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Title: Design Engineer Qualification Standard

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ESD-QS-011-R0	April 2021	New	Initial Release

Table of Contents

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This document describes the training and qualification requirements for the Design Engineer (DE) position at Los Alamos National Laboratory (LANL). A Design Engineer translates design inputs into design output documents using design analysis and calculations, national codes and standards, DOE orders and standards, maintenance considerations, LANL best practices, and complex-wide lessons learned. Analysis performed by a DE requires sufficient detail in the purpose, method, assumptions, design input, references, and units such that a qualified engineer is able to review and understand the content and verify the adequacy of the results without recourse to the originator. A DE is assigned to a project by Engineering Management.

This qualification standard is owned by ESD. The ES-EPD Group Leader, herein referred to as ES-EPD, is responsible for management, maintenance and implementation of the qualification standard. This qualification standard applies to the Engineering Services Design Engineer position.

This qualification standard is outside the scope of DOE Order 426.2[1] because DE cannot directly impact the safety basis. The FDAR/LBO ultimately approves the design and as such, qualification under this standard is not required for a design engineer to work on nuclear facilities.

The Design Engineer serves an important role in ensuring facility changes and new construction are designed with safety in mind, and with the appropriate amount of rigor. ESD elected to develop a qualification program for the following benefits:

1. Consistent design development for ES Design Engineers
2. Ensure a solid understanding of the PD340 "Conduct of Engineering and Configuration Management for Facility Work" design process to include review and coordination requirements
3. Ensure a solid understanding of the Engineering Standards Manual and Associate Procedures
4. Ensure best practices are followed for each design discipline

2.0 PRECAUTIONS AND LIMITATIONS

Required training for qualification shall be planned during periods when training will not interfere or cause a distraction to workers during actual operations. During unanticipated or abnormal events, the instructor or evaluator must cease training activities and take appropriate corrective action. DEs who are "in training" may not make decisions independently. Their work must be performed under the supervision of a qualified DE. However, DEs in training may

[1] The purpose of DOE O 426.2 is as follows: To establish selection, training, qualification, and certification requirements for contractor personnel who can impact the safety basis through their involvement in the operation, maintenance, and technical support of Hazard Category 1, 2, and 3 nuclear facilities.

independently perform specific tasks or job assignments for which they are qualified and authorized.

The Laboratory's learning management system, UTrain is the official system of record for tracking training and qualification of workers at LANL.

Additional training and qualification requirements for the Mechanical Design Engineer Qualification may exist outside of this Qualification Standard (e.g., training on B31-series codes is available and such codes have minimum experiential requirements [ref ESM Ch. 17 Section GEN]).

3.0 ANALYSIS

A Job Task Analysis document for the DE position was begun in 2013. That analysis served as the starting point for the current 2020 analysis. Meetings and discussion with key personnel occurred to review the qualification standard and verify all aspects of the content contained within. The task to training matrix (TTM) was validated by Subject Matter Experts (SMEs) within ESD.

Many documents were analyzed that contained job responsibilities or other relevant information for the DE such as:

- *P341, Facility Engineering Processes Manual*
- *P342, Engineering Standards Manual*
- *DOE-STD-1189-2016, Integration of Safety into the Design Process*

3.1 Task Analysis

The tasks included in the Task to Training Matrix, TTM were then evaluated using the DIF (Difficulty-Importance-Frequency) Survey process to determine rigor of training for each task.

As in the table below, each task was then reviewed for training rigor and determination was made for each task as either NT-No Train; T-Train; or OT-Over Train.

TRAINING RIGOR DETERMINATION	TRAINING REQUIRED
NT-No Train	No training required; required read
T-Train	Train one time only
OT-Over Train	Train one time and then re-train every two years

Training Activities for Tasks

Based on the training rigor for each task, training activities were then determined for each task. Existing program training materials were reviewed to determine the adequacy of coverage of the learning objectives or tasks. Some tasks were

identified to be a “train” but no corresponding training currently exists. This is training that must be developed. In this circumstance substitute or equivalent training must be identified.

The approved task analysis was then documented in Attachment 7.1, *Design Engineer Job Task Analysis* and *Task to Training Matrix*. This matrix lists the DE task list, the DIF training rigor determination for each task, and the training activities corresponding to each task.

4.0 INSTRUCTIONS FOR QUALIFICATION AND AUTHORIZATION TO WORK

To become fully qualified and authorized to perform the duties associated with the DE position, the following steps must be completed:

- The Responsible Line Manager (RLM) notifies the ES-DO Training Coordinator of the need to assign the DE UTrain curricula to each DE who requires qualification.
- Training Coordinator assigns the Design Engineer UTrain curricula
- The RLM assigns a mentor to the trainee candidate and manages the mentor/mentee progress throughout the qualification process
- As each candidate completes a training course or requirement, UTrain is updated.
- Once all requirements are completed and the requisite number of years attained, the DE candidate then sits for the DE Oral Checkout.
- Upon successful completion of the DE Oral Checkout the DE is qualified as a Design Engineer.
- The RLM approves qualification documentation.
- The RLM authorizes the worker to perform associated activities as a qualified Design Engineer.

