New in this revision (older revisions addressed in 19.0 History)

Updated NA-LA delegations, clarified applicable NCS including NFPA editions, and eliminated STD-342-500 Design Guides (5.0). Made RCD a living document, required BIM for selected projects, made PDL optional, and expanded as-built direction (7.0). Eliminated Att G, Engineering Deliverables for Projects (Guidance), replaced by ES-EPD-FM01, Project Deliverables Checklist/Division of Responsibilities). Throughout: Many basis footnotes moved to requirements basis (ID) document, LANS became Triad, updated to DOE O 420.1C Chg. 3, other minor changes.

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

It derives from P342, Engineering Standards, which is issued under the authority of the Associate Laboratory Director of Facilities & Operations (ALDFO) as part of the Conduct of Engineering program implementation at the Laboratory.

Please contact the ESM General POC for interpretation, variance, and upkeep issues.

Z1010 ADMINISTRATION

ESM Usage

(Requirement X-00YZ): This phrasing appears in this Z10 section (and increasingly other ESM chapters); this is a LANL-internal reference to a basis file that captures and categorizes ESM drivers—and is not relevant to most users.

LANL personnel direction is so noted (e.g., "LANL-Only"); LANL-internal hyperlinks are likewise noted (e.g., "internal").

Fonts

Italics use: Where appropriate throughout the ESM, guidance is provided to aid in the implementation of requirements. Guidance will be *italicized* text and/or otherwise clearly indicated (e.g., by headings). Document titles in italics is normally simply a formatting style. Likewise, words and short phrases in italics and/or capitalized indicates them as a defined term (defined either in this document, the CoE Glossary (future), or the ESM chapter in which it appears).[1]

All other text (plain type) indicates mandatory requirements (usually with "shall" or "must").

1.0 Purpose

The LANL Engineering Standards define the minimum design criteria, fabrication, construction, and installation practices to ensure that the design, repair,[2] and alteration of LANL facilities and selected programmatic equipment associated with them satisfy requirements, needs, and customer expectations in a safe, secure, cost-effective, and environmentally responsible manner.

The requirements supplement those defined in the applicable DOE Orders listed in Appendix B of the Prime Contract; national codes and standards; and federal, state, and local codes and regulations.[3] They generally do not apply retroactively (i.e., do not force changes to existing SSCs that are not being worked on).[4]

2.0 Applicability of LANL Engineering Standards to Categories of Systems

Facility ("Real Property")	Utilities & Infrastructure	Programmatic		
		R&D	Process*	Tenant
Yes	Yes	See R&D Applicability topic	Yes	Yes**

* Long-term, e.g., DARHT, NHMFL, RLWTF, PF-4 production, and LANSCE

** For safety concerns (anchorage, pressure safety, egress, fire loading) and other times; see ESM Chapter 16 IBC Program, Section IBC-GEN Scope tables

3.0 R&D Applicability[5]

The LANL Engineering Standards shall be applied to (a) R&D equipment in nuclear facilities, (b) when directed by the Standards themselves, and (c) when otherwise appropriate. This includes cases where the Engineering Standards, DOE directives, or national codes and

[1] Italicizing defined terms is an I-code practice potentially being adopted by LANL Standards starting in 2022.
[2] The IEBC considers replacement-in-kind maintenance a Level 1 Alteration, or at least a Repair. Because of that, building materials generally need to meet current code, ESM, and spec requirements unless a code of record allowance is granted.
[3] Adaptation of PD340 r7 Chg. 2. Standards Program POCs will determine if minimum is met by a given implementation.
[4] See Repair in Purpose footnote for basis.
[5] Ref LANL PD340 and PD370 series.

standards on which they are based include such equipment in their scope or applicability. Where this is the case, the ESM may indicate programmatic and/or R&D applicability.

4.0 Risk-Based Approach to Rigor in LANL Standards and Usage Guidance

	Increasing Project Risk →			
ML	**4**	**3**	**2**	**1**
Scope (example)[6]	Repairs and most IEBC Level 1 & 2 alterations	IEBC Level 2s with structural, fire, or pressure safety		New structures, additions, IEBC Level 3s
Cost and/or Complexity	Low	Medium		High
Design	In-House	Design-Bid-Build		Design-Build
Construct	Self-Perform	Subcontractor(s) Familiar		Sub(s) Unfamiliar

5.0 Codes and Standards

For a new project activity, the code and standards to be used are established at the outset per topic 3.0 Code of Record. This topic addresses how those documents are selected.

A. Comply with the applicable portions of each code, standard, DOE Order, and other document invoked by the ESM[7], design and/or build subcontract, and the NNSA/Triad contract[8]. (*most Triad contract design mandates are in Appendix B)*. (Requirement 1-0001; s*ee Usage Notes on page 2 regarding meaning*)

See also "National Codes and Standards" article below.

1. Exception for DOE Standards invoked by NNSA-LANL contract (App B)[9]: Follow the invoked version except where a newer one is specifically directed in the LANL Standards; however, the Standards Manager or POC may allow use of a newer version in writing.

   a. For App B matters, the ESM is written to implement the majority of directives relating to design; however, LANL project engineers are still responsible to ensure they comply with the entire NNSA/Triad contract. [Triad contract link (internal)]

B. Codes of Federal Regulation (CFRs): Follow all applicable laws and rules,[10] latest edition. Follow Executive Orders only when mandated by DOE or LANL documents.[11]

[6] Examples shown based on buildings but other criteria are incorporated in ESM.
[7] Referring here to actual ESM requirements (e.g., NEC code year adoption), not citations of code editions in footnotes, endnotes, or other ESM bases/commentary. In the rare case where the ESM or AE contract indicates a different edition than NNSA Triad contract (e.g., 10CFR851 example under CFR heading below), follow ESM and seek clarification from Standards POC as necessary. When invoked documents have been superseded, use the superseding document(s) after confirming with the POC for the invoking LANL Standard.
[8] Where an NNSA contract modification has an implementation plan, plan sets minimum documents and effective dates.
[9] Some DOE orders invoke specific DOE-STD editions; in rare case, STDs are directly in LANL contract's App B. STDs invoked in latest orders here. https://www.directives.doe.gov/invoked_standards. Approach also holds for 10 CFR series.
[10] CFRs are self-invoking federal agency requirements that have the force of law.
[11] EOs are mandates to Federal agency heads who must then direct their departments to comply through Order or other directive. LANL follows such implementing directives when imposed, not the EO itself unless invoked by reference in the directive.

1. If the ESM or project contract states a later edition than the CFR, then the ESM or contract governs (e.g., NFPA 70 edition shall be per ESM Chapter 16; ASME code editions per ESM Chapter 17 if stated, otherwise latest[12]).[13]

   Rules, Orders, and Laws can be found here

2. *CFRs: Partial listing of potentially applicable CFRs:*

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

   b. 10 CFR 436, Subpart A, *Methodology and Procedures for Life Cycle Cost Analysis*

   c. 10 CFR 830, *Nuclear Safety Management*

   d. 10 CFR 835 Subpart K, *Occupational Radiation Protection Design and Control*

   At https://www.energy.gov/ea/enforcement-regulations-and-directives-worker-safety-and-health:

   e. 10 CFR 851, *Worker Safety and Health Program*

   f. 29 CFR 1910, *Occupational Safety and Health Standards*

   g. 29 CFR 1926, *Safety and Health Regulations for Construction*

C. State and Local: Comply with applicable laws and regulations. (Requirement 1-0002). *Guidance: There may be statutory exemptions or other legal exclusions under which certain laws or regulations may not apply to Triad. Therefore, one must be careful in determining these. If there is any question as to whether specific laws and regulations apply to Triad, confer with POC who will engage LANL Legal Counsel.*

1. The New Mexico building codes must be followed as modified below. Thus, comply with the NM Commercial Building, Electrical, Fire, Energy, Plumbing, and Mechanical Code versions in the NM Administrative Code; however, follow these requirements for precedence (Requirement 1-0003):

   a. NM amendments that strengthen the model codes on which they are based must be followed unless specifically excluded by the LANL Standards.

   b. NM Code relaxations versus the model codes cannot be taken unless specifically and unambiguously referenced/adopted by the ESM.

   c. Where a LANL standard may be less stringent than NM code, follow the more stringent State requirements.

   d. Where LANL standards are more stringent than the NM codes, LANL documents govern. *As examples, LANL currently adopts the model building codes in ESM Chapter 16 IBC Program with strengthening amendments; such LANL modifications must be followed. Likewise, LANL follows DOE energy mandates (see ESM Chapter 14) that are generally more stringent than the NM Energy Conservation Code.*

[12] ASME codes allow a six-month implementation period, so if a LANL project code of record date is more than six months after the date of ASME code issuance, then the new code edition shall be the code of record (and may be adopted sooner).
[13] Conversely, if by chance 10CFR851 or the LANL/DOE or project contract states a later edition than the ESM, then that governs.

e. *The affected Standards Discipline POCs should maintain awareness of NM building code provisions affecting LANL projects.*

D. National consensus codes and standards:

1. Building codes: See ESM Chapter 16, Section IBC-GEN, Appendix A – LBC for code editions to use.

   a. For codes such as the IBC, follow the design-related national consensus standard (NCS) editions referenced by the code for new buildings, additions, and complete rehabilitations as a minimum — unless newer editions are specifically invoked by the ESM.[14]

2. For NFPA/fire: Comply with all applicable[15] NFPA codes and standards (except NFPA 5000) and Tentative Interim Amendments. (Requirement 1-0005). Follow editions specified in ESM Chapter 2 Fire Protection Att. 1—*Adopted Editions of NFPA Fire Protection Codes, Standards, and Recommended Practices*. When the applicable codes and standards or required edition is in doubt, seek direction from LANL Fire Protection POC (who will involve AHJ as required).

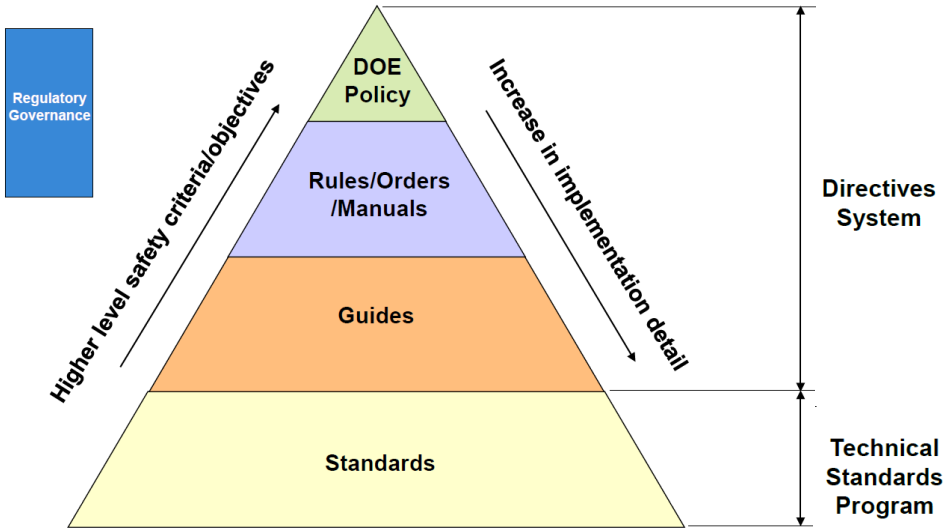
3. For design and construction activities, projects must identify and satisfy the ESM and applicable industry, national, and DOE codes and standards. Latest edition is the default expectation, subject to exceptions such as IBC and NFPA noted just above and certain modifications for which code of record (COR) editions may be allowed; see COR subsection later in Z10. (Requirement 1-0004)

4. If an entire document is required by the ESM or contract then its "shall" statements must be followed if applicable. If the ESM or LMS specifically mandates selected sections (including optional/non-mandatory sections or appendices) of national or DOE documents, then those sections become required. *Guidance: Handbooks[16] should never be required, nor any part of any ESM document with "guide" or "guidance" in its title.*

5. Interpretations shall be utilized as if written in the ESM/code/standard itself.[17]

[14] Using newer-than-referenced NCS for design can cause conflicts since codes are integrated with or modify them, especially with structural (e.g., ASCE 7). For products, using newer NCS should not cause problems (thus allowable)—and is often necessary due to manufacturer availability (e.g., more-recent ASTM for drywall, B&PV code for pressure vessels).
[15] *Applicable* NFPA codes and standards include those referenced in the ESM, DOE orders and standards, and any NFPA codes and standards specifically referenced by a requirement within any of those documents. The scope, applicability, and retroactivity statements in the code or standard must be considered as well (e.g. NFPA 45 is not applicable to all laboratories) Specific standards and recommended practices are also applied based on providing a graded approach to Highly Protected Risk (HPR) practices in nuclear, high-value, hazardous, and critical facilities; even when not specifically referenced by building or fire codes, or DOE standards or orders.
[16] DOE-TSPP-4-2013 2.1: "Care should be taken …to avoid identifying requirements in DOE Handbooks, which do not contain requirements ..." ESM being revised to remove suggestions that Handbooks are requirements.
[17] Either from issuing org or LANL. Users are not expected to locate and manage all such interpretations; however, they must follow same for any for which they become aware.

