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 Director of Nuclear and High Hazard Operations (ADNHHO) 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

Italics use: Where appropriate throughout the ESM, guidance is provided to aid in the implementation of requirements. Guidance will be *italicized* text or otherwise clearly indicated (e.g., by headings). All other text (plain type) indicates mandatory requirements. Document titles in italics is not in and of itself indicative of guidance but a formatting style. Likewise, terms in italics indicates them as a defined term (defined either in this document or the ESM chapter in which it appears).[1]

[1] Italicizing defined terms is an I-code practice potentially being adopted by LANL Standards starting in 2018.

1.0 Purpose

The LANL Engineering Standards define the minimum design criteria, fabrication, construction, and installation practices to assure that the design, repair, 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 G of the Prime Contract; national codes and standards; and federal, state, and local codes and regulations.[2] They generally do not apply retroactively (i.e., do not force changes to existing SSCs that are not being worked on).[3]

2.0 Applicability of LANL Engineering Standards to Categories of Systems

Facility ("Real")	Utilities, Infrastructure, and Environmental	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 beam and target areas
** 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[4]

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 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 Factors in Risk-Based Approach to Rigor in LANL Standards (High Level Guidance)

	Increasing Project Risk →			
ML	4	3	2	1
Scope (example)[5]	Repairs and most IEBC Level 1 & 2 alterations	$500k+, 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

[2] Adaptation PD340 r6. Standards Program POCs will determine if minimum is met by a given implementation.
[3] When work involves facility materials, such repair (and alteration) is governed by IEBC as amended by ESM Ch 16 and latest materials and methods are often required.
[4]
[5] These are examples based on buildings and ESM Chapter 16, but scope magnitude may have other criteria

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. Contract: Comply with the applicable portions of the latest edition of each code, standard, DOE Order, and other document invoked by the ESM[6], design and/or build subcontract, and the NNSA/LANS contract[7]. (*most LANS contract design mandates are in Appendix G)*.

1. Exception for building codes: Follow ESM Chapter 16, Section IBC-GEN, Appendix A- LBC for code editions to use. Also, for codes such as the IBC, follow the design-related national consensus standard (NCS) editions referenced by the code.[8]

2. For Contract App G matters, the ESM is written to implement the majority of directives relating to design; however, projects are responsible to ensure they comply with App G and the LANS Contract.

   Best (internal): http://int.lanl.gov/org/dir/pcm/index.shtml
   External: http://nnsa.energy.gov/fieldoffices/losalamos/newcontract[9]

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]

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 7; ASME code editions per ESM Chapter 17 if stated, otherwise latest[12])[13]

   Rules, Orders, and Laws can be found at:
   http://www.lanl.gov/orgs/eng/engstandards/helpful_links.shtml.

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

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

   b. 10 CFR 830, *Nuclear Safety Management*

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

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

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

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

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[6] 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/LANS contract (e.g., 10CFR851 example under CFR heading below), follow ESM; 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.
[7] Where the contract has an implementation plan, plan governs documents and effective dates.
[8] 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). Using newer NCS for products should not cause problems; when necessary due to manufacturer availability, it is allowable (e.g., latest ASTM for drywall, B&PV code for pressure vessels).
[9] The DOE Directives system is explained briefly and well here.
[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. LANS follows such implementing directives when imposed, not the EO itself unless invoked by reference in the directive.
[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.

C. State and Local: Comply with applicable laws and regulations.[14] *Guidance: There may be statutory exemptions or other legal exclusions under which certain laws or regulations may not apply to LANS. Therefore, one must be careful in determining with which state and local laws LANS need comply. If there is any question as to whether specific laws and regulations apply to LANS, confer with LANL Legal Counsel.*

1. The New Mexico building codes must be followed[15] 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:

   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.[16]

   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.

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

D. National consensus codes and standards:

1. For design and construction activities, projects must identify and satisfy the ESM and applicable industry, national, and DOE codes and standards.[17]

2. 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/DOE-type documents, then those sections obviously become required. *Guidance: Handbooks[18] should never be required, nor any part of any ESM document with "guide" or "guidance" in its title.*

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[14] From LANS Contract Section I; "I-123 DEAR 970.5204-2 LAWS, REGULATIONS, AND DOE DIRECTIVES (DEC 2000) (DEVIATION) (a) In performing work under this contract, the contractor shall comply with the requirements of applicable Federal, State, and local laws and regulations (including DOE regulations), unless relief has been granted in writing by the appropriate regulatory agency." This is consistent with GSA policy in P100. Does not mean LANL is subject to LA County Building Department.

[15] Per Ritschel, 5/30/2007, LC-BL 07-005, re NM Building Code applicability (EMRef-55), LANL is subject to the NM-specific Codes to the extent they do not conflict with other laws or LANL or DOE directives, but not the enforcement activities of the Construction Industries Division that oversees them. This is corroborated by Technical Position NSEP-TP-2007-1 (EMRef 64): *Technical Position on the Requirement in DOE O 420.1B to Use National Consensus Industry Standards and the Model Building Codes*, which is a contractual document as are all TP per Prime Contracts.

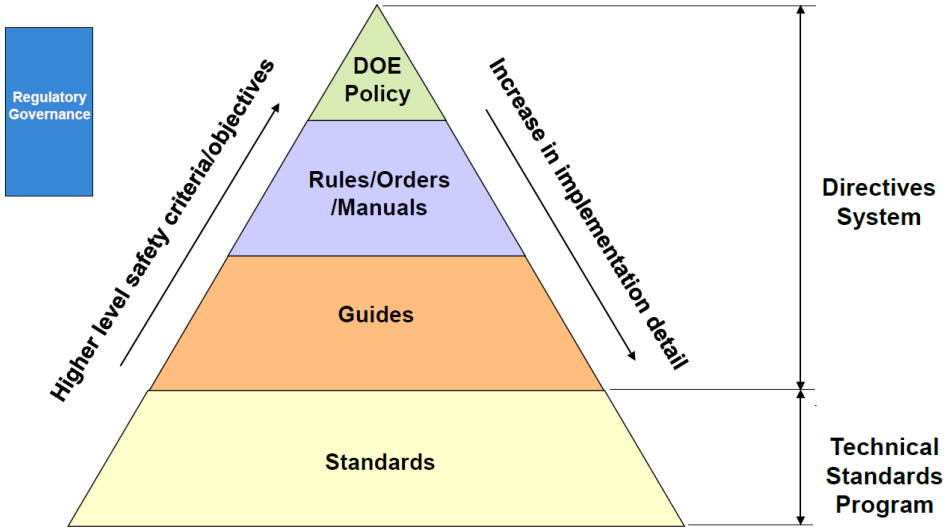
[16] Since this would require DOE approval per NSEP-TP-2007-1 (EMRef-64).

