SUSTAINABLE DESIGN OF FACILITIES

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It derives from P342, Engineering Standards, which is issued under the authority of the Division Leader of Engineering Services as part of the Conduct of Engineering program implementation at the Laboratory.

LANL-only
Contact the Standards Chapter POC for interpretation or variance; please make suggestions here

New in this revision (full history in Revision Record of at the end)

Guiding Principles effective buildings size changed to 5,000 GSF. Requirements Table updated and Chapter reorganized. Minor revisions and deletions of definitions and terms. Note: The Clean Energy Rule (CER) will not take effect before May 1, 2026, so it is not addressed.

ABBREVIATIONS AND DEFINITIONS

Abbreviations and definitions are maintained in the *Conduct of Engineering Glossary*, GLOS-COE-1. The following are included for convenience or are specific to this chapter.

Abbrev.	Meaning
EPP	Environmentally Preferable Products
FEMP	Federal Energy Management Program (DOE organization behind DOE-specific energy mandates)
GBCI	Green Business Certification Inc.: the certifying agency for LEED and other certification systems.
GP	The group of criteria defined by *Guiding Principles for Sustainable Federal Buildings and Associated Instructions* issued by the Council on Environmental Quality in December of 2020. *Often referred to as "The Guiding Principles," the document outlines a set of sustainable principles and practices to guide agencies in designing, locating, constructing, maintaining, and operating Federal buildings in a sustainable manner.*
IEBC	*International Existing Building Code*, published by the International Code Council (ICC)
LCCE	Life-Cycle Cost-Effective *(analysis discussed in detail at this link)*
LEED®	Leadership in Energy and Environmental Design: a green building rating system developed by United States Green Building Council (USGBC) and certified by Green Business Certification Inc. (GBCI).
SD	Sustainable Design (green building)
USGBC	U.S. Green Building Council: the organization that developed the Leadership in Energy and Environmental Design (LEED®), a green building certification system.

Term	Definition[1]
ASHRAE 90.1	ANSI/ASHRAE/IESNA 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
Federal Building	Any building to be constructed by, or for the use of, any Federal agency including buildings built for the purpose of being leased by a Federal agency.
Federal high-performance building	A federal building that does not meet all requisite criteria outlined in the *Guiding Principles for Sustainable Federal Buildings* due to its inherent function, mission, safety, or other factor; but which has optimized the GP's criteria on a life-cycle basis.
Green building certification system	A type of building certification system that rates or rewards relative levels of compliance or performance with specific environmental goals and requirements. Rating systems and certification systems are terms frequently used interchangeably. Examples include Guiding Principles, LEED, Green Globes, and Living Building Challenge.
Modernization	The comprehensive replacement or restoration of virtually all major systems (such as plumbing, mechanical, electrical), interior finishes (such as ceilings, partitions, doors, and floor finishes), and building features (as in space reconfiguration or exterior wall, window, or roof replacement).
No-waste building	A building that is operated to reduce, reuse, recycle, compost, or recover solid waste streams (with the exception of hazardous and medical waste), thereby resulting in zero waste disposal.
No-water building	A building that is designed, constructed, or renovated and operated to greatly reduce total water consumption, use non-potable sources as much as possible, and recycle

[1] Adapted from *Guiding Principles for Sustainable Federal Buildings* and elsewhere.

	and reuse water in order to return the equivalent amount of water as was withdrawn from all sources, including municipal supply, without compromising groundwater and surface water quantity or quality.
Remodel/ Renovation	Less than "modernization," but more than a Level 1 Alteration or "Change of Occupancy" or "Change of Use" (e.g., whereby those over 5k GSF must follow Guiding Principles)

1.0 REQUIREMENTS

CAUTION: This subject is evolving rapidly, so check the materials included with the Chapter References and Resources for latest mandates and guidance, and contact the Chapter POC if in doubt. Also – the impact of this chapter on projects can be significant and warrants review early in the project planning and programming phases and is required by CD-1 Approve Alternative Selection and Cost Range (the OK to start preliminary design) in DOE Order 413.3B. Table 1 summarizes the chapter sections to be followed.

