



Design Standards Manual: Chapter 2 – General Design Standards and Procedures

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2.0 General Design Standards and Procedures

2.1 Introduction

As a design professional or Architect/Engineer (A/E) doing work for Sandia National Laboratories (SNL), you are responsible for the final design of a project, according to the requirements in this *Design Standards Manual*, project-specific design criteria (when included), and additional contract documents. It is also your responsibility to provide a facility design that meets the required functions in the most cost-effective manner to satisfy current mission needs of SNL and provide flexibility, as requested, in meeting future mission needs.

You are responsible for compliance with State of New Mexico requirements for licensure as regulated by the New Mexico Board of Examiners for Architects, the New Mexico Board of Landscape Architects, and the New Mexico State Board of Licensure for Professional Engineers and Surveyors.

In accordance with the laws of the State of New Mexico, your design must comply with the 2009 International Building Code® (IBC®). The deliverable design package, including drawings, specifications, code footprint/analyses, and calculations must bear the seal, signature, and date of signature from the New Mexico licensed design professional responsible and in charge of design. Multidiscipline projects require multiple seals, signatures, and dates of signatures. Alterations to the design package (including the post-construction red-lines) that materially change the original design intent, and result in the production of new or changed documents, must be resealed. Amended construction documents must be maintained in accordance with IBC chapter 1 provisions.

You are also responsible for following SNL standard specifications and standard drawings and verifying that the drawings match these standards.

2.2 Design Process

The Sandia National Laboratories New Mexico (SNL/NM) site uses an integrated whole building design approach on all new construction and major renovation projects. This design approach considers the interrelationships among building siting, design elements, energy and resource constraints, building systems, and building function, before predesign activities are initiated. To identify the effects these factors have on one another requires a multidisciplinary design and construction team consisting of Site Planners, Landscape Architects, Architects, Engineers, Contractors, Interior Designers, Lighting Designers, Building Owners, Occupants, Maintenance Personnel, and any other relevant stakeholders. Such a multidisciplinary team must be assembled prior to initiating design activities to ensure the coordination of individual design efforts and sharing of specialized expertise to achieve an integrated whole-building design process.

This internal integrated SNL/NM project team generally consists of a SNL/NM Project Lead (PL) and primary discipline leads (civil, landscape, architect, structural, mechanical, electrical, controls, fire protection, security, telecommunications, building operations, and safety) assigned to each project.

You are responsible for determining all requirements necessary to create a comprehensive, functional, buildable, and code-compliant project design. Use resources, such as the Conceptual Design Report (CDR), design criteria, building systems summaries (available for major facilities from the Systems Engineer), this *Design Standards Manual*, and additional information gathered through the Title I "programming" exercise to determine solutions to design questions. During the initial phase of a project,

the CDR and design criteria are developed from an analysis of project requirements to establish functional and performance specifications and architectural design attributes. The development of the CDR and design criteria must align with the standards and methods of this *Design Standards Manual*. To ensure this alignment, initial design phase activities must also include the participation of the SNL/NM project team, as well as the facility owner, occupant, and maintenance representatives.

A working relationship is developed early in the design process between the A/E team and the SNL/NM project team to expedite the transfer of additional required information. You may be required to go directly to additional SNL/NM stakeholders to obtain additional design direction if the project team counterpart is not available. All correspondence and stakeholder interactions of this type must be documented and copied to the applicable SNL/NM project team members. The SNL/NM Project Lead must provide an expanded list of all project stakeholders to you early in the design process.

2.3 Design Quality

Architectural and engineering design must be code-compliant, functional, and cost-effective. The designer must tailor the facility's design to fit its intended function using sustainable design principles, including but not limited to low maintenance, energy and water efficiency, material and resource conservation, and indoor environmental quality. The designer must design facilities that are easily maintained, with readily accessible equipment areas, low maintenance interior and exterior surfaces, and quality roofing systems. To promote an orderly and efficient appearance, architectural features of new facilities must complement and enhance existing architecture at the site.

Begin with informed assumptions and proceed to identify solutions. As problems gain more definition and as alternative solutions become more refined, use your professional judgment and ingenuity to produce a coordinated interdisciplinary design that is cost-effective, easily contractible, constructible, high-performing in energy efficiency, code-compliant, and aesthetically pleasing. Along with support consultants, perform functional analyses and programming in developing design solutions. These solutions reflect coordination of the competing functional, budgetary, and physical requirements for the project. Prior to and throughout the design process, meetings to establish, discuss, and resolve design issues are required. These meetings are a normal part of the design process and are critical to achieving a fully integrated, whole-building design. For specific design review requirements, see the project-specific design criteria.

Throughout the design process, conduct discipline coordination sessions to resolve conflicts about the use of building space. In the concept-definition phase and up to 30% design completion, mechanical rooms, electrical rooms, utility chases both intra-floor and inter-floor, and outdoor equipment, such as substations and cooling towers, are shown on the drawings. As equipment items are chosen up to 60% design completion, the drawings are refined to include feeder conduit and liquid piping runs, major ductwork runs, equipment locations on the utility room floor plans and outside, and general assignment of interstitial spaces above ceilings and in chases. At 90% design completion and with delivery of the final contractual design package, all discipline conflicts must be resolved, to include but not be limited to, the following:

- Compliance of all design documents with applicable building codes
- National Electrical Code[®] (NEC[®]) clearances and exit paths for electrical panel boards, switchgear, and drives
- Access to air handlers and other HVAC equipment, including space to service filters, fan belts, motors, and bearings, and remove heat exchanger components