[17] DOE O 420.1C Chg 1 CRD 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…" Also, DOE O 252.1A Chg 1 CRD: "…the contractor, when...selecting technical standards for use to support assigned DOE missions and functions, must: 1. Select, use, and adhere to appropriate voluntary consensus standards (VCSs), except where use of VCSs is inconsistent with law or impractical…"

[18] 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; LANL contract should be.

3. Official interpretations shall be utilized as if written in the ESM/code/standard itself.[19]

Guidance: The figure below depicts the DOE regulatory framework (not LANL or national consensus):[20]



E. NFPA: Comply with all NFPA codes and standards except NFPA 5000. For NFPA 70 (NEC), follow edition required by ESM Chapters 7 and 16[21] ; for those invoked by IBC or IFC, follow edition referenced by same preferentially to latest; for all others, follow latest.

F. Errata (correct errors) to any document and Tentative Interim Amendments (for NFPA) are mandatory regardless of contract award date or code of record.[22]

G. Other interim updates such as addenda[23] and supplements to national consensus standards[24] shall likewise be considered adopted upon issue.

H. *Online Codes and Standards: 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

A. LANL Engineering Standards Manual (ESM), STD-342-100[25]

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 (full 2010 adoption is pending).

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

See Attachment F of this Section Z10.

[19] Code and standard users are not expected to locate and manage all such interpretations; however, they must follow same for any for which they become aware
[20] Graphic credit: DOE
[21] Mandate of 10CFR851; at time of writing, LANL edition adoption followed State of NM's lead.
[22] NFPA states: "An official NFPA Document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect."
[23] Examples are telecom (TIA) standards addenda and ASHRAE 90.1 which is under continuous maintenance through addenda
[24] And the NEC (based on above re NFPA) but not building codes, unless NM adopts. ICC issued some code supplements in the early years; NMDOT has also issued supplements.
[25] The LANL eng stds originated in the 1980s. In 1998, LIR 220-03-01 established the FEM etc. In 2003, FEM renamed LEM, later ESM (OST220-03-01-ESM, etc.). LIR became IMP342, ESM was renumbered ISD 342-1 in 2005, then ISD 341-2 in 2006. The IMP became PD342 in 2009; became P342 in 2010 (this created STD-342-100 etc.).

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

Comply with the CSM when creating or revising drawings for facility work or 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 are consistent with those for Master Specs—i.e., using where applicable, tailoring to a final product, etc. See Att F.
3. Comply with Standard Detail Drawings unless indicated as guidance in the ESM.
4. CAUTION: Example drawings depict required content and format with potentially mock data and so, unlike Standards Details, are not necessarily valid design templates.

E. LANL Design Guides, STD-342-500

This is non-mandatory collection of guides on the LANL internal network may be useful in designing certain facility, R&D, or programmatic systems or components.

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. 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.[26]
2. *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).*

B. Forms and authorities are summarized in Table Z10-2 below.

C. Guidance: Amendments affect institutional documents but don't modify issued design – that must normally be done by engineering by way of an FCR or revision. 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.

[26] 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. An example might be 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.

Table Z10-2 Standards Amendments: Clarifications, Interpretations, Alternates, and Variances — Methods and Approvals Summary

Requirement Category	TYPE 1		TYPE 2		TYPE 3	
Typical scope	**specs**		**ESM**		**contract**	
Scope details	• **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 Contract-mandated and not delegated to LANL**	
	Method	**Approving Authority**	**Method**	**Approving Authority**	**Method**	**Approving Authority**
POC Help	Phone or Email					
Amendments						
Formal Clarification or Interpretation	Form 2176	POC	Form 2176	Design Authority	Form 2176	Design Authority
Alternate Method or Variance (Type 1 or 2)	permission[27]	POC	Form 2137**	Design Authority	N/A	N/A
Equivalency or Exemption (Type 3)	N/A	N/A	N/A	N/A	Form 2137*** + P 310-1, *Exemptions to Appendix G Requirements or* 10CFR851 variance website; etc.	DOE Los Alamos Field Office or higher
But if work contrary to Standards is submitted for acceptance…	…then an NCR is normally required. When NCR use-as-is or repair disposition is proposed, an amendment per above is also required with NCR to involve institutional requirement owner.					

* 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.

** 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 observe[28]) for review of request and recommend a disposition to the Design Authority.

*** Contract: A committee consisting of the requestor, FDAR, and POC should be convened (with invitation to LA Field Office to observe) for review of request and recommend a disposition to the Design Authority who will then decide to either deny the request or forward to the LA Field Office for action[29].

Table Z10-2 Definitions

POC	POC is the Standards Program staff point-of-contact listed on this webpage, along with any alternates.
POC Help	Informal assistance from the POC for informational purposes only. For formal direction use forms shown.

[27] 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, DRS), 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).

[28] Alternatively, the DA may involve the Field Office through other means.

[29] Ibid.

Clarify	To make the Engineering Standards or referenced document understandable and free from confusion.
Interpret	To formally provide an acceptable method of compliance with the Engineering Standards or referenced document.
Design Authority (DA)	The Site Chief Engineer (see P340, P342). This amendment process authority is not delegated to FDARs. For fire matters, substitute Fire Marshal (and possibly FP-Div forms)[30]; for electrical safety, Electrical Safety Committee. The safety (or security) management program owner (SMPO) is the technical and administrative authority, is similar in this process, and is the term used by Form 2137 at time of writing.
Alternate Method	A deviation from an Engineering Standards or referenced code technical requirement that includes compensatory measures that accomplish the desired intent or results but using a different approach with alternative materials, design, or methods of construction or equipment
Variance	A deviation from the explicit expectations in the Engineering Standards or referenced code or standard; 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. [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. [DOE O 252.1C];

Table Z10-3 NNSA Delegation to LANL (Guidance for POCs and SMPOs)