Guidance: The graphic below depicts the DOE regulatory framework (not LANL or national consensus):



Graphic credit: DOE

E. Errata (error corrections) to any document are mandatory regardless of contract award date or code of record; likewise, addenda, supplements, and other interim updates[18] to national consensus standards are adopted upon issue.

F. *Online Codes and Standards Guidance: Free access to many national codes and standards is available to those with a LANL IP address (or token card) at: http://www.lanl.gov/library/find/standards/index.php*

5.1 LANL Engineering Standards

Comply with the following documents/collections:

A. LANL Engineering Standards Manual (ESM), STD-342-100 (Requirement 1-0006)

This Section's numbering (Z10, Z1010, etc.) and most other chapters are organized by the UNIFORMAT II 1998 or 2010 system described in ASTM E 1557.

B. LANL Master Specifications Manual (LMS), STD-342-200

1. See Attachment F of this Section Z10. Comply with each Section unless indicated as guidance in the ESM.

C. LANL CAD Standards Manual (CSM), STD-342-300

Comply with the CSM when creating or revising drawings for facility work and R&D or programmatic systems similar to facility systems (see CSM for details).

D. LANL Standard Drawings and Details, STD-342-400

1. This includes Example Drawings and the ST-series repeatable details.
2. Standard Detail usage requirements mirror those for Master Specs—i.e., using where applicable, tailoring to a final product, etc. See Z10 Att. F.
3. Comply with unless indicated as guidance in the ESM.

[18] Example: ASHRAE standards which are under continuous maintenance through addenda.

4. CAUTION: Example drawings depict required content and format with potentially mock data and so, unlike Standards Details, are not necessarily valid design templates.

6.0 Clarifications, Alternate Methods, Variances, and Non-Conformances

A. LANL Standards amendments (clarifications, interpretations, alternate methods, and variances), including those for referenced codes and standards, are either project-specific or applicable sitewide.

B. Amendments issued for sitewide use and webposted with the subject LANL document(s) are applicable to all users of that document edition and become moot once removed from web (*they're generally moot once the document they reference is revised to address issue*).

1. The Standards Program may elect to revise the subject document(s) rather than issue an amendment.[19]

a. *A newer revision of a LANL Standard document may provide clarification of intent in a previous revision, but for an underway project to utilize the newer revision, use of a change process is often required (see Code of Record heading later).*

2. *All issued variances/alternate methods available (internal)*

3. *Issued Clarifications and Interpretations available (internal)*

C. Forms and authorities are summarized in Table Z10-1 below. (Requirement 1-0007)

D. *Guidance on issued design: Amendments affect institutional documents but don't modify design — that must normally be done by engineering with an FCR or revision.*[20]

[19] The project may then utilize the entire revision by COR modification, but it may not selectively utilize only selected document relaxations without POC written permission (aka cherry picking requirements) because the relaxation may be tied to an off-setting requirement increase. Example : A thickness requirement reduction that was made along with the addition of an anti-corrosion coating; one cannot reduce the thickness without including the coating.

[20] In the case where an amendment doesn't require design change but helps the inspectors with enforcement by clearing up an ambiguity, then the inspectors will utilize that amendment in doing their job regardless of whether the design is changed. In this example of usage, the LANL inspector should confirm that it does not negatively modify the specific project requirement approved by the EOR, and then reference the amendment in their inspection record.

Table Z10-1 Standards Amendments: Clarifications, Interpretations, Alternates, and Variances — Methods and Approvals Summary

SMPO = LANL safety or security management program owner

Requirement Category (LANL)	TYPE 1		TYPE 2		TYPE 3	
Typical scope	**specs**		**ESM**		**contract**	
Basis for Requirement	• **POC preference and neither ESM* nor ESM-driven (not Type 2 or 3)** • **Nothing ML-1 or 2**		• **SMPO preference or NNSA-delegated to SMPO (not Type 3)** ○ **including ESM and other docs with ML-1/2 pedigree**		**NNSA contractual and not delegated to LANL**	
POC Help	Phone or Email					
Amendments						
	Method	**Approving Authority**	**Method**	**Approving Authority**	**Method**	**Approving Authority**
Formal Clarification or Interpretation	Form 2176	POC	Form 2176	LANL Authority	Form 2176	LANL Authority
Alternate Method or Variance (Type 1 or 2)	Permission**	POC	Form 2137***	LANL Authority	N/A	N/A
Equivalency or Exemption (Type 3)	N/A	N/A	N/A	N/A	Form 2137**** + P 310-1, *Exemptions or Equivalencies to Appendix B Requirements or* 10CFR851 variance website; etc.	NNSA Los Alamos Field Office or higher
If constructed work is contrary to Standards	An NCR is normally required; when NCR proposes use-as-is or repair disposition an amendment per above is also required to involve institutional requirement owner. See NCR topic below (*6.2.C.)*					

* Not-ESM examples: LANL Master Spec, Std Detail, CAD Stds Manual, Welding Procedure Spec, Std Procedure. ESM-driven requirements are therefore in ESM also, so would not be Type 1.

** POC permission shall be documented and maintained in project file. This can be by POC email, email documenting verbal permission with POC copied, a 2137 form (with all but POC N/A), another electronic system for capturing issues/responses (e.g., SharePoint, Design Review Tool), or other method that shows POC permission (Standards Manager should be copied on all methods). Written requests should be specific about revision and citation in question and justification for change. POCs will judge preference versus code/std/ESM. Also, where ESM, spec index, or similar method indicates that a given spec template is to be considered guidance, then POC permission is not necessary (but user input regarding improvement is desired).

***VSS: For ESM issues involving vital safety systems, a committee consisting of the CSE, FDAR, and POC should be convened (with invitation to LA Field Office to participate during or afterwards) for review of request and recommend a disposition to the NNSA-Delegated Authority/SMPO. Alternatively, the SMPO may involve the Field Office through other means.

**** Contract: A committee consisting of the requestor, FDAR, and POC should be convened (with invitation to LA Field Office to participate) for review of request and recommend a disposition to the NNSA-Delegated Authority who will then decide to either deny the request or forward to the Field Office for action.

Definitions for Table Z10-1

POC	The Standards Program point-of-contact listed on this webpage and any alternates.
POC Help	Informal assistance from the POC for informational purposes only. For formal direction use forms shown.
Clarify	To make a document understandable and free from confusion.
Interpret	To formally provide an acceptable method of compliance
LANL Authority	See Table Z10-2 below. SMPO = LANL safety or security management program owner
Alternate Method	A deviation from a requirement that includes compensatory measures that accomplish the desired intent or results by using a different approach with alternative materials, design, or methods of construction or equipment.
Variance	A deviation from the explicit expectations; an exception.
Equivalency	An alternate method to a Type 3 requirement; alternatives to how a requirement in a directive is fulfilled in cases where the "how" is specified. These represent an acceptable alternative approach to achieving the goal of the directive. [see DOE O 252.1C] DOE G 420.1-1A guides evaluation of equivalencies for the recommended codes and standards (*see Section 5.4.16*).
Exemption	A variance to a Type 3 requirement; a release from one or more requirements in a directive. [see DOE O 252.1C]

Table Z10-2 LANL Authorities (e.g., from Delegation by NNSA)

Standards Topic (alphabetically)	Primary ESM Chapter(s)	Primary Mandate	LANL Authority (SMPO)
Building codes and engineering except for topics below	16	DOE O 420.1C, Facility Safety	To Building Code Official per Ref. 1, Att. C
Electrical safety per NFPA 70 (NEC); 70E labeling	7	10 CFR 851, Worker Safety and Health Program	All AHJ matters to Electrical Safety Committee per Ref. 2; see P101-13 for ESC details. *("AHJ Electrical Safety" is in ALDESHQSS)*
Fire protection, life safety	2	DOE O 420.1C, Facility Safety	To Fire Protection AHJ (Fire Marshal) as shown by NNSA-approved PD 1220, Fire Protection Program, per Ref. 1 Att. A
General/Owner	All but 17	DOE O 420.1C, Facility Safety	To Owner and Owner's Inspector per Ref. 1, Att. B[21]
Pressure safety	17	10 CFR 851, Worker Safety and Health Program	Building Code Official[22] per Ref. 1, Att. D
Rad protection	11	10 CFR 835, Occupational Radiation Protection	All matters within envelope of approved rad protection plan (P121, Radiation Protection); to "Radiation Protection Program (RPP) Manager" (*in ALDESHQSS)*
Secure communications	18	DOE O 470.6, Technical Security Program	As allowed by order; to LANL PTS Site Manager *(in NIE)*
Security	9	DOE O 47X series	As allowed by applicable orders; to "Officially Designated Security Authority" *(in Defense Security Program [DFS] in ALDESHQSS)*

Reference 1: NA-LA Letter FO: 34JF-2021-003148 to Andrea N. Martinez, Prime Contract Office, from Jennifer L. Jung, Contracting Officer and Theodore A. Wyka, Manager, NA-LA, Subject: NNSA-2021-003148 - *Delegation of Owner, Building Code Official, and Authority Having Jurisdiction Roles and Responsibilities to Triad National Security, LLC Personnel* (NNSA-2021-003148) (EMRef-79).[23]

Reference 2: NA-LA Letter FO: 14JF-2019-001448 to Kelly Beierschmitt, Deputy Laboratory Director for Operations, Triad, from Jennifer L. Jung, Contracting Officer and William S. Goodrum, Manager, NA-LA, Subject: *Delegation of*

[21] Owner and OI act as institutional customer of all projects and ensure results are in LANL's best interest. As such, many ESM requirements that are not contract driven are nevertheless valid needs/desires.
[22] Once the Pressure Safety Committee qual standard is functioning, BCO will become the PS Committee.
[23] Where DOE/NNSA has not reserved authority on particular national codes and standards, LANL authority may be assumed (includes those incorporated by reference within delegations above). Mandate editions current as of date of Z10 issuance.

Owner, Building Code Official, and Authority Having Jurisdiction Roles and Responsibilities to Triad National Security, LLC Personnel, dated May 16, 2019 (NNSA-2019-0014488) (EMRef-78)

6.1 Clarifications and Interpretations

A. SMPOs are responsible for the technical content of the LANL Standards. They may delegate various authorities to Standards Discipline POCs.[24]

B. *Standards users should contact the POCs first for assistance (not SMPOs).* Contact Alternates only when primarily is unavailable in necessary timeframe*. Standards webpages and ESM documents list contact information. For larger projects, procedures for RFIs (e.g., AP-850-300 FM08) may dictate communication pathways.*

C. *Guidance: Informal POC help may be requested by and responded to via phone or email.*

D. Official clarification and interpretation requests may only be submitted by LANL personnel and require the use of LANL Form 2176, *CoE Formal Clarification or Interpretation Request* per Table Z10-1*.*

E. *The POC may respond directly to interpretations and clarifications, or first call upon the assistance of others including their technical committee. Responses should be copied to the ESM Standards Manager and tech committee when significant or of interest.*

6.2 Alternate Methods, Variances, and Non-Conformances

A. Personnel shall not deviate from the LANL Standards in developing the technical requirements (including programming, functions & requirements, and requirements & criteria documents); in design; during fabrication, construction, testing, inspection; or in written direction to any LANL entity or subcontractor unless the Standards Program has granted such variance as described below.

1. Alternate methods and variances must proceed as follows:

a. LANL Requestor collaborates with POC. When required by Table Z10-1 above, develop the request using Form 2137.

1) As it is in the best interest of LANL to consistently follow the Standards, it is expected that variances will be granted only rarely, and only when a strong justification exists. The requestor should provide sufficient justification in their request, and to show that the variance has significant long-term cost savings, programmatic benefit, etc. associated with it.

b. POC reviews the request, and either concurs with or without comments or recommends against; approval authority takes final action.

1) Guidance: Variance extensions should be processed as a revision to the original request; documentation provided with the extension request should be current and support the justification.

B. LANL review, acceptance, or lack of rejection of design or other submittals not meeting the Engineering Standards or Subcontract does not constitute an approved alternate or variance to the Standards – nor tacit approval to continue with non-acceptable work. Compliance is required unless variance is formally granted per above.

[24] The Conduct of Engineering Program Office manages the overall LANL Standards program.

C. Nonconformances (NCRs) and Standards-related Work: Variances and Alternate Methods discussed above are intended for proposed, future work (willfully proceeding with work contrary to the design is not allowed). When work that does not conform to the design is not promptly corrected, an NCR[25] is required to disposition the situation, address causes of non-compliance, and gain necessary approval signatures. Replacement or rework is typically required; however, use-as-is and repair dispositions may be granted in rare cases and if the NCR disposition does not conform to the LANL Standards, Program concurrence in the form of an alternate method or variance is required; see below.