The initial training/mentoring period for this qualification is approximately 18 months starting on the day of assigned curricula.

4.1 Mentoring

The RLM assigns a mentor to the DE candidate specific to each topic in the applicable mentor sheets.

- Multiple mentors may be assigned to a DE candidate.
- Mentors must be complete in UTrain #14219

The LANL Performance Management process may be used to document the long and short-term goals for both the mentor and the DE candidate in training. Interactions between mentors and mentees, must be documented in order to

track the numbers of completed hours. Mentoring forms are located at the COE website under the Facility Design Engineer tab:

https://int.lanl.gov/org/ddops/aldfo/engineering-services/conduct-engineering/engineering-training-qualification.shtml.

A completed mentoring form will be part of the final documentation that must be turned into the COE office for verification of completed qualification requirements.

4.2 Entry-Level Education and Experience for Design Engineer

Job	Education	Experience
Design Engineer	Graduate of an ABET accredited engineering curriculum with a baccalaureate degree in engineering.	5 years experience
	Engineering Technologist with a baccalaureate degree in Engineering Technology	5 years experience
	Engineering Technologist with a High School Education	13 years experience
	Engineering Technologist with an applicable Associates Degree	9 years experience
	Position-specific requirements as defined in the job description and/or posting.	

4.3 Medical Examination

A baseline/initial medical examination is not required for this position.

4.4 Health, Safety, and Environmental Protection Training Prerequisites

Applicable training may be assigned as necessary by the facility.

4.5 Facility Specific Training

Applicable facility specific access training may be assigned as necessary per site requirements.

4.6 Job Specific Training

Additional required training at the institutional/facility level may be assigned per site requirements.

Additional job specific technical training may be assigned by the responsible manager.

4.7 Evaluations and Examinations

Successful completion of knowledge assessments, (e.g. quizzes, test) for training courses is required if applicable to the course. The DE candidate must also successfully complete an oral checkout as the final requirement of qualification.

4.8 Continuing Training

After the DE has been initially qualified and authorized to work, the DE must complete and maintain all continuing training requirements as assigned by ESD Management. The continuing training program is designed to maintain and enhance the knowledge and skills required to perform assigned duties, as well as to retain compliance with applicable LANL requirements (e.g. safety, access, handling of information). The continuing training program is tracked using the LANL Learning Management System and is conducted throughout the two year requalification period.

For LANL continuing training activities such as briefings or classroom training, Form 1651, “LANL Training Course Information/Roster” or equivalent must be submitted to the ESD Training Coordinator by the DE for entry into UTrain by deployed training staff.

The continuing training program may address but is not limited to the following elements:

- applicable procedure changes
- selected fundamentals
- applicable industry operating experience (Lessons Learned)
- Organization briefings, required reading, technical presentations, or meetings that meet the continuing training program elements, as above, such as system and component changes, Lessons Learned; fundamentals; and procedure changes.
- Specific external training brought to LANL such as American Society of Mechanical Engineers (ASME) training, or Occupational Safety and Health (OSHA).
- Workshops, or technical presentations

- Seminars
- Conferences
- Teleconferences
- Online programs
- Study groups

5.0 DOCUMENTING AND MAINTAINING QUALIFICATION

Initial qualification requirements, listed on Attachment 7.1, are documented in the Laboratory's Learning Management System. Initial worker qualification is documented on Attachment 7.3. Engineering Services Division, "*Design Engineer Package Review Form*" to document the qualification of a DE.

The "*Design Engineer Qualification Package Review Form*" lists all required documentation and UTrain reports showing completion of all requirements and when complete comprises the "Design Engineer Qualification Package."

The DE is qualified for two years after approval signature is obtained which signifies the beginning of the qualification period. Notification of requalification will be through the COE Office and/or UTrain.

Requalification Requirements
Requalification must occur every two years and be documented in UTrain. This may be accomplished through the use of a memo approved by ES-EPD.

If additional training requirements are identified for this qualification, the new requirements will be added to the initial training program. New requirements must be completed within one year from the effective date of the qualification standard revision. If additional training requirements are not met the worker cannot independently perform tasks associated with that training.

6.0 PERIOD OF QUALIFICATION

Qualification is valid for two years unless revoked for cause.