Standards Topic	Primary ESM Chapter(s)	Primary Mandate	NNSA Delegation
Building codes and engineering except for topics below	1, 3-8, 10, 12-16, 19, etc.	DOE O 420.1C, Facility Safety, Chg 1	To Design Authority per Ref. 1
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. 1; see P101-13 for ESC details
Fire protection, life safety	2	DOE O 420.1C, Facility Safety	Per Ref. 1, to Fire Marshal as shown by NNSA-approved PD 1220, Fire Protection Program
Pressure safety	17	10 CFR 851, Worker Safety and Health Program	To Design Authority per Ref. 1
Rad protection	11	10 CFR 835, Occupational Radiation Protection	All matters within envelope of approved radiation protection plan (P121, Radiation Protection)
Secure communications	18	DOE O 205.1B Chg 3 on cyber security management	As allowed by order and DOE M 205.1-3, Telecommunications Security Manual
Security	9	DOE O 47X series	As allowed by applicable orders

Reference 1: NNSA authority delegation of 2015-4-14 (OPS.26CF-608295, EMRef-72).[31]

6.1 Clarifications and Interpretations

A. SMPO: LANL safety and security management program owners (SMPO) are responsible for the technical content of the LANL Standards. They may delegate various authorities to Standards Discipline POCs.[32]

B. *Standards users should contact the POCs first for assistance (not SMPOs).* Contact Alternates only when primarily is unavailable in necessary timeframe. *Standards*

[30] See PD 1220 Fire Protection Program.
[31] 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 issue.
[32] The Conduct of Engineering Program Office manages the overall LANL Standards program

webpages and ESM documents list contact information. For larger projects, ADPM procedures for RFIs (e.g., CMP 300) may dictate communication pathways.

C. *Informal POC help may be requested by and responded to via phone or email. Responses should include a statement such as "This opinion is for informational purposes only," but this is true even if unstated.*

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* in accordance with Table Z10-2.

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 Z10-3 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 Contract 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.

C. Nonconformances (NCRs) and Standards-related Work: Variances and Alternate Methods discussed above are primarily intended for proposed, future work; conversely, willfully proceeding with work contrary to the LANL Engineering Standards is an entirely unacceptable practice. Moreover, when work (construction, fabrication, etc.) is recognized as non-conforming with the Standards or work scope and not promptly corrected, a nonconformance report (NCR) or equivalent[33] must generally be generated and used to disposition the situation, address causes of non-compliance, and gain necessary approval signatures. Replacement or rework is generally the necessary outcome, while use-as-is and repair dispositions may be granted in rare cases (and requires Standards Program concurrence; see below).

[33] P330-6, Nonconformance Reporting controls the broader LANL NCR process. Requirement for NCRs for all ML levels is beyond P330-6 but is appropriate for construction and fabrication work. In construction work, NCRs may be deferred/forgone for pending rework/scrap when allowed (and tracked) by LBO Chief Inspector (ref. ESM Ch. 16).

1. IBC-related work: NCR conditional release normally requires LANL Building Official approval (see ESM Chapter 16).
2. 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 scrap (from use-as-is or repair) and return of NCR to the requestor.
3. 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, 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, Variances, Alternate Methods, and Clarifications in Operating Facilities regarding which changes if any do not require entry into the process.*

D. Subcontractor Deviation Disposition Requests (SDDRs, 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. By definition, the codes and standards used to perform the design and construction are considered the "code of record (COR)."[34]

B. The COR shall be initiated during conceptual design and is placed under configuration control during preliminary design. 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).[35]

C. Establishment and maintenance of a facility or system's design basis during design and construction, including COR is required[36], 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

[34] 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.]

[35] 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."

[36] 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…"

ESM, DOE Standards, and national and state codes and standards[37]) 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 documents coming out of preliminary design 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).
Guidance: Larger and more complex projects will be required to develop and maintain a Requirements & Criteria Document (RCD) per AP-341-602 that can serve the purpose of controlling COR. At some point during design, R&C change control might be transferred to the SDDs and FDDs if present.

Producing a CD-ROM of the LANL Standards can be helpful and greatly aid design reviewers; CENG will produce these upon request.

At time of writing, other parts of the ESM and Conduct of Engineering Program require additional documentation of the COR. For example:

- *Architectural Chapter 4 Section B-C-GEN requires a drawing sheet that summarizes occupancy classification, type of construction, building areas and number of stories, corridors and area separations, floor and roof loadings, and hazard classifications*
- *Structural Chapter 5 Structural Section I requires a Design Basis Document;*

E. 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.[38]
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[39] of the existing structure, system or subsystem[40] *Consider upgrading whenever safety is an issue.*
Regarding Nuclear	

[37] 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).
[38] Once there is occupancy (partial or full) per ESM Ch 16 Section IBC-GEN or it has gone operational it is considered existing
[39] Replacement value determined using typical LANL cost estimating procedures
[40] 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). This is necessary to assure that significant renovations are more than just skin deep. Over time, this requirement will bring about safety, functionality, and efficiency upgrades to the underlying SSCs. This percentage was accepted by the TRB (now ESB) on 7/19/00. Fifty percent was/is used is many codes as a threshold: UBC-97 App 3421, IEBC-2015 Substantial Improvement definition; 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations; for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5. Fifty percent of total square footage is also used for Level 3 alterations per the IEBC (*Ch 4*)

Nuclear facility "major mod" (see App A for definition)	Follow DOE O 420.1C as implemented by ESM, except when project is D&D[41]. *Exception or equivalency to ESM normally requires Site Chief Engineer plus NNSA and/or HQ; see Alternate Methods (etc.) heading 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.*

F. Application to Projects and Underway Concept

LANL STRs must ensure that subcontracts require designers to 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.[42] 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.[43]
2. FOD- and programmatic-managed work including maintenance: For work not meeting the criteria above, the date used for determining applicability of new or revised Standards is the managing organization's (e.g., FOD or programmatic line manager) approval to proceed with final design (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 must be updated to current LANL Standards prior to beginning construction (or process Variance Form 2137 showing cost/benefit of not doing so and receive

[41] DOE 420.1C Att. 3, 3.b: "Before using these codes and standards, their application to specific DOE design(s) must be reviewed. Once a code or standard is identified as applicable, the applicable requirements (i.e., mandatory statements) must be applied in the design." D&D: DOE O 420.1C, Att. 2, Ch. I, 2.c: "Except for the requirements of Section 3.b (3), this chapter does not apply to nuclear deactivation or decontamination and decommissioning activities at end of facility life if the safety analysis demonstrates that adequate protection is provided consistent with the requirements of 10 C.F.R. Part 830 through alternate means and it is not cost beneficial to apply the provisions of this chapter for the limited remaining life of the activity."

