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SUSTAINABLE DESIGN OF FACILITIES

This mandatory functional series document is available to all online at http://engstandards.lanl.gov.

It derives from P342, Engineering Standards, which is issued under the authority of the Associate Director of Engineering and Engineering Sciences (ADE) as part of the Conduct of Engineering program implementation at the Laboratory.

REVISION RECORD

Rev	Date	Description	POC	OIC
0	2/9/04	Initial issue as ESM Ch 1 Section Z10 App A. Includes and expands SD material from Arch Chapter.	Tobin H. Oruch, *FWO-DO*	Gurinder Grewal, *FWO-DO*
1	6/9/04	Organizational and wording changes for clarity.	Tobin H. 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 Certification for line items, other minor changes.	Tobin H. Oruch, *ENG-CE*	Gurinder Grewal, *ENG-CE*
3	10/27/06	Administrative changes only. Org and contract reference updates. IMP and ISD 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. Added new resource links. 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*

CONTACT THE SUSTAINABLE DESIGN STANDARDS POC
for upkeep, interpretation, and variance issues

ESM Ch. 14	**Sustainable Design POC / Committee**

1.0 ACRONYMS/DEFINITIONS

LEED	U. S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building rating systems
SD	sustainable design (or green building)

2.0 REQUIREMENTS

NOTE: The sustainable design requirements that appear in this section will need to be incorporated early in the project planning and programming phases.

A. Energy Efficiency: **All new buildings (and additions and alterations** meeting IEBC definition of same) must, as a minimum, meet requirements of the New Mexico version of the International Energy Conservation Code (edition required by and linked from ESM Chapter 16 Section IBC-GEN App A).[1]
   1. Documentation (calculations, product information, etc.) showing compliance with the IECC (or the underlying ASHRAE/IESNA 90.1 requirements) must be submitted for LANL acceptance.

B. In addition to the above, **design office, lab-type, and other commercial-like buildings and additions** to achieve 30% better than ASHRAE 90.1-2004, *Energy Standard for Buildings Except Low-Rise Residential Buildings* (10CFR433 driver reproduced in Appendix A of this chapter).[2]

   1. The building energy use shall be modeled (with model submitted to LANL for acceptance; IECC and other prescriptive methods not sufficient), and compliance shown by a computerized analysis tool meeting ASHRAE 90.1 requirements.[3]

   2. Designer shall include laboratory fume hoods and kitchen ventilation systems as part of the ASHRAE-covered HVAC loads subject to the 30 percent savings requirements, rather than as process loads.

   3. If project believes that 30% is not life-cycle cost-effective, then this chapter's POC shall be consulted; given properly prepared LCC analysis (ref. ESM Ch 1 Z10 App E), a reduction in this requirement will be allowed through a formal interpretation (2176 form).

C. Ensure that **new construction and major renovations of buildings over 5000 sq. ft. -- but less than $5M[4] Total Estimated Costs (TEC[5]) or otherwise unable to meet LEED Gold**[6]

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[1] More extensive modifications and new buildings are subject to the more stringent requirements (30% goal, LEED, etc); in such cases, compliance with IECC is automatic and not a concern.

[2] 10 CFR Part 433 requires this when life-cycle cost effective. Certain industrial facilities (e.g., nuclear) would be exempt based on CFR title; others might not prove cost-effective. The ASHRAE guide for small office buildings and several other studies suggest that 30% would be cost-effective, and with the ability to handle plug loads separately per 10CFR part 433.5, achievement of goal is less challenging. Consultation with POC ensures latest available data is utilized and CFR requirements for LCCA are followed. Meeting above requirement supersedes and satisfies any other ESM whole building requirements suggesting ASHRAE 90.1 latest edition is required.
Consolidated Final Rule text at FEMP site here (12/21/2007)
For renovations, a case might be made that 20% improvement over pre-renovations 2003 baseline (if unknown, use CBECS 2003 data) is appropriate (per MOU on *Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings*

[3] Several tools listed here. See also Selecting Appropriate Building Energy Simulation Software here.

[4] Direct requirement of DOE O 430.2B CRD (Att 1), becoming DOE O 436.1.

[5] TEC is Total Estimated Cost. This is less all costs associated with the programmatic equipment such as project management, design, procurement, installation, commissioning, and readiness acceptance. From DOE G 430.1-1, 03-28-97, Chapter 6 pg 2,

-- comply with applicable Guiding Principles established in the Memorandum of Understanding on Federal Leadership in High Performance and Sustainable Buildings (HPSB) here.