6.1 Loss of Qualification and Authorization

Qualification status may be revoked or limited for the following reasons:

- Performance deficiencies
- Unfit for duty
- Failure of requalification test

- Failure to complete required training
- Failure to maintain security clearance

Should ES-EPD in consultation with the Engineering Manager revoke the qualification of an individual for any reason, ESD must document the revocation, or limitation in a memorandum, with concurrence from the ES Division Leader, to the worker, and ES-DO. The memorandum must specify the reasons, the restrictions, and the conditions for reinstatement of qualification. ES-EPD in consultation with the Engineering Manager is then responsible for ensuring that corrective actions are taken and a remediation plan is developed to correct any deficiencies. The worker regains qualification upon successful completion of the remediation plan and signature of ES-EPD.

RLMs shall revoke the authorization of an individual who fails to maintain his or her "Qualification" status in the Worker Qualification Authorization System (WQAS) (or equivalent system) or shows serious job performance deficiencies, which indicate that they may perform in an unreliable manner.

6.2 Extended Absences

When a qualified DE has been absent from his or her job duties for greater than 3 months, but less than 12 months, selected retraining (including retaking written and oral examinations and operational/performance evaluations, if applicable), as deemed necessary by ES-EPD must be given prior to reassignment to duties. The qualification base date remains the same as it was before the absence.

When a qualified DE has been absent from his or her job duties for greater than 12 months, comprehensive written and oral examinations and operational/performance evaluations as applicable (the same as required of initial candidates) may be given at the discretion of ES-EPD in order to determine weak areas. Retraining and reexamination if applicable, must be required in areas of weakness, and upon successful completion, a new qualification date may be established.

6.3 Qualification Extension/Equivalencies and Exceptions

Exceptions and equivalencies from training requirements in this qualification program are discouraged but may be granted on a case by case basis by ES-EPD Management. The extension must be documented on Form ESD-TRN-002, *Engineering Services Division Request a Training Equivalency or Exception*. Documentation must state the reason the workers qualification was allowed to expire, the rationale for providing the extension, and the actions to be followed by the DE to complete his or her qualification requirements. Extensions may not exceed a cumulative time period of 90 days. This fillable form can be found on the Conduct of Engineering website.

7.0 RECORDS

Individual training records document a worker's training, qualification, and/or certification requirements associated with the worker's assignments. Individual training records may include, but are not limited to the following:

- Scored tests, quizzes, oral checklists
- OJT checklists and performance exams
- Certifications and licenses indicating completion of courses or programs
- Management approved forms requesting training exemptions or extensions of qualification
- Proof of degrees, licenses, experience, resumes and similar documents

Training records must be stored and maintained in accordance with 36CFR1228, Disposition of Federal records and ITS-FSD-001, current version, *LANL Conduct of Training Manual.*

8.0 ATTACHMENTS

Attachment 8.1 *LANL Design Engineer Task to Training Matrix*
Attachment 8.2 *LANL Design Engineer Required Curricula for Qualification*
Attachment 8.3 *Design Engineer Qualification Package Review Form*
Attachment 8.4 *Design Engineer Oral Checkout Process*
Attachment 8.5 *Design Engineer Oral Checkout Study Guide*

ATTACHMENT 8.1

LANL DESIGN ENGINEER TASK TO TRAINING MATRIX

IB Informal Briefing
LT Live Classroom Training or WebEx
M Formal Mentoring
O Online Briefing with Evaluation or Assessment
OJT On-the-job Training
RR Required Read
V Vendor Presentation
VT Formal Vendor Training
VID Video
WBT Web Based Training

Task Description	Training Decision (NT/T/OT)	Training Requirement (How We Will Train)
1. Duty Area: General Roles and Responsibilities (UTrain Curriculum #14178)		
Identify the roles and responsibilities of the Integrated Project Team	T	RR - P341, Facility Engineering Processes Manual UTrain 54169 RR - SD 350 Project Management for Capital Asset Acquisition and Construction, Policy Web Site RR - AP-350-200, Project Closeout UTrain 40134 RR - AP-350-300, Design Phase UTrain 40143 RR - AP-350-400, Construction and/or Installation – UTrain 40145 RR - AP-350-406, Startup and Commissioning UTrain 40148 RR - AP-350-420, Project Turnover and Acceptance UTrain 40149 RR - AP-350-430, Project Closeout UTrain 40151 IB - UTrain item 49510, COE AP-350 Series Briefing M - ESD-DE-MEN-001, UTrain 50390
Identify the Roles and Responsibilities of the Different ES groups	T	IB - COE Roles and Responsibilities of ES Groups UTrain 52076
Manage Engineering Service	T	RR - ESR Management Desktop Instruction or OJT