[42] ASM proforma (Exh A General Conditions 5/18/2015) GC-7A Codes and Standards (for AE services in AES and D-B CONST): Wherever references are made in this subcontract to standards or codes in accordance with which the Services under this subcontract are to be performed, the current edition or revision of the standards or codes current on the effective date of the solicitation (RFP) for this subcontract shall apply, unless otherwise expressly stated. In case of any conflict between any referenced standards and codes and any Subcontract Documents, SUBCONTRACTOR shall immediately notify CONTRACTOR of such conflict together with a recommendation for resolution. CONTRACTOR shall confirm the Subcontract Document requirement in writing or direct an alternative solution in accordance with the General Condition titled "CHANGES."

For construction-only Subcontracts, (in CONST, CPFFS, EFS, IDIQ-BS, LFS, R&D and T&M) Exh A fixes the editions as date of contract award unless the work scope states otherwise: 'GC-7 STANDARDS AND CODES (Jun 2009): Wherever references are made in this subcontract to standards or codes in accordance with which the Work under this subcontract is to be performed, the edition or revision of the standards or codes current on the effective date of this subcontract shall apply unless otherwise expressly stated. In case of conflict between any referenced standards and codes and any Subcontract Documents, the General Condition titled "SUBCONTRACT INTERPRETATION" shall apply.' [which says write for clarification].

[43] Thirty days allows a project to issue its RFP with detailed ESM, code, and standard edition dates. These are ideally updated during best and final; they must be expressly stated in Subcontract per Exh A (see above). For especially protracted design procurements, version update during best and final will be mandatory to meet 6 month limit. Minor change order cost proposals are not considered RFPs here.

approval[44]). 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.[45] *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.[46] *Guidance: It is often allowable and in a project's or Subcontractor's advantage to voluntarily adopt/accept newer standards during design. Newer LANL and national standards and specs 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. These can improve the design, construction, start-up, and operation phases – though there might be added cost of redesign if the newer code or standard is adopted while the design is on-going (less so with time and materials than fixed price) or complete. The COR should be controlled during final design and construction with a process for reviewing and evaluating new and revised requirements to determine their impact on project safety, cost, and schedule before a decision is taken 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.*

G. Engineering Services Contracting Method: Use of design-build contracts is highly discouraged for moderate and high hazard, less-than-haz-cat-3 (e.g., radiological), and nuclear systems and facilities.[47]

H. Engineering Services during Construction (aka Title III): Projects must retain the original design agency to provide engineering services during construction – or LANL's Project Manager and Site Chief Engineer must agree when doing otherwise.

Scope of services must include: review and approval of submittals including shop drawings and "or equal" substitutions; RFI and SDDR review, disposition, and incorporation; review/comment on change order requests affecting 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 Special Tests per IBC Ch 17; LEED submittal handling per ESM Chapter 14 where required (final reports on guiding principles, IECC compliance, and energy efficiency when LEED is not required); 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

[44] Affected discipline POCs will be engaged to review, and most-affected or General POC should sign for all. If extended by variance, such approval is valid for 24 months (construction must begin within that time, track to that date).
[45] Beyond 24 months there is typically enough change to warrant a review and sometimes update and reissue. In most cases, changes are small and completely redesigning the job is not necessary. Example of the need/benefit of design rework was the new seismic criteria issued in 2007; the previous criteria significantly under-represented the risk; depending on the project, proceeding to build using old seismic design criteria might have even jeopardized approval to operate, thus wasting money (in this case the Structural Chapter directed analysis for projects underway). Other examples were the new requirements of the Welding Program and IBC Program -- big safety/quality gains requiring minor changes to design package/construction RFP. Note: IBC 105.5 Expiration says that permits expire in 180 days if work has not commenced (or if halted 180 days), though extensions are possible. LANL's 2-year requirement is necessary because approval to start construction is often delayed by funding considerations and is not out-of-line with design duration of many line item projects.
[46] 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 spectrum per ESM Chapter 5.
[47] Lesson learned, RLUOB. Complexity of design and high potential for late-emerging requirements makes this fixed-price, fast-track construction contracting method undesirable.

close-out activities which include participating in the final inspection; preparation of record documents including updated drawings, document listing for EDMS, and Project Equipment Listing; and assisting in competing the certificate of occupancy.[48]

1. As-built design outputs are required as follows:

   a. For ML-1, ML-2, other hazard controls (OHC) ML-3 equipment, and all "priority" drawings, the EOR/DPIRC must be contracted to provide "as-built" documents (not just as-found/documented record documents) of key design outputs delivered [e.g., drawings, commercial grade dedications (CGD), specs (unless it may be waived by FDAR and is, including changes as a result of switching from use of an IESL-qualified supplier to CGD), vendor data, SDDs, databases, and final calcs with verified assumptions]. See CAD Standards Manual for additional requirements for as-built drawings[49]

   b. Delegated design/build specialties such as fire alarms, sprinklers, and controls. Such subs shall provide as-built drawings and calculations (*deferred and delegated design also addressed in ESM Ch. 16 IBC-GEN*).

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.[50]

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.[51] 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

[48] These services are essential to an effective design change process. Original EOR generally provides highest quality and most efficient services, particularly if this work scope is in original EOR contract. When EOR is outside LANL, using them maintains unambiguous liability and responsibility for design adequacy. IBC 107.3.4.1 also discusses designer continuity.
[49] As-built records are essential to ensure alignment between design and field per DOE-STD-1073 Configuration Management.
[50] 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.
[51] 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 is per Exhibit A GC-6 which states that Exhibit D Scope of Work has precedence over Exh D Technical Specifications which has precedence over Exhibit E drawings.

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 precedence in subcontracts shall apply 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"x4" support but the Drawings show the use of an inadequate 2"x3" support. Since the specification 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. Also, in the original example, if the FDAR requires that the Drawings be revised so that the entire technical baseline reflects the constructed condition, then a design revision must be processed.*

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, Variances, Alternate Methods, and Clarifications 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.

