle cost effectiveness, mission requirements, and unique project scopes.

Table 3. Guiding Principles summary for existing buildings.

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
1.0 - Employ Integrated Design Principles			
1.1 Integrated Design and Management	Core	Establish sustainability goals as part of the project to meet the Guiding Principles and incorporate those goals into the building's operations and maintenance (O&M) procedures. Ensure opportunities to optimize energy, water, materials, indoor environmental quality, recycling and composting, occupant health and wellness, transportation (including public transit, safety, parking, and electric vehicle charging), siting and landscape, the protection of historic properties and other cultural resources, community integration, and building resilience continue to be considered to support the building's function and mission throughout the life of the building.	Design team
1.2 Sustainable Siting	Non-Core	Sustainable siting requirements include the following: (1) mitigate any potential or existing impacts to neighboring prime farmland; (2) take action to enhance, mitigate, and preserve existing areas with permeable soils; (3) minimize potential harm to or within the floodplain; (4) protect and conserve existing landscapes, wetlands, forest, and wilderness areas; (5) if impacting the site, minimize site disturbance; (6) implement policies and programs to preserve threatened or endangered species and their habitats, including pollinators' habitats; (7) optimize linkages and connections to surrounding destinations and neighborhoods; (8) continue using historic properties, especially those located in central business districts; and (9) enhance appropriate security design parameters.	Design team/laboratory planning and policies
1.3 Stormwater Management	Non-Core	Employ or maintain strategies, such as low impact development (LID), that reduce stormwater runoff and discharges of polluted water offsite to protect the natural hydrology and watershed health.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
1.4 Infrastructure Utilization and Optimization	Non-Core	Assess existing transit opportunities and prioritize transportation strategies that promote alternative transportation. These strategies may include commuting programs, cycling, alternative fuel vehicles, electric vehicles, walkability factors, and transit incentives applicable to the building. Include the building in any master planning related to transportation. Consistent with 42 U.S.C. § 6364, establish an electric vehicle supply equipment (EVSE) policy and install one or more electric vehicle charging stations if parking is provided.	Design team/ laboratory planning
1.5 Commissioning	Core	Ensure compliance with 42 U.S.C. § 8253(f)(3)(B) to identify and assess (re/retro-) commissioning measures for the facility in accordance with FEMP guidance, "Facility Energy Management Guidelines and Criteria for Energy and Water Evaluations in Covered Facilities" and "Commissioning for Federal Facilities." The "Exclusion of Small Facilities" pertaining to commissioning, as outlined in FEMP's Facility Energy Management Guidelines and Criteria for Energy and Water Evaluations in Covered Facilities, cannot be used to exempt the building from this criteria.	Project management team
2.0 - Optimize Energy Performance			
2.1 Energy Efficiency	Core	Ensure that the building energy use is 20% below a Fiscal Year (FY) 2015 energy use baseline. OR Ensure the building has an ENERGY STAR score of 75 or higher. AND Employ strategies to improve energy performance and reduce energy usage and, for all procurements involving energy-consuming products and services, incorporate energy efficiency criteria consistent with ENERGY STAR and FEMP-designated, energy-efficient products, in accordance with 42 U.S.C § 8259b (10 CFR §§ 436.40-436.43).	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
2.2 Energy Metering	Core	Verify the use of existing meters or, if no meter exists, install building-level meters or advanced meters to the maximum extent practicable for electricity and install standard metering devices for natural gas and steam, in accordance with DOE's Federal Building Metering Guidance.	Design team
2.3 Renewable Energy	Non-Core	Evaluate applicable renewable electric energy strategies related to the project or building that could support, as needed, agency progress toward renewable energy goals, where cost effective, per 42 U.S.C. § 15852(a). Implement, as appropriate, life-cycle cost effective, onsite renewable electric or thermal energy projects. *(Campus/Installation-wide approach can be utilized if the agency has assessed and can verify that the building will directly benefit from the renewable energy system. Alternatively, the agency should develop an internal energy accounting or tracking system to apportion renewable energy or attributes to the building to avoid any double counting.)*	Sustainable INL