1. Use-as-is and Repair Dispositions – Standards Program Involvement

   a. Standards Program concurrence: When work is contrary to the LANL Standards, the Requestor must follow the variance process described above.

   b. Standards Program rejection requires NCR disposition change to rework or reject (from use-as-is or repair) and return of NCR to the requestor.

2. Use As-Is and Repair – Design Change Implications

   a. Variances are permission documents, not design control. Use-As-Is and Repair NCR dispositions are subject to design control measures commensurate with those applied to the original design. *The disposition will normally require entry into the design change process in accordance with P341 (internal) Facility Engineering Processes Manual, or other governing requirements documents to reflect the nonconformance and are subject to design control measures commensurate with those applied to the original design. Refer to AP-341-519 Design Revision Control and AP-341-405 Identification and Control of Technical Baseline in Operating Facilities regarding which changes if any do not require entry into the process.*

D. SDDRs: Subcontractor Deviation Disposition Requests (LANL Form 2178) proposing to deviate from LANL Engineering Standards shall follow the same Standards Program concurrence process as variances for NCRs.

7.0 Code of Record

A. The set of technical and quality codes and standards used to perform the design and construction are considered the "code of record (COR)."[26]

B. The COR shall be initiated during conceptual design and is placed under configuration control during preliminary design. Typically this means the COR is formally established when Title II design begins. Exceptions to this shall be clearly delineated in appropriate design input type documentation such as the Requirements & Criteria Document (RCD), or contract documents when design is performed by a Subcontractor (bid documents

[25] P330-6, Nonconformance Control and Reporting controls the broader LANL NCR process. In construction work, NCRs may be deferred/forgone for pending rework/scrap when allowed (and tracked) by LBO Chief Inspector (ref. ESM Ch. 16).

[26] DOE-STD-1189 has useful COR discussion. Also: For a nuclear facility, the COR contains or references requirements that directly affect public, worker, environmental, or nuclear safety; engineering disciplines, including civil, structural, mechanical, electrical, instrumentation and control, piping, and fire protection; and management systems including safety, security, and quality assurance. The COR includes Federal and state laws and regulations, DOE requirements, and specific design criteria defined by national codes and standards. This includes national codes and standards invoked through 10 CFR Part 830, Nuclear safety management; 10 CFR Part 851, *Worker safety and health program*; the design criteria in DOE O 420.1, *Facility Safety*, and through applicable state and local building codes. [From Office of Environmental Management Interim Policy, Code of Record for Nuclear Facilities, Dae Chung, 9/3/09, available from POC.]

either contain the COR of the project or language to the effect of how the COR will be determined if part of the bid is to establish for next phase).[27] This remains the COR for the final design and for construction unless the project (or operating organization) makes the unusual decision to change to adopt a newer code or standard (e.g., for compelling safety benefit).[28] Adoption of a newer code or standard shall be considered a design change.

C. Establishment and maintenance of a facility or system's *design basis* during design and construction, including COR, is required[29], and must include documentation required by this Section Z10 and other applicable ESM chapters. Projects must document and maintain the specific edition of the design codes and major standards (including LANL ESM, DOE Standards, and national and state codes and standards[30]) used as their basis in a project record document once they have reached the "underway" date discussed below.

Guidance: AP-341-616 Technical Baseline Change Control during Design establishes the requirements for design change control for Hazard Category 2 or 3 nuclear facilities. A number of preliminary design outputs should be under change control at the start of final design.

D. Codes and major standards must be documented on the Drawings (title sheet ideally).

E. RCD and COR Upkeep: Where an RCD is provided to the Design Agency as a design input document, the Design Agency shall thereafter maintain it throughout design and construction, capturing both COR and other design input changes using redlining, and promptly obtain LANL approval of changes. These redlines shall be submitted for LANL approval at each design review as a minimum during the design phase and with any needed changes during the construction phase.

1. Where a COR document separate from the RCD exists, Design Agency shall also maintain the COR as described for the RCD.

2. SDDs and FDD: Where project scope includes system and/or facility design descriptions, FDAR may direct requirement and criteria change control by those documents alternatively to RCD and/or COR.

F. *An e-file of the LANL Standards set can help capture the initial COR and establish the LANL STD version for the project; CENG will provide upon request.*

Guidance: Other parts of the ESM and Conduct of Engineering Program require additional documentation of the COR. For example, Structural Chapter 5 Structural Section I requires a Design Basis Document and Architectural Chapter 4 Section B-C-GEN requires a drawing sheet that summarizes occupancy classification, type of construction,

[27] DOE O 420.1C Chg 3 Attachment 2 Chapter II, 3.a.(2)(a)
[28] DOE O 413.3B on nuclear facilities: "…the COR is controlled during final design and construction with a process for reviewing and evaluating new and revised requirements. This will determine their impact on project safety, cost and schedule before a decision is made to revise the COR. New or modified requirements are implemented if technical evaluations determine that there is a substantial increase in the overall protection of the worker, public or environment, and that the direct and indirect costs of implementation are justified in view of this increased protection" Also, generally consistent with GSA PBS-P100-2014 (Facilities Stds) 1.1: "The design team must review compliance with the building program at each stage of the project, as required in Appendix A [Submission Requirements], to ensure that the requirements of the program, the P100, and relevant codes and standards have been met and to guard against unplanned expansion of the program because of design and engineering choices."
[29] DOE O 420.1C CRD Section 1 Para 1.c: "For design and construction activities, contractors must identify the applicable industry codes and standards, including the International Building Code (IBC), and the applicable DOE requirements and technical standards …"
[30] Design codes/standards, but not materials standards such as ASTMs on conduit or rebar— these are incorporated by reference by the codes and can be assumed (and easily determined years later by looking at the project spec or code books).

building areas and number of stories, corridors and area separations, floor and roof loadings, and hazard classifications.

G. COR Modification for Existing SSCs

Does any part of work include…	**…then**
Regarding IBC and Programmatic	
SSC is in IBC Program scope per ESM Chapter 16 IBC-GEN scope tables	IEBC applies work and often impacts/updates the COR. See Chapter 16 including IBC-GEN Attachment B on IEBC and the minor work allowed to follow COR.[31]
Programmatic SSCs that are outside IBC Program scope	Fifty (50) Percent Rule applies: Bring such existing SSCs into compliance with current codes and requirements in the ESM when renovation or other upgrade work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement (market) value[32] of the existing structure, system or subsystem.[33] (Requirement 1-0008) *Consider upgrading whenever safety is an issue.*
Regarding Nuclear	
Nuclear facility "major mod" (see App A for definition)	Follow DOE O 420.1C as implemented by ESM, except when project is D&D. (Requirement 1-0009) *Exception or equivalency to ESM normally requires Site Chief Engineer plus NNSA and/or HQ; see Alternate Methods (etc.) heading in Table Z10-1 above.*
Nuclear facility SSC mod less than major	Latest ESM requirements apply but original or lesser requirements may be used when allowed by the ESM (e.g., Ch. 16 IBC-GEN Att B, LEBC) or by a variance. Tailoring of national standards is allowed where specifically discussed by chapters. V*ariance from Site Chief Engineer may be possible.*

H. Application to Projects and Underway Concept (LANL-Only)

LANL project team must produce designs that ensure final project complies with applicable portions of the Standards including the following criteria:

1. Major projects: For projects formally managed per SD350, *Project Management for Capital Asset Acquisition and Construction*, the COR (version of the Engineering Standards and its references to be used) default is the date of design contract solicitation (except where subcontract sets it as award date). (Requirement 1-0010). Projects may elect to document/lock-down the COR to the version no earlier than 30 days prior to the technical subject matter expert (TSME) approval date of the Request for Proposal for design services (including design-build). In no case may COR be earlier than 6 months before subcontract award. (Requirement 1-0011)

2. FOD- and programmatic-managed work including maintenance: When not a major project, the date used for determining applicability of new or revised Standards is the managing organization's (e.g., FOD or programmatic line

[31] Once there is occupancy (partial or full) per ESM Ch 16 Section IBC-GEN or it has gone operational it is considered existing
[32] Replacement value determined using typical LANL cost estimating procedures
[33] Requirement applies on a system or subsystem basis (e.g., a glovebox system, process systems in DARHT, NHMFL, RLWTF, PF-4 production, LANSCE beamline, etc.; systems and subsystems are characterized by ESM Chapter 1 Section 210).

manager) approval to proceed with final design phase (or no more than 30 days prior to date of RFP for design services, if sooner).

3. Design Shelf-life: For all tasks, when the design has been substantially completed but construction has not begun within 24 months, the design shall be updated to current LANL Standards prior to beginning construction (or process Variance Form 2137 showing cost/benefit of not doing so and receive approval). Similarly, if the design process is stopped part-way for over 24 months, upon restart of design the COR must be reset to no earlier than 30 calendar days prior to the date of restart of design, and latest LANL Standards met. (Requirement 1-0012) *Guidance: For modifications, also ensure any changes in the field have not affected design compatibility.*

4. COR Change While Underway: In rare cases involving safety, the ESM or Site Chief Engineer may require analysis and possible adoption of new criteria for projects underway.[34] *Guidance: It is often allowable and in a project's or Subcontractor's advantage to voluntarily adopt/accept newer standards during design to incorporate local and national lessons learned for safety, cost effectiveness, new products, and overseer expectations, and have updated product information and logistical information for working at LANL.*

I. Engineering Services Contracting Method (LANL-Only): Use of design-build contracts is highly discouraged for complex, moderate and high hazard, less-than-haz-cat-3 (e.g., radiological), or nuclear systems and facilities. (Requirement 1-0013)

J. Engineering Services during Construction (aka Title III) (LANL-Only): Projects must retain the original design agency to provide engineering services during construction.[35] (Requirement 1-0014)

LANL-only Guidance: Title III scope of services should include: review and approval of submittals; RFI and SDDR review, disposition, and incorporation as part of the design or design changes; review/comment on change order requests affecting design scope or quality; processing of non-conformance reports; creation, review, disposition and incorporation of design revision documents including DRNs and FCRs; seismic anchorage and bracing design of non-structural (e.g., architectural, mechanical and electrical) components (if not completed in design phase) and assistance with IBC Ch. 17 Special Tests per structural observation where required by ESM Chapter 16, and typical standard-of-care observation of work in general for other disciplines for conformance to design; project close-out activities which include participating in the final inspection; preparation of record documents including updated drawings.

1. Final project record documents shall include the incorporation of LANL-approved interim changes (e.g., FCRs, DRNs), redlining when allowed or required (e.g., design-build team-internal process), and discovered differences (e.g., from walkdowns) in the native software (e.g., AutoCAD) and in PDF, and signed by Design Agency. Ref. LANL Master Spec Section 01 7839 Project Record Documents. (Requirement 1-0015) *Design Agency encouraged to walk down the work.*

   a. For calculations, Design Agency shall as-built/finalize those that contained non-bounding (non-conservative) assumptions and provide matrix tabulating how such assumptions were verified.

[34] Past examples include new admin requirements like increased pressure safety documentation and occupancy permits; also technical requirements like DOE-STD-1189 compliance and increased seismic demand per ESM Chapter 5.
[35] LANL's Project Manager and Site Chief Engineer must agree when doing otherwise.

b. Interim change (e.g., FCR) incorporation is not necessary for: Demolition plans that become moot; vendor data; QA records; informal isometric sketches for piping installation; temporary bracing plans for formwork or erection.

2. As-builts (A-B) drawings: These are a subset of project record documents. A-B drawings accurately reflect the final condition ascertained by LANL walk down and are only produced for the most critical documents (see Definitions). LANL will utilize record drawing drafts (produced per direction above), walk them down, and deliver any additional changes to Design Agency or other Final Document Creator shown in Table Z10-3 to produce the As-built. *Design Agency also encouraged to walk down the work*. (Requirement 1-0016)

a. When "Final Document Creator" incorporates redlines from Verifier walkdown and add "as-built with (or without) changes" — and by whom verified — to the document record of revision, provide for LANL for review, and re-issue. (ref. CAD Std Manual Section 100 for details).

b. Guidance: LANL A-B walkdowns are appropriate for all "Priority" and "Support" documents which are generally those necessary for safe operation. Most are captured by the categories shown in the table below. (This is generally under 10% of the total for nuclear and, for non-nuclear, only a handful of drawings). See A-B in Definitions.