A. Altitude: 7,500 feet[52]

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)[53]

- 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)

Note: Exceptions to the above (where altitude and the other data must be corrected to actual):

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.[54] For lower Pajarito Road and other areas use actual elevation when required for adequate design margin.

[52] Altitude 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. Altitude affects design and operation of many mechanical, electrical, and other components; this effect is addressed in more detail in those ESM chapters.
[53] FWO Calculation No. 00-00-CALC-M-0003
[54] Both approximate actual elevations

2. Design "clean" fire extinguishing agents using a design altitude no higher than actual (e.g., Spec Section 21 2200); furthermore, to ensure conservatism, use 5% less than actual altitude or use 5% more agent than calculated at actual altitude.

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).*

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:

Structures	Expected Life, years[55]
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.

1. Systems and Components for which replacement or life extension is anticipated in less than 35 years:
   - Roofing (see table above)
   - Flooring (carpet and rolled goods)
   - Mechanical equipment (active)
   - Electrical equipment with moving parts or contacts; PV panels

[55] These goals are for projects and also form the basis for the technical content of the LANL Engineering Standards. Numbers consistent with those used by MSS Maint Eng Group 11/2005 for decision making and modeling per K. Carr. IRS depreciation period for commercial buildings is 39 years; LANL and other government buildings are usually used even longer. R.S. Means may also have useful data but was not used. For energy LCC calcs, 42 USC 8254 revised 2007 says 40 years for public (e.g., line item quality) buildings unless fewer years is more appropriate. 10CFR436.14 uses a max of 40 years for energy system calcs. CMRR-NF goal was 50 but life extension likely.

- Controls (see table above)

2. *Guidance on life cycle analysis is provided in Z10 Attachment E. Additional design life standards are available from https://cais.doe.gov/caisinfo/doc.html in the condition assessment grouping, both for building systems and other structures and facilities (OSFs).*

E. Worker Safety[56]

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

[56] Lesson learned, RLUOB deep-shaft lift station. Supports 10CFR851 Subpart C (.21, .22)

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*
8. *Note: Address all cases where existing equipment has inadequate ratings (e.g., NFPA 70B §4-4.3.) for the intended application to the Standards Discipline POC.*
9. *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 (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 Ch 16 consistent with above.
3. 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 in accordance with DOE O 430.1C. 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).[57] *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.*

[57] 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.

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

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 optical character recognition (OCR) functionality which allows content searching. Non-electronic deliverables are only allowed when electronic is impossible (e.g., samples, mockups, prototypes, spare parts).

C. Document design by a set of calculations, drawings and/or sketches, and design/evaluation criteria commensurate with project scope that demonstrate the design is both safe and cost effective. 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 Agency need not maintain duplicative records of these records—and shall not deliver same (to prevent duplication/confusion). See also Z1040 Project Closeout topic at end of this document.

11.3 Calculations[58]

A. Prepare design calculations to document analytical determinations in accordance with the design agent'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 agents who do not have formal calculation procedures, calculations must be prepared in accordance with LANL AP-341-605, Calculations.

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.

[58] "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.

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.

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

F. Hand calculations may be scanned by LANL. For this reason, calculations must be printed clearly and with sufficient darkness to ensure clarity. Index calculations in a logical order and include adequate sketches to allow an engineer to follow and comprehend them easily.

11.4 Software Calculations[59]

A. General Requirements for Software Used in Calculations

1. Refer to ESM Chapter 21, Software.

11.5 Other Outputs

A. When required by Attachment B, SDDs must be numbered per LANL AP-341-611.[60] For other non-drawing documents, LANL Project Engineer must consult Conduct of Engineering documents to determine how they will be numbered.

B. Project Document List (PDL): An index of all project drawings, calculations, trade study reports, and other documents must be delivered as a turnover document prior to close-out of the project.

1. The design agency, unless otherwise stated in the Contract Documents, is responsible for populating this PDL.

2. At LANL PE discretion, project may produce the PDL with categories in Table Z10-6 below in an Excel spreadsheet, saving it as a CSV (comma delimited) file type, and submitting to the LANL STR for subsequent receiving LANL FDAR review, approval, and submission to the Records Center so that they can be entered into the project EDMS (using fields required by AP-341-403 is preferred to list below).

Table Z10-6 Minimum PDL Fields[61]

Document Type *(See AP-341-402, Attachment A. Document Type is synonymous with Document Acronym)*	Facility Name
Document Title	Facility Number
Document Revision Level	System Name
Engineering Document Number *(See AP-341-402)*	System Identifier
Document Category *(See AP-341-405)*	Pending Changes
Document Security Classification	Next Review Date
Document Management Level *(Document management level is same as the highest management level structure, system, and component describes in the document. ML-1>ML-2>ML-3>ML-4)*	
Document Owner *(Document owning organization)*	Document Location
Document Approval Date	Document Media
Document Current Status	SI-DC Control Number
TA Number	

3. Projects using DRS review system may employ other means to accomplish the document control and transfer-to-EDMS functions.

[60] These are living documents that must go into document control using LANL SDD numbering.
[60] These are living documents that must go into document control using LANL SDD numbering.
[61] AP-341-403 Master Document List r1 (internal link)

C. *Guidance: If it is likely that System Engineer wants calcs and other documents cataloged and retrievable individually from EDMS, then consider following the LANL document numbering format and use numbers assigned by CoE so the documents can be entered directly into the LANL system after LANL approval. For a larger project, it may be possible to assign blocks of numbers. Failing that, EOR would use internal numbering and LANL would approve/adopt and assign LANL doc number*

D. *Guidance: Projects intending to require BIM should incorporate relevant portions of AIA E 201, E202[62], AIA's integrated project delivery contract set, and/or ConsensusDOCS 301[63].*

E. 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)[64] Outputs prepared by non-LANL engineers, consultants, 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[65], 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 Z10-7A
Always engineering/PE sealed, even if deferred or delegated[66]

Discipline	Task
Any	Calculations, designs, specifications, reports, and other engineering outputs including drawings and diagrams (including P&IDs and PFDs, and details based on LANL Standard Details)
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.
Fire	FHA and determining the appropriate design density and area of application
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[67]
Structural	Equipment anchorage