1. Screen the HPSB criteria for applicability, determine necessary measures to achieve applicable goals, and document these decisions and their ultimate completion during construction to the satisfaction of the Engineering Services-Design Engineering Sustainable Design Lead Reviewer or Ch 14 POC. *Templates are available from the POC.*

D. **LEED: New buildings and major renovations and additions in excess of $5M TEC**:

1. Obtain LEED-Gold rating through the U.S. Green Building Council (including registration, submission of documentation, verification, and installation of plaque).[7]
   a. LEED Gold rating gets an automatic 100% Guiding Principles (GP)[8] compliant ranking.[9]
2. When the cost of programmatic equipment (design, procurement, related oversight, etc.) is excluded from the Total Estimated Costs (TEC) calculation and the result is under $5M, obtaining LEED Gold certification is not required. However, the calculation must be made a project record document, available for review.[10]
3. LEED requirement is only applicable where project/building meets LEED Minimum Program Requirements (MPRs) such as minimum 5000 gross square footage; at least one FTE; complete, permanent building or space; etc.[11]
4. Renovations
   a. If planned renovations are less than either (i) 50% of building's aggregate gross square footage or (ii) TEC under 25% of the replacement value of the building, then LEED is not applicable.[12]

TEC is defined as all engineering design costs (after conceptual design), facility construction costs, and other costs specifically related to those construction efforts. These are typically capitalized. TEC will include, but not be limited to: project and construction management during Titles I, II, and III [preliminary & final design, construction]; design and construction management and reporting during design construction; contingency and economic escalation for TEC-applied elements; ED&I during Titles I, II, and III; contractor support directly related to design and construction; and equipment and refurbishing equipment.

[6] Supports 430.2B requirement for percentage of total building portfolio meeting HPSB.

[7] Could be LEED for New Construction, LEED for Neighborhood Development, Core & Shell, etc. See USGBC Rating System Selection Guidance

[8] DOE O 430.2B CRD (Att 1). This will result in meeting the Guiding Principles of Executive Order (EO) 13423. Constructing to LEED Gold will generally ensure elements are met so this is not burdensome. The full text of the "Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding" is here: MOU. The Federal requirements are that all "new construction and major renovations" must follow the GPs.

[9] LEED off-ramps (2-6) that follow are with concurrence of Wayne Evelo (DOE/NNSA/Los Alamos Site Office, Energy & Natural Resources Prgm Mgr), following input by DOE-HQ, per 4/4/2011 email. Ref ESM-CIR-2011-010.

[10] Outside of DOE and a few other situations, USGBC's LEED rating systems are voluntary and generally focused on traditional building sustainability, not programmatic equipment matters. Were such equipment costs included, some very small scope or scale projects might be subject to LEED whereas they would never be considered for LEED elsewhere as it would not be cost-effective. Programmatic equipment is as designated by the Facility DAR (e.g., TA-55 may consider gloveboxes facility whereas another facility might consider them programmatic).

[11] Failing to meet MPRs guarantees USGBC rejection. Square footage increased from USGBC's 1000 per DOE/Evelo direction (consistent with 2010 SSP guidance for HPSB threshold, which is based on OMB grading per Begley, NA-161).

[12] Projects below these thresholds would be rejected by USGBC. TEC of 25% from proposed 10CFR433 rulemaking published at 75 FR 29933. Floor area of 50% corresponds to an IEBC Level 3 Alteration and is also supported by the USGBC Rating System Selection Guidance, Version 2, 11/24/10 which states: "If a particular rating system is appropriate for 40% or less of the

b. If thresholds above are exceeded but the definition of **Major Renovation** from the USGBC Selection Guide is seemingly not met, obtain formal interpretation (LANL Form 2176) regarding applicability of LEED. The Site Chief Engineer is the approval authority for these formal interpretations.[13]

5. For any project which believes either (i) all LEED prerequisites cannot be reasonably met (e.g., energy efficiency upon renovation meeting ASHRAE 90.1-2007, etc.) or (ii) Gold-level credit count cannot be reasonably met, obtain DOE Program/Site Office (e.g., Federal Project Director/acquisition executive) concurrence for waiver or other direction (e.g., alternative certification of LEED Silver, LEED Certified, etc.) by written direction and/or concurrence via project execution plan.[14]