Request, ESR status and updates from Open through Completion using Footprints		M - ESD-DE-MEN-001, UTrain 50390
Identify Stakeholders and the DE's authority in communication / design	T	M - ESD-DE-MEN-001, UTrain 50390
Develop Subcontract and/or Procurement Packages	T	IB - COE Develop Subcontract and/or Procurement Packages UTrain 52077 M - ESD-DE-MEN-001, UTrain 50390
2. Duty Area: Preliminary Design (UTrain Curriculum #14179)		
Develop Engineering Support proposals to include Man Hours and schedules (PEEP or alternative)	T	M - ESD-DE-MEN-001, UTrain 50390
Identify applicable design inputs during a walk down	T	RR - AP-341-510, Field Walk-down, Data Gathering, and Inspections UTrain 44242 M - ESD-DE-MEN-001, UTrain 50390 OJT - COE OJT Identifying Design Inputs During a Walk Down UTrain 52079
Provide discipline specific input into a project Statement of Work	T	RR - AP-341-702, Statements of Work UTrain 55427 M - ESD-DE-MEN-001, UTrain 50390
Provide discipline specific input into a Requirements Criteria Document, RCD	T	RR - AP-341-602, Requirements and Criteria Document UTrain 44258 IB - COE How to Complete a Requirements Criteria Document (RCD) UTrain 52078 M - ESD-DE-MEN-001, UTrain 50390
Identify the reviews and approvals required for each LANL Alteration Level	T	M - ESD-DE-MEN-001, UTrain 50390
Prepare and implement a Design Change Form (DCF)	T	O - AP-341-517, UTrain 47300
Locate existing Technical Baseline Drawings	T	O - D2 General User Overview, UTrain 38870 IB – Electronic Document and Records Management System (EDRMS), UTrain 50360
3. Duty Area: Detailed Design (UTrain Curriculum #14180)		
Develop Drawings	T	RR - AP-341-608, Engineering Drawings and Sketches, UTrain 44263 M - ESD-DE-MEN-001, UTrain 50390 IB – The ABCs of Design Reviews, UTrain 50366

		IB – 30 60 90% Design Detail Requirements, UTrain 50367 IB – Types of Design Reviews, UTrain 50368
Identify Project Numbers, C#s, and DCF Numbers	T	M - ESD-DE-MEN-001, UTrain 50390 IB – Project IDs, DCFs and Drawing Numbers, UTrain 50371
Identify unique equipment names from MEL	T	RR - AP-341-404, Master Equipment List, UTrain 44237 M - ESD-DE-MEN-001, UTrain 50390
Identify the approvals need to use a sketch in lieu of a drawing and the associated relaxed requirements	T	M - ESD-DE-MEN-001, UTrain 50390 IB – Sketch or Drawing, UTrain 50369
Coordinate design development with other disciplines	T	IB - Z10 Deliverables UTrain 52080 RR - DI-ES-EPD-006, Roles and Responsibilities for Design Manager, UTrain 50363
Develop Specifications	T	RR - AP-341-610, Specifications for SSCs Utrain 55426 O - R2A2s for Identification and Communication of Technical Requirements UTrain 48167
Identify when a requirement should be captured in specs vs drawings	T	M - ESD-DE-MEN-001, UTrain 50390
Develop a Test and Inspection Plan	T	M - ESD-DE-MEN-001, UTrain 50390
Develop a Submittal List	T	M - ESD-DE-MEN-001, UTrain 50390 RR – DI-ES-EPD-005, Design and Submittal Review Guide, UTrain 50362
Develop a Post Modification / Post Maintenance Test	T	RR - AP-341-801, Post Modification/Post Maintenance Testing, UTrain 44253 M - ESD-DE-MEN-001, UTrain 50390
Develop a Statement of Special Inspections	T	IB - COE Develop a Statement of Special Inspections UTrain 52081
Develop Installation and Demolition Instructions	T	O - AP-341-517, Design Change Form Revision, UTrain 47300 M - ESD-DE-MEN-001, UTrain 50390
Perform Calculations	T	RR - AP-341-605, Calculations, UTrain 44261 M - ESD-DE-MEN-001, UTrain 50390
Qualifies software when used for calculations	T	LT - Curricula 9404 COE Safety Basis Overview for Engineers LT - Engineering Standard Manual Chapter 21 Software Overview, UTrain 38047 LT - Engineering Standard Manual Chapter 21 Software Preparers, UTrain 34048

Implement ES CAD Standards and the National CAD Standards when reviewing and developing designs	T	Curricula 3612 LT - Introduction to LANL Engineering Standards, UTrain 24140 O - COE Facility Work Part 1 and Quiz 25461/25567 O - COE Facility Work Part 2 and Quiz 25568/26330
Identify the level of detail expected at each design submittal	T	IB - Working towards the Z10 deliverables M - ESD-DE-MEN-001, UTrain 50390
Review a design as a Checker, Verifier, and Interdisciplinary Reviewer	T	RR AP-341-620, Review and Verification of Design Documents, UTrain 44269 RR - NQA-1 Requirement 500 Curricula: 3172 O - NQA-1 Indoctrination: Module 1 Requirements 1-4, UTrain 41675 O - NQA-1 Indoctrination: Module 2 Requirements 5-8, UTrain 41678 O - NQA-1 Indoctrination: Module 3 Requirements 9-12, UTrain 41679 O - NQA-1 Indoctrination: Module 4 Requirements 13-18, UTrain 41685 O - Reviewer/Checker On Design Reviews, UTrain 45863 RR - DI-ES-EPD-006, Roles and Responsibilities for Design Manager, UTrain 50363 RR- Reviewer Role Reference, UTrain 50361