Table Z10-3 LANL Roles in As-builting by Doc Category

Doc Category	Doc Types	Typical LANL Verifier	Final Doc Creator
Where Final Document Creator is Typically Not LANL			
Building automation system (non-nuclear facility HVAC)	Shop drawings, programming	I&C engineering or delegate (*ES-EPD*)	Constructor (e.g., delegated design/build Subtier)
Fire protection 1. Fire Area Boundary Drawings 2. Fire Barrier Penetrations Database 3. Fire Suppression P&IDs, Details and Schedules, and Sequence of Operation / I&C Diagrams 4. Sprinkler System Hydraulic Calculation(s) 5. Location Drawings of Underground Water Mains and Control Valves, Hydrants, and Fire Department Connections 6. Fire alarm system diagrams and programming	Calcs, drawings, shop drawings, specs, FACP programming	Field Eng, Building Insp, or ES-FP per Div. of Responsibility	Constructor (e.g., delegated design/build Subtier)
System and Facility Design Descriptions	SDDs, FDD	System Eng or others	Author of latest approved version (Design Agency is default)
All other drawings required to be A-B by FDAR and not shown above, typically including P&IDs, electrical one-lines and panel schedules, other *Priority* and *Support* documents, and ML-1, -2, and -3 SSC drawings (critical or needed for safe operation)	Drawings; specs (unless waived by FDAR)	Field Engineer or Building Inspector	Design Agency

Doc Category	Doc Types	Typical LANL Verifier	Final Doc Creator
Where LANL is Developer, Verifier, and Final Document Creator			
Floor Plan of Record (FPR)	Drawing per ESM Ch. 4 GEN and CAD Standards Manual	IFPROG	
Emergency Evacuation Diagram (where required; based on FPR)	same	ES-EPD, ES-UI, or others	

I. Guidance: Requests for Proposal ("bid documents") should state the key design basis codes/editions such as Building Code of Record (e.g., IBC-20XX) and Life Safety Code of Record (e.g., IBC-20XX, IFC-20XX, and NFPA 101-20XX where XX is actual year. When a modification to an existing facility, this and other inputs should be provided (IEBC alteration level, etc.; see IBC-GEN Preliminary Project Determination Form).

8.0 "Conflicts" and Adequacy

A. "Conflicts:" The most stringent requirement among requirements including ESM chapters and the codes and standards invoked by them must be followed, even when they might be conflicting. Refer remaining questions concerning "conflicts" in the ESM to the applicable LANL discipline POC. *Guidance: In such cases, clarifications may be issued.*

B. Codes and Standards: If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so barring other direction ("A" above), comply with the most stringent requirements among the documents.[36]

C. "Guidance Conflicts:" Having a requirement in one place and a guidance statement in another place that is similar or addressing the same issue is not a conflict and the requirement must be followed (*this is often intentional – practicing technique of having the mandate in one/best place and referring to it or reiterating it elsewhere*).

D. Precedence in design process: The ESM has precedence over the LMS, and the LMS has precedence over the STD Details. Thus, in case of conflict, projects must design to meet the document with highest precedence.[37] Similarly, the designer must update LMS and Details where they have become outdated.

E. Incorrect Standards: The adequacy of design inputs is generally the responsibility of the design authority. Nevertheless, if the design agency believes the LANL Standards (a design input) to be incorrect (e.g., compliance will cause a problem), it is their responsibility to bring the issue to the attention of the applicable ESM Discipline POC (via the STR or LANL Project Engineer as appropriate) for resolution.

F. Precedence in issued design: ASM pro forma precedence in subcontracts applies to all projects, thus: The Scope of Work has precedence over the Specifications which has precedence over the Drawings.

1. *Guidance: This precedence may obviate the need for a design revision in some cases. Suppose a Specification requires the use of a load-bearing 2" x 4" support but the Drawings show an inadequate 2" x 3" support. Since the specification*

[36] DOE O 420.1C requirements take precedence over NFPA and IBC requirements and are addressed through EQs or EXs; conflicts between NFPA and IBC requirements are resolved by the DOE/NNSA Los Alamos Field Office in consultation with DOE/NNSA and LANL IBC and fire protection program SMEs.

[37] A variance is not required in this instance but the POC must be notified of conflict in writing (e.g., email). Approach is similar to ASM pro forma order of precedence for subcontracts is per Exhibit A GC-6 which states that Scope of Work has precedence over Technical Specifications which has precedence over Exhibit E drawings.

supersedes the drawing, design revision per AP-341-519 is not strictly necessary. However, if the situation was reversed and the Spec called for an inadequate support relative to the correct Drawings, then a design revision would be necessary to change the Spec.

Issued Design Situation	***Need for Design Revision per AP-341-519***	***Comments***
Spec wrong, Drawings correct	*Yes*	*Since Spec has precedence over Drawings*
Spec correct, Drawings wrong	*Maybe*	*Possibly Yes if needed for drawing update process to satisfy FDAR and their use of AP-341-405**

** AP-341-405, Identification and Control of Technical Baseline in Operating Facilities*

9.0 "Constants"

Following are "constants" to be used for design at LANL. These are generally adequate and conservative; however, when other ESM chapters contain other constant values, they take precedence. Also, there may be instances where these or other ESM "constants" are not conservative; then, designer must use conservative or actual values. (Requirement 1-0017)

A. Elevation: 7,500 feet[38]

B. Latitude: 35.9 deg N, Longitude 106.3 deg W (TA-6 weather station)

C. Barometric Pressure (avg): 11.10 psia (22.65 inches Hg).

D. Air Density (7,500 feet): I-P: 0.057 pounds/cubic foot (0.075 pcf at standard air)[39]

- S-I: 0.00091 g/cm^3 (0.0012 at standard air/sea level)

E. Air Density Ratio: 0.075/0.057 = 1.32 (reciprocal = 0.76)

Elevation Note: Exceptions to the above:

1. For design near upper West Jemez Road (TAs 16/22/8/9/28) use 7,700 feet; at TA-57 Fenton Hill site use 8,600 feet.[40] For lower Pajarito Road and other areas use actual elevation when required for adequate design margin.
2. Design clean fire extinguishing agent systems with a design elevation no higher than 7,000 feet.

10.0 Design Goals

A. When designing new systems and facilities, consider how decommissioning and demolition might be performed and design to facilitate it where practical, including waste minimization, recycling, and reuse (*additional requirements for hazardous systems appear in ESM Chapter 10; actual D&D controlled by Chapter 16 IBC-GEN).*

[38] Elevation at LANL generally ranges from 6250 ft at TA-39 to 7780 ft at TA-16; 7500 is generally conservative for most calculations with exceptions noted. Info from USGS 1:24000 quadrangles: Frijoles, NM and White Rock, NM. Elevation affects design and operation of many mechanical, electrical, and other components; this effect is addressed in more detail in those ESM chapters.
[39] FWO Calculation No. 00-00-CALC-M-0003
[40] Both approximate actual elevations

B. Unless stated as otherwise in the project-specific documents, designers must use the following parameters for decision analysis and design goals, and materials and finishes must be chosen accordingly (Requirement 1-0018):

Table Z10-4 – SSC Design Life Defaults

Structures	Expected Life, years
Office Trailer (also see Ch 16 IBC-GEN regarding temporary)	20
Light Construction (e.g., modular, pre-engineered, or GPP [~$10M maximum] facility)	35
Medium Construction (e.g., line item office or lab)	50
Heavy Construction (e.g., bunker, nuclear facility, or other concrete-walled/roofed structure)	60
Systems	
Roofs	20
Other systems — active/moving components of systems in architectural, mechanical, electrical, I&C, and nuclear systems	20
HVAC control system	15
Other HVAC/R system components: As shown in ASHRAE HVAC Applications manual (Owning and Operation Costs chapter), but never more than 35 years	

C. Difficult-to-replace systems and components must be designed to perform for the life of the facility with minimal life-extension activity. Examples of such systems and components:

- Structural and architectural components of concrete, metal, ceramic, and stone including exterior wall finishes
- Flooring, hard-surface (e.g., polished concrete or ceramic or quarry tile)
- Building services piping concealed in walls, floors, and overheads
- Ductwork and other passive mechanical components
- Electrical wiring, conduit, fixtures, transformers

D. For systems and components that cannot be reasonably expected to perform for the system or facility life without replacement or life extension, design for lowest life-cycle cost and ease of replacement/life-extension. (Requirement 1-0019)

1. Systems and Components for which replacement or life extension is anticipated in less than 35 years:
   - Roofing (see Table Z10-4 above)
   - Flooring (carpet and rolled goods)
   - Mechanical equipment (active)[41]
   - Electrical equipment with moving parts or contacts; PV panels
   - Controls (see table above)
2. *Guidance on life cycle analysis is provided in Z10 Attachment E. Additional design life standards are available from* https://fims.doe.gov/caisinfo/doc.html*, both for building systems and other structures and facilities (OSFs).*

E. Worker Safety (Requirement 1-0020)

1. Design to ensure the safety of construction, operation, and maintenance personnel. Use best available, cost-effective technology and good engineering

[41] Implicit in the requirement to design for lowest lifecycle cost is that the design agency must submit LCC analysis supporting their decisions when LANL reviewers question that the correct, LCC-based choice was made (thus, said request shall be treated as a compliance comment). This is most likely on mechanical equipment (e.g., HVAC) but could theoretically arise with any design choice.

judgment to achieve this. When in doubt, consult system engineering, operations, maintenance, and safety professionals.

2. Reviewer "compliance" comments regarding safety will be arbitrated by the Standards POC if necessary.

3. *Guidance: For special hazards (those other than normal, industrial hazards), a team composed of the functions listed in (1) above should be formed and follow a documented ISM process that considers and mitigates the hazard through design and/or administrative controls. The design documentation must include a table or other document showing:*

   a. Hazards with probability and consequence judgments

   b. Methods evaluated to eliminate or reduce the hazards

   c. Applicable regulations and codes along with requirements of the regulation or code specific to the identified hazards

   d. Engineered hazard controls evaluated

   e. Engineered hazard control features included in the design, and justification for not including any such controls in the design

   f. Administrative controls (including PPE) recommendations if necessary

4. For hazardous processes design including nuclear, also see requirements in ESM Chapter 10 and OSHA *Process Safety Management of Highly Hazardous Chemicals*, 29 CFR 1910.119. For nuclear design, also follow ESM Chapter 12 and DOE-STD-1189, *Integration of Safety into the Design Process,* as applicable.

F. *Near-end-of-life Repair versus Replace (Guidance): Projects should provide documented analysis (e.g., life-cycle cost analysis or spend-limit analysis) to support a recommendation to modify, refurbish, repair, or otherwise retain – as opposed to replace – an existing major equipment item that has been in service for more than 75 percent of the life expectancies given above. Compare the alternatives over the duration of the remaining service life of the facility using analysis methods of ESM Chapter 1 Section Z10 Attachment E. Include consideration of the following factors:*

   1. Age and condition of the existing equipment,

   2. Extent of the proposed modification and the availability of proper parts for the modifications,

   3. Availability of qualified personnel to perform the proposed modifications to the existing equipment,

   4. Remaining service life of the existing equipment and of the facility; embedded software maintenance costs/considerations

   5. Estimated cost of facility downtime for proposed modification versus facility downtime for replacement,

   6. Estimated cost for proposed modification versus cost for replacement,

   7. Improvements in factors such as safety, efficiency, reliability, and maintainability afforded by modern replacement equipment compared to modified existing equipment.

   Note: Refer all cases where existing equipment has inadequate ratings (e.g., NFPA 70B §4-4.3.) for the intended application to the Standards Discipline POC.

Refer to other ESM sections for calculation requirements pertaining to those system elements.

11.0 Design Output Requirements (Calcs, DWGs, Sealing, etc.)

11.1 Complete Design: The design agency is responsible for a complete, coordinated design package.

A. This includes but is not limited to:

1. Drawings (or sketches where allowed that are (a) consistent with calculation results, (b) consistent with other discipline drawings, and (c) that are coordinated with the Specifications.

2. Inspections plans when required by ESM Chapter 16 consistent with above.

3. Design package up-to-date, technically correct, without repetition or conflict internally nor with construction subcontract pro forma (general conditions, etc.) and meeting all imposed and derived design inputs (and any approved changes).

- *For General Plant Projects (GPP) or Institutional General Plant Projects (IGPP), a scoping document, either a Functional Requirements Document per AP-341-601 and/or a Requirements and Criteria Document per AP-341-602, will be prepared by (or for) LANL. The scoping document, along with the design contract Statement of Work (SOW), will be the basis for developing the design and construction documents.*
- *For Line Item Projects, a Conceptual Design Report (CDR) will be prepared by (or for) LANL per DOE O 413.3C. The CDR, along with the design contract SOW, will be the basis for developing the design and construction documents.*

B. Design agency must perform required internal checking and verification reviews in accordance with their QA plan prior to submitting to LANL reviewers. Externally produced design will be reviewed by LANL in accordance with AP-341-620, *Review and Verification of Design Documents*; AE must resolve comments to satisfy that AP.

C. In general, design must stand alone and not rely on reference to the ESM for directing the work of the constructor (e.g., Subcontractor; exceptions allowed for reference to complex LANL programs such as Welding and NDE; however, IBC Program is addressed by Section 01 4000).[42] *Guidance: The LANL Standards are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system. Also, some LANL policy documents (P's, PD's) may also provide design criteria/requirements.*

D. Delegated Design: It is the DPIRC's responsibility to mandate and communicate applicable requirements of this and other sections of the ESM and their own Subcontract to delegated sub-tier subcontractors to assure that the requirements are implemented in the Subcontractor's design submittal. Responsibility for the adequacy of the delegated design remains with the DPIRC.