- Clear space to open all access doors and panels fully, with the understanding that doors of one equipment item may swing into the clearance space of another when the second item does not require simultaneous access
- Design of service lights, catwalks, and convenience receptacles in larger interstitial spaces where the room lighting and receptacles may be inadequate
- Three-dimensional space assignment of the disciplines in interstitial spaces and chases
- Structure-mounted pick points and dolly space for removal and replacement of major items, such as a large motor
- Location of lighting fixtures so they are not blocked by other equipment and that they cast light into spaces that can be occupied and not, for instance, on top of a fume hood. This includes arrangement of fixtures in a lay-in ceiling to accommodate modular furniture and not just in a symmetrical pattern for an empty room.
- Location of variable air volume (VAV) boxes such that they can be serviced easily
- Location of electrical junction boxes for lighting, communications, alarms and access control, and other systems that could reasonably be expected to require periodic access during the life of the building, such that access to each item does not require dismantlement or outages of items not related to that discipline
- Minimizing the location of major items within a closed area (formerly referred to as a vault-type room or VTR), such that they are not readily accessible for servicing, even when dedicated to that closed area
- Location of outside equipment such that adjacent space use is compatible; for instance, not locating an air intake near a vehicle area, and not locating fire sprinkler and roof drains near pedestrian paths
- Partitioning of building utility space separate from (but may be adjacent to) programmatic utility runs
- Full design (route and spacing) of conduit and piping runs of 2 inches and larger, and restricted use of home-run designators to smaller terminal runs and branch circuits
- Access means or choice of equipment items that afford ready servicing in lobbies, open stairwells, and other areas where ceiling height is multistory

Portions of a facility design that are subcontracted, such as site preparation, asbestos remediation, fire protection sprinkler design, and similar specialties, must be contracted for and delivered such that the contracted portion is incorporated into your deliverable package, so it may be considered by the Engineer or Architect with responsible charge, reviewed by the SNL project team, and integrated so that the subcontracted effort is a part of the whole as if it had not been subcontracted. For example, you must not set aside portions of the design work to be completed later and forward as a short-suspense submittal or shop drawing.

Construction projects at SNL occasionally affect structures, systems, and components (SSCs) that have been designated as Safety-Significant or Safety-Class. Safety SSCs are defined as those SSCs identified in the Documented Safety Analysis (DSA) for the facility as required by Title 10 of the Code of Federal Regulations (CFR) Section 830 (10 CFR 830), and are commonly found in nuclear facilities. New or modified Safety SSCs must be designed to readily facilitate all required functional testing.

2.3.1 Value Engineering

The designer is responsible for performing value engineering to determine the project component alternatives that satisfy the same basic function or set of functions at the optimum project cost. Value engineering, which always includes, at a minimum, the SNL/NM project team, project owner, and occupants, follows a result-driven job plan consisting of the following phases:

- Selection
- Information
- Creativity
- Analysis
- Development
- Presentation
- Implementation
- Verification

Value engineering begins during the programming stage of the design and continues throughout the design process.

2.3.2 Life-Cycle Analysis

The Federal Energy Management Program (FEMP) established 10 CFR 436 to promote life cycle cost-effective investments in energy systems, water systems, and energy and water conservation measures for federal buildings. This life-cycle cost (LCC) methodology is a systematic analysis of relevant costs, excluding sunk costs, over a study period, relating initial costs to future costs by discounting future costs to current values.

Perform LCC analyses in the early phases of line-item projects and major projects to support value engineering and sustainable design. Life-cycle costing makes economic comparisons between systems similar in function and enables selection of the lowest LCC system.

Combining value engineering and life-cycle costing can potentially identify the best value alternative by comparing the first cost and life-cycle costs of each alternative. In this manner value engineering and life-cycle costing are both used during early project phases to develop an "equal playing field" for determining tradeoffs and making decisions to balance, among other criteria, environmental performance with total cost, reliability, safety, and functionality. This equal comparison enables sustainable development technologies and integration to be fully evaluated for overall performance.

An integrated project team approach is critical to achieving an integrated whole building design. Value engineering and LCC professionals should be included in the design team in the earliest-possible project phases. The framework for integrating value engineering and LCC into the design process is as follows:

- Perform a requirements assessment to establish the parameters for sustainable development
- Perform conceptual planning using macro-level value engineering and life-cycle costing (including energy modeling)
- Conduct programming and budgeting activities
- Perform design using complete value engineering and life-cycle costing evaluations

2.4 General Requirements for Construction Drawing Files

2.4.1 *CADD Standards Manual*

Facilities drawing files for SNL/NM must be created or modified to comply with the *CADD Standards Manual*. This manual contains specific information and files related to CADD requirements, standards, and processes. Exceptions to compliance requirements may be made as necessary to benefit the project, if approved by the SNL/NM Sandia-Delegated Representative (SDR), who is usually the Project Lead. No exceptions are allowed for final as-built files.

2.4.2 Locating Drawing Files

Because facilities at SNL/NM are continually being modified or extended, Facilities Engineering uses an active record drawing file system to represent those changes. Identification of the most up-to-date record drawing files that are affected by a particular project is part of the project design requirements. Half-scale hard copies and current, online, read-only access to numerous drawing files are available in the Facilities Engineering Library.

2.4.3 Requesting Drawing Files from the Drawing File System

The Facilities Management and Operations Center (FMOC) operates a closed drawing file system. Only authorized personnel with a valid user name and password may check out record drawing files. Off-site contractors are assigned an on-site CADD Technician as a point-of-contact for all files being checked in and out of the Facilities Document Management System.

2.4.4 Using Record Drawing Files

Modifications to existing facilities must be made by revising the record drawing files, unless otherwise directed. New drawings must be prepared if the existing record drawings are too crowded or obsolete. All plans, elevations, sections, details, and diagrams must be completed to sufficient size and detail to clearly and completely define the project for bidding and construction purposes.