6. When LEED is mandated:

   a. To better ensure successful verification, design and construct to achieve two or more credits than the minimum. Ref http://www.usgbc.org. [15] *Guidance: Project Engineer must decide which party will register with USGBC, pay fees, and submit documentation -- and contract for same if AE. ConsensusDOCS 310 Green Building Addendum is a useful reference in crafting subcontract language. It is "appropriate for use on projects with green building elements, particularly those seeking a third-party green building rating certification such as LEED. It provides a contractual mechanism to identify clear objectives, and assign roles and responsibilities to achieve green goals. The parties designate a Green Building Facilitator (GBF) to coordinate or implement identified objectives, which can be a project participant or consultant. It contemplates that such services will be included in the underlying agreement with the project participant or in a separate agreement with a GBF."*[16]

   b. Guidance: LANL Infrastructure Planning group is increasingly providing the LANL role for sustainability expertise. E.g., providing awareness, information and direction on how to best meet LEED and DOE requirements. This, at times, will include opinions on the proper use of LEED, or not. They will not suggest relief from LEED and/or DOE requirements, in any form, for projects that are clearly intended for compliance.

7. Ensure all new **roofs** have a thermal resistance of at least R-30. Install cool roofs for new construction at CD-2 or less or when replacing roofs unless determined uneconomical by a life-cycle cost analysis. [Secretarial Memo of June 1, 2010]

8. Install **solar hot water** supply in new buildings and major renovations if life-cycle cost effective and if required by DOE O 436.1 (effective upon incorporation of DOE O 436.1 in LANS contract).

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gross floor area of a LEED project building or space, then that rating system should not be used. If a particular rating system is appropriate for 60% or more of the gross floor area of a LEED project building or space, then that rating system should be used."

[13] Projects not meeting this definition would be rejected by USGBC, who's Selection Guide defines **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.

[14] DOE O 430.2B CRD 7.a, which empowers DOE Program/Site Office for same.

[15] DOE O 430.2B CRD (Att 1), added to LANS contract 6/11/08 by Mod 46. Also see Endnote 3 on pg 12 of this document regarding TEAM Initiative and EISA 2007.

[16] Contact Ch 14 POC for details.

9. For new buildings, meet or exceed EPA's "Designed to Earn **Energy Star**" (ENERGY STAR) Building criteria, applying the more stringent of (1) standard set forth in the ENERGY STAR Table of Target Energy Performance Results (achieve rating of 75 or higher) and (2) the 30-percent-better-than ASHRAE 90.1-2004 criteria above. Also: http://www.energystar.gov/index.cfm?c=new_bldg_design.new_bldg_design [17]
10. Develop and follow a **Waste Minimization Plan**. Develop prior to construction start and follow throughout project. *The goal encouraged is that subcontractor recycle or salvage at least 50 percent of construction, demolition and land clearing waste, excluding soil, where markets or on-site recycling opportunities exist.*
11. Projects constructing new **laboratories** shall follow Labs21 principles where life-cycle-cost-effective[18]. Refer to Labs21 and Lawrence Berkeley Lab's Design Guide for Energy-Efficient Research Laboratories for additional SD guidance. Such projects shall consider using the Environmental Performance Criteria of Labs21.
    a. *Guidance: Labs21 Best Practice Guides (may have value for non-lab applications, too): http://www.labs21century.gov/toolkit/*

3.0 GENERAL GUIDANCE

A. Designing, constructing, and operating facilities in an efficient and environmentally sound manner is important to LANL. The LANL Prime Contract and Implementing Procedure 300 (Integrated Work Management) call for all work at the Laboratory to be conducted in an environmentally sound manner and with the application of preventive measures. High-performance facilities are intended to minimize impacts to the site and surrounding areas, optimize energy and water use, enhance worker productivity, provide good indoor environmental quality, incorporate environmentally preferable building products, and manage construction and building operation waste in a resource-conserving manner. This approach to building design, construction, and operation is commonly referred to as sustainable (or green building) design and development (SD). The primary objectives of SD are to:

- minimize, during design, the anticipated waste generation and resource consumption of a facility in all of its life cycle phases: construction, operation, closure, and disposition,
- provide, during design and construction, for the comfort, productivity well-being of building occupants,
- decrease operating and maintenance costs,
- limit, during design, operation, and construction, facility impacts on the surrounding environment and environmental processes (such as the water cycle).