[42] Merely referring to the ESM necessitates inclusion of those portions of the ESM in the RFP; this increases RFP volume and complexity. This also holds for design-build: although no separate construction RFP exists, the constructor should not be expected to integrate the ESM and specs/drawings; this is design purpose/designer responsibility.

11.2 Project Files — General

A. The project shall produce and deliver an electronic file that includes all information important to the accomplishment of the design for the entire lifecycle of the design, procurement, and construction, testing/startup, and commissioning.

B. Electronic files shall have text search functionality (e.g., perform OCR and resave as necessary; exception for scanned handwritten documents). Non-electronic deliverables are only allowed when electronic is impossible (e.g., samples, mockups, prototypes, spare parts).

C. When the design is complete, there must be a historical record showing how the design progressed and reasons for changes.

D. The project file shall include design review records, submittals, changes, and test and inspection results. *It should also include significant written correspondence, summary of significant telephone calls, design and design-evaluation criteria whether furnished by LANL or designer-generated, and working notes*.

E. The Design Agency is responsible for producing and delivering the complete project file as described above; however, when LANL directs the use of LANL document control services to (1) manage reviews (e.g., of submittals) or (2) maintain official versions of drawings, documents, and/or records, the Design Agency should not deliver duplicative files of these records. See also Project Closeout subsection near the end of this document.

11.3 Calculations[43]

A. Prepare design calculations to document analytical determinations in accordance with the Design Agency's LANL-approved Quality Assurance Plan. Room numbers, equipment nomenclature, fixture numbers, zone numbers, or any other designations must be consistent with those indicated on the drawings or in the specifications. Calculations must be checked, reviewed, sealed when required, signed and dated by the designer and the checker, complete in all respects and must reflect the basis for selection of systems and components. For design agencies who do not have formal calculation procedures, calculations must be prepared in accordance with LANL AP-341-605, Calculations (internal link).

B. Provide a narrative description of purpose, methods, and conclusions for each calculation. Include notes/comments that strengthen the design coherence and communicate intent. Note references (source) for unusual formulas or methods of analysis, including edition of the reference and page number. Clearly identify numbers in formulas as to the units involved; e.g., psi, gpm, etc. List all assumptions and exceptions, and define all units. Identify assumptions that require verification. Provide copies of tabulated data used.

C. Neatly arrange sketches, input, output, and other material pertinent to the analysis and use 8 ½ x 11 inch sheets, where practical, and include in the complete analysis presentation.

D. Submit calculations to LANL for review and acceptance as requested or required. This approval does not relieve the designer of any responsibility for correctness and coordination with the drawings and specifications.

[43] "Every calculation based on experience elsewhere fails in New Mexico," attributed to a communication from Gen. William T. Sherman to Gen. Lew Wallace, NM Territorial Governor 1878-1881, and used by Wallace (Lew Wallace: An Autobiography, 1906). The rigor required here helps ensure calcs are correct regarding LANL conditions and can be checked.

E. The calculations will become record calculations for LANL and may be used in the future for modifications.

F. Hand calculations must be printed clearly and with sufficient darkness to ensure clarity when scanned. Index calculations in a logical order and include adequate sketches to allow an engineer to follow and comprehend them easily.

11.4 Software Calculations[44]

A. When performing design, refer to ESM Chapter 21, Software.[45]

1. Chapter 21 provides minimum requirements for software quality assurance (SQA) including both SSC and Non-SSC software. Key points germane to subcontracted work at time of writing:

a. For Non-SSC software (e.g., safety design or analysis), the chapter includes basic reporting requirements to facilitate LANL's oversight of project-specific determinations, etc. *It may also be used as an example of a comprehensive approach when assessing Subcontractor SQA programs.*

- For "Simple and Easily Understood" software that is used in the design of SSCs (ref. SOFT-V&V *subsection 9*), each calculation can be individually verified, and only the software identification and determination requirements of SOFT-GEN apply. If not individually verified but rather pre-verified (per SOFT-V&V *subsection 6 or 7*), then graded requirements of SOFT-GEN apply.

Note on SSCs with software (e.g., firmware) being specified or designed, and for any software being delivered for LANL ownership and use: Chapter 21 requires the same documentation deliverables that LANL personnel provide[46] (to the extent the information is known in the design and construction phases; when not known, insert TBDs and deliver as "Draft").

Unless otherwise indicated in subcontract documents, the construction Subcontractor serves as the Software Owner (SO) up to the point of turnover. Upon turnover, the SO responsibility transfers to the LANL system engineer. The FDAR is the SRLM and retains that responsibility throughout the software life cycle however may delegate activities through subcontract to the Subcontractor.

b. Subcontractor quality assurance programs must meet the requirements of [Chapter 21], comply with O 414.1D, and—where required by subcontract—ASME NQA-1, including Part I and Part II, Subparts 2.7 and 2.14.

[45] CH. 21 is overwhelmingly concerned with ML-1, 2, and 3 related work. Software risk determination: As with MLD approval above, when there is a reasonable probability that computer programs used for design or for control of SSCs or administrative limits (e.g., nuclear materials) are "safety" per ESM Chapter 21 Software, the Design Agency shall follow that chapter's process to determine this.

[46] For SSC software: Use of chapter forms/document numbers provides standardization and retrievability of documents that LANL must maintain going forward. As necessary, documentation will be updated or produced by construction subcontractors and verified by LANL in the start-up/commissioning process in conjunction with the system engineer function.

11.5 Other Outputs

A. When required by Attachment B, SDDs must be developed by Design Agency per DOE-STD-3024, *Content of System Design Descriptions*, and numbered per LANL AP-341-402.[47] For other non-drawing documents, follow AP's numbering where practical, especially when LANL will maintain during operations.

B. BIM: For all line item ($50m+) projects for new buildings and major additions, employ building information modelling software and deliver model. (Requirement 1-0021) *Guidance for LANL: Designate level of detail expected and invoke relevant parts of AIA E201, E202[48], and integrated project delivery contract set (and/or ConsensusDOCS 301[49]).*

C. Project Document List (PDL): Unless waived by LANL (e.g., IPT), the Design Agency shall produce and deliver an index of all project drawings, calculations, trade study reports, and other documents during the project and finalizing at close-out. (Requirement 1-0022)

1. *Guidance: Include design outputs and other deliverables (including revision and date). Projects using LANL's design review tool may employ other means to accomplish document control (and transfer-to-EDRMS functions).*

D. Professional Engineer Sealing (Stamping): Comply with the New Mexico Engineering and Surveying Practice Act (Chapter 61, Article 23 NMSA 1978) and NMAC 16.39 (especially 16.39.3.12).—thus licensed in NM except where noted below. (Requirement 1-0023). Outputs prepared by non-LANL engineers, consultants, and contractors (i.e., Subcontractors) that are involved in the practice of engineering must bear the seal (stamp) and signature of a professional engineer (PE), currently licensed in New Mexico[50], in responsible charge and directly responsible for the engineering work per below.

1. Engineering, and therefore sealing of design, is required as defined below.

Table Z10-5A
Always engineering/PE sealed (stamped), even if deferred or delegated[51]

Discipline	Task
Any	Calculations, designs, specifications, reports[52], and other engineering outputs including drawings and diagrams (including P&IDs and PFDs, and details based on LANL Standard Details).
Any	Field change documents only where they affect an existing calculation or require a new calculation, necessitate a new drawing or revision to existing drawing, or any other circumstances when the LANL project engineer determines a that the change meets intent of state law requiring sealing.
Any	Performance requirements (when no further engineering will be performed—only implementation such as with controls and fire per table below)
Controls	Initial sequence of operations. All nuclear safety system work.

[47] These are living documents that must go into document control using LANL SDD numbering.
[48] E201™–2007 Digital Data Protocol Exhibit…Parties not covered under such agreements should consider executing AIA Document C106™–2007, Digital Data Licensing Agreement."
[49] Paper from 2008 ABA Construction Forum Plenary 5: BIM BREAKS THROUGH: The ConsensusDOCs new Building Information Modeling (BIM) Addendum and How to Make it Work for You and Your Clients
[50] Site Chief Engineer may waive NM licensure requirement when in the best interest of the institution/Federal government. Compensatory measures may include licensure elsewhere and review/acceptance by a LANL engineer acceptable to ChEng.
[51] Except when addressed in second table. Defer and delegate are defined by ESM Ch. 16 IBC-GEN. If LANL is Design Agency, no seal but shall be designed or verified by a degreed engineer.
[52] NM Act states "reports." LANL interprets this as geotechnical, structural integrity, and other safety-affecting reports but not conceptual design reports, other CD-phase or prior products, and other reports or outputs that do not have a safety consequence.

Fire	FHAs, fire protection preliminary design (system performance criteria). New building or addition fire suppression or fire alarm shop (working) drawings (also see Table 5B).
Structural	demolition direction; concrete reinforcement; structural detailing/connections (all materials)
Structural	Steel joists: joist and/or joist girder designations, loading diagrams, and steel joist/joist girder design calculations[53]; bridge crane structural design
Structural	Equipment anchorage

Table Z10-5B

Tasks not necessarily performed by an engineer; PE seal (stamp) not required

Discipline	Output
Any	Repair or modification design meeting the IEBC Level 1 Alteration definition (replacement in kind) or LANL's Level 2A and which presents no unusual conditions, hazards, change of occupancy, or code violations—and is not mandated by NM state law[54]
Any	Shop/fab drawings, including direction on shop or field fab of HVAC ducting and other mechanical and electrical components; steel joist placement plans[55]
Any	Cost estimates and reports that draw no conclusions and contain no original engineering (e.g., an SDD that is based on technical baseline documents)
Any	*Record document* final production (field change document incorporation), including *As-builts* — but if differences between design and execution are discovered by a walkdown, then seal is required indicating PE acceptance of final configuration
Controls	Non-nuclear: instrumentation and controls including final sequence of ops (approved by EOR); building access control
Fire[56]	Note: Per Table Z10-5A, the fire protection preliminary (i.e., engineering) design cannot be delegated to the fire protection technicians with the sprinkler or fire alarm or other vendor responsible for producing the detailed design (shop drawings). Fire Alarm[57]: Shop drawings for reconfigurations to or additions of notification appliances, alarm initiating devices, or supervisory devices that can be supported by the existing circuits.[58] Automatic Sprinklers: Shop drawings for the reconfiguration of the layout of any number of existing sprinkler heads and installation of up to 19 additional sprinkler heads.[59] Emergency Lights and Exit Signs: Per direction provided in the previous rows for "Any Discipline." Fire-Rated Features[60]: Per direction provided in the previous rows for "Any Discipline."

[53] SJI position paper
[54] For protection of LANL's interests, more restrictive than allowed by NMAC 14.5.2 Para 10.C.4 exception on permits. See ESM Ch 16 IBC-GEN for level definitions.
[55] SJI position paper. Other structural design follows previous table (Z10-7A)
[56] Fire: In the spirit of NMSFO Scope of Work Letter option for modification or alterations to existing fire protection systems consisting of minor changes that does not cause a significant change to the originally approved design. Must be performed by National Institute for Certification in Engineering Technologies Level-III-certified person(s). NICET Certified Mark shall be used.
[57] Revision to the fire alarm system record (as-built) drawings are required for any level of alteration and regardless of whether a PE stamp is required.
[58] The changes cannot be for a new (not previously existing) feature or function, such as an emergency control function, unless limited to a single installation (E.g. providing duct detection and shut down for a single air handling unit upgrade, or providing emergency recall and shut down for a rehabilitated elevator.)
[59] The changes must maintain the hydraulic characteristic (i.e., demand) of the system. It cannot change the hydraulic demand, the hazard classification, or otherwise necessitate new hydraulic calculations in the opinion of the LANL Fire Marshal.
[60] Fire barriers, fire doors, fire-resistant joints, firestopping, spray-on fire resistant materials, fire dampers, and similar assemblies.

2. PEs must only seal those discipline drawings for which they are in responsible charge and directly responsible for the engineering work, none for which they are not.

   a. Competency: Except as noted in b & c below, PEs shall only practice and seal for those disciplines listed as a competency on the NM Licensure Board website. The LANL Site Chief Engineer, Building Official, and ES-EPD discipline leads may waive this requirement based on significant demonstrated experience and competency (via variance or memo to project file).[61]

   b. Overstamping: For the purposes of the Act, a licensee of the NM Board "has 'responsible charge of the work' as defined in Section 61-23-3, para. K, and may sign, date and seal/stamp plans, specifications, drawings or reports which the licensee did not personally prepare when plans, specifications, drawings or reports have been sealed only by another licensed engineer, and the licensee and/or persons directly under his/her personal supervision have reviewed the plans, specifications, drawings or reports and have made tests, calculations or changes in the work as necessary to determine that the work has been completed in a proper and professional manner." (16.39.3.12.E)

   c. Incidental Practice: The single seal of either a NM engineer or architect meets the requirement for professional certification on projects which do not exceed a construction valuation of $600k AND do not exceed a total occupant load of 50. (Requirement 1-0024). However, when a majority of the work is of a specialized nature such as fire, structural, or electrical, then a PE's certification competent in that discipline must appear on the documents.