Table Z10-7B
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) and which presents no unusual conditions, hazards, change of occupancy, or code violations[68]

[62] E201™–2007 Digital Data Protocol Exhibit…Parties not covered under such agreements should consider executing AIA Document C106™–2007, Digital Data Licensing Agreement."
[63] 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
[64] From LANS Contract Section I, I-123 DEAR 970.5204-2 LAWS, REGULATIONS, AND DOE DIRECTIVES (DEC 2000) (DEVIATION) (a) "In performing work under this contract, the contractor shall comply with the requirements of applicable Federal, State, and local laws and regulations (including DOE regulations), unless relief has been granted in writing by the appropriate regulatory agency." The NM Engineering and Surveying Practice Act, paragraphs 61-23-3.E, 61-23-21, and 61-23-22 define the practice of engineering and establish qualification and performance requirements for registered professional engineers as a matter of public safety.
[65] 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.
[66] 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.
[67] SJI position paper

Any	Shop/fab drawings, including direction on shop or field fab of HVAC ducting and other mechanical and electrical components; steel joist placement plans[69]
Any	Field changes (e.g., FCRs), even those involving sketches, unless they affect an existing calculation or require a new calculation, necessitate a new drawing or revision to existing drawing for clarity of new design, or any other circumstances when the project engineer determines a more formal design change (e.g., DRN) is warranted
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)
Controls	Non-nuclear: instrumentation and controls including final sequence of ops (approved by EOR); building access control
Fire[70]	Work involving fire alarm control panels and/or five (5) or less detection devices and associated wiring[71] Final hydraulic calculations on nine (9) or less fire sprinkler heads[72]

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).[73]

   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 an NM engineer or architect meets the requirement for professional certification on projects which do not exceed a construction valuation of $400k AND do not exceed a total

[68] For protection of LANL's interests, more restrictive than exceptions allowed by NMAC 14.5.2 Para 10.C.4 on permits
[69] SJI position paper
[70] Must be performed by National Institute for Certification in Engineering Technologies Level-III-certified person(s). NICET Certified Mark shall be used.
[71] NMAC 16.39.3.8 (G) (7/1/06). Based on 9/26/06 memos from Streit and Wolfe (Phoenix policy) regarding 9/25 opinion from Counsel (Ritschel) (EMRef-54)
[72] Nine heads is historical LANL practice with the crafts and more conservative than 20 which is used by Phoenix and being contemplated by NM
[73] 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.

occupant load of 50.[74] However, when a majority of the work is of a specialized nature such as fire, structural, or electrical, or if an electrical design becomes necessary as defined in D5000 (*1.1-E*), then a PE's certification competent in that discipline must appear on the documents.

3. Non-NM PEs: An 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:[75]
   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.
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.[76]

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[74] NM Architectural Act, 61-15-2(B) and NMAC 16.30.1.7(G); and the Engineering Act, 61-23-22(A) and NMAC 16.39.4.8. The incidental practice provisions of both statutes establish this requirement. Also, see NM "Handbook for Building Officials, 2011 Edition" Section I, Para B.2.a http://www.sblpes.state.nm.us/handbook.html

[75] Points (a)-(c) from NM "Handbook for Building Officials, 2011 Edition" para V.E.30, with same discipline proviso added. Pts (d)-(e) protect LANL from excessive out-of-state outsourcing which can decrease design quality because of unfamiliarity with LANL environmental conditions and logistical issues with travel and ready access.

[76] From NMSA 1978, Section 61-15-9 on Project exemptions:
D. A New Mexico registered professional engineer who has complied with all the laws of New Mexico relating to the practice of engineering has a right to engage in the incidental practice, as defined by rule, of activities properly classified as architectural services; provided that the engineer does not hold himself out to be an architect or as performing architectural services; and further provided that the engineer performs only that part of the work for which the engineer is professionally qualified and uses qualified professional engineers, architects or others for those portions of the work in which the contracting professional engineer is not qualified. The engineer shall assume all responsibility for compliance with all laws, codes, rules and ordinances of the state or its political subdivisions pertaining to documents bearing an engineer's professional seal.

From architecture regulations at NMAC 16.30.1.7:
G. "Incidental practice of architecture and engineering" means:
(1) architectural work incidental to engineering shall be that architectural work provided on projects with a building construction value not greater than four hundred thousand dollars ($400,000) and having a total occupant load not greater than fifty (50);
(2) engineering work incidental to architecture shall be that engineering work provided on projects with a building construction value not greater than four hundred thousand dollars ($400,000) and having a total occupant load not greater than fifty (50);
(3) all buildings and related structures within the regulatory provisions of the New Mexico Building Code (NMUBC) will require the proper authentication of the building construction documents by all participating disciplines in accordance with their respective governing acts on projects with a building construction value greater than four hundred thousand dollars ($400,000) or having a total occupant load greater than fifty (50), with the exception of [excerpts]:
   (d) nonresidential buildings, as defined in the New Mexico Building Code [NMCBC], or additions having a total occupant load of ten (10) or less and not having more than two (2) stories in height, which shall not include E-3 Day Care), H (Hazardous) or I (Institutional) occupancies;
   (e) alterations to buildings or structures which present no unusual conditions, hazards or change of occupancy.
(4) the owner, user or using agency shall select the prime design professional (architect or engineer) for any project based on the requirements and nature of the project.
(5) occupant load shall be defined and determined by the method set forth in the current, adopted code.

6. LANL engineers 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.[77]

11.6 Design/Evaluation Criteria

A. Documentation must include, but is not limited to, the following:

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, e.g., construction projects over $500k, etc.); FDDs, when required by App B, per App 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 systems design.[78]

12.0 Environmental Management[79]

A. Design documents must comply with the environmental requirements defined in Exhibit F of the design contract document, 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:

- 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
  - 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

[77] Memos from Lab Counsel to Tobin Oruch, 7/19/01 and 9/25/06 (EMref-3 and 53). Direct-report (staff augmentation/job shop) subcontractors to LANS are also considered exempt from sealing as they are LANL employees of a sort, albeit not LANS per se; task-order subcontractors are not exempt. Direct-report means that the LANS engineers are in "responsible charge" of the work. "Responsible charge" defined in requirement above.
[78] As allowed by copyright law. Gain manufacturer permission or suppler certifications if necessary.
[79] 10 CFR 851, Worker Safety and Health Program, requires contractors (LANL) to roll down their 10 CFR 851 program health, safety, and environmental requirements to all subcontractors.