TABLE 1. Chapter Section Applicability

CHAPTER SECTION		PROJECT SCOPE					
		New Equipment, "Alteration"[2], or "Change of Occupancy or Use"	Remodel/Renovation/ Modernization		New Buildings and Additions		If per DOE O 413.3B*
			≤5,000 GSF	>5,000 GSF	≤5,000 GSF	>5,000 GSF	
1.1	Products and equipment	X	X	X	X	X	X
1.2.A	EV Chargers	X	X	X	X	X	X
1.2.B	Utility meters			X		X	X
1.2.C	SME Review	X	X	X	X	X	X
1.3.A	Federal Efficiency Standards				X	X	X
1.3.A.6	Efficient Labs[3]	X	X	X	X	X	X
1.3.B	ASHRAE 90.1	X	X	X			
1.4.A	Guiding Principles			X		X	X
1.4.B	LEED Gold						X

***** Also, when *DOE O 413.3B Program and Project Management for the Acquisition of Capital Assets* is applicable *(e.g., ≥$50M)*, and the building exceeds 25,000 GSF, fossil fuel energy used for building operations shall be eliminated.

USAGE NOTES:

1. Significant requirements have been numbered (e.g., "Requirement 14-00YZ" appears after a paragraph or heading). A separate document available on the chapter webpage and for LANL internal use captures and categorizes the basis for each.
2. When multiple, separate projects, in their aggregate, may result in extensive alterations or modernization of a building, projects should coordinate with the Chapter POC/SME, and other projects, to ensure compliance.

[2] LANL-centric IEBC alteration-type definitions are in GLOS-COE-1 (previously ESM Ch 16, Section IBC-GEN FM01(I) Preliminary Project Determinations Instructions). If other Table 1 project scopes are also applicable, follow them preferentially to this column.
[3] Efficient Lab best-practices to be followed when scope of work includes design or alterations to fume hoods or other exhaust systems in laboratory spaces to ensure success meeting requirements in sections 1.3.A, 1.3.B, 1.4.A, and 1.4.B.

3. To expedite preferred product specifying, several LANL Master Spec sections have been revised to specify statutory products where appropriate; however, this may not address all potential products for every project, therefore, the project's design agency is responsible for the creation of appropriate project spec sections.

4. For LEED projects, LMS Section 01 8113.13 Sustainable Design may assist with collection of related project documentation; however, it will require modification for application to only Guiding Principles (GP) projects or ones that require both certifications.

1.1 SPECIFICATION AND PROCUREMENT OF PRODUCTS AND EQUIPMENT (EPP)

(REQUIREMENT 14-0001)

A. When specifying and procuring products or services for construction, compliance with the following statutory programs is required:

   1. EPA Comprehensive Procurement Guidelines (CPG) Program. Purchase program-designated products with the EPA recommended content levels to the maximum extent practicable as identified under the CPG program.

   2. USDA BioPreferred ® Program. Purchase program-designated products to the maximum extent practicable that meet USDA BioPreferred's minimum biobased content level, or the highest percentage biobased material practicable.

   3. ENERGY STAR® Program or Federal Energy Management Program (FEMP). When purchasing energy- or water-consuming equipment, it shall meet the Federal requirements.

   4. EPA SNAP Program. Appliances or HVAC equipment that contain refrigerants must be approved by refrig_approval@lanl.gov.

B. When both an EPA-designated item and a BioPreferred item could be used for the same purposes, and a product that meets both is not available, select the CPG Program item.

C. Projects should also prioritize multi-attribute preferred products and services identified in Chapter's Attachment 1 - Environmentally Preferable Products for Specifications. ***When purchasing for a GP or LEED facility, low-emitting materials may be required.***

D. If a product or service cannot be obtained due to any criteria below, then a written justification may be submitted to the contracting officer to seek exemption from the statutory program requirements.[4]

   1. not available within a reasonable schedule,

   2. unreasonable price (initially over 10% more, or higher life-cycle cost), or

   3. fails to meet reasonable performance requirements.

Guidance: ENERGY STAR-qualified and FEMP-designated products may be assumed to be LCCE. In making a determination that a product is ***not*** *LCCE, rely on analysis methods in 10 CFR 436, subpart A.*

For further guidance on product categories refer to the listing of required EPP and recommended attributes in ESM Chapter 14, Attachment 1[5]. Additional resources are posted with the Chapter.