Because the hard-copy drawings may be outdated, information used to interface or develop the design must be field verified.

2.4.5 Drawing Numbering System

Distinguishable types of project drawing plot files that are commonly (or are specified to be) created on separate drawing files must be numbered in a modified "Uniform Drawing System" numbering scheme as described in the *CADD Standards Manual*.

2.4.6 Standard Drawings

Standard drawings are used to facilitate the design process by providing typical details and templates for incorporation into design packages. Although all of the drawings are called standard drawings, there are actually three categories of standard drawings:

- **Standard Drawings:** These drawings are to be used as-is for construction. No modifications to these drawings are required beyond project-specific title block additions.
- **Template Standard Drawings:** These drawings are to be used as a starting point to create a new building or utility drawing that are be assigned its own unique number and filed as such.
- **Design Standard Drawings:** These drawings are to be used for design calculations and conceptual design layout. These drawings are not be included in a construction set except for design-build projects.

Hard copies of standard drawings are located in the FMOC Engineering Library in 11" by 17" blue binders labeled "Active Standard Drawings." These drawings are not to be removed from the Library, though copies of the drawings may be made. All standard drawings are CADD vector files and are also available in Adobe Acrobat (.pdf) format. All A/E's on SNL/NM's distribution list should have electronic copies of the standard drawings. If electronic copies are required but not available in your system, request them from the SNL/NM Project Lead.

2.4.7 Drawing Set Organization

The construction drawing set must be organized as shown in Table 2.1.

Table 2.1 Drawing Set Organization

Discipline	Discipline Designator
G	General
C	Civil
W	Civil Work
L	Landscape
S	Structural
a	Architectural
F	Fire Protection
P	Plumbing
M	Mechanical (includes Mi - HVAC controls)
E	Electrical
T	Telecommunications
T	Security
	Other disciplines (such as non-HVAC controls and asbestos)

2.5 Construction Specifications

2.5.1 Overview

The SNL Construction Specifications include Standard Specifications, Special Specs, and MasterSpec templates. The Standard Specifications contain broad specifications that are typically used in their entirety without modification. Project specific specifications are referred to as Special Specifications. The Master Specification templates are available to be edited to reflect project-specific applications.

2.5.2 Standard Specifications

Standard Specifications have been developed by SNL Architects and Engineers to establish a consistent building system throughout the SNL campus with a certain level of quality, energy efficiency, safety, security, and maintainability. You must become familiar with the specifications verify that they are applicable to their project or if modifications are required. If it is determined that a Standard Specification needs modifications for a specific project, you must consult with the SNL project team to discuss the extent of the changes.

Continuous improvement is a goal of the Standards Program and the design community is encouraged to submit ideas for improvement.

2.5.3 Special Specs

Special Specs are specifications developed for a particular project and only apply to that project. Special Specs are either a new specification or a modified Standard Specification. Special Specs must be written in accordance with the *Construction Specifications Practice Guide* published by the Construction Specifications Institute (CSI).

Special Specs may be considered as Standard Specification if submitted to the Standards Program as an improvement idea.

2.5.4 MasterSpec Templates

Master Specification Templates from MasterSpec[®] (1994 and 2004 format) are available from the Standards Program that may be used to develop a new specification to be considered as a standard or as project-specific.

2.6 Miscellaneous Design Issues

2.6.1 Sandia-Furnished Material

You must identify all Sandia-Furnished Material (SFM) in the specifications and the construction contract and verify that the existing equipment is functional for the intended use in the design.

2.6.2 Installation of Customer Equipment

When installing equipment owned by the end-user customer, You must document all installation issues with the equipment, including size, weight, electrical, data communications, chilled water, exhaust, drains, serviceability, safety, and so on.

2.6.3 Descriptive Submittals

Projects submittals must be in accordance with SNL Standard Specification 01330, *Submittal Procedures*. Design professional must review all specifications to verify that the desired Descriptive Submittals are being requested and must list all necessary submittal requirements to ensure full project compliance.

2.6.4 Master Equipment List Update

When equipment items are removed or added to a building as part of a project, the design professional must provide information to SNL's Maintenance Planning Services to update the Master Equipment List (MEL) as appropriate. You must compare project equipment selections and/or removals during design to the MEL Update Notification form. This is especially important and applicable for equipment replacements, and remodels and renovations involving equipment replacements, as well as new construction projects. Advise the SNL/NM Project Lead (PL) or project team discipline lead, as applicable, of the scope of the project during design and provide the list of as-designed equipment to be provided/removed. The list becomes a part of the design package and is updated during construction, as necessary, by approved submittals or change orders.

2.6.5 Temporary Services

Prepare complete designs for all temporary service connections and installations required for the construction contractor's use of government-owned utilities. These designs are subject to requirements noted herein.

2.6.6 Site Access Requirements

Most areas at SNL/NM are subject to security and access regulations. To obtain access to the Project areas, you must submit a letter to the SDR identifying personnel needing access, company name or affiliation, and the anticipated dates and times of visits. Those who have an active U.S. Department of Energy (DOE) L or Q clearance are furnished temporary badges that permit access. All others are provided an escort while in a secure area. All personnel must have a badge, regardless of whether they are in secure areas or not. Contact the SDR at the beginning of the project for more details.

2.6.7 Tobacco-Free Campus Requirement

Sandia National Laboratories sites are completely tobacco-free campuses per corporate procedure HR100.4.10, *Maintain a Tobacco-Free Environment*; therefore, all facility designs must not include any provisions for smoking areas, smokeless tobacco use, tobacco vending, or similar features.