- Air quality
- Threatened or endangered species
- Cultural resources
- Floodplains and wetlands
- Environmental reporting

Coordinate review of designs at each stage of development with ENV Division SMEs[80].

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 ADPM procedures.

B. Sustainable Design and Environmentally Preferable Purchasing

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

13.0 Environmental Qualification[81]

A. The requirements identified within this section are for safety SSCs or those SSCs that provide a mission critical, defense in depth, or worker safety function or whose failure may impact the operation of safety SSCs.

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.[82]

[80] This is a LANL Project Engineer responsibility. Use of PRID helps ensure this.

[81] The environmental considerations are "good engineering practice" and must be established for safety-related systems to ensure that the environment in which the systems will be placed is conducive to the performance attributes of the selected components. DOE G 420.1-1, Section 5.1.1.3, establishes the requirement for SC EQ as deemed necessary to ensure reliable performance of a safety system under those conditions and events for which it is intended.

The requirements and guidance were developed through several standards. ASME AG-1, "Code on Nuclear Air and Gas Treatment," Article IA-4000 – Design Considerations, requires the identification of environmental conditions for safety-related systems. Additional requirements and guidance were developed through several standards that identify environmental conditions that could adversely impact the operability of the most sensitive (e.g., I&C) equipment. These standards establish methods to recognize and classify such environmental conditions. The standards are: ISA-71.01, "Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity;" ISA-71.02, "Environmental Conditions for Process Measurement and Control Systems: Power;" ISA-71.03, "Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences;" ISA-71.04, "Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants;" IEEE 1-2000, "Recommended Practice – General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation;" IEEE-1159, "Recommended practice for Monitoring Electric Power Quality;" IEEE 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations;" and IEEE-1100, "Recommended Practice for Powering and Grounding Electronic Equipment IEEE Emerald Book."

[82] "Testing shall demonstrate adequacy of performance under conditions that simulate the most adverse design conditions." NQA-1, Requirement 3

a. 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.(3)(a)] See ESM Chapter 12 Nuclear for additional requirements and LANL Master Spec Section 01 8712 *Seismic Qualification of Equipment – Nuclear Safety Related* (future). [For SSCs requiring EQ by the IBC, see 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*].

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

3. *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)[83]. *Guidance: Manufacturers may provide recommendations.*

1. If safety-related (SC, SS, important-to-safety, 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)[84]. *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.*

[83] Lesson learned, RLUOB fan coil units

[84] 1997 IAPMO UMC, Section 305. Also DOE-HDBK-1140, "Human Factors / Ergonomics Handbook for the Design for Ease of Maintenance," Section 4.9.3.6, identifies a maximum usage height of 12 feet for a painter's type stepladder. For safety-related systems this represents the minimum height for ease of surveillance and maintainability given the potential apparatus available for the performance activities.

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.[85]

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.[86]

15.0 Project Equipment List (PEL)

A. Projects must develop an equipment/component listing as a turnover document prior to close-out. SSCs must include, as a minimum, all safety SSCs and all other facility SSCs requiring maintenance or surveillance or critical to mission objectives or facility operations or desirable for inclusion in the maintenance program for other reasons. Special tools and equipment should be included in this master list.[87]

B. When data is not entered directly into the LANL Computerized Maintenance Management System (CMMS; now Asset Suite) MEL, a spreadsheet that can be uploaded to the MEL must be provided. The EOR, unless otherwise stated in the Subcontract Documents, is responsible for populating all required fields of a Project Equipment List (PEL) spreadsheet where data is known (listing unknowns like model and serial numbers as TBD), saving it as a CSV (comma delimited) file type, and submitting to the LANL STR for subsequent constructor finalization (per LANL Master Spec Section 01 3300 Submittal Procedures) and then LANL system engineer review, approval, and incorporation into the MEL per AP-341-404, *Master Equipment List*. The spreadsheet format to be used is controlled by that AP (*its App B*).

C. 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 (for IBC scope projects, see ESM Chapter 16, e.g., *IBC-GEN Preliminary Project Determinations Form 01*). 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.

D. 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.

16.0 Project Engineering

A. Guidance: LANL’s approach to project engineering is described in greater detail in Engineering Processes Manual P341 and elsewhere.

[85] Enhancement of IBC 1015.6
[86] CRAD 9.10 for the CMR Con Ops Assessment, 2-20-2009
[87] DOE O 433.1A, Maintenance Management Program for DOE Nuclear Facilities, Att. 1 CRD para 2.a.1; and DOE G 433.1-1 para 4.4.3.1

17.0 Signs, Labels, and Tags

A. Identify SSCs in accordance with the nomenclature indicated in LANL Engineering Standards Manual, Chapter 1, Section 200, 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.

Z1020 QUALITY REQUIREMENTS (Programmatic & Facility)

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 Reporting*
- *P330-11, Identification and Control of Items [including storage levels]*
- *PD340, Conduct of Engineering*
- *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 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*).
- See ESM Chapter 12—Nuclear, Quality Assurance Subsection, for additional requirements (*including 10CFR830*).

C. Ensure that MLs are sufficiently delineated in the scope documents (e.g., Exhibit D and Section 01 1100 Summary of Work) 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). For ML-1 through ML-3 projects, harmonize Spec Section 01 4000 with ASM pro forma Exhibit H. Section Z10 Attachment F Specifications has additional, related discussion.

Z1040 PROJECT CLOSEOUT

A. At the completion of facility projects, transmit drawings, specifications, and other project records to LANL Document Control (*SI-DC*) 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.
2. For projects subject to SD350, *Project Management for Capital Acquisition and Construction*, also follow ADPM procedures (*internal*) on turnover, acceptance, and closeout.
3. In addition to any hardcopy requirements, transmit all submittals electronically in native format (e.g., Word, AutoCAD, etc.) when that is available (pdf otherwise). PDF OCR requirements under Project Files heading above also apply here.