[4] Per FAR Clause 23.103(a)(2)). For approval, contact Contracting Officer (LANL ASM Procurement Specialist) for D.1 or D.2, and applicable Standards POC for D.3.
[5] Attachment 1 to the Chapter may be updated periodically by Ch 14 POC-only approval and without revision to chapter body due to on basis changes.

1.2 GENERAL REQUIREMENTS

A. Provide **electric vehicle (EV) chargers** where dedicated Government Owned Vehicle (GOV) parking is part of the scope of the project at 25% of GOV spaces (round to the nearest even number). When non-GOV parking is part of the scope of the project, EV chargers may also be needed to meet Guiding Principles or LEED requirements. (Requirement 14-0002) *Guidance: A Standard Detail set (ST-G4090-1 – 6) has been developed to assist with same.*

B. Provide **meters** (building and sub-level) per Attachment 2, *Utility Metering Requirements*.[6]

C. **Review**: A LANL SD SME (e.g., Chapter POC or UI-Utilities Resource Management) shall review new construction and major modernization projects to ensure compliance with this chapter.[7]

1.3 ENERGY EFFICIENCY IN BUILDING DESIGN AND CONSTRUCTION

A. **Energy Efficiency Standards for New Federal Construction**

1. Design new buildings and additions to meet ASHRAE 90.1-2019 and, if life-cycle cost-effective, achieve energy consumption levels that are at least **30% below the levels of the 2019 ASHRAE Baseline Building**. (Requirement 14-0003)

2. If a 30-percent reduction is not life-cycle cost-effective, the design shall be modified to achieve an energy consumption level at or better than the maximum level of energy efficiency that is LCCE, but at a minimum complies with ASHRAE 90.1-2019.

3. Energy consumption for the purposes of calculating the 30% savings requirement shall include the building envelope and energy consuming systems normally specified as part of the building design by ASHRAE 90.1 such as space heating, space cooling, ventilation, service water heating, and lighting and all receptacle and process loads, except for energy-intensive process loads that are driven by mission and programmatic/operational requirements, not necessarily buildings, and not influenced by conventional building energy conservation measures such as specialized medical or research equipment and equipment used in manufacturing processes.

4. Energy consumption levels for both the ASHRAE Baseline Building and proposed building shall be determined by using the **Performance Rating Method found in Appendix G of ASHRAE 90.1** (the ASHRAE Standard 90.1 Performance Based Compliance Form shall be provided for LANL review at 30% design completion). The formula for determining percentage of improvement shall be as follows (Sections in 90.1-2019):

Percentage improvement = 100 x (1-PCI/PCIt), where:

PCI = Performance Cost Index calculated per Section G1.2

PCIt = Performance Cost Target calculated by formula in Section 4.2.1.1.

5. De minimis usage: When the total energy consumption from all sources is less than 12.7 kBtu/GSF/yr, ASHRAE Performance Rating Method (Appendix G) energy modeling is not required; however, in lieu of, and no later than preliminary design review (30%), a simple calculation estimating energy use shall be provided to LANL SD (e.g., UI-Utility Resource Management) and Mechanical

[6] Per Energy Policy Act of 2005, and LANL Utilities and Infrastructure.
[7] PAR (nee PRID triggers if a project involves a new structure or facility modifications involving electrical, natural gas, water, ventilation (excludes demolition).

SMEs for concurrence. Then, no later than final design (90%), a COMCheck report shall be provided to demonstrate compliance with mandatory provisions of ASHRAE 90.1-2019. No documentation of any kind is needed for facilities without external power or only lighting.

Guidance: ASHRAE 90.1 training slides may be posted with this Chapter's "References." Also, the 90.1 "User's Manual" is a 'must have' when addressing anything in the Standard.[8]

6. Laboratories: To meet the energy efficiency standards when designing and constructing new lab spaces, follow energy efficient laboratory design principles when safe and LCCE. If judged not possible, or not LCCE, a reduction in this requirement will be allowed through a formal process (e.g., Variance Form 2137). (Requirement 14-0004).