2.7 Design Information and Calculations

Design drawings for all disciplines must be accompanied by sufficient supporting calculations and system operating conditions to clearly convey assumptions, constraints, and how code requirements have been

met. Additionally, design of chemical rooms, service/storage areas/yards, and/or other elements - including hazardous materials and life safety implications - must include relevant reference to codes-driven tables and calculations (and calculation sheets). Information and calculations must be provided with each submittal.

You must present design information and calculations on 8½-inch by 11-inch sheets with minimum half-inch margins on all sides, logically arranged, indexed, and bound in book form. Type or hand-letter all material, neatly arrange the sheets, and include the sources of all contents. Present the formulas used and clearly state all assumptions made. Present the following information on each sheet:

- SNL/NM Project Number
- Sheet Number
- Subject
- Building Number
- Date

Include the following as supporting information:

- System and subsystem flow diagrams, including operating conditions and parameters
- Free-body diagrams
- One-line schematic diagrams, including operating conditions and parameters
- Utility system calculations, including operating conditions and parameters
- SNL/NM-provided information and direction

When using computer-aided design systems to perform design calculations, also include:

- The computer program name and version used.
- Information on the building model or paradigm used by the software, so that an engineer unfamiliar with the program can understand the functions, limitations, and method of analysis used. The documentation must be sufficiently complete to allow an engineer to verify the method of data input and interpret the output calculation by hand. This requirement can be waived if the software is also in use at SNL/NM.
- Identification of the free-body diagrams, one-line power diagrams, marked plans, flow diagrams, and sketches that are part of the design package, so that another Engineer can easily check for accuracy. This can be part of the calculations pages mentioned above.
- A copy of the computer output. Retain a complete copy of input data, worksheets, discs, and other quality assurance records with the project file for possible audit purposes.
- Spot-reviews or verifications of the computer output for accuracy and reasonableness.

If the building is a Moderate Hazard Facility, a separate Design Basis Document must be provided, describing all elements and systems of the building.

2.8 Energy Conservation and Sustainable Design Requirements

The goal of SNL is to create buildings and infrastructure that promote a healthful, resource-efficient, and productive working environment. To achieve this goal, all new buildings and renovation projects must be designed, constructed, and commissioned for operation using an integrated whole-building design

approach and the latest sustainable building technologies. Every reasonable effort must be made to employ life-cycle cost-effective energy and water conservation concepts during design and construction based on the established value engineering concepts that ensure an appropriate balance between project cost, security, maintainability and facilities life-cycle costs.

Sandia National Laboratories is included in the list of federal agencies required by the Energy Policy Act of 2005 (Public Law 109-58) to incorporate the performance criteria used for ENERGY STAR[®]-qualified and FEMP-designated products into procurement contracts for energy consuming products and systems. These requirements must be included in all construction specifications and construction, renovation and service contracts.

To demonstrate a commitment to this goal, the following strategies, as confirmed by the responsible SNL/NM Project Lead, must be pursued for all project work at SNL/NM:

- 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 balanced with first cost constraints.
- Commission equipment and controls in all new construction and renovation projects as an integrated effort during construction, to verify building system performance and functionality for the customers and for Facilities operations and maintenance.
- 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.
- Specify environmentally preferable construction materials and construction waste reduction methods.
- Seek recognized certifications that demonstrate this philosophy, such as Leadership in Energy and Environmental Design (LEED[®]), ENERGY STAR, and Green Building awards and certificates.

2.8.1 Sustainable Design, *Guiding Principles*, and LEED Certification

Sustainable or green-building design minimizes site disturbance, optimizes energy and water use, provides good indoor environmental quality, selects environmentally preferable building products, handles construction and demolition waste in a resource-conserving manner, and improves operations and maintenance.

Two references are commonly recognized as the standard for Sustainable Design and Development of Buildings and Infrastructure. The U.S. Green Building Council (USGBC[®]) has developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System to evaluate life cycle environmental performance from a whole-building perspective. In addition, an interagency federal task force has developed a set of sustainable design and development principles, comparable to the LEED rating system, known as the Whole Building Design Guide. Both of these programs provide excellent information and should be referenced while conducting facility planning and design work for SNL/NM. Search the Internet for more information about these programs.

You must use sustainable design principles for work conducted at SNL/NM. Architectural and Engineering firms that market sustainable, energy-efficient design as part of their services must assist the FMOC in institutionalizing sustainable design efforts at SNL/NM.

All new buildings and major renovation projects must meet the High-Performance Sustainable Buildings Guidance which includes the *Guiding Principles for Sustainable New Construction and Major Renovations (Guiding Principles)* and LEED certification requirements. These are separate, but related, activities.

Submit a Sustainable Design Report during the design process that outlines the sustainable-design approach and demonstrates compliance with the both *Guiding Principles* and LEED certification requirements.

A *Guiding Principles* Subject Matter Expert (SME) is available at SNL/NM to assist the Project Lead in documenting compliance. *Guiding Principles* compliance is internally verified and tracked using the EPA web-based Portfolio Manager system.

In addition, all new buildings and major renovation projects must be certified as "green" buildings through the LEED rating system at the Gold level or higher. All new building and major renovation designs, must be scored using the LEED rating system, in anticipation of submission for certification as a green building. Actual LEED certification requires applicant buildings to satisfy a number of prerequisites and attain a certain number of credits. Once the LEED program prerequisites have been satisfied, applicant buildings are rated based on the number of credits achieved within the rating system. There are four levels of LEED certification: Certified, Silver, Gold, and Platinum (highest).