18.0 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*

19.0 Appendices

App. A Acronyms and Definitions

20.0 Attachments

Att. A Technical Baseline Drawings Guidance

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

Att. C Deliverable Schedule 30-60-90-100% (Projects over $500k)

Att. D Facility Design Descriptions (New Facilities)

Att. E Life Cycle Cost Methodology Guidance

Att. F Specifications

Att. G Engineering Deliverables for Projects (guidance)

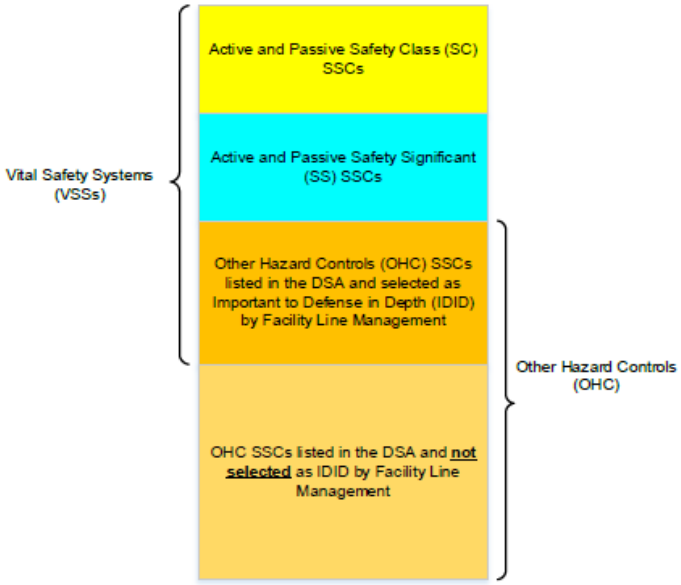
Appendix A Acronyms and Definitions

For reference only: Other DOE-wide definitions may be found in DOE-HDBK-1188. Other LANL terms may be defined in the Acronym Master List, PM Glossary, Packaging & Transportation Glossary, P341 Engineering Processes Manual.

Term	Definition
ADPM	Project Management Directorate of LANL (formerly ADPMSS, ADPMGT, 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	Documentation (for example, electrical one-line diagrams, and database records) verified by physical inspection as depicting the actual physical configuration and verified as consistent with the design requirements. [DOE-STD-1073-93]. Alternatively, see Record Document.
Building Official	See ESM Chapter 16 Section IBC-GEN and 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 when issued]
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 contracts. When not LANL self-performed, this is the Subcontractor
Contractor	Procurement (ASM) proforma (aka boilerplate) defines this as LANS, the prime contractor to DOE; however, in older ESM chapters this term 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 subcontractor of LANS' or a LANS employee. When the intention is that task is performed by LANS, then the term LANL is preferred since unambiguous and more timeless.
DCF	Design Change Form, a design change control document. Ref P341 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 [PD342]. See also DPIRC and EOR.
Design basis	This includes the design inputs such as design criteria and codes, plus design decisions captured in studies and calculations.
Designer	Anyone working in a design agency capacity, whether engineer, architect, drafter, or designer.
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.
EQ	Environmental qualification. A process to ensure SSCs perform intended function under normal and off-normal conditions. See Z10 subsection by this title.
eng	engineering
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 DOE Handbook - 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 App D of this document.
FOD	Facility Operations Director. One of approx. eight LANL managers responsible for the operation, engineering, and maintenance of facilities and tenants. "The FOD takes direction from the RAD and is the senior line manager who provides owner stewardship and overall facility operations. The FOD provides organizational leadership for facility Maintenance; Operations; Environment, Safety, Health, and Quality (ESH&Q); Waste Services; and Engineering. The FOD has the role of coordinating the efforts of these managers to ensure that all facility and programmatic activities are performed in a safe and compliant manor. Facility operations related deployed personnel will report through the FOD; exceptions for unique reasons will report through the RAD." [P313, has become SD312]
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.]: • High Hazard: The hazards analysis shows the potential for significant offsite consequences. (DOE STD 3009 Chg Notice 2) • Moderate Hazard: The hazards analysis shows the potential for significant on-site consequences (DOE STD 3009 Chg Notice 2) • Low Hazard: The hazards analysis shows the potential for only significant localized consequences (DOE STD 3009 Chg Notice 2)
IBC	International Building Code, published by the International Code Council. See ESM 16.
LANS	Los Alamos National Security, the prime contractor at LANL at time of writing. This is expected to change to a new entity in late 2018; at that point, take all references in the Standards to LANS to mean the new prime contractor.
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)*
MDL	Master Document List: a database of the engineering and facility related documents. Such listings are the responsibility of the Information Resource Management Document Control Services (IRM-DCS) team. At present, drawings are mirrored in the online Archibus document system (moving to the Documentum EDMS), and floor plans of record also have a stand-alone webpage. [AP-341-403]
MEL	Master Equipment List: an online database of installed equipment (SSCs) that require maintenance or surveillance. The MEL is in the CMMS (e.g., Asset Suite) system for most facilities. [AP-341-404]
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

Term	Definition
	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. From P341: 
Operating facility	A facility that is post-startup/turned over from construction phase and thus managed by an operations organization (but pre-decommissioning phase).
P	Procedure, a LANL policy document replacing certain IMPs, ISDs, and LIRs.
PD	Program Description, a LANL policy document replacing certain IMPs, ISDs, and LIRs.
PE	Normally professional engineer, but might be project engineer depending on the context.
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 document	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. They are described by AP-341-405. They might include: • Alarm Response, Emergency, or Abnormal Operating Procedures, • Documents required to determine event compensatory actions (e.g. selected P&IDs, selected Electrical Single Lines, selected fire protection drawings, etc.), • Documents required by Technical Safety Requirements (TSR) or Operational Safety Requirements (OSR) to clarify technical requirements Priority is the LANL term for Essential in DOE-STD-1073 Configuration Management.

Term	Definition
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.
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.
Record Document	Term popular in AE community describing typically-provided documents that incorporate field changes performed by constructor (e.g., subcontractor) but not necessarily verified by the EOR. These are not as-builts (see that definition above. [based on DPIC's 1999 Contract Guide (risk management handbook for AEs), pgs III-23 thru 25]
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 SCC below
Safety SSC	In this document, an SSC in a nuclear or chemical 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).
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 Glossary]. Such documentation shall be submitted to Chapter POC and/or FDAR for approval where directed by the ESM or upon request.
SI-DC	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.

Term	Definition
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]
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	Term for entity under contract to LANS. 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.
temporary	See ESM Chapter 16 IBC-GEN for definition and discussion