   Applicable projects shall consider using the International Institute of Sustainable Laboratories' (I2SL) I2SL Best Practice Guides and the Smart Labs design guidelines. Design using these best practices where applicable will assist in meeting the required energy efficiency metric for GP and Federal Efficiency Standards and includes these seven key elements:

   a. Dynamic, direct-digital control systems,

   b. Real time demand-based ventilation to control air changes per hour,

   c. Efficient lighting (LEDs with occupancy sensors or timers),

   d. Optimization or reduction of the exhaust fan discharge velocity (design study of exhaust dispersion based on site conditions),

   e. Pressure drop optimization,

   f. Fume hood flow optimization: apply AIHA/ANSI Z9.5 Standard to analyze if fume hood standby ventilation can be reduced,

   g. Final commissioning and continuous commissioning with automated cross platform fault detection diagnostics. At LANL, fault detection diagnostic software is managed by MSS-APT and is easily achievable with a digital control system on the yellow network.

   LANL is an implementing partner of DOE's Smart Lab Accelerator Program. The Smart Lab concept includes an integrated set of laboratory design criteria and performance standards that improves safety protocols and reduces energy consumption while offering continuous commissioning for real-time monitoring of facility conditions. Contact Chapter POCs and refer to postings with the Chapter for more information.

B. **Efficiency Requirements for Remodels, Renovations and Modernizations.** (Requirement 14-0005)

1. **New systems**[9] **and equipment**[10] in existing buildings, whether part of an alteration or stand alone, shall follow the ASHRAE 90.1-2019. Efficiency of equipment must meet the more stringent of ASHRAE 90.1-2019 or 10 CFR 436 (Section 1.1.A.3. above) when applicable.

2. **All other building alterations** shall follow the ASHRAE 90.1-2019.

[8] LANL internal access via Accuris; LANL-external can purchase here.
[9] A system, as defined by ASHRAE 90.1-2019, is a combination of equipment and auxiliary devices (e.g., controls, accessories, inter-connecting means, and terminal elements) by which energy is transformed so it performs a specific function, such as HVAC, service water heating, or lighting.
[10] Equipment, as defined by ASHRAE 90.1-2019, are devices for space or cooling, ventilation, humidification, dehumidification, electric power, lighting, transportation, refrigeration, cooking, or service water heating. See ASHRAE 90.1-2019 for full definition and examples of equipment type.

3. **Change in Space Conditioning or Change of Occupancy or Use that would result in an increase in demand for energy** (such as warehouse to office space) shall follow the ASHRAE 90.1-2019, Section 4.1.1.5. A change of use that does not result in an increase in demand for energy shall follow items 1 or 2 above for all alterations taking place with the change.

4. **Compliance** for remodels, renovations and modernizations shall be shown through the use of COMCheck or ASHRAE Compliance Form.

5. **When adding or renovating fume hoods or laboratory exhaust systems**, due to Federal requirements for facilities to reduce energy intensity and use life-cycle cost analysis[11], follow energy efficient laboratory design principles in 1.3.A.6 above, when safe and LCCE. (Requirement 14-0006)

1.4 SUSTAINABLE BUILDING DESIGN AND CONSTRUCTION

A. Guiding Principles (GP) for Sustainable Federal Buildings

1. New construction, additions, renovations, and modernization of buildings[12] over 5,000 square feet shall comply with the requisite criteria of the most current Guiding Principles for Sustainable Federal Buildings by meeting 18 core and 9-out-of-12 non-core criteria using Appendix A or B of the GP. (Requirement 14-0007)

   a. For projects pursuing LEED certification, because some Federal regulations do not necessarily correlate with LEED prerequisites and credits and others do, an abbreviated checklist is available from the Chapter POC and posted with the Chapter resources. LEED certification does not substitute for Guiding Principles.

   b. The building's inherent function, mission, safety, or designation may preclude it from meeting the minimum threshold of requisite criteria in a life cycle cost-effective manner [42 U.S.C. § 17061(12)]. A building that has only met the criteria that are life cycle cost-effective may be designated as a "Federal high-performance building." GP performance must be tracked and reported to Chapter 14 POC/SME throughout the project regardless of expected outcome. Remodels and Renovations following the GP are not required to expand scope to meet a criterion.