Sandia National Laboratories in New Mexico provides a LEED Accredited Professional[®] (AP[®]) to register and obtain certification. The certification process first requires registration of the building project with the USGBC to show intent to obtain LEED certification. The USGBC recommends registering early in the project, preferably during the schematic design phase. Following completion of construction activities, an application is submitted to the USGBC LEED Certification Manager. This application includes a narrative of the project, a LEED Scorecard, complete documentation per credit (tabbed) with cover sheets from the Application Template, and a certification fee. The application then goes through an administrative review, a technical review, followed by notification of LEED certification. The USGBC presents the project with a certificate and a metal LEED plaque indicating the certification level. The standard review timeline can take anywhere from eight weeks to several months. As a member of the USGBC in the government-owned, contractor-operated category, SNL/NM building projects are entitled to receive membership benefits and discounts on fee schedules relating to the registration, technical support, and certification process.

See Table 2.2 for additional requirements based on project type and size.

Table 2.2 High-Performance Sustainable Building Requirements Matrix

High-Performance Sustainable Building (HPSB) Requirements Matrix						
Building Type	Description	Size (Gross Square Feet)	Project Cost	Guiding Principles (GP) Required? New Construction, Major Renovation, or Existing Building	USGBC LEED Required? and Minimum Certification Level	Comments
New	New Construction	>5,000	>\$5M	Yes	LEED New Construction—Gold	Parking structures, process and power-generating systems, and distribution systems are exempt.
		Any size	<\$5M	Yes	No	
	Lease—New Construction (NC)	>5,000	N/A	Yes	LEED NC—Silver (Gold preferred)	
	Grandfathered	Any size	N/A	No	LEED NC—Any level	Must meet 12/1/08 requirement
Existing	Existing Building—as is	>5,000	N/A	Yes	No	15% must meet GP by FY15 using FY09 baseline (building count or GSF still under discussion). Leases >5,000 GSF included.
	Major Renovation	>5,000	>\$5M	Yes	LEED Existing Buildings: Operations & Maintenance™—Gold	
		>5,000	<\$5M	Yes	No	
		<5,000	<\$5M	No	No	
	New lease	>5,000	N/A	Preferred	LEED Existing Buildings: O&M—Silver preferred	Preference given to LEED buildings, if available and cost-effective. LEED Commercial Interiors (CI) might apply, if leasing space in an office building.
	Existing Lease (option renewal)	>5,000	N/A	No	No	Leases >5,000 GSF included in existing building FY09 baseline and eligible for the 15%.
	Grandfathered	Any size	Any cost	No	LEED Existing Buildings or Existing Buildings: O&M—Any level	Must meet 12/1/08 requirement

2.8.2 Building Systems Commissioning

SNL/NM requires that all new construction and major renovation projects include building systems commissioning as a quality control measure. At a minimum, commissioning procedures verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended. The following fundamental best-practice commissioning procedures must be followed:

- Designate a commissioning authority, preferably during preliminary design
- Document the operating parameters for each element and system included in the scope of commissioning
- Create a commissioning plan that
 - Integrates commissioning requirements into the contract documents
 - Verifies adequacy of installation, functional performance, training, and manufacturer's documentation
 - Documents the results upon completion of commissioning, with an action plan as necessary to ensure correction of any out-of-compliance condition

The Project Lead designates the commissioning team or commissioning authority for the project and ensures that appropriate budget for commissioning has been established, approximately 1.0 to 1.5% of construction cost.

2.8.3 Energy Service Meters

Each distinct building energy service must have a measurement system to accumulate a record or indicator reading of the overall amounts of the electricity and natural gas being delivered. Exception: A building of 5,000 gross square feet (GSF) or less in a complex of buildings may have its measurement system included with another building in the same complex. All required meters must be equipped with provisions to allow for remote reading throughout the SNL/NM Energy Metering System.

2.8.4 Energy Monitoring and Control Systems

All new permanent buildings greater than 5,000 square feet must have a Facilities Control System for interconnection with the SNL/NM Facilities Control System (FCS), unless specifically exempted by the project-specific design criteria, the SNL/NM Project Lead, or both.

2.8.5 Energy Policy Act of 2005 Requirements

According to the Energy Policy Act (EPAAct) of 2005, new buildings must be designed to achieve energy-consumption levels approximately 30% below those of the 2004 ASHRAE standard on the International Energy Conservation Code, unless clearly demonstrated not to be LCC-effective. Similar reductions are required for major renovations of existing buildings. The exact energy-consumption goals for a particular building must be negotiated during the Title I and Conceptual Design activities, taking into account the building's mission, model, and programmatic equipment.

2.9 Conceptual Design (Project Definition) Requirements

If included in your contract, provide conceptual design (project definition) scope and deliverables including the following:

- Updated functional and operational requirements documents
- Space and equipment data sheets
- Updated record drawings for Request for Quotation (RFQ) purposes
- Site plans
- Floor plans
- Building elevations
- Building sections

2.10 Title I (Schematic Design) Requirements

Provide Title I Quality Assurance Review deliverables (unless stated otherwise by design criteria) to include the following:

- Design analysis (design narrative and calculations)
- Drawing prints and files
- Preliminary cost estimates
- All additional requirements as defined in the project-specific design criteria

These Title I review requirements are described in the following sections.

2.10.1 Design Analysis

Present conceptual design analyses for the entire facility or portions thereof, including appropriate environmental or utility systems when required. The conceptual design analyses for alternate approaches to the job include the following:

- Statement of purpose and function
- Statement of factors considered and provided for
- Economic justification
- References of previous studies of record

In general, these analyses present the complete documentation of the facts that are considered when forming conclusions for alternate approaches.