2.4 Benchmarking	Non-Core	Benchmark building performance at least annually, preferably using ENERGY STAR Portfolio Manager, and regularly monitor building energy performance against historic performance data and peer buildings.	Sustainable INL
3.0 - Protect and Conserve Water			
3.1 Indoor Water Use	Core	Conduct analysis showing at least a 20 percent reduction when comparing installed fixture performance to a base case that represents the code-minimum, using the FEMP Water Evaluation Data Tool or water fixture performance calculator. Employ strategies that minimize water use: Install WaterSense equipment when replacing fixtures. Eliminate the use of single-pass (also called "once-through") cooling equipment using potable water and optimize cooling tower operations to minimize makeup water.	Design team
3.2 Water Metering	Non-Core	Install building-level water meters (standard or advanced) and monitor to ensure optimized management of water use during occupancy, including detection of leaks, in accordance with DOE's Federal Building Metering Guidance.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
3.3 Outdoor Water Use	Non-Core	Evaluate and implement, as applicable, water efficient landscaping best practices that incorporate native, non-invasive, drought-tolerant, and low maintenance plant species. Employ water efficient irrigation strategies to reduce outdoor potable water consumption. Where installed, demonstrate that the permanent irrigation system uses 50 percent or less of the potable water used in conventional practices, assuming typical annual baseline water use. Install water meters for irrigation systems serving more than 25,000 ft^2 of landscaping. If installing landscaping, use xeriscaping techniques or do not irrigate beyond the establishment of plantings.	Design team
3.4 Alternative Water	Non-Core	Not applicable.	—
4.0 - Enhance the Indoor Environment			
4.1 Ventilation and Thermal Comfort	Core	In accordance with 41 CFR §§ 102-74.195 and 102-74.185 of the Federal Management Regulation, comply with all ventilation and thermal comfort requirements. Agencies should refer to the General Services Administration's (GSA's) SFTool, "Enhancing Health with Indoor Air," resources on enhancing indoor air quality.	Design team
4.2 Daylighting and Lighting Controls	Non-Core	Verify the building maintains all required illumination levels in accordance with 41 CFR § 102-74.180 of the Federal Management Regulation and maximize the use of automatic dimming controls or accessible manual controls in regularly occupied spaces. Maximize access to and benefits of daylight by ensuring that regularly occupied spaces along the exterior wall have fenestration and control solar gain, daylight transmittance, and glare. Evaluate and assess occupant workplaces to allow more open space around windows with appropriate glare controls, except where not appropriate because of building function, work mission, or structural constraints.	Design team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
4.3 Low-Emitting Materials and Products	Non-Core	Verify policy or purchasing procedures are in place to use low-emitting (low or no VOC) materials. Applicable materials and products may include common supplies and replacements for composite wood products, flooring and carpet systems, wall panels, insulation, adhesives, sealants, interior paints and finishes, solvents, janitorial supplies, and furnishings. Agencies should refer to EPA's "Volatile Organic Compounds' Impact on Indoor Air Quality" resources for information on low-emitting products.	Design team
4.4 Radon Mitigation	Core	In accordance with 41 CFR § 102-80.20 of the Federal Management Regulation, test for radon in buildings and mitigate high levels so they do not exceed 4 pCi/L (picocuries/liter). Verify a policy is in place that manages the process for testing and relevant mitigation activities to adequately protect occupant health.	Project management team/Facility O&M plans
4.5 Moisture and Mold Control	Non-Core	Verify a moisture control and mitigation strategy is in place (may be part of O&M protocols) for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.	Facility O&M plans
4.6 Indoor Air Quality During Construction	Non-Core	Implement or verify a policy is in place to protect indoor air quality during operations and during any applicable renovations in the existing building. This may include strategies for having permanent entryway systems in place to capture dirt and particulates entering the building and specific procedures to protect occupants during renovations.	Project management team
4.7 Environmental Smoking Control	Core	In accordance with 41 CFR § 102-74.315 and 102-74.330 of the Federal Management Regulation, prohibit smoking in any form inside buildings and within 25 feet of all building entrances, operable windows, and building ventilation intakes. Ensure signage is installed as appropriate.	Laboratory-wide policies and programs