2. Project management must establish roles and responsibilities for project verification and identify such in Statement of Work or other pertinent project documents (default is Design Agency unless otherwise indicated).

3. Buildings that are exempt from compliance with the GP:

   a. are non-building assets; or

   b. are leased; or

   c. slated for disposal (as a status indicator of report of excess [ROE] submitted or ROE accepted, Determination to Dispose, or Surplus; or

   d. meet all these conditions:

      i. Unoccupied: The building is occupied 1 hour or less per person per day on average,

      ii. Low/No Energy Use: Total usage from all sources is less than 12.7 kBtu/GSF/year, and

[11] 42 USC 8252, Energy Policy Act of 2005 (requires life-cycle cost analysis), EISA 2007, and Energy Act of 2020.
[12] Includes joined transportables when over 5,000 square feet.

iii. Low/No Water Use: Consumption is less than 2 gal/day on average.

Additional resources can be found on GSA's Clearinghouse.

B. **Fossil Fuel-Generated Energy and LEED Gold certification**

For New buildings, additions, renovations, and modernizations with a TEC over the threshold defined by DOE O 413.3B (e.g., $50M), and when required by the order:

1. Fossil: Individual buildings over 25,000 gross square feet, must be designed to use no fossil fuel-generated energy for building operations by 2030[13]. Where feasible also design to achieve a no-water building and no-waste building. (Requirement 14-0008)

2. LEED: The projects must meet U.S. Green Building Council's LEED v4 Gold or higher certification (including registration, submission of documentation, verification, and installation of plaque)[14] absent an approved waiver from the National Nuclear Security Administration (NNSA) Project Management Executive (PME). (Requirement 14-0009)

Guidance: New construction and major renovations normally follow LEED BD+C; Refer to www.usgbc.org. LEED applies prerequisite and optional credits for the siting, design, construction, commissioning, and operation of new facilities and modernizations of existing facilities.

3. When pursuing LEED, the design agency (Engineer of Record or Architectural and Engineering subcontractor), is responsible for registering, submitting documentation, and ensuring certification through GBCI including costs related to registration and certification. Project management may establish different roles and responsibilities and identify such in Statement of Work or other Project documents.

4. LEED-Ineligible Projects

   a. When the PME confirms LEED v4 Gold requirements cannot be met for a NNSA capital asset project with a Total Project Cost of $50M or greater, a LEED waiver process shall be implemented. The NNSA LEED waiver process is available with the Ch 14 references.

   b. LEED certification depends on a project meeting LEED Minimum Program Requirements (MPRs).[15] Parking structures, exclusively process and power-generating buildings, and distribution systems are exempt. (Requirement 14-0010).

   c. Major Renovations under LEED BD+C

      i. If planned renovations are less than either (1) 50% of building's aggregate gross square footage[16] or (2) Total Estimated Cost (TEC) under 25% of the replacement value of the building, then

[13] Effectively, any project starting in 2025 or later should design for the requirement by implementing building electrification. Ref. Appendix C, Part 5 of DOE O 413.3B Chg 7.
[14] Ref. DOE O 413.3B Chg7 (began with Chg4). Also, buildings which are part of a phased project for which DOE O 413.3B Program and Project Management for the Acquisition of Capital Assets is applicable, such as multiple new, collocated buildings, where combined project cost meets threshold. See USGBC Rating System Selection Guidance.
[15] For v4, MPRs include: minimum 1000 gross square footage; complete, permanent location on existing land, and other criteria.
[16] Projects not meeting this definition would be rejected by USGBC, who's 2010 Selection Guide defined **Major Renovation as: "**Includes extensive *alteration* work in addition to work on the *exterior shell* of the building and/or *primary structural components* and/or the core and peripheral MEP [mechanical/electrical/plumbing] and service systems and/or site work. Typically, the extent and nature of the work is such that the *primary function space* cannot be used for its intended purpose while the work is in progress and where a new certificate of occupancy is required before the work area can be reoccupied." Standards Program concurrence ensures consistent interpretation.

the project is ineligible for LEED certification. (Requirement 14-0011).