Complete a Squad Check	T	RR - DI-ES-EPD-006, Roles and Responsibilities for Design Manager, UTrain 50363
Track time spent on a project to meet deliverables within budget	T	M - ESD-DE-MEN-001, UTrain 50390 SS – Time Management Fundamentals, UTrain 50578
Implement Effective Engineering via a Graded approach ● Drawings ● Specifications ● Calculations ● Identify the level of rigor required for ML-1, 2, 3, & 4 designs ● Identify the level of rigor required for Hazard Category 2 & 3 Nuclear Facility designs ● Conduct and document an Alternative Study	T	LT -Curricula 9404 COE Safety Basis Overview for Engineers RR - AP-341-502, Management Level Determination, UTrain 55428 RR - AP-341-603, Alternative Studies, UTrain 55382 IB - COE Implement the Graded Approach UTrain 52083 M - ESD-DE-MEN-001, UTrain 50390
4. Duty Area: Construction Support and Closeout (UTrain Curriculum #14181)		
Develop As-built, As-designed, and As-found drawings	T	RR - AP-341-511, Design Information Reconstitution UTrain 44248 RR – CAD Standards Manual, STD-342-300 UTrain 54168 “P342 Engineering Standards” M - ESD-DE-MEN-001, UTrain 50390
Create and update Technical Baseline Drawings	T	RR - AP-341-405, Identification and Control of Technical Baseline in Operating Facilities UTrain 54133 M - ESD-DE-MEN-001, UTrain 50390
Dispositions FCRs, DRNs, SDDRs and RFIs	T	M - ESD-DE-MEN-001, UTrain 50390 IB – When to Use FCRs vs. DRNs, UTrain 50389
Prepares and disposition NCRs	T	M - ESD-DE-MEN-001, UTrain 50390
Revise and markup design packages	T	RR - AP-341-519, Design Revision Control UTrain 44245
Reviews and approves vendor submittals	T	IB - COE Review and Approval of Vendor Submittals DRS Training UTrain 52082 RR - DI-ES-EPD-005, Design and Submittal Review Guide, UTrain 50362 M - ESD-DE-MEN-001, UTrain 50390

5. Duty Area: Relevant Codes and Standards (UTrain Curriculum #14182)		
Identify the scope and applicability of the following codes and standards. Enforce applicable codes and standards during design development and reviews. ● ICC IBC - International Building Code ● ICC IEBC - International Existing Building Code	T	LT - Introduction to LANL Engineering Standards UTrain 24140 V - IBC/IEBC Review
Identify the scope and applicability of LANL's Conduct of Engineering ● P342 - Engineering Standards ○ STD-342-100, Engineering Standards Manual (ESM) ○ STD-342-200, Master Specifications ○ STD-342-300, Drafting Standards Manual ○ STD-342-400, Standard Drawings and Details ○ STD-342-500, Design Guides ● Engineering Processes (APs)	T	LT - Introduction to LANL Engineering Standards UTrain 24140
Submit a Variance request	T	M - ESD-DE-MEN-001, UTrain 50390
6. Duty Area: Architectural (UTrain Curriculum #14183)		
Develop Architectural Design Drawings		
● Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Doors 2. Walls 3. Windows 4. Insulation 5. Finishes	T	IB – COE Types, Sizes and Quantities of SSCs for Architectural Design UTrain 52084
● Identify the proper symbology for Architectural Drawings per the National CAD Standards.	T	IB – COE Symbology for Architectural Drawings per Nat'l CAD Stds UTrain 52085
Perform the following Architectural calculations:		
● IBC egress distance, and opening sizes, and number of exits	T	IB - COE IBC Egress Requirements UTrain 52086
Identify the scope and applicability of Architectural codes and standards. Enforce applicable codes and standards during design development.	T	IB - COE Scope, Application and Enforcement of Architectrural Codes and Standards UTrain 52087
7. Duty Area: Civil (UTrain Curriculum #14184)		
Develop Civil Design Drawings		
● Identify the required types, sizes, quantities of	T	M - ESD-DE-MEN-002, UTrain 50392