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
4.8 Integrated Pest Management	Non-Core	In accordance with 41 CFR § 102-74.35 of the Federal Management Regulation, ensure effective and environmentally sensitive integrated pest management (IPM) services, including the planning, development, operations, and maintenance for pest control, removal, and prevention in both indoor and outdoor spaces. Ensure that pest management contracts are effectively coordinated with the activities of other building service programs that have a bearing on pest activity such as food service, landscaping, child care, waste management, and repairs and operations.	Laboratory-wide policies and programs
4.9 Occupant Health and Wellness	Non-core	Implement occupant health and wellness program. Fitness center availability in the building either onsite or on campus. Provide desks with adjustable heights for 25 percent of regular occupants. Provide water bottle refill stations, establish a plan to test water quality, and ensure proper maintenance of the stations.	Laboratory-wide policies and programs
5.0 - Reduce the Environmental Impact of Materials			
5.1 Materials - Recycled Content	Core	Verify that a policy or procedures are in place to procure and use RCRA, Section 6002, Compliant Products, which meet or exceed EPA's CPG program. The CPG program provides recycled content recommendations, for O&M in accordance with 42 U.S.C. § 6962, et seq.	Laboratory policies/design team/project management team/pollution prevention team
5.2 Materials - Biobased Content	Core	Verify that a policy or procedures are in place to procure and use USDA BioPreferred products, which are designated products with the highest biobased content level per USDA's recommendations in accordance with 7 U.S.C. § 8102.	Laboratory policies/design team/project management team/pollution prevention team
5.3 Products	Non-Core	Verify that a policy or procedures are in place to procure and use products recommended under EPA's "Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing," as appropriate and applicable.	Laboratory policies/design team/project management team/pollution prevention team

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
5.4 Ozone Depleting Substances	Core	Verify that a policy or procedures are in place to procure and use safe alternatives for ozone depleting substances in accordance with 42 U.S.C. § 7671k and 42 U.S.C. § 7671l. Maximize the use of safe alternatives, where EPA's SNAP program has identified acceptable substitutes and alternatives. Refer to EPA's SNAP regulations, 40 CFR part 82, which list substitutes that have been determined as unacceptable, acceptable to use conditions, and acceptable subject to narrowed use limits.	Laboratory policies/Design team/project management team/pollution prevention team
5.5 Hazardous Waste	Core	Verify that a program or procedures are in place to ensure compliance with all relevant hazardous waste construction or operational activities that are covered by the RCRA, Subtitle C and Subtitle I, and the CERCLA, per 42 U.S.C. § 9601, et seq., and its implementing regulations in 40 CFR, Parts 239-282. This criterion is achieved so long as it can be demonstrated that the building has a program and procedure to manage hazardous waste or the building does not generate, store, treat, or dispose of hazardous waste (40 CFR §§ 260.10 and 261.3).	Laboratory policies/design team/project management team/pollution prevention team
5.6 Solid Waste Management	Non-Core	Verify a waste management and recycling policy, program, or procedures are in place. Where markets exist, ensure diversion of at least 50 percent of nonhazardous and non-construction related materials from landfill and non-energy-generating incineration, in alignment with EPA's Waste Management Hierarchy.	Laboratory policies/project management team/pollution prevention team
6.0 - Assess and Consider Building Resilience			
6.1 Risk Assessment	Non-Core	Ensure that the building and any planned mission critical activities housed in the building have been evaluated and integrated as part of a recent agency, facility, installation, or campus resilience or adaptation assessment. This can include any resilience and adaptation assessment activities associated with installation master plans, climate adaptation plans, or equivalent agency, installation, or campus resilience or adaptation plans.	Laboratory policies/design team/project management team/sustainable INL