2.0 ATTACHMENTS

Attachment 1, *Environmentally Preferable Products for Specifications*

Attachment 2*, Utility Metering Requirements*

REVISION RECORD

Rev	Date	Description	POC	OIC
0	2/9/04	Initial issue as ESM Ch. 1 Section Z10 App A, expanding SD material from Arch Chapter.	Tobin Oruch, *FWO-DO*	Gurinder Grewal, *FWO-DO*
1	6/9/04	Organizational and wording changes for clarity.	Tobin Oruch, *FWO-DO*	Gurinder Grewal, *FWO-DO*
2	5/18/05	Z10 App A became Ch. 14. Added waste min plan, IECC vice 90.1 option for GPPs, LEED for line items, other minor changes.	Tobin Oruch, *ENG-CE*	Gurinder Grewal, *ENG-CE*
3	10/27/06	Admin changes only. Org and contract reference updates. Doc number changes based on IMP 341. Other admin changes.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
4	6/11/07	Added 30% better than ASHRAE 90.1-2004. LANL to pay LEED fees.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
5	6/16/08	Revised to address changes in final 10CFR433, including additions, HVAC upgrades, plug load calcs, projects underway. Incorporated 430.2B requirements including LEED Gold and ENERGY STAR. Deleted PM 411 and other old reporting requirements.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
6	8/25/10	Added IECC as minimum requirement for new buildings, additions, and alterations. Deleted 10CFR433/434 for process buildings. Noted $5M LEED is TEC and deleted restriction to LEED-NC; delivery team to pay fees. Eliminated report for sub-LEED buildings.	Tobin Oruch, *CENG*	Larry Goen, *CENG*
7	4/5/11	Deleted 30% > ASHRAE for renovations; clarified HPSB requirement; for LEED, added off-ramps and clarified.	Tobin Oruch, *CENG*	Larry Goen, *CENG*
8	8/28/13	Updated LEED driver, criteria; ASHRAE 2007 or 2010 vice 2004. EPP requirements and Att. 1; other changes.	Tobin Oruch, *ES-DO*	Larry Goen, *ES-DO*
9	11/26/18	New summary table, 90.1 and/or IECC, invoked 10CFR433 directly, newer HPSB GPs, new LEED threshold, other changes.	Tobin Oruch, *ES-FE*	Larry Goen, *ES-DO*
10	7/31/19	Aligned HPSB and LEED requirements to NNSA Federal Green Buildings Training, stressed Smart Labs, other minor changes throughout. Updated Attachment 1.	Tobin Oruch, *ES-FE*	Jim Streit, *ES-DO*
11	09/26/22	Adopted ASHRAE 90.1-2016 (and 2019 when mandated) to align with 2018 IECC. Mandated 2020 GPs. Added Zero Carbon Emissions Ready requirements per EO 14057. Added Attachment 2 on metering per VAR-10538. Added Definitions and Bases for Requirements; clarified	Dalinda Bangert, *UI-OSI*	Mike Richardson, *ES-DO*

Rev	Date	Description	POC	OIC
		requirements throughout, moved much guidance to references maintained on chapter webpage. Deleted references to specific versions. Added Requirements ID Log references and moved bases/footnotes to log (LANL internal-use log posted with chapter).		
12	02/09/24	Changed GSF threshold for GP requirement. Added Net-Zero Emissions Building requirements per DOE Orders 436.1A and 413.3B Chg. 7, and updated definitions. For 10CFR433, updated formula to calculate percentage of improvement to align with current version. Reformatted Table 1 and adopted ASHRAE 90.1 vice IECC-2018. Clarified Bases and requirements throughout. Removed solar hot water requirements and other USC citations.	Dalinda Bangert, *UI-OSI*	Mike Richardson, *ES-DO*
12.1	04/24/24	Revised Table 1 summary of requirements for $50M and Sections A & H to reflect later sections.	Dalinda Bangert, *UI-OSI*	Mike Richardson, *ES-DO*
13	07/21/25	Guiding Principles effective buildings size changed to 5,000 GSF. Requirements Table updated and Chapter reorganized. Minor revisions and deletions of definitions and terms. Note: The Clean Energy Rule (CER) will not take effect before May 1, 2026, so it is not addressed.	Dalinda Bangert, *UI-RM*	Mike Richardson, *ES-DO*