B. It is LANL's goal to apply sustainable design and development principles to all new buildings, additions, and HVAC renovation projects to provide a healthful, resource-efficient and productive working environment. To achieve this goal requires an awareness of and a commitment to sustainable design through an integrated, whole-building design approach.

[17] Ibid.
[18] Ibid; requires use of programs such as this.

C. The LANL Sustainable Design Guide was created to provide guidance on incorporating the latest sustainable building strategies and technologies on LANL-specific projects. It is a thorough, complete, and comprehensive resource for implementation of sustainable design principles and practices specific to LANL project. This resource should be applied to all new facilities and major renovation projects.

D. ASHRAE's "Advanced Energy Design Guide for **Small Office Buildings**" (2004), provides a hands-on approach to design through use of products that are practical and commercially available as "off-the-shelf technology from major manufacturers," and is oriented to achieving a 30% energy savings over ANSI/ASHRAE/IESNA Standard 90.1-1999 (would be about 25% improvement over 2004[19]). The guide focuses on office buildings of up to 20,000 sq. ft. (SD and Mechanical POCs have copies). For medium offices and up to 50% target, also see this PNNL document.

E. **Large office buildings** 50% energy savings technical report recommendations.

F. ASHRAE 90.1-2004 includes a new informative appendix to rate the energy efficiency of building designs that exceed its minimum requirements. The guidance provided in this appendix should be beneficial to HVAC designers.

G. Guidance: The DOE et al has released a report titled "Contrasting the Capabilities of Building Energy Performance Simulation Programs." The report discusses 20 energy-modeling computer programs: BLAST, BSim, DeST, DOE-2.1E, ECOTECT, Ener-Win, Energy Express, Energy-10, EnergyPlus, eQUEST, ESP-r, HAP, HEED, IDA ICE, IES <VE>, PowerDomus, SUNREL, Tas, TRACE, and TRNSYS. Drawing from information provided by the program developers, the report compares the programs' handling of a range of parameters, including daylighting, renewable energy systems, and climate data availability. The report is online at http://www.buildingtools.energy.gov

H. The U. S. Green Building Council's Leadership in Energy and Environmental Design (LEED-NC) Green Building Rating System, (www.usgbc.org) also has LEED-NC Multiple Buildings and On-Campus Building Projects, an application guide that provides direction in applying LEED-NC to projects in a campus or multi-building setting, such as corporate campuses, college campuses, and government installations (i.e. a single owner or common property management and control). It is intended for projects where a) several buildings are constructed at once or in phases, or b) a single building is constructed in a setting of existing buildings with common ownership or planning with the ability to share amenities or common design features. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=276

I. A How-To Guide to LEED Certification for New Mexico Buildings is to be available at www.cleanenergyNM.org and http://chapters.usgbc.org/newmexico/

J. The Whole Building Design Guide (www.wbdg.org) has tools that can help ensure that sustainable elements are incorporated into the facility design.

K. Data center projects should consider Best Practices Guidelines and other materials at http://hightech.lbl.gov/datacenters.html

L. The GSA has documented which LEED credits are most easily achieved in their *GSA LEED Applications Guide, 2/1/2005.* http://www.wbdg.org/ccb/GSAMAN/gsaleeda.pdf

M. New Buildings Institute's (NBI) Advanced Buildings initiative has a number of free resources for energy reduction through its PowerYourDesign.com website. NBI's Core

[19] Also, per PNNL-SA-76651, ASHRAE 90.1-2010 (and IECC 2012) is about 25% better than 90.1-2004/IECC-2006, and ASHRAE 90.1-2007 is about 4% better than 2004.

Performance method may be employed for LEED credits, however, modeling may be required anyway due to 10CFR433.

N. Specific items for consideration as part of this sustainable design effort are referenced by specific discipline in other sections of the ESM. Additionally, key concepts and components of sustainable design, and suggested elements for consideration, are described below. The A/E is encouraged to suggest other measures and develop integrated solutions to meet the intent of sustainable design, and conduct a benefit/cost analysis of selected options. The A/E should coordinate with the ESM Discipline POCs with regards to green building materials, pollution prevention issues, and associated benefit/cost analysis. In all cases, it is essential to evaluate these items from a whole building (integrated) design approach (whole building design looks at how materials, systems and products of a building connect and overlap, and how the building and its systems can be integrated with supporting systems on its site and in its community). To demonstrate a commitment to LANL SD goals and objectives, the following strategies, as confirmed by the responsible LANL Project Manager, will be pursued for all new building and major renovation projects at LANL:

- Adopt energy and environmental performance goals to minimize energy consumption and reduce environmental impacts. General Note: energy efficiency also includes the office products and appliances purchased for new facilities. LANL has requirements to purchase Energy Star compliant equipment (covers offices, appliances, and conference rooms) http://www.energystar.gov/[20]
- Assess opportunities from a whole-building approach to maximize energy and water conservation through comprehensive, integrated evaluations of all components, systems, and, as appropriate, processes.
- Use life-cycle-cost decision-making. See ESM Chapter 1 Section Z10 (App E) on LCC. Also consider FEDS 6.0, which calculates lowest life cycle cost-effective energy systems for all building types. www.pnl.gov/FEDS
- Commission equipment and controls in all new construction and major renovation projects as an integrated effort during design and construction to verify building system performance and functionality for the Users and for Facilities operations and maintenance. Reference ESM Ch 15, Commissioning.
- Develop environmental performance objectives to minimize waste generation (low-level waste, hazardous waste, etc) from the mission operations going into the new facility.
- Employ a broad range of advanced energy and water efficiency strategies, including but not limited to central plant optimization, airside supply and exhaust distribution optimization, energy recovery methods, lighting design optimization, and water use reduction measures.
- Site selection, minimizing site disturbance, and comfort and well-being of building occupants are covered in other areas of this document.
- Measure energy and water consumption using direct digital control (DDC) monitoring systems or by other means if DDC not available.
- Specify environmentally preferable construction materials and construction waste reduction methods. General note: environmentally preferable products also includes office furniture, recycling containers, trash containers, park benches, picnic tables, plastic fencing, etc. These things are often purchase during the construction project.

[20] DOE O 430.2B

- Enhance indoor environmental quality by including features such as daylighting, low emitting materials, indoor air quality protection measures and practices during the construction process, and controllability of individual occupant spaces for temperature, lighting, and air flow.

4.0 ADDITIONAL GUIDANCE BASED ON LEED CATEGORIES

Designers should apply the following guidance on SD principles and practices to the design of all new facilities and major renovation projects:

A. SUSTAINABLE SITES

1. General: The location of a building affects a wide range of environmental factors such as the energy consumed by occupants for commuting, the impact on local ecosystems, and the extent to which existing structures and infrastructures are utilized. Site planning should consist of a whole system approach that seeks to reduce environmental impacts, and protect habitat and open space. A separate site analysis will be conducted as part of Line Item projects. Optimize potential of selected site through site planning, which evaluates solar and wind orientation, local microclimate, drainage patterns, utilities and existing site features to develop optimal building site design and low maintenance landscaping.
2. Specific: Protect and/or develop sustainable site conditions by:
   - Providing erosion and sedimentation control during construction
   - Appropriately managing storm water runoff and its contact with potential pollutants
   - Minimizing the extent of site clearing, excavations, and material and equipment storage activities on previously undisturbed land.
   - Designing onsite collection, conveyance, and storage capacity for storm water that enables infiltration into the subsurface,
   - Reducing heat islands through use of highly reflective materials for impermeable surfaces (such as roof, walkways, parking lots, etc.)
   - Minimizing light pollution from exterior lighting fixtures, preventing light trespass beyond the project boundary, and specifying shielded or full cutoff-type fixtures.

B. WATER EFFICIENCY

1. General: Reducing water consumption and improving water quality are key objectives of Sustainable Design. To the maximum extent feasible, projects should increase their dependence on water that is collected, used, treated (if applicable), and reused on site. The protection and conservation of water will be considered throughout the life of the building, and be incorporated within the whole building-integrated design approach.
2. Indoor Water. Employ strategies that in aggregate use a minimum of 30 percent less potable water than the indoor water use baseline calculated for the building, after meeting the Energy Policy Act of 1992 fixture performance requirements.[21] WaterSense, an EPA sponsored partnership makes it easy to find and select water efficient fixtures, and ensures consumer confidence in those water efficient products with a label backed by third party, independent, testing and certification.
3. Outdoor Water. Use water efficient landscape and irrigation strategies to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by

[21] MOU Among The Undersigned Federal Agencies For Federal Leadership In High-Performance Sustainable Buildings Circa February, 2006, FEMP.

conventional means (plant species and plant densities). Employ design and construction strategies that reduce storm water runoff and polluted site water runoff. [22]