Guiding Principle	Core / Non-Core	Requirement Summary	Responsible Party
6.2 Building Resilience and Adaptation	Non-Core	Use any current building or portfolio risk assessments to determine and prioritize which parameters have been or can be incorporated into the site or facility operations or planned renovation project to ensure resilient building design or operations over the intended service life, considering mission criticality, cost, and security. In the operation plans of the building, campus, or installation consider the resilience and adaptive capacity of the building to cope with stressors and mitigate based on mission criticality and cost. Implement no cost and life-cycle cost effective climate resilience measures, where feasible. Consider the level of passive survivability and functionality during emergencies and integrate any applicable strategies into plans.	Laboratory policies/design team/project management team/sustainable INL

4. NET-ZERO EMISSIONS BUILDINGS

Net-zero or zero emissions buildings combine energy efficiency and clean energy generation to eliminate GHG emissions due to building energy consumption.

INL has developed a net-zero plan to achieve net-zero carbon emissions by 2031. Key elements of the plan include reducing energy waste, eliminating fossil fuel use in buildings where possible (except for necessary scientific processes), deploying clean energy generation microgrid systems, and converting to electric and other zero-emission vehicles.

INL is implementing net-zero and carbon pollution-free electricity (CFE) plans to manage the overall clean power requirements on a campus-wide basis for the entire Laboratory. Under such plans, individual buildings will be covered in the INL campus net-zero accounting rather than on a building-by-building net-zero basis.

New building construction and design teams can support the INL net-zero effort through the following means:

- Highly energy-efficient buildings
- All electric buildings
- Use of building energy management systems with ongoing data collection
- Use of solar thermal water heating and building heating (solar thermal walls), where cost effective
- Onsite generation of CFE, where cost effective
- Where back up power is required for mission systems, investigate the applicability and cost effectiveness of using renewable energy or non-fossil fuel back-up power sources and document during the design process.

Per DOE O 436.1A Contractor Requirements Document:

> *Design new construction and modernization projects, greater than 25,000 gross square feet, to be net-zero emission by 2030.*

- Per the "Definition of a Zero Emissions Building" (https://www.energy.gov/sites/default/files/2024-06/bto-national-definition-060524.pdf), at a minimum, a building that achieves zero operational emissions from energy use meets the following criteria:
    1. Energy efficient: The building is among the most efficient.
    2. Free of onsite emissions from energy use: The building's direct GHG emissions from energy use equal zero.
    3. Powered solely from clean energy: All the energy used by the building, both onsite and offsite, is from clean energy sources.
- *Applicability to campuses and installations*: For the purposes of meeting the net-zero emissions requirement, an agency may consider all buildings within the set boundaries of a campus or installation net-zero emissions buildings if there is onsite renewable energy and grid-provided CFE sufficient to provide an annual balance of zero Scope 1 and Scope 2 GHG emissions for the campus or installation as a whole.

  For more information regarding Scope 1 and Scope 2 GHG emission, see the EPA website.

5. LOCATION SPECIFIC RESILIENCE DESIGN CRITERIA

Frequency and duration of climatic hazards can have high impacts on mission critical asset and infrastructure types at INL. INL developed a Climate Vulnerability Assessment and Resilience Plan (VARP) (INL/RPT-22-68812) in accordance with the "Vulnerability Assessment and Resilience Planning Guidance, Version 1.2" document issued in February 2022. A prescribed process was used to identify mission-critical systems and components, determine historical and expected climate impacts, and develop resilient solutions.

Analyses of climate modeling sources revealed that under scenarios of higher and lower GHG emissions (Representative Concentration Pathway [RCP] 4.5 and 8.5), INL anticipates an increase in climate hazards, including drought, heat waves, wildfire, and precipitation. Some critical asset and infrastructure types at INL presented resiliency gaps to these increased climatic events.