3. Non-NM PEs: A NM-licensed engineer or landscape architect may "overstamp" outputs prepared and stamped by a registered engineer or landscape architect respectively in another state for submittal to LANL only when ALL of the following circumstances have been met (Requirement 1-0025):

   a. the outputs have been prepared by an engineer or landscape architect registered in a US jurisdiction;

   b. the reviewing engineer or landscape architect has the authority to make any changes to the construction documents in accordance with his/her professional knowledge and judgment, and is of the same engineering discipline;

   c. the engineer or landscape architect has reviewed the outputs prior to the preparation and sealing of the final set of construction documents to be submitted; and

   d. out-of-state-license work does not exceed 30% of the project's total design work in hours or cost.

[61] An example of meeting this requirement is that only PEs with an "R" designation may perform structural designs (civil is insufficient), but true of all disciplines. Per NMAC 14.5.2.10.B Professional seals requirements: "The building official or the plan review official is authorized to require submittal documents to be prepared and sealed by an architect, registered in accordance with the New Mexico Architectural Act, and the rules promulgated pursuant thereto, or by a professional **structural** engineer, registered in accordance with the New Mexico Engineering and Surveying Practice Act, and the rules promulgated pursuant thereto." LANL exerts this right as building official, and as owner for non-IBC projects.

4. Where sealing is required, documents must be sealed before construction begins. See ESM Chapter 16 Section IBC-GEN for details and rare exceptions.

5. Architectural: Follow the requirements above except that output documents must bear the seal of a NM-registered architect per the NM Architectural Act based on Article 15 of Chapter 61. (Requirement 1-0026)

6. LANL engineers and architects performing engineering services involving the operation of LANL on LANL property are exempt from the licensing and sealing requirements of the New Mexico Engineering and Surveying Practice Act. (Requirement 1-0027)

11.6 Design/Evaluation Criteria

A. Documentation must include, but is not limited to, the following (Requirement 1-0028):

1. Design output documents required per Attachment B and following the schedule for submission in Attachment C Deliverable Schedule 30-60-90-100% (when required); FDDs when required by Z10 Att B and per Att D; and additional documents required by the project's requirements and other ESM chapters (e.g., Structural Chapter's design basis document, and documents required by Hazardous and Nuclear Chapters).

2. For modifications to existing systems and facilities with technical baseline documents (e.g., *Priority* and *Support* drawings), modify the existing drawings using DCF-controlled sketches preferentially to creating new drawings. See CAD Standards Manual for more detail.

3. Equipment Selection Criteria: Include information such as flow rates, pressure or head requirements, operating temperatures, voltage, amperage, efficiency, energy consumption, and sound ratings. If manufacturer selection program is used, verify that altitude correction (e.g., fuel-burning, air-moving, motor size) is properly performed.

4. Include copies of catalog sheets showing equipment performance points for all major equipment included in the system's design.[62]

B. *Guidance (LANL-Only): For design output and other project deliverables, refer to* ES-EPD-FM01, Project Deliverables Checklist/Division of Responsibilities.

12.0 Environmental Management

A. Design documents must comply with the environmental requirements defined in the design contract document Exhibit F (internal), and provide mitigations to potential environmental insult appropriate to the scope of the project. Such mitigations could include but are not limited to the following (Requirement 1-0029):

- Design for pollution prevention/waste minimization, including but not limited to:
  - evaluation of non-hazardous material substitution alternatives;
  - evaluation of alternative technologies that result in reduced waste or contaminant generation;
  - design that results in overall reduction in the use of natural resources;
  - use of energy and water efficient equipment and appliances;
  - use of environmentally preferable products, furnishing and equipment;
  - minimization of waste generation, with a special emphasis on mixed waste generation; and

[62] As allowed by copyright law. Gain manufacturer permission or suppler certifications if necessary.

- recycling/reuse options.

- Waste management and disposal
- Working within the boundary of a potential release site
- National Environmental Policy Act
- Wastewater discharges
- Storm water management
- Air quality
- Threatened or endangered species
- Cultural resources
- Floodplains and wetlands
- Environmental reporting

LANL Project Engineer shall coordinate review of designs at each stage of development with ENV Division SMEs.[63]

Additional requirements related to the environment and waste are located in Chapter 3 Civil (disturbance, runoff, etc.); Chapter 6 Mechanical (boilers); Chapter 7 (diesel generators); Chapter 10 Hazardous Processes; Chapter 14 Sustainable Design; and ALDPM procedures.

B. Sustainable Design and Environmentally Preferable Purchasing

See ESM Chapter 14, Sustainable Design, for requirements for specification work required.

13.0 Environmental Qualification

A. The requirements identified within this section are for safety SSCs (VSS, Other Hazard Controls) or those SSCs that provide a mission critical, or worker safety function or whose failure may impact the operation of safety SSCs. (Requirement 1-0030)

B. *For non-safety systems, this EQ section may be taken as guidance that establishes sound engineering practice for the proper and reliable performance of SSCs.*

13.1 Requirements

A. The environmental conditions in which SSCs must operate or which can affect the proper or continued operation of SSCs must be clearly identified in design and equipment selection and documented (e.g., the basis for the selected parameters captured in the SDD).

1. Normal ambient, abnormal operating, climatic, and event conditions must be evaluated in the identification of applicable environmental conditions.[64]

2. Safety-class SSCs must be designed to perform all safety functions with no failure mechanism that could lead to common cause failures under postulated service conditions. The requirements of IEEE Std-323, *IEEE Standard Criteria for Qualifying Class IE Equipment for Nuclear Power Generating Stations*, or other applicable standards, must be used to ensure environmental qualifications of safety-class SSCs. [DOE O 420.1C Att. 3, 3.a.(2)(a)] See ESM Chapter 12 Nuclear for additional requirements and LANL Master Spec Section 01 8712 *Seismic Qualification of Equipment – Nuclear Safety Related*. [For SSCs requiring

[63] Use of PRID helps ensure this.
[64] "Testing shall demonstrate adequacy of performance under conditions that simulate the most adverse design conditions." NQA-1, Requirement 3

EQ by the IBC, see 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*].

3. Safety significant SSCs located in a harsh environment must be evaluated to establish qualified life. This may be accomplished using manufacturer recommendations or other appropriate methods [DOE O 420.1C Att. 3, 3.a.(2)(b)]

4. *Guidance: The environmental factors that should be considered when selecting SSC location or SSCs for a location include, but are not limited to, the following:*

acoustic noise	*airflow*
area flooding	*barometric pressure variations*
chemical and particulate (dust) contamination	*corrosive atmospheres*
electronic noise, or electromagnetic interference (EMI)	*elevation above sea level*
grounding	*humidity and temperature extremes including fire-induced*
interference from large motors and power feeders	*lighting*
lightning protection	*physical security*
power supply quality (electrical surges, frequency variations, etc.)	*radiation*
seismic considerations including proximity to earthquake faults	*vibration*

14.0 Equipment Location/Design

A. Maintenance: Active mechanical, electrical, controls, and similar equipment must be accessible for inspection, service, repair, and replacement without removing permanent construction or necessitating abnormal or unsafe action (e.g., crawling on ducts, piping, conduit, or cable trays) (Requirement 1-0031). *Guidance: Manufacturers may provide recommendations.*

1. If safety-related (SC, SS, OHC, hazardous-process-related) equipment is not accessible with a man-lift or rolling platform, then provide permanent OSHA compliant structures for access to equipment installed 12 feet or higher above finished floors (e.g., HVAC and controls) (Requirement 1-0032). *Guidance: This requirement should be considered not only for safety-related equipment but for any component that is located 12 feet or higher, especially if frequent access is necessary.*

B. Outside: Select sites carefully when locating equipment on grade. Ensure that factors such as snow accumulation and drift, ice, windy areas, rainwater from roof overhangs, etc., do not affect equipment performance and maintenance. *Avoid locations on the north side of the building.*

C. Noise: Locate equipment to minimize noise and sound vibration transmission to occupied areas of the building and adjacent occupied areas/structures.

D. Roofs: Locate equipment a minimum of 10 feet from the edge of roof or inside face of parapet whenever practicable. If the distance is less than 10 feet, specify a 42-inch-high restraint, e.g., guard rails, parapet, screen wall, etc. (Requirement 1-0033)

E. Security: Locate equipment in lowest practical security zone area when possible to facilitate maintenance. Consider protecting critical equipment from attack (e.g., gunfire and explosives); see ESM Chapter 9, Security.

F. ALARA: To the extent practical, locate major equipment in non-radiation areas (see ESM Chapter 11, Radiation Protection).

G. Provide new and modified equipment with energy isolating devices capable of accepting a lockout device. (Requirement 1-0034)

15.0 Project Equipment List (PEL)

A. Projects must develop an equipment/component listing as a turnover document. LANL transforms the PEL to the Master Equipment List (MEL) for the operating facility.

B. PELs must follow applicable ESM Ch. 1 Section 200 – Item Numbering and Labeling requirements (include all required SSCs, mandated item naming/labeling syntax and names & acronyms for systems and items, use of Upload Workbook, data, etc.) so that PEL-to-MEL manipulation and upload to CMMS is seamless.

C. Design Agency shall initiate the PEL. PEL shall include all items specified by the design with fields populated with all information known at the point of final design completion; transmit to LANL.

D. The Constructor, unless otherwise stated in the Subcontract Documents, is responsible for populating construction-phase fields (e.g., manufacturer, model number) of the Design Agency-created PEL workbook with actual SSCs selected for EOR review and then LANL system engineer review, approval, and incorporation into the MEL per Section 200.

E. Management Level: The overall (highest) level for the project (and sometimes some SSCs) will be initially provided to the project by the LANL Design Authority in the statement of work. When the entire project is not ML-4, the designer is responsible for proposed determinations of ML for all SSCs in the work scope (per AP-341-502 on management level determination) and submitting same (with timeliness to avoid rework) to LANL FDAR for formal concurrence. ML is captured/controlled by PEL/MEL.

16.0 Signs, Labels, and Tags

A. Identify SSCs with the nomenclature required by ESM Ch. 1, Section 200, Item Numbering and Labeling.

B. Building/structure signage (including wayfinding signage) as addressed in ESM Chapter 4, Architectural (Section B-C_GEN).

C. *Guidance: Some additional information on labeling may be found in the LANL Conduct of Operations Manual P315 (Section 18).*

D. For other signs refer to LANL P 101-19, Safety Signs, Labels, and Tags.

E. Labeling: In addition:

- Label mechanical equipment labeling per ESM Mechanical Chapter 6 Section D10-30GEN.
- Label electrical equipment per ESM Electrical Chapter 7 Section D5000; also, on renovation projects, install arc-flash warning labels on existing electrical equipment where lock-out/tag-out will be required for the renovation work.
- Chemical container labeling per P101-14, Chemical Management.

17.0 Quality Requirements (Z1020)

A. Projects must comply with applicable LANL QA-related requirements documents. *These may include:*

- *DOE O 414.1D, Quality Assurance (or adopted successor)*

- *10CFR830 Nuclear Safety Management, Subpart A, Quality Assurance Requirements*
- *SD 330 LANL Quality Assurance Program* [and related P documents] which implement ASME NQA-1-2008 with the NQA-1a-2009 addenda for nuclear facilities
- *P330-6, Nonconformance Control and Reporting*
- *P330-11, Identification and Control of Items [including storage levels]*
- *PD340, Conduct of Engineering and Configuration Management for Facility Work*
- *P840-1, Quality Assurance for Procurements (and successor, e.g., P841-1)*
- *Additional requirements in other ESM chapters including Ch 21, Software*
- *Division or project-specific QA requirements*

Useful guidance:

- *DOE G 414.1-2, Quality Assurance Management System Guide for use with 10 CFR 830.120 and DOE O 414.1*
- *DOE G 413.3-2, Quality Assurance Guide for Project Management*

B. For nuclear safety-related projects:

- Safety Class, Safety Significant, ML-1, and ML-2 items (imposing most/all of ASME NQA-1) requires use of suppliers from the Institutional Evaluated Supplier List (IESL) *(internal only)* and/or use of a commercial grade dedication process (see AP-341-703, *Commercial Grade Dedication*).
- ML-3 SSCs have higher requirements than ML-4; these are discussed in LANL SD330 and implementing P-numbered documents and CoE APs.

C. Projects and Design Agencies must ensure that MLs are sufficiently delineated in the scope documents such that the supplier can readily correlate the QA program requirements to the associated scope using MLs (not critical when all ML-4).