4. Specific: Protect and conserve water through design considerations, including:
   - Use of roof runoff and/or gray water to irrigate landscaping.
   - Use of only native, drought tolerant plants for landscaping.
   - Use of recycled content water for cooling tower feed.
   - A minimum of 5 cycles of concentration for cooling tower operation.
   - Exceeding the requirements of the Energy Policy Act of 1992 for plumbing fixtures.
5. Water Efficiency Guide for Laboratories: Labs21 has published a Water Efficiency Guide for Laboratories, a new Best Practice Guide outlining opportunities for laboratories to make cost-effective improvements in water efficiency, especially with respect to the amount of water used in cooling towers and for special process equipment. This guide, as well as others on related topics, can be accessed at http://www.labs21century.gov/toolkit/bp_guide.htm

C. ENERGY EFFICIENCY AND CONSERVATION

1. General: To successfully design and construct an energy-efficient building it is necessary to design from the outside in. Therefore, the building envelope is the first item of concern in the design process. Once energy conservation features (i.e. insulation levels, spectrally selective glazing, daylighting, etc.) have been determined, equipment (i.e. HVAC, lighting) can be right-sized to meet the building's energy requirements. Energy analysis software is an extremely useful tool to evaluate alternatives. The preferred energy analysis software is DOE-2 for PCs. http://simulationresearch.lbl.gov/dirsoft/d2whatis.html Many popular modeling softwares are compared at http://www.eere.energy.gov/buildings/tools_directory/pdfs/contrasting_the_capabilities_of_building_energy_performance_simulation_programs_v1.0.pdf
2. *Guidance: Energy efficiency also includes the office products and appliances purchased for new facilities. LANL has requirements to purchase Energy Star Compliance Equipments (covers offices, appliances, and conference rooms) http://www.energystar.gov/*
3. Specific: Minimize energy consumption through Building orientation and massing, natural ventilation, day lighting and other passive strategies that can lower a facilities energy demand. Exceed Federal energy performance standards for energy efficiency (10CFR435). Consider the following measures:
   - Effectively employ daylighting technologies and associated daylighting controls to reduce artificial (dimmable) lighting when possible.
   - Select energy-efficient products and equipment such as Energy Star products, multi-stage boilers and chillers, etc.
   - Orient building's major axis on an east-west line to maximize passive solar heating on the long south face. Provide a Trombe wall, integrated as part of the building design, to provide passive solar heating of the building.

[22] Ibid.

- Building-integrated photovoltaics (BIPV) to meet a pre-selected amount of non-critical building power needs. This analysis should be coordinated with the ESM Electrical POC and may be considered a demonstration project.

D. MATERIALS AND RESOURCES

1. General: Building materials affect the environment throughout their life-cycle starting with the extraction of raw materials and manufacturing the final product through transporting, installing, using and finally disposing of the product. In fact, construction debris accounts for over half the volume of America's landfills. Environmentally preferable building materials minimize life cycle environmental impacts and minimize impact on occupant health.
2. Specific: Projects should seek to meet environmentally preferable products requirements and use environmentally preferable products and processes that do not pollute or unnecessarily contribute to the waste stream and do not deplete limited natural resources, by:
   - Maximizing the recycled content of all new materials, especially from a post-consumer perspective. To the extent feasible, consider materials containing recycled content and salvage/recycle of construction waste during construction. Consult 40 CFR 247, Comprehensive Procurement Guide for Products Containing Recovered Materials. http://www.epa.gov/cpg/products.htm. *Guidance: Consider use of "P2-EDGE" Software for design and construction evaluation. Free BEES software is useful for product evaluations http://www.bfrl.nist.gov/oae/software/bees.html .*
   - Specifying materials harvested on a sustained yield basis such as lumber from certified forests.
   - For EPA-designated products, use products meeting or exceeding EPA's recycled content recommendations. For other products, use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.
   - Encouraging the use of USDA-designated biobased products. Use products meeting or exceeding USDA's biobased content recommendations. For other products, use biobased products made from rapidly renewable resources and certified sustainable wood products.
   - Encouraging the use of recyclable assemblies and products that can be easily "de-constructed" at the end of their useful lives and encouraging the reuse of materials. Limiting construction debris and encouraging the separation of recyclable waste streams during the construction process. A construction waste management plan is useful in achieving this aim.
   - Eliminating the use of materials that pollute or are toxic during their manufacture, use or reuse.
   - Eliminating the use of ozone depleting compounds during and after construction.
   - Giving preference to locally produced products and other products with low embodied energy content.
   - Providing a dedicated area for the collection of materials for recycle.
3. A reasonable goal is to use materials with recycled content such that post-consumer recycled content constitutes at least 10 percent of the total value of the materials in the

project or combined post-consumer and 1/2 post-industrial recycled content constitutes at least 20 percent.[23]