- Resilience Gap 1. Lack of Adaptive Capacity to Severe Precipitation Events: Various Site infrastructure and grounds may require additional resilient protection against increased flooding events. This has resulted in a "high risk" score in the Risk Assessment Tool to some site buildings. To reduce interruptions in operations and costs of repairing infrastructure, a sitewide drainage plan was expressed as a resilience solution with Site-specific building managers.
- Resilience Gap 2. Lack of Adaptive Capacity to Extreme Temperature Fluctuations and Strong Wind Events: Some site buildings' heating, ventilation, and air conditioning (HVAC) systems across all facilities lack adaptive capacity against increased heat waves, cold waves, and strong winds. This has resulted in a high risk to specialized or mission-critical equipment, information technology (IT) and telecommunication systems, Site workforce, and energy generation and distribution systems. Updating and replacing HVAC system components for redundancy was expressed as a resilience solution with Site-specific building managers.
- Resilience Gap 3. Lack of Adaptive Capacity to Power Outages due to Climate-Related Effects on Energy Infrastructure: INL depends on two main local electric energy suppliers and one natural gas supplier. Sitewide power generation and backup generation sources and overall services lack sufficient resiliency and protection against climate-related effects on energy supply due to heat and cold waves, water availability, and severe storm events. Additional mission-critical equipment and IT and communication systems are of high risk due to climate effects on Energy Infrastructure vulnerability. Resilience solutions to reduce probabilities of loss of power across the Site due to interdependencies on local energy suppliers include hardening energy infrastructure systems and supporting backup power supply across the Site.

- Resilience Gap 4. Lack of Adaptive Capacity to Wildfire: Some site buildings and grounds at the Site lack sufficient resiliency and protection against increased wildfire events. This has resulted in a high risk to Site buildings, Site workforce, and Site ecology and land preservation. An improved fire-safe protective design was recommended (i.e., leave firebreaks around structures such as parking lots or landscaping).

INL identified close to 300 resilient solutions to mitigate projected increases in climatic hazards and consolidated them into 11 solution categories:

1. Upgrade or replace older, inefficient HVAC systems
2. Upgrade Site drainage plan and systems
3. Harden energy supply and infrastructure, including modular reactor installation, electric distribution and system upgrades, and install a second point of interconnect to utility
4. Harden/stabilize road infrastructure
5. Enhance fire-safe protective design
6. Fortify critical infrastructure and supply chains
7. Install additional backup power for vulnerable critical buildings and operations
8. Support the study, development, and installation of microgrid infrastructure systems
9. Update underperforming infrastructure and implement adaptable infrastructure strategies
10. Improve human capital systems that contribute to increasing human resilience
11. Implement processes that enable a healthy and robust ecosystem that sustains sagebrush-dependent species

While the VARP identified current climatic vulnerabilities, some of these mission-critical assets and infrastructure maintain high adaptive capacity to withstand increased frequency and duration of climate hazards. Adapted climate resiliency measures already taken include:

- Xeriscape landscaping to provide firebreaks around buildings. Use of climate adapted plants better suited to the high desert environment to reduce the need for supplemental water,
- Renewing building envelope and infrastructure (e.g., reroof, HVAC upgrade or replacement, make-up air installation) to withstand increased climatic events that would otherwise threaten mission operations,
- Hardening roads and grounds (e.g., roadway replacement, apron replacement, sidewalk replacement) to endure increased heat and cold waves that could result in buckling and failure,
- Improving sitewide drainage (e.g., installing gutters, sitewide drainage plans, storm drain catch basin) to catch and reserve supplemental water sources and improve drainage during high precipitation events,
- Establishing redundancy in operations (e.g., redundant water tank, replacing generators) to ensure Laboratory-wide operations and missions continue amidst increased pressure on systems that could cause failure.

6. LEED

The Leadership in Energy and Environmental Design (LEED) rating system provides a certification that can be used to promote the building's operational efficiency and meet many of the Guiding Principles requirements. Consult with the Project Management Office regarding DOE O 413.3B requirements related to LEED.