SSCs to meet design requirements 1. Potable water piping 2. Sanitary waste and vent piping 3. Site Storm Drainage 4. Site Sanitary Sewer 5. Site Natural Gas 6. Building Site 7. Retaining Walls 8. Materials		IB – COE Types, Sizes and Quantities of SSCs for Civil Design UTrain 52088
• Identify the proper symbology for Civil Drawings per the National CAD Standards.	T	IB – COE Symbology for Civil Drawings per the National CAD Standards UTrain 52089
Interpret results of stress and strain using MathCAD software or equivalent	T	M - ESD-DE-MEN-002, UTrain 50392
Interpret results of deformation/bending moments using MathCAD software or equivalent	T	M - ESD-DE-MEN-002, UTrain 50392
Perform the following Civil calculations:		
• Earth retaining structures using MathCAD software or equivalent	T	M – ESD-DE-MEN-002, UTrain 50392
• Storm Drainage Calculation using SewerGEM/StormCAD software or equivalent	T	M – ESD-DE-MEN-002, UTrain 50392
Identify the scope and applicability of Civil codes and standards. Enforce applicable codes and standards during design development.	T	M - ESD-DE-MEN-002, UTrain 50392
8. Duty Area: Structural (UTrain Curriculum #14185)		
Identify the scope and applicability of Structural codes and standards. Enforce applicable codes and standards during design development.	T	M - ESD-DE-MEN-003, UTrain 50393
Develop Structural Design Drawings		
Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Proper Structural Drawing composition	T	M - ESD-DE-MEN-003, UTrain 50393
Identify the proper symbology for Structural Drawings per the National CAD Standards.	T	IB – Identify the proper symbology for Structural Design Drawings per the National CAD Standards. UTrain 52090
Perform the following Structural calculations:		
• Understand and Develop Structural Analysis Models and designs using RISA 3D or equivalent	T	M - ESD-DE-MEN-003, UTrain 50393 OJT - Run a sample Problem in Verification manual RR RISA – 3D Tutorial, UTrain

		50576 https://risa.com/assets/documentation/Tutorials_3D.pdf VID- https://www.youtube.com/playlist?list=PLYrS-U5MZrOlkm0fTX5cMylmJgR5DItW9 UTrain 50577
9. Duty Area: Electrical (UTrain Curriculum #14186)		
Develop Electrical Design Drawings		
Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Transformers 2. Switches 3. Motor Protection and Starters 4. Conductor and Raceways 5. Art 250 Conductors 6. Receptacles 7. Junction Boxes 8. Panelboards, Switchboards, Switchgear 9. Luminaires 10. Overcurrent Protection 11. GFCI 12. Disconnects 13. VFDs 14. Motors 15. Generators 16. UPSs 17. ATSs 18. SPDs 19. Lightning Protection System	T	IB – COE Types, Sizes and Quantities of SSCs for Electrical Design UTrain 52091 M - ESD-DE-MEN-004, UTrain 50394 RR - P101-10 Non-Ionizing Radiation – UTrain 48604 RR - P101-13 ELECTRICAL SAFETY PROGRAM – UTrain 43774
● Identify the proper symbology for Electrical Drawings per the National CAD Standards	T	IB – COE Symbology for Electrical Drawings per the National CAD Standards UTrain 52092
Perform the following Electrical calculations:		
● Short circuit, arc flash, and incident energy calculations using SKM Power Tools Software, ETap, or equivalent	T	VT - SKM Power Tools Training 101, UTrain 50491 VT - SKM Power Tools Training 102, UTrain 50492
● Coordination Study using SKM Power Tools Software, ETap, or equivalent	T	VT - SKM Power Tools Training 101, UTrain 50491 VT - SKM Power Tools Training 102, UTrain 50492
● Lighting calculation using Visual Lighting Software or equivalent	T	M - ESD-DE-MEN-004, UTrain 50394

• Lightning Protection calculation via the rolling ball method	T	IB – COE Calculations for Electrical Design UTrain 52093 M - ESD-DE-MEN-004, UTrain 50394
• Voltage Drop Calculation	T	IB – COE Calculations for Electrical Design UTrain 52093 M - ESD-DE-MEN-004, UTrain 50394
• Motor Derating calculation	T	IB – COE Calculations for Electrical Design UTrain 52093 M - ESD-DE-MEN-004, UTrain 50394
• Load calculation	T	IB – COE Calculations for Electrical Design UTrain 52093 M - ESD-DE-MEN-004, UTrain 50394
Identify the scope and applicability of Electrical codes and standards. Enforce applicable codes and standards during design development.	T	M - ESD-DE-MEN-004, UTrain 50394 IB – NFPA 780 Installation of Lightning Protection Systems, UTrain 50402
10. Duty Area: Mechanical (UTrain Curriculum #14187)		
Develop Mechanical Design Drawings and Specifications		
• Identify the required types, sizes, quantities of SSCs to meet design requirements 1. HVAC piping 2. HVAC ducting 3. Plumbing Piping Systems 4. Fundamental Controls Variables 5. Pumps 6. Fans 7. Heat Exchangers 8. Chillers 9. Cooling Towers 10. Boilers 11. Heat Transfer Coils 12. Unit Heaters 13. VAVs with Reheat 14. FCUs 15. Air Handlers 16. Water Heaters 17. Pressure Safety Vessels 18. Derating HVAC equipment 19. Chemical water treatment for HVAC 20. Air filtration for HVAC	T	IB – COE Types, Sizes and Quantities of SSCs for Mechanical Design UTrain 52094 M - ESD-DE-MEN-005, UTrain 50395 RR – P101-16, Industrial Ventilation (Non-HVACR) UTrain 33801
• Identify the proper symbology for Mechanical Drawings per the National CAD Standards	T	IB – COE Symbology for Mechanical Drawings per the National CAD Standards UTrain 52095