After the analyses have been considered and a choice agreed on in conference with the SDR, complete the chosen conceptual analysis and submit it at Title I. At a minimum, it must contain the pertinent facts involved in the concept, the conclusions reached, along with the reasons for these conclusions, and the alternatives considered.

2.10.2 Drawings

The design criteria identify the specific requirements for determining percentage complete for each discipline prior to starting design. If not indicated, the Title I final submittal is approximately 30% complete for the entire project.

Civil

- Complete drawing list, for example:
 - Grading, drainage, and paving concept plan
 - Utility location and connection point plan, including the following: Water (domestic, fire protection), sanitary sewer, power, communications, and gas (propane and natural gas, if available)
- Reasonably complete site plan and removal plans
- Utility plans
- Grading plans
- Preliminary utility profiles

Landscaping

- Site Plans
- Details

Structural

- Complete drawing list
- Load requirements (design parameters)
- Foundation and Framing Plans (70% complete)
- Nontypical sections and detail cuts
- Typical details
- Elevations
 - Braced frames
 - Trusses

Architectural

- Complete drawing list, for example:
 - Code footprint
 - Dimensioned floor plan
 - Dimensioned building elevations
 - Dimensioned building sections
 - Typical exterior wall section
 - Room finish schedule
- Typical sections

- Reasonably complete floor plans (defined as 70% to 80% complete)
- Principal elevations

Fire Protection

- Sprinkler layout plans
- Fire alarm plans

Mechanical

- Complete drawing list, for example:
 - Heating, ventilating, and air conditioning (HVAC) systems: Evaluation and selection of systems and HVAC concept floor plan
 - Plumbing and piping: Plumbing conceptual floor plan and compressed-air conceptual floor plan
- Preliminary equipment list
- Reasonably complete floor plans showing locations of major items of equipment, pipe and duct routing, air registers, and/or grills
- Preliminary flow diagrams with major control items, shutoff valves, and tanks. When Facilities Control System monitoring and direct digital control is selected, show all necessary control sensors and the complete sequence of operation on the flow diagram.

Electrical

- Complete drawing list, for example:
 - One-line power diagram
 - Lighting layout plan
 - Power plans
 - Lightning protection grounding plans
- Preliminary lighting fixture layout
- Preliminary receptacle layout
- One-line power diagram, 90% complete
- Other systems (location, size, and type of major components)

Telecommunications

- Port location plan

Security

- Sensor locations
- Diagrams and details

2.10.3 Preliminary Cost Estimates

Preliminary Construction Cost Estimates are submitted along with the Title I package. Estimates must be prepared per requirements noted in DOE Order 430.1-1, *Cost Estimating*. Additional direction may be provided in the design criteria. Appropriate labor rates for use in the estimate must be confirmed with the project team, and procurement analysis (make or buy, design build) must be adequately addressed by the project team for use in the estimate.

2.11 Title II (Design Development) Requirements

Provide Title II Quality Assurance Review deliverables (100% complete) to include the following:

- Drawings
- Specifications
- Design Analysis
- Cost Estimate
- Energy Conservation Report (as required by design criteria)

These Title II review requirements are described in the following subsections.

2.11.1 Drawings

Provide complete working-drawing prints and files, prepared in accordance with this manual, including all plans, elevations, sections, details, diagrams, and notes required to completely delineate the work.

Civil

- Complete drawing list
- Complete site plan and removal plans
- Utility plans
- Grading plans
- Utility profiles
- Communication duct bank section and typical details
- Utility demand calculations and sizes

Landscaping

- Site plans
- Details

Structural

- Complete drawing list
- Updated load requirements (design parameters)
- Foundation and framing plans

- Sections and detail cuts
- Elevations
 - Braced frames
 - Trusses

Architectural

- Enlarged partial floor plans
 - Restrooms
 - Darkrooms
 - Control rooms or areas
- Reflected ceiling plans
- Door and window schedule
- Interior elevations at key areas
- Expansion joints if applicable

Fire Protection

- Automatic sprinkler plans and details
- Fire alarm
 - Floor plan and details
 - Riser diagram

Mechanical

- HVAC
 - Size major HVAC components
 - Provide HVAC air flow criteria or requirements
- Plumbing and piping
 - Size plumbing and compressed air systems
 - Riser diagrams for plumbing and compressed air
 - Fixture schedule
 - Enlarged partial floor plans for key areas

Electrical

- Lightning and grounding protection plan
- Fixture schedule
- Lighting plans
- Lighting control diagram (as applicable)
- Power plans
- One-line diagrams
- Detail drawings

- Panel schedules
- Updated calculations and coordination study

Telecommunications

All drawings listed in the *Telecommunications Systems Design Manual* that can be accessed on the Standards Program web site.

Security

- Access control plans and details
- Intrusion alarm plans and details

2.11.2 Specifications

Provide complete construction specifications prepared in accordance with the procedures in this manual.

2.11.3 Design Analysis

Provide final calculations with all background source material. This material must be neatly indexed and bound.

2.11.4 Cost Estimate

Submit the Final Construction Cost Estimate. The estimate must be prepared per the requirements noted in DOE Order 430.1-1, *Cost Estimating*. Additional direction may be provided in the design criteria. You must organize and segregate the estimate so that all exterior work is identified in a separate category. SFE must be included and identified as a separate category.

2.11.5 Energy Conservation Report

Submit a Final Energy Conservation Report (as required by design criteria) containing the results of energy consumption calculations for the base-case building and the results of the energy analysis and life-cycle cost analysis for any energy conservation alternatives. Deliver complete electronic files (Microsoft Word and Excel) and data files of computer calculations such that SNL/NM could achieve the same results.