The LEED rating system and certification by the U.S. Green Building Council (USGBC) is one industry standard peer-reviewed mechanism for validating the design and construction of green buildings. While there is a small initial investment for preparing the LEED submittal package and administrative fees to the USGBC for registering and certifying a building, the cost premium is typically recovered through reduced energy and operating costs for the building over its life. Furthermore, the documentation deliverables and building commissioning process required by both LEED and the Guiding Principles help ensure that the building will perform according to its design potential.

Within the DOE Complex, several sites have achieved LEED certification on new buildings. For a list of federal and private buildings certified through the USGBC, see http://www.usgbc.org/projects.

INL has several buildings that achieved LEED certification:

- Center for Advanced Energy Studies (LEED Gold)
- Advanced Test Reactor Complex Common Support Building (LEED Certified)
- Radiological Environmental Sciences Laboratory (LEED Gold)
- Energy Systems Laboratory (LEED Gold)
- Materials and Fuels Complex Irradiated Materials Characterization Laboratory (LEED Gold)
- Energy Innovation Laboratory (LEED Platinum).

Several LEED rating systems are available for specific building types and applications. The most applicable rating systems are LEED for Building Design and Construction (BD+C), LEED for Building Operations and Maintenance (O&M), and LEED for Interior Design and Construction (ID+C).

Additional information and details for each of the LEED rating systems may be found on the USGBC website: http://www.usgbc.org/leed.

Each LEED rating system measures the building's sustainable performance by focusing on the following areas of sustainable design, which are similar and generally compatible with the focus areas of the Guiding Principles:

- Integrative Process: Maximize opportunities for integrated, cost effective adoption of green design and construction strategies,
- Location and Transportation: Promote the use of commuting and alternative transportation such as bicycles, mass transit, and alternatively fueled vehicles,
- Sustainable Sites: Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust,
- Water Efficiency: Reduce potable water consumption and/or wastewater treatment demand,
- Energy and Atmosphere: Promote energy efficiency and renewable energy consumption,
- Materials and Resources: Efficient material use through the specification of recycled, rapidly renewable, salvaged, and local building materials during the design and recycling of building waste during construction and occupancy,

- Indoor Environmental Quality: Promote the health and productivity of building occupants by providing well-ventilated and thermally comfortable interior spaces, daylight and views, and materials that do not off gas,
- Innovation: Encourage projects to achieve exceptional or innovative performance.

7. LEASED BUILDINGS

The INL "Leased Building Performance Specification and Standardization" document (SPC-3036) provides guidance for energy and performance criteria for leased buildings. The document also calls out the preference for all electric and net-zero ready buildings.

8. LIFE-CYCLE COST EFFECTIVENESS

High-performance and sustainable building design and Guiding Principles implementation must be done in a cost effective manner. The following resources must be used in the design and planning process to determine if cost effective parameters are satisfied. Documentation of the cost effective analysis will be required by Sustainable INL to show proof of adherence to the Guiding Principles.

Per 10 CFR 436.11, "life cycle cost" means the total cost of owning, operating, and maintaining a building over its useful life (including its fuel and water, energy, labor, and replacement components), determined on the basis of a systematic evaluation and comparison of alternative building systems, except in the case of leased buildings in which the life cycle cost shall be calculated over the effective remaining term of the lease.

The DOE process for determining life-cycle cost effectiveness is found in 10 CFR Part 436, Subpart A, "Methodology and Procedures for Life Cycle Cost Analyses," which establishes a methodology and procedures for estimating and comparing the life cycle costs of federal buildings, for determining the life-cycle cost effectiveness of energy conservation measures and water conservation measures, and for rank ordering life-cycle cost effective measures to design a new federal building or to retrofit an existing federal building. It also establishes the method by which efficiency shall be considered when entering into or renewing leases of federal building space.

The term "cost effectiveness" should include the use of benefit-cost analysis in accordance with Office of Management and Budget (OMB) Circular A-94.