Perform the following Mechanical calculations:		
• Perform pipe friction loss calculations for liquids and gases	T	IB – COE Calculations for Mechanical Design UTrain 52096 M - ESD-DE-MEN-005, UTrain 50395
• Perform HVAC duct pressure loss calculations	T	IB – COE Calculations for Mechanical Design UTrain 52096 M - ESD-DE-MEN-005, UTrain 50395
• Demonstrate application of psychrometrics	T	M - ESD-DE-MEN-005, UTrain 50395
• Identify impacts of altitude on Mechanical calculations	T	IB – COE Impacts of Altitude on Mechanical Calculations UTrain 52097 M - ESD-DE-MEN-005, UTrain 50395
Identify the scope and applicability of Mechanical codes and standards. Enforce applicable codes and standards during design development.	T	LT - P101-34 Pressure Safety UTrain 56365 IB – COE Scope, Application and Enforcement of Mechanicall Codes and Standards UTrain 52098 M - ESD-DE-MEN-005, UTrain 50395
Recognize pressure safety applicability	T	WBT - P101-34 PRESSURE, VACUUM, AND CRYOGENIC SYSTEMS, UTrain 53576 IB – COE Recognize Pressure Safety Applicability UTrain 52099 M - ESD-DE-MEN-005, UTrain 50395
Create a pressure safety implementation plan	T	IB – COE Create a Pressure Safety Implementation Plan UTrain 52100 M - ESD-DE-MEN-005, UTrain 50395
11. Duty Area: Fire Suppression (UTrain Curriculum #14188)		
Develop Fire Suppression Design Drawings and Specifications		RR – COE PD1220 Fire Protection Program UTrain 52133
• Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Water based fire suppression systems 2. Special fire suppression systems (total-flooding) 3. Standpipe Systems 4. Fire Pumps 5. Fire Water Supplies 6. Piping 7. Fire sprinklers 8. Fire Alarm Interface 9. System appurtenances	T	IB – COE Types, Sizes and Quantities of SSCs for Fire Suppression Design UTrain 52101 M - ESD-DE-MEN-006, UTrain 50396
• Identify the proper symbology for Fire	T	IB – COE Symbology for Fire

Suppression Drawings per the National CAD Standards		Suppression Drawings per the National CAD Standards UTrain 52102 M - ESD-DE-MEN-006, UTrain 50396
Perform the following calculations:		
• Hydraulic calculations by hand, AutoSprink or equivalent	T	IB – COE Calculations for Fire Suppression Design UTrain 52103 M - ESD-DE-MEN-006, UTrain 50396
• Clean agent concentration calculations	T	IB – COE Calculations for Fire Suppression Design UTrain 52103 M - ESD-DE-MEN-006, UTrain 50396
Identify the scope and applicability of Fire Protection codes and standards. Enforce applicable codes and standards during design development.	T	IB – COE Scope, Application and Enforcement of Fire Suppression Codes and Standards UTrain 52104 M - ESD-DE-MEN-006, UTrain 50396
12. Duty Area: Fire Detection and Alarm (UTrain Curriculum #14189)		
Develop Fire Alarm Design Drawings and Specifications		
• Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Fire alarm systems 2. Panels/Sub Panels 3. Initiating Devices 4. Notification Appliances 5. Raceways and conductors	T	IB – COE Types, Sizes and Quantities of SSCs for Fire Detection and Alarm Design UTrain 52105 M - ESD-DE-MEN-007, UTrain 50397
• Identify the proper symbology for Fire Suppression Drawings per the National CAD Standards	T	IB - COE Symbology for Fire Detection and Alarm Drawings per the National CAD Standards UTrain 52106 M - ESD-DE-MEN-007, UTrain 50397
Perform the following calculations:		
• Voltage drop calculations	T	OJT – COE Calculations for Fire Detection and Alarm Design UTrain 52107 M - ESD-DE-MEN-007, UTrain 50397
• Battery calculations	T	OJT – COE Calculations for Fire Detection and Alarm Design UTrain 52107 M - ESD-DE-MEN-007, UTrain 50397
Identify the scope and applicability of Fire Protection codes and standards. Enforce applicable codes and standards during design development.	T	IB – COE Scope, Application and Enforcement of Fire Suppression Codes and Standards UTrain 52104 M - ESD-DE-MEN-007, UTrain 50397