2.11.6 Bid Support

Prior to award of construction contract, you must support the SNL/NM project team in the following areas:

- Attendance at the prebid conference
- Responses to bidders' requests for information (RFIs)
- Correction of design errors or omissions in the form of prebid addendums
- Possible review of certain elements of the construction proposals prior to Award of Contract

2.12 Title III Requirements

You must provide Title III services and deliverables (as noted in the contract) to include the following:

- Responses to construction contractor RFIs
- Review and approval of descriptive submittals
- Updated electrical Coordination Study (if required; see 2.12.2)
- Resolution of constructability change orders
- On-site representation at the construction site
- Attendance at construction progress meetings
- Provide information for Safety Analysis Report
- Site observations

You must create the following as-built documents as part of Title III services (as noted in the contract):

2.12.1 As-Built Drawings

Gather construction as-built notes from the General Contractor and incorporate these notes into the record CAD files.

2.12.2 Calculations

Update the calculations books with any changes required during the course of construction. If the submitted electrical power equipment is different from that which was specified and designed against, perform an updated Coordination Study based on the submitted equipment. If the submitted equipment cannot meet the coordination requirements, reject the submittals.

2.12.3 Correspondence

Deliver all communications and memos that contain pertinent final information to the SDR for record purposes. Organize the sheets in a chronological order of the life of the project.

2.12.4 Descriptive Submittals

Deliver to the SDR all descriptive submittals generated during Title III that were not available during Title II or earlier, such as shop drawings, catalog cuts, Material Safety Data Sheets, and materials information, such as sample boards and maintenance manuals. Organize the descriptive submittals in chronological order by discipline.

2.13 Required Document Quantities for Title I, II, and III

The number of documents to submit to Facilities Engineering for review at Title I and Title II, and for reference at Title III, varies according to project scope and customer organization involvement. In some instances, half-size drawings are acceptable in lieu of full-size drawings. The number and type of drawing sets required are typically specified at the prenegotiation conference or project-specific design criteria.

In all instances where the number of documents was not prenegotiated, you must provide the following at each submittal:

2.13.1 Title I Review

The following deliverables are required for Title I review:

Deliverable	Quantity
Drawings	1 set D-size, 15 sets 11 inches by 17 inches
Outline Specifications	8 sets
Estimate and Analysis	5 sets
Energy Conservation Report (as specified in the design criteria)	5 sets
All electronic files	1 set disks

2.13.2 Title II Review

The following deliverables are required for Title II review:

Deliverable	Quantity
Drawings	6 sets D-size, 10 sets 11 inches by 17 inches
Specifications	10 sets
Design Analysis Estimate	8 sets
Energy Conservation Report (as specified in design criteria)	5 sets
All changed and new electronic files	1 set disks

2.13.3 Title III

With the exclusion of bid sets, the following deliverables are required for Title III review:

Deliverable	Quantity
Drawings	2 sets D-size, 6 sets 11 inches by 17 inches
Specifications	8 sets
All changed and new electronic files	1 set disks

2.13.4 Post-Title III

The following deliverables are required for Post-Title III review:

Deliverable	Quantity
Drawings, as-built	5 sets 11 inches by 17 inches, 1 set disks
All changed and new electronic files	1 set disks

Facilities Engineering returns Title I review marked-up documents for use during Title II. When submitting Title II, return the Title I markups to the SDR, who returns Title II markups for use in making final corrections to the bid documents. You must then return Title II markups along with original drawings for signoff by the SDR.

2.14 Quality Assurance

For each major project (typically line-item projects and above), the SNL/NM Project Lead is responsible for developing a Quality Assurance (QA) Plan as defined in the design criteria. The degree of risk identified in the project's Risk Assessment Plan determines the extent of the QA Plan. Typical elements of the plan include, but are not limited to, design documents review and control, construction documents review and control, construction tests and inspections, change order review and control, facility acceptance and transfer, and completed project documents distribution.

Personnel in the following disciplines, in addition to the customer, should be given the opportunity to review and comment in their areas of expertise for projects:

- SNL/NM Project Lead
- Building Management
- Fire Protection
- Safety, Industrial Hygiene, Radiation Protection, Asbestos/Lead Abatement
- Architecture
- Electrical and Structural Systems Engineering
- Mechanical and Civil Systems Engineering
- Elevators and Cranes/Hoists
- Electrical Systems
- Mechanical Systems
- Building Mechanics, Facilities Control System
- Roofing
- Door Hardware
- Landscaping, Irrigation, Roads
- Custodial Services
- Construction Inspection and Acceptance
- Physical Security
- Electronic Security
- Telecommunications Operations
- Loading Docks
- Docks and Receiving Rooms
- Mail Services
- Hazardous and Solid Waste
- ES&H Customer Support

Documentation of the quality assurance process is initiated and maintained by the SNL/NM Project Lead. You may be delegated to host part of the process as part of their task.

2.14.1 FMOc Quality Assurance Review Process

Line-item projects, general plant projects (GPPs), expense-funded projects with a construction budget of \$250,000 or more, and specific projects with unique ES&H requirements require a multidisciplinary QA review including the customer as well as the applicable disciplines listed in the previous section. This review is typically performed during the development of the CDR and the design criteria, and with the submittal of the Title I (approximately 30% completion) and Title II (100% completion) designs. The intent of the review is to ensure that the required percent of the design is complete and compliant with all applicable codes and orders. The reviews should also confirm that the customer's requirements are satisfied in the most cost effective manner. This review does not relieve you of the required internal reviews prior to submitting your work to SNL/NM.