9. BEST PRACTICES

This section summarizes several best practices for achieving success when designing, acquiring, and/or operating high-performance buildings. The best practices list is not all-encompassing, but it does outline design and construction recommendations that work well for INL's geographic area:

- Incorporate high-performance sustainable design requirements into the critical decision process and conceptual design as prescribed in DOE O 413.3B and its associated guide DOE G 413.3-6B, "High-Performance Sustainable Building."
- Integrated design is a requirement of the Guiding Principles. "LEED Building Design and Construction Checklist," provides an overview of integrated design for further discussion during each stage of the design and construction process and can be found at the link to the USGBC in the References section of this document. Using an integrated design process will help to ensure the building is designed in a holistic manner. Integrated design is a team approach that includes all stakeholders involved in the building design, construction, and eventual operation and ownership.

- Individual building systems should not be designed without considering their effect on other building systems. An example of good technical integrated design would be sizing HVAC systems to include heat generated from internal loads such as server rooms, kitchens, legacy lighting systems, and similar. The constructed building would be more cost effective over its life if it is not over-heated or over-cooled and would likely have reduced capital costs during construction.
- Building design energy simulation is a significant part of integrated design. Energy simulation modeling results for energy use should be completed for each phase of the design process. These models should highlight energy/load reductions for each design alternative and energy efficiency measure.
- The best strategy for lighting is to first minimize the amount of lighting needed and then control the light so it is energized only when the areas are occupied. Consider using task lighting whenever possible to reduce the amount of general area lighting needed.
- Investigate if natural light can provide all or some of the lighting in any spaces ("daylighting"). Then, include daylighting and automated dimming controls in the design. Daylighting is akin to using renewable energy. It provides an improved work environment and reduces lighting system needs. Daylight simulation (physical or digital models) for critical functional spaces should be performed as part of the conceptual design and final design development packages.
- All internal and external lighting should be light-emitting diode (LED) technology. LED lighting will provide improved efficiency, quality, and quantity of light. LED lighting will also provide significant reduction in relamping and lighting-related maintenance over the lifetime of the building.
- Occupancy controls are required to meet ASHRAE 90.1. Consider the use of wireless lighting controls to reduce the cost of installation and make the final lighting control design more flexible. At a minimum, occupancy control should be provided to all common use areas such as restrooms, conference rooms, and break rooms.
- Specify the most efficient HVAC equipment that is cost effective. Specify setback/setup temperature control and economizer cycles for all HVAC equipment. Consider tying zone conditioning in parallel with lighting occupancy to allow standby conditions when zones are unoccupied during normal building open hours. Consider evaporative cooling where appropriate. Full building control systems are the preferred method of controlling all building functions, including lighting, and must be compatible with INL Engineering Specification 230914, "Instrumentation and Control Devices for HVAC."
- Carefully consider the following high-performance design strategies for INL's geographical area:
  - Use outside air (economizer) in lieu of mechanical cooling when ambient conditions are appropriate to meet indoor cooling needs,
  - Cool roof (white) with R30 insulation (INL standard since 2010)
  - High insulation levels throughout,
  - Entry vestibule design to mitigate against high winds,
  - Provisions for air handling unit (AHU) exhaust air to pass through entry vestibules and mechanical/electrical rooms prior to being expelled to the outside where appropriate,
  - Thermostats with overrides tied into the building automation system, allowing occupants to temporarily set individual zones to occupied conditions during normally unoccupied periods.
- Calculate life cycle costs to compare capital and projected O&M costs and use these results to make informed decisions during the design process.
- Document post-construction and maintenance-related recommendations to help building managers better understand overall operations of assigned buildings.

- Ongoing Measurement and Verification. As part of measurement and verification required by the Guiding Principles, regular summaries of energy and water trending should be provided to building management personnel, including at minimum, a breakdown for HVAC, lighting, and plug loads when sub-metered. This type of trending assist building managers identify systems that become less efficient over time or when controls have failed.
- Post Occupancy Evaluation. Consider using staff surveys for new buildings at the end of Year 1, Year 2, Year 5, and then every five years to evaluate thermal and visual comfort and indoor environmental quality attributes. Survey results, when taken in conjunction with measurement and verification data, may well be used to help understand how HVAC systems and air distribution change over time.