D. *LANL personnel using suppliers and products for various management level applications should be aware that these suppliers and products may also need to be approved by the LANL Building Official (LBO) when such work is on buildings or building systems. This is because the IBC requires LBO approval for a wide range of testing, fabrication, and special cases. See ESM Chapter 16 Section IBC-GEN.*

E. Follow LANL Master Specification Section 01 4000, *Quality Requirements*, for facility related work (may adapt for other work). Harmonize Spec Section 01 4000 with ASM quality pro forma (e.g., Exhibit H). *Section Z10 Attachment F* – Specifications *has additional, related discussion.*

18.0 Project Closeout (Z1040)

A. At the completion of facility projects, transmit drawings, specifications, and other project records to LANL Document Control Records Management (*DCRM*) in accordance with LANL Master Specifications Section 01 7839, *Project Record Documents* (or project-specific spec section with equivalent or superior requirements).

1. For drawings, follow additional requirements for transmittal in the LANL CAD Standards Manual, STD-342-300.
2. For projects subject to SD350, *Project Management for Capital Acquisition and Construction*, also follow ALDCP procedures (*in EDRMS*) on turnover, acceptance, and closeout.

19.0 History (Record of Revisions)

While not stated, an effort is made to update references including org changes with each revision.

Rev	Date	Description	POC	RM
0	2/9/04	Initial issue. Collected/expanded on topics in other ESM chapters. New topics: backfit, D&D, specs, App A on Sustainable Design.	Tobin Oruch, *FWO-DO*	Gurinder Grewal, *FWO-DO*
1	6/9/04	Added various spec requirements, Buy American Act guidance, COR, MEL population. Refined definitions, "conflicts," constants, output submittals, and programmatic applicability.	Tobin Oruch, *FWO-DO*	Gurinder Grewal, *FWO-DO*
2	5/18/05	Added Applicability section, rules for projects underway superseding LIR. Clarified sealing of design. For building systems, changed 50% rule to IEBC. Variance requirements per IMP 311. App A on SD became ESM Chapter 14.	Tobin Oruch, *ENG-CE*	Gurinder Grewal, *ENG-CE*
3	2/1/06	Added Design Goals, App A-E, shed requirements, interp and variance forms from Ch 1 Section 100. Deleted backfit requirements in AP. Minor changes based on indep ext. review.	Tobin Oruch, *ENG-CE*	Mitch Harris, *ENG-DO*
4	10/27/06	Moved Applicability to new ESM Intro doc; revised re NM laws and App G, moved IBC req'ts to new Ch 16; modified PE sealing exemption for fire; added superseded drawing practices.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
5	6/19/07	Clarified D&D, PE overstamping, fire exemptions. Added Details to Specs; adjusted for new ML level defns; App B clarified to also apply to new systems and major mods. Re-instituted NM building code compliance.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
6	6/16/08	Added DOE-STD-1189, Env Mgmt. Clarified State code, NCR, COR including eng during construction, Temp Facilities, MDL and MEL per APs. Minor changes to App A, C, D.	Tobin Oruch, *CENG*	Kirk Christensen, *CENG*
7	5/21/09	Added worker safety and Exhibit I; D-B guidance. Clarified ESM not be part of construction RFP; calcs requirements, sealing of FCRs, shop drawings. Former Apps became Atts and defs moved to App A.	Tobin Oruch, *CENG*	Gary Read, *CENG*
8	1/7/10	Clarified use of addenda and supplements; new variance Form 2137; added design review reqts, FCN Criteria Document; deleted drawing type table; clarified access to equipment, spec coordination and development.	Tobin Oruch, *CENG*	Larry Goen, *CENG*
9	8/25/10	Official interps/clarifs now require Form 2176; VARs require Form 2137; code issues require SMPO. Specs moved to Att F. Temp Facilities and Sheds moved to Ch 16 IBC-GEN. PD342 became P342, ESM became STD-342-100, etc.	Tobin Oruch, *CENG*	Larry Goen, *CENG*
10	6/20/11	Clarified use of interps, order of precedence, COR changes; moved D&D to IBC-GEN; added PE graphic. Condensed revision history.	Tobin Oruch, *CENG*	Larry Goen, *CENG*
11	9/29/14	Clarifications on applicability, edition, amendments, NCRs and conditional release, COR, eng during construction, sealing, definitions. DOE O 420.1C changes.	Tobin Oruch, *ES-DO*	Mel Burnett, *CENG*
12	6/30/15	Variance process changes per NNSA authority delegation. Added need for as-builts in all cases (3.0.H). Software requirements and fire/controls sealing revised. New project document list/upload site requirement. Other minor changes.	Tobin Oruch, *ES-DO*	Mel Burnett, *CENG*

13	7/16/15	New authority delegation table (Z10-3). As-built requirements reverted to those in Rev. 11. Re sealing, added NICET Mark for fire shop drawings and other minor changes.	Tobin Oruch, *ES-DO*	Mel Burnett, *CENG*
14	4/5/18	Required applicable NCS including NFPA editions to be used; streamlined variance process for spec preferences; replaced software requirements with reference to Ch 21; PE sealing clarified; other updates throughout.	Tobin Oruch, *ES-FE*	Larry Goen, *ES-DO*
15	2/1/22	Updated NA-LA delegations, clarified applicable NCS including NFPA editions, and eliminated STD-342-500 Design Guides (5.0). Made RCD a living document, required BIM for selected projects, made PDL optional, and expanded as-built direction (7.0). Eliminated Att G, Engineering Deliverables for Projects (Guidance), replaced by ES-EPD-FM01, Project Deliverables Checklist/Division of Responsibilities). Throughout: Many basis footnotes moved to requirements basis (ID) document, LANS became Triad, updated to DOE O 420.1C Chg 3, other minor changes.	Tobin Oruch, *ES-FE*	Jason Apperson, *ES-DO*

20.0 Appendices

App. A Acronyms and Definitions

21.0 Attachments

Att. A Technical Baseline Drawings Guidance

Att. B Technical Baseline Deliverables (New Facilities and Systems)

Att. C Deliverable Schedule 30-60-90-100%

Att. D Facility Design Descriptions (New Facilities)

Att. E Life Cycle Cost Methodology Guidance

Att. F Specifications

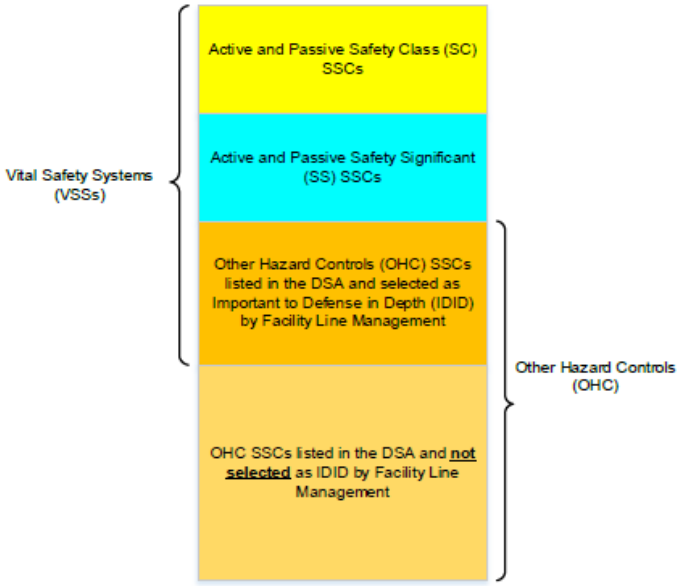
Appendix A Acronyms and Definitions

For reference only: Other DOE-wide definitions may be found on this Directives webpage. Other LANL terms may be defined in the Acronym Master List, PM Glossary, Packaging & Transportation Glossary, P341 Engineering Processes Manual.

Term	Definition
ALDCP	Associate Lab Director of Capital Projects (formerly ADPMSS, ADPMGT, ADPM/PM Division)
AE (or A/E)	Architect-Engineer. A design agency, normally not LANL but could be.
AHJ	Authority having jurisdiction. Term for technical authority in NFPA, explosives safety, and Uniform Plumbing and Mechanical documents. This and similar terms are known generically as SMPOs at LANL (see SMPO).
As-built	Important documentation (e.g., electrical one-line diagrams, database records) that is (1) verified by physical inspection as depicting the actual physical configuration and (2) verified as consistent with the design requirements. [based on DOE-STD-1073-16 and AP-341-405]. These are a subset of the entirety of Project Record Documents (PRDs). PRDs not as-built are therefore really just as-designed.
Building Official	See ESM Chapter 16 Section IBC-GEN and its LBO definition
CD-x	Critical Decision, a DOE approval for a line item project to proceed to next phase. CD-0 is Approve Mission Need [conceptual design can then begin; that represents about 30% of the overall design effort]. CD-1 is Approve Alternative Selection and Cost Range. [Thus, preliminary design can begin; this results in 60% maturity]. CD-2 is Approve Performance Baseline (definitive scope, schedule and cost baselines have been developed, and the project is ready for implementation. [This authorizes Detailed Design, which progresses design to a 90% complete level] CD-3 is Approve Start of Execution [e.g., construction], [Design is 90% complete] CD-4 is Approve Start of Operations or Project Completion. [Design is 100% complete] [DOE O 413.3]
CENG	Conduct of Engineering Office (CoE Office, officially CENG-OFF). In the context of approvals this refers to the CENG Office Director.
ChEng	LANL Site Chief Engineer
Commissioning	A systematic process of assuring, by verification and documentation, from the pre-design phase to a minimum of one year after construction, that all facility systems perform interactively in accordance with the design documentation and intent, and in accordance with LANL's operational needs [see ESM Chapter 15, Commissioning]
Consider	When used in a guidance (e.g., italicized) statement, it is suggesting the designer look at and think about following the guidance offered. When "consider" is used in a requirement statement it strongly indicates that LANL does not want the suggestion dismissed out of hand. Good practice is to document the thought process of this consideration, particularly when rejecting the suggestion partially or wholly. In some cases in the ESM, documentation is specifically required (e.g., design notes or memo to file); in other cases, submittal of such documentation for approval is required. See also "shall consider."
Constructor	Term for the entity performing fabrication or physical construction activity used primarily in the Engineering Standards but not subcontracts. When not LANL self-performed, this is the Subcontractor.
Contractor	Procurement (ASM) proforma (aka boilerplate) defines this as Triad, the prime contractor to DOE (NNSA); however, in older ESM chapters Contractor may still be in use as the entity performing the work which may be design, offsite fabrication, onsite construction, and/or maintenance. This may be a Triad employee or someone in Triad employ. (When the intention is that task is performed by Triad, then the term LANL is preferred since unambiguous and more timeless.)
DCF	Design Change Form, a design change control document. Ref P341 Facility Engineering Processes Manual and AP-341-517.

Term	Definition
Design agency	The LANL organization or subcontractor (A/E) responsible for the preparation of engineering design and documentation [P342]. See also Designer, DPIRC, and EOR.
Design basis	Design basis consists of the design inputs, the design analysis and calculations, and the design outputs. It includes topical areas such as seismic qualification, fire protection, and safe shutdown. The design basis explains why a design requirement has been specified in a particular manner or as a particular value. [DOE-STD-1073-16]
Designer	Anyone working in a design agency capacity, whether engineer, architect, drafter, or designer. See also Design Agency, DPIRC, and EOR.
DPIRC	Design professional in responsible charge; the lead project engineer or architect in the *Design Agency*. Term is used by IBC (e.g., 107.3.4) and ESM Chapter 16. For AEs, the persons sealing (stamping) the documents.
EOR	Engineer of Record. Normally refers to the discipline lead in the *Design Agency* but can be the entire agency.
EQ	Environmental qualification. A process to ensure SSCs perform intended function under normal and off-normal conditions. See Z10 subsection by this title.
ES	Engineering Services Division of LANL (includes design, project, and facility system engineers).
ESM	LANL's Engineering Standards Manual of which this document is a part
FRD	Functional and Requirements Document, formerly Functions & Operating Requirements. Required for large projects, FRDs are developed from the Mission Need, Program Requirements Documents, and specific facility characterization data to more concisely quantify and qualify project requirements. [AP-341-601]. Not required in some cases and, when present, a precursor to the RCD.
Facility	1. A synonym for Real Property and Installed Equipment. RP&IE is the land, improvements on the land such as buildings, roads, fences, bridges, and utility systems and the equipment installed as part of the basic building construction that is essential to normal functioning of a building space, such as plumbing, electrical and mechanical systems. This property/equipment is also referred to as institutional or plant and was formerly known as Class A. [DOE Order 4330.4B] Note: In nuclear space, DOE O 420.1 and 10CFR830 uses this term to include all activities that occur within the facility also. 2. From Acquisition and Project Management Glossary of Terms Handbook: Any building, structure, or other improvement to real property including their functional systems and equipment; site development features such as landscaping, roads, walks, and parking areas; outside lighting and communications systems; central utility plants; utility supply and distribution systems; and other physical plant features. [compiled from DOE O 430.1B,10 U.S.C. Sec. 2801(c)(1) and DOE G 413.3.21] 3. From former DOE-HDBK-1188 - Glossary of Environment, Safety and Health Terms: FACILITY. Any equipment, structure, system, process, or activity that fulfills a specific purpose. Facilities do not have to be structures. Examples include accelerators, storage areas, fusion research devices, nuclear reactors, production or processing plants, coal conversion plants, magnetohydrodynamics experiments, windmills, radioactive waste disposal systems and burial grounds, environmental restoration activities, testing laboratories, research laboratories, transportation activities, and accommodations for analytical examinations of irradiated and unirradiated components.