There are a number of ways to conduct an effective QA review, including the SNL/NM Project Lead sending the documents to all of the reviewers, providing the documents in a central location at designated times, holding a workshop with the reviewers to present the project and solicit comments, or a combination of these. The SNL/NM Project Lead determines the most effective method to conduct the reviews considering the project budget and schedule. In all instances the SNL/NM Project Lead provides notice to the reviewers of the impending review and sufficient amount of time for review.

2.14.2 Design Package Quality Assurance Review

The FMOc Design Package Quality Assurance Review Form (FDPQARF) is initiated by the SNL/NM Project Lead and delivered to the reviewers to record his or her comments. The reviewers must mark all comments on the FDPQARF because these sheets serve as the permanent record of the review. After reviewing comments, the SNL/NM Project Lead provides a written response back to the reviewer on all comments. Reviewers' comments that are adopted in their entirety are so noted on the FDPQARF. If a comment is not adopted or is adopted with exceptions, the SNL/NM Project Lead notes the action and the reason for exception on the FDPQARF or on an attached sheet, and returns it to the reviewer. The project design team meets with the reviewers, individually or as a group, as needed to discuss the comments or to resolve any disagreements.

After all comments have been reviewed, the SNL/NM Project Lead is responsible for resolving conflicting comments and consolidating the responses into a single electronic document to be returned to you.

2.14.3 QA Process and A/E Liability

The QA process is a tool to assist the project team in finding errors and omissions; however, the absence of comments on a specific issue from SNL/NM does not release you from fulfilling all contractual requirements.

2.15 Project Closeout

The SNL/NM Project Lead must participate in elements of project closeout. These elements include, but are not limited to, Facility Acceptance, Final Cost Report Process, Contracts Close-out and Contractor Evaluations, and Record files.

2.15.1 Facility Acceptance

The project design team must participate in the final construction walk through, preparation of as-built drawings, and completion of documentation.

2.15.2 Final Cost Report Process

This process establishes policies, procedures, responsibilities, and guidance for the preparation of line-item and general plant project Cost Reports. The Final Cost Report on a construction project should be completed as close to the date of beneficial occupancy as possible but not to exceed six months after the facility is in service. Beneficial occupancy occurs when a building or structure is occupied by the technical or administrative organization for which it was intended, although all equipment may not be installed.

Responsibilities of the SNL/NM Administrative Support Office

The following are the responsibilities of the SNL/NM Administrative Support Office:

- Serve as the coordinator in gathering all the necessary information from the A/Es, the design engineers, the line organization, the financial system, and any others required for the timely preparation and issuance of Final Cost Reports on line-item and GPP construction projects.
- Monitor the closing of all purchase orders related to projects that have been beneficially occupied.
- Work with the SNL/NM Project Lead and design engineers to determine how purchase order costs should be aggregated to best fit the engineer's descriptive write-up for the Final Cost Report.
- Work with the SNL/NM Project Lead and design engineers in preparation of their portion of the Final Cost Reports on Construction Projects. A list of all purchase orders applicable to the project along with the associated cost must be provided.
- Provide the design engineers with suggested format and cost breakdown for their write-ups for Final Cost Reports. All Final Cost Reports are different. They cannot follow the same format used for constructing a new building. The Administrative Support Office has on file several Final Cost Reports that have been accepted by the DOE Sandia Site Office (DOE/SSO), and provide examples to use as a format guide.
- Finalize preparation of the Final Cost Report and transmittal letter to DOE/SSO.

Responsibilities of SNL/NM Project Lead

The following are the responsibilities of the SNL/NM Project Lead:

- Complete the Final Cost Reports with the assistance of the Systems Engineers.
- Work with the line organizations and provide the Business Office with equipment write-ups and/or listings for equipment procured by them with line-item construction funds. The Administrative Support Office provides the purchase order listing for this exercise.
- Provide explanations as to cost and schedule variances as compared to the original directive.
- Verify the SNL project team has received all final project files.

Responsibilities of SNL/NM Line Organization

The line organization works with the SNL/NM Project Lead in providing the Administrative Support Office with equipment write-ups, listings of equipment procured by them with line-item construction funds, or both.

2.15.3 Contract Closeouts and Contractor Evaluations

The project team participates in the performance evaluation of A/E and construction contractors as shown on Standard Forms 1420, Construction Contracts, and 1421, Architect-Engineer.

2.15.4 Record Files

The SNL/NM project team participates in the handling of the project records, as directed by the SNL/NM Project Lead, for permanent retention by the following FMOC functions:

- Maintenance Engineering
- Systems Engineering Document Management

2.16 Safety Requirements

The SNL project team members, including Project Lead, operations leads, architects, engineers and other design professionals, must incorporate safety into all project designs to meet current OSHA 1910, 1926, and SNL's corporate requirements for fall protection. All safety related portions of a design, including design drawings, specifications, code footprint, and calculations, must bear the seal, signature, and date of a New Mexico-licensed design professional as required and regulated by the New Mexico Regulation and Licensing Department's professional discipline Boards.

2.16.1 Fall-Protection Design Requirements for Rooftop Parapets

All rooftop parapets must be 42" minimum above the finished roof surface to the top of the coping cap. Railings, tie-offs, or other means of fall protection must meet current OSHA and project team requirements.

2.16.2 Fall-Protection Design Requirements for Sloping Roofs

For all sloping roofs, fall-protection design must incorporate an engineered solution for tie-offs or railings and must meet current OSHA and project team requirements.

2.16.3 Other Fall-Protection Design Requirements

The design of all new buildings, additions, and renovations must include an engineered solution for skylights, roof-access hatches, roof-access ladders, or roof-access stairs that meets current OSHA and project team requirements.

- End of Chapter -