10. ADDITIONAL RESOURCES

Many resources are available from other DOE laboratories and within external professional organizations that can attest to successfully implementing high-performance building projects. The following resources, arranged alphabetically, are recommended for more information on designing, constructing, operating, and leasing high-performance sustainable buildings:

- International Institute for Sustainable Laboratories (I2SL), http://www.i2sl.org/

  The I2SL is devoted to the principles of sustainable laboratories and related high-technology facilities, from design to engineering to operation. Through worldwide partnerships and the exchange of technical expertise, I2SL will encourage the development of high-tech facilities that address the rapid pace of science, medicine, research, and development in an ever-changing and dynamic environment.

- Smart Labs Toolkit, https://betterbuildingssolutioncenter.energy.gov/smart-labs-accelerator-toolkit

  Coordinated by DOE, partners work together to develop standardized approaches to overcoming common barriers to energy efficiency in laboratories.

- Sustainable Facilities Tool, https://sftool.gov/

  The Sustainable Facilities Tool (SFTool) provides information to help conserve resources and reduce operating costs by bringing together sustainability information, case studies, and a green product search. Use the SFTool as a quick reference for day-to-day questions or dig deeper to understand more about efficiency, indoor environmental quality, conservation, and synergies between them.

- Sustainability Performance Office (SPO), https://www.energy.gov/management/spd/sustainability-performance-division

  The U.S. DOE Sustainability Performance Office (SPO) oversees departmental sustainability efforts and related federal laws and regulations. SPO proactively leads DOE's sustainability efforts, collaborates with DOE programs, and promotes the cost effective use of resources while monitoring the effectiveness of sustainability programs and initiatives.

- FEMP Energy-Efficient Covered Product Categories, https://www.energy.gov/eere/femp/search-energy-efficient-products

  Federal agencies are required to purchase energy-efficient products. To help buyers meet these requirements, the FEMP maintains acquisition guidance for product categories, which are specified under various efficiency programs.

- University of Idaho Integrated Design Lab (IDL) in Boise, Idaho, www.idlboise.com

  The University of Idaho IDL in Boise, Idaho, is dedicated to developing high-performing, energy-efficient buildings in the Intermountain West. This mission is approached through research as well as education and outreach to students, owners, and professional design and construction teams to transform design practices and keep pace with technologies, materials, and methods of construction that best meet the needs of building owners and society in general. Those who use IDL's resources will design and construct buildings that are more comfortable for people, require less energy to maintain and operate, and enhance the health and productivity of their occupants.

- U.S. Green Building Council Website, www.usgbc.org

  Green building resources include LEED checklists, reference guides, other technical information for the various LEED rating systems and registration for courses and workshops. LEED Reference Guides are available for purchase.

- Whole Building Design Guide, www.wbdg.org

  The website is a portal that provides government and industry practitioners with one-stop access to up-to-date information on a wide range of building-related guidance, criteria, and technology from a whole building perspective. The website hosts FEMP training on sustainability topics, including the Guiding Principles: http://www.wbdg.org/continuing-education/femp-courses.

11. SUMMARY

This High-Performance and Sustainable Building Strategy provides a guide for sustainable design at INL. Following the recommendations and requirements outlined within will assist obtaining the most sustainable, efficient, and healthy buildings possible for INL.

Including high-performance and sustainable technical and functional requirements early in the facility development process will result in the maximum sustainability possible for the least amount of capital outlay. If performed correctly, resultant buildings will be more life-cycle cost effective and may reduce initial capital cost of design and construction.

Providing healthy sustainable buildings is the key for INL's future in attracting the best and brightest minds to support INL's mission.

The recommended review cycle for this document is annually or as needed to stay current with the most recent executive and DOE orders and the latest versions of the Guiding Principles, LEED rating systems, and the relevant INL programs.

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