Term	Definition
FDAR	Facility Design Authority Representative. The LANL [Facility Design Authority] designates FDARs to facilities and projects. An FDAR is a qualified individual who is responsible for approving design requirements, design configuration, and changes thereto throughout the facility and the project lifecycle. The designated Laboratory FDARs cannot delegate their FDAR authority. FDARs are responsible for maintaining design requirements, design configuration, and changes thereto during the facility operating life in the area noted on their qualification cards [PD340]. The receiving FDAR is the person to be responsible for the equipment once a project is turned over to operations.
FDD	Facility Design Description: Document that identifies top-level functions and requirements associated with SSCs; provides basis requirements and describes features of the facility; Describes simple, less important systems without having to develop separate SDDs (e.g., potable water system); refers to individual SDDs for details on critical systems. Ref Att D of this document.
Fire Marshal	Authority having jurisdiction for fire protection and life safety requirements of the building codes, fire codes, and NFPA set of codes and standards. Typically the group leader of the LANL Fire Protection Group.
FOD	Facility Operations Director. One of approx. eight LANL managers responsible for the operation, engineering, and maintenance of facilities and tenants. [see SD900 (forthcoming)]
General Documents	Technical documents that are not categorized as Priority or Support but provide engineering details necessary for procurement of replacement parts, modifications, maintenance, and operation of the facility SSCs.
Hazard category	For nuclear, the DOE-STD-1027 category (1, 2, or 3). For non-nuclear, per SBP111-1, Facility Hazard Categorization [Accelerator; High, Moderate, Low; Office; Less-than-Low, etc.] and DOE-STD-3009, and hazards analysis: • High Hazard: The potential for significant offsite consequences. • Moderate Hazard: The potential for significant on-site consequences. • Low Hazard: The potential for only significant localized consequences.
Hazard Category 1, 2, and 3 DOE Nuclear Facilities	Nuclear facilities that meet the criteria for their respective hazard category consistent with the provisions of DOE-STD-1027-92, Change Notice 1. Hazard Category 1, 2, and 3 DOE nuclear facilities, are required to have safety bases established in accordance with Subpart B of this part. Hazard categories are based on their radioactive material inventories and the potential consequences to the public, workers, and the environment. Hazard Category 1 represents the highest potential consequence and Hazard Category 3 represents the lowest potential consequence of the facilities required to establish safety bases (10 CFR 830.3).
IBC	International Building Code, published by the International Code Council. See ESM Ch. 16.
Infrastructure	Roads, parking lots, bridges, tunnels, sidewalks, fencing, stormwater management.
IPT	Integrated project team. A team formed and led by a LANL project manager (when assigned) and comprised of functional experts needed to execute capital asset work, such as engineering, procurement, construction, etc. Ref. LANL SD350.
LANS	Los Alamos National Security, the prime contractor at LANL from 2006 to October 31, 2018. Take all references to LANS in the Standards to mean Triad Nuclear Services (TNS), the prime contractor beginning November 1, 2018 or its successor.
LMS	LANL Master Specifications. These CSI-numbered/formatted specifications address construction-type work, fabrication, and maintenance (maintenance examples: piping repairs and testing, carpet and other similar replacements).
Major modification	Change to a nuclear facility that substantially changes the existing safety basis [adaptation of DOE-STD-1189-2008]. Determination is made through a checklist (see SBP114-1, *Safety Basis Development for Projects, Att 2)*
MEL	Master Equipment List: an online database of installed equipment (SSCs) that requires maintenance or surveillance. The MEL is in the CMMS (e.g., Asset Suite) system for most facilities. Reference ESM Ch. 1 Section 200.

Term	Definition
ML	Management level: A classification system for determining the degree of management control that is applied to work. There are four categories (in descending order): ML-1, ML-2, ML-3, and ML-4. Defined in AP-341-502.
Nonreactor nuclear facility	Those facilities, activities, or operations that involve, or will involve, radioactive and/or fissionable materials in such form and quantity that a nuclear or nuclear explosive hazard potentially exists to the workers, the public (all individuals outside the DOE site boundary), or the environment, but does not include accelerators and their operations and does not include activities involving only incidental use and generation of radioactive materials or radiation such as check and calibration sources, use of radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and X-ray machines.
OHC	Other hazard controls in nuclear facilities [DOE-STD-3009 term]. OHCs are identified by Safety Basis as part of the documented safety analysis development. (Note, some older DSAs refer to DID SSCs rather than OHC; the concept is the same). From P341 (r7 Fig. 4): 
Operating facility	A facility that is post-startup/turned over from construction phase and thus managed by an operations organization (but pre-decommissioning phase).
PE	In design sealing context means professional engineer; means LANL project engineer elsewhere in ESM.
POC	Point-of-Contact. Every document in the Standards set has one person responsible for its interpretation, upkeep, and general assistance. The LANL Site Chief Engineer designates POC for the majority of subject areas of the Engineering Standards including civil, architectural, structural, mechanical, pressure safety, etc. The SMPOs of other LANL Safety Management Programs (e.g. fire protection, radiation protection, electrical safety) and Security designate POCs in their areas of responsibility.
Priority documents	Essential documents that are defined by LANL AP-341-405. They include documents that are required to: • Respond to an event that can cause loss of life or serious injury to a worker or the public or which can cause significant environmental damage or off-site release. • Support the safe performance of facility operations within the facility's approved safety envelope • Perform Technical Safety Requirements (TSRs) in Hazard Category 2 or 3 nuclear facilities

Term	Definition
	• Perform Operational Safety Requirements (OSRs) in High and Moderate Hazard nonnuclear facilities • Define the bounding conditions for safe operations as defined in the Accelerator Safety Envelope (ASE) for an accelerator facility Priority drawings are a subset of Priority Documents. Priority drawings include: • Building Evacuation Route Diagrams for occupied LANL buildings. • Selected P&IDs, Electrical Single Lines, and Fire Protection drawings that meet the definition above of Priority Documents. [LANL AP-341-405 r6.2] FDAR determines which documents meet definition above. See also Support Documents. Priority is the LANL term for Essential in DOE-STD-1073 Configuration Management.
Programmatic	A synonym for Personal Property and Programmatic Equipment. PP&PE is equipment used purely for programmatic purposes, such as reactors, accelerator machinery, chemical processing lines, lasers, computers, machine tools, etc., and the support equipment dedicated to the programmatic purpose. This property/equipment is also referred to as organizational, research, production, operating or process and was formerly known as Class B. [DOE Order 4330.4B]. Work or equipment that is tenant, R&D, or process – not facility, utility, infrastructure, or environmental program related.
Project	As used in the Engineering Standards only, ANY task or activity involving the installation, modification, or permanent removal of an SSC at LANL managed formally or otherwise. Includes related fabrication, construction, procurement, and maintenance activities (may not be a formal project or subproject per SD350 definitions). "Task" means the same.
Project Record Document	Final (e.g., closeout) documents that incorporate all field changes. "As-builts" are generally a small, critical subset of these. [based on CSI MasterFormat 01 7839 and DPIC's 1999 Contract Guide (risk management handbook for AEs), pgs III-23 thru 25]
R&D	See PD 370, *Conduct of Engineering for Research and Development (R&D).*
RCD	Requirements and Criteria Document. Establishes design requirements and maintains the technical baseline for a project. Required for line item, GPP, and complex projects. Will be based on FRD, if present. [AP-341-602]
RFP	Request for Proposal, a solicitation to bidders that includes the technical scope of work.
Safety Class (SC) SSC	A nuclear facility term, *Safety class structures, systems, and components* means the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses. [10 CFR 830: § 830.3 Definitions.]
Safety-related	See *Safety SSC* below
Safety SSC	In this document, an SSC in a nuclear, accelerator, or high-hazard non-nuclear facility could potentially impact worker or public safety or the environment if they failed. Will be ML-1 or ML-2.
Safety Significant (SS)	Nuclear facility term for structures, systems, and components not designated as safety-class SSCs but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from safety analyses. [10 CFR 830: § 830.3 Definitions, except parenthetical note.]
SDD	System Design Description: Document that provides detailed description of SSCs; identifies requirements associated with SSCs; provides bases for requirements to explain why they exist; describes features of system design provided to meet requirements.
Shall	Denotes a requirement (versus "should") [DOE O 6430.1A and DOE Std Style Guide]. "Must" denotes the same and is the preferred term in DOE orders and LANL policy documents [LANL P311-1]. ("Will" is sometimes used to convey future LANL actions, often in specifications).

Term	Definition
Shall consider	Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc. [archived DOE O 6430.1A 0101-3.2]. Such documentation shall be submitted to LANL project reviewer(s) for approval where directed by the ESM or upon request.
SI-DCRM	Service Innovations Division's Document Control Services Group (formerly IRM-DCS)
Site Chief Engineer	Individual charged with ultimate Design Authority responsibility for LANL; see also PD340. Sometimes abbreviated ChEng.
SMPO	Safety (or security) Management Program Owner. Term for the technical authority on issues relating to certain national code and standards, DOE Orders, and Engineering Standards. As examples, the SMPO for the IBC is called the LANL Building Official. The SMPOs for NFPA and the Uniform Plumbing and Mechanical codes are the AHJs discussed in those documents. Security has authority delegations similar to those for safety. [comes from 10CFR 830.3 that gives examples of SMPs; also in PD340. Prime Contracts uses Responsible Area Owner and recognizes separate AHJ-type roles in P310-1]. Used most in Z10 subsection on clarifications, alternate methods, and variances.
SSC	Structure, system, or component
STR	Subcontract Technical Representative. The LANL STR has technical and performance oversight of the Subcontractor's Scope of Work, including but not limited to engineering, procurement, safety, quality, schedule, and coordinated execution of the Work that is carried out by the Subcontractor. The STR has no authority to direct commercial or technical changes to the Subcontract.
Subcontractor	The individual or legal entity that has entered into a subcontract with Triad for delivery of goods and/or services (P850). Subtier Subcontractors (Subtiers) work for Subcontractors. Prime Subcontractor is a term used occasionally to reinforce responsibility of that entity (versus subtier responsibilities).
Standard Drawings and Details	The example drawings and repeatable details on the Engineering Standards website.
Support Documents	Technical documents that are needed to safely maintain and operate the facility such as lockouts and tag outs, venting, etc. [LANL AP-341-405 r6.2]. FDAR determines which documents meet definition. See also Priority Documents.
Temporary	See ESM Chapter 16 IBC-GEN for definition and discussion.
Title I (Preliminary Design)	Continues the design effort utilizing the conceptual design and the project design criteria as a basis for project development. Title I design develops topographical and subsurface data and determines the requirements and criteria which will govern the definitive design. Tasks include preparation of preliminary planning and engineering studies, preliminary drawings and outline specifications, life-cycle cost analysis, preliminary cost estimates, and scheduling for project completion. Preliminary design provides identification of long-lead procurement items and analysis of risks associated with continued project development. For a detailed description of the services provided during preliminary design, see Department of Energy Acquisition Regulation (DEAR) 936.605c and 952.236.70. [superseded DOE 4700.1 Chg 1 Attachment 3, 6-2-92; Title I term no longer widely used.
Title II Design	This continues the development of the project based on approved preliminary design (Title I). Definitive design includes any revisions required of the Title I effort; preparation of final working drawings, specifications, bidding documents, cost estimates, and coordination with all parties which might affect the project; development of firm construction and procurement schedules; and assistance in analyzing proposals or bids. For a detailed description of the services provided during definitive design, see DEAR 936.605(c)(3) and (4) and DEAR 952.236.70. [superseded DOE 4700.1 Chg 1 Attachment 3, 6-2-92; Title II term no longer widely used]
Title III Services	Those activities required to assure that the project is constructed in accordance with the plans and specifications (e.g., construction inspection), and that the quality of materials and

Term	Definition
	workmanship is consistent with the requirements of the project (e.g., materials testing). (See DEAR 936.605(c)(3) and (4) and DEAR 952.236.70 for additional details.) [superseded DOE 4700.1 Chg 1 Attachment 3, 6-2-92; Title III term no longer widely used]
TNS (or Triad)	Triad Nuclear Services, the prime contractor at LANL, or its successor.
Utilities	Services to and from structures such as potable and fire water, sanitary sewer, steam & condensate, natural gas, telephony, and electrical transmission and distribution.