E. INDOOR ENVIRONMENTAL QUALITY

1. General: The ultimate success or failure of a project often rests on the quality of its indoor environment, because healthy, comfortable employees are invariably more satisfied and productive. Projects should be designed and constructed to provide high-quality, interior environments for all users. A construction Indoor Air Quality plan is helpful to ensure construction methods and practices result in a building is healthy for occupancy.
2. Protect Indoor Air Quality during Construction. Follow the recommended approach of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995. After construction and prior to occupancy, conduct a minimum 72-hour flush-out with maximum outdoor air consistent with achieving relative humidity no greater than 60%.[24]
3. Specific: Enhance indoor environmental quality through appropriate ventilation, moisture control, and the avoidance of materials and products with high VOC emissions will enhance occupant health and comfort. The integrated design approach for projects should seek to:
    - Value aesthetic decisions, such as the importance of views and the integration of natural and man-made elements.
    - Provide thermal comfort with a maximum degree of personal control over temperature and humidity.
    - Supply adequate levels of ventilation and outside air to ensure indoor air quality;
    - Avoid the use of materials that emit pollutants, such as volatile organic compounds (VOCs) or other toxins.
    - Assure acoustic privacy and comfort through the use of sound absorbing material and equipment isolation.
    - Control disturbing odors through contaminant isolation and careful selection of cleaning products.
    - Create a high performance luminous environment through the thoughtful integration of natural and artificial light sources.

F. GENERAL

1. Utilize the "LANL Sustainable Design Guide" described above.

[23] MOU Among The Undersigned Federal Agencies For Federal Leadership In High-Performance Sustainable Buildings Circa February, 2006, FEMP.
[24] Ibid.

APPENDIX A

10 CFR PART 433
Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings

Section Contents

Authority: 42 U.S.C. 6831–6832, 6834–6835; 42 U.S.C. 7101 *et seq.*

Source: 71 FR 70281, Dec. 4, 2006, unless otherwise noted.

§ 433.1 Purpose and scope.

This part establishes an energy efficiency performance standard for the new Federal commercial and multi-family high-rise buildings, for which design for construction began on or after January 3, 2007, as required by section 305(a) of the Energy Conservation and Production Act, as amended (42 U.S.C. 6834(a)).

§ 433.2 Definitions.

For purposes of this part, the following terms, phrases and words are defined as follows:

ANSI means the American National Standards Institute.

ASHRAE means the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Baseline building means a building that is otherwise identical to the proposed building but is designed to meet but not exceed the energy efficiency specifications of *ANSI/ASHRAE/IESNA Standard 90.1–2004, Energy Standard for Buildings Except Low-Rise Residential Buildings* , January 2004 (incorporated by reference, see §433.3).

Commercial and multi-family high-rise residential building means all buildings other than low-rise residential buildings.

Design for construction means the stage when the energy efficiency and sustainability details (such as insulation levels, HVAC systems, water-using systems, etc.) are either explicitly determined or implicitly included in a project cost specification.

DOE means the U.S. Department of Energy.

Federal agency means any department, agency, corporation, or other entity or instrumentality of the executive branch of the Federal Government, including the United States Postal Service, the Federal National Mortgage Association, and the Federal Home Loan Mortgage Corporation.

IESNA means Illuminating Engineering Society of North America.

Life-cycle cost means the total cost related to energy conservation measures of owning, operating and maintaining a building over its useful life as determined in accordance with 10 CFR part 436.

Life-cycle cost-effective means that the proposed building has a lower life-cycle cost than the life-cycle costs of the baseline building, as described by 10 CFR 436.19, or has a positive estimated net savings, as described by 10 CFR 436.20; or has a savings-to-investment ratio estimated to be greater than one, as described by 10 CFR

436.21; or has an adjusted internal rate of return, as described by 10 CFR 436.22, that is estimated to be greater than the discount rate as listed in OMB Circular Number A–94 (Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

Low-rise residential building means any building three stories or less in height above grade that includes sleeping accommodations where the occupants are primarily permanent in nature (30 days or more).

New Federal building means any building to be constructed on a site that previously did not have a building or a complete replacement of an existing building from the foundation up, by, or for the use of, any Federal agency which is not legally subject to State or local building codes or similar requirements.

Process load means the load on a building resulting from energy consumed in support of a manufacturing, industrial, or commercial process. Process loads do not include energy consumed maintaining comfort and amenities for the occupants of the building (including space conditioning for human comfort).

Proposed building means the building design of a new Federal commercial and multi-family high-rise building proposed for construction.

Receptacle load means the load on a building resulting from energy consumed by any equipment plugged into electrical outlets. [71 FR 70281, Dec. 4, 2006, as amended at 72 FR 72570, Dec. 21, 2007]

§ 433.3 Materials incorporated by reference.

(a) *General* . DOE incorporates by reference the energy performance standard listed in paragraph (b) of this section into 10 CFR part 433. The Director of the Federal Register has approved the material listed in paragraph (b) of this section for incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Any subsequent amendment to this material by the standard-setting organization will not affect the DOE building energy performance standard unless and until DOE amends its building energy performance standards. DOE incorporates the material as it exists on the date specified in the approval and a notice of any change in the material will be published in the Federal Register.

(b) *List of standards incorporated by reference. ANSI/ASHRAE/IESNA Standard 90.1–2004, Energy Standard for Buildings Except Low-Rise Residential Buildings* , January 2004, American Society of Heating Refrigerating and Air-Conditioning Engineers, Inc., ISSN 1041–2336.

(c) *Availability of references*. The building energy performance standard incorporated by reference is available for inspection at:

(1) National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call (202) 741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html*

(2) U.S. Department of Energy, Forrestal Building, Room 1M–048 (Resource Room of the Federal Energy Management Program), 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–9138, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

(d) *Obtaining copies of standards*. The building energy performance standard incorporated by reference may be obtained from the American Society of Heating Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle, NE., Atlanta, GA, 30329, *http://resourcecenter.ashrae.org/store/ashrae/*

§ 433.4 Energy efficiency performance standard.

(a) All Federal agencies shall design new Federal commercial and multi-family high-rise residential buildings, for which design for

construction began on or after January 3, 2007, to:

(1) Meet *ANSI/ASHRAE/IESNA Standard 90.1–2004, Energy Standard for Buildings Except Low-Rise Residential Buildings*, January 2004 (incorporated by reference, see 433.3); and

(2) If life-cycle cost-effective, achieve energy consumption levels, calculated consistent with paragraph (b) of this section, that are at least 30 percent below the levels of the baseline building.

(b) Energy consumption for the purposes of calculating the 30 percent savings shall include space heating, space cooling, ventilation, service water heating, lighting and all other energy consuming systems normally specified as part of the building design except for receptacle and process loads.

(c) If a 30 percent reduction is not life-cycle cost-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 life-cycle cost-effective, but at a minimum complies with paragraph (a) of this section. [71 FR 70281, Dec. 4, 2006, as amended at 72 FR 72570, Dec. 21, 2007]

§ 433.5 Performance level determination.

(a) Each Federal agency shall determine energy consumption levels for both the baseline building and proposed building by using the Performance Rating Method found in Appendix G of *ANSI/ASHRAE/IESNA Standard 90.1–2004, Energy Standard for Buildings Except Low-Rise Residential Building*, January 2004 (incorporated by reference, see (433.3), except the formula for calculating the Performance Rating in paragraph G1.2 shall read as follows:

Percentage improvement = 100 x (Baseline building consumption—Proposed building consumption)/ (Baseline building consumption—Receptacle and process loads).

(b) Each Federal agency shall consider laboratory fume hoods and kitchen ventilation systems as part of the ASHRAE-covered HVAC loads subject to the 30 percent savings requirements, rather than as process loads.

§ 433.6 Sustainable principles for siting, design and construction. [Reserved]

§ 433.7 Water used to achieve energy efficiency. [Reserved]

§ 433.8 Life-cycle costing.

Each Federal agency shall determine life-cycle cost-effectiveness by using the procedures set out in subpart A of part 436. A Federal agency may choose to use any of four methods, including lower life-cycle costs, positive net savings, savings-to-investment ratio that is estimated to be greater than one, and an adjusted internal rate of return that is estimated to be greater than the discount rate as listed in OMB Circular Number A–94 “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.”