13. Duty Area: Instrumentation and Controls - General (ML-1 to 4) (UTrain Curriculum #14190)		
Develop Instrumentation and Control Design Drawings - General (ML-1 to 4)		RR - COE AP-341-613 R1.1 INSTRUMENTATION SET POINT CONTROL, UTrain 44268
● Identify the required types, sizes, quantities of SSCs to meet design requirements 1. Control modules 2. Equipment touch interfaces (HMI)	T	M - ESD-DE-MEN-008, UTrain 50398
● Develop a system control sequences 1. Recognize controlling variables 2. Properly apply automated components 3. Assign a reasonable set points 4. Write basic control sequences	T	M - ESD-DE-MEN-008, UTrain 50398
● Identify the proper symbology for Instrumentation and Control Drawings per the ANSI/ISA-5.1-2009 Standard	T	M - ESD-DE-MEN-008, UTrain 50398
Perform the following Instrumentation and Control calculations:		
● Voltage drop and battery capacity calculations	T	M - ESD-DE-MEN-008, UTrain 50398
Identify the scope and applicability of the following Instrumentation and Control codes and standards. Enforce applicable codes and standards during design development.		
● NFPA 70E - Standard for Electrical Safety in the Workplace	T	M - ESD-DE-MEN-008, UTrain 50398
Rudimentary understanding of standard PLC programming languages.	T	M - ESD-DE-MEN-008, UTrain 50398
14. Duty Area: Instrumentation and Controls - Safety Systems (ML-1 and 2) (UTrain Curriculum #14191)		
Properly identify when safety instrumented systems are required based on LANL and industry standards.	T	M - ESD-DE-MEN-009, UTrain 50399
Perform and/or correctly analyze the following Safety related calculations: 1. SIL verification calculations 2. SIL determination based on properly selected IPLs 3. Nuclear setpoint calculations	T	M - ESD-DE-MEN-009, UTrain 50399 RR - COE AP-341-613 R1.1 INSTRUMENTATION SET POINT CONTROL, UTrain 44268
Identify the scope and applicability of the following Safety Instrumentation and Control standards. Enforce applicable codes and standards during design development.	T	M - ESD-DE-MEN-009, UTrain 50399

1. ANSI/ISA - 61511 : Functional Safety - Safety Instrumented Systems for the Process Industry Sector (Previously ISA-84) 2. DOE-STD-1195 : Design of Safety Significant Instrumented Systems Used at DOE Nonreactor Nuclear Facilities 3. IEEE		
15. Duty Area: Instrumentation and Controls – BAS (UTrain Curriculum #14192)		
Develop Building Automation System (BAS) Control Design Drawings 1. Identify basic controller types 2. DDC modules 3. Field sensing and control devices 4. Dampers 5. Valves	T	M - ESD-DE-MEN-010, UTrain 50400 RR - COE AP-341-613 R1.1 INSTRUMENTATION SET POINT CONTROL, UTrain 44268

Attachment 8.2

LANL Design Engineer Required Curricula for Qualification

Required Curricula for Core Qualification
Curriculum 14255 Design Engineer

Required Curricula for Architectural Qualification
Curricula 14183 Architectural for Design Engineer
Required Curricula for Civil Qualification
Curricula 14184 Civil for Design Engineer
Required Curricula for Structural Qualification
Curricula 14185 Structural for Design Engineer
Required Curricula for Electrical Qualification
Curricula 14186 Electrical for Design Engineer
Required Curricula for Mechanical Qualification
Curricula 14187 Mechanical for Design Engineer
Required Curricula for Fire Suppression Qualification
Curricula 14188 Fire Suppression for Design Engineer
Required Curricula for Fire Detection and Alarm Qualification
Curricula 14189 Fire Detection and Alarm for Design Engineer
Required Curricula for Instrumentation and Controls – General (ML-1 to 4) Qualification
Curricula 14190 Instrumentation and Controls – General (ML1 to 4) for Design Engineer
Required Curricula for Instrumentation and Controls – General (ML-1 and 2) Qualification
Curricula 14191 Instrumentation and Controls – General (ML1 and 2) for Design Engineer
Required Curricula for Instrumentation and Controls – BAS Qualification
Curricula 14192 Instrumentation and Controls – BAS for Design Engineer

Attachment 8.3

Design Engineer Qualification Package Review Form

<table>
<tr><td colspan="3">Qualification Package Review Form
Design Engineer
There are ____ pages in this package.</td></tr>
<tr><td colspan="3">This is a Conduct of Engineering qualification standard quality control review that, when completed, comprises a complete and accurate “Qualification Package” with all required and completed documents. Any requirement or form that is not applicable to this qualification should be noted as “N/A.”</td></tr>
<tr><td colspan="2">Document Control Number (Z Number, DE Area):</td><td>Date Review Completed:</td></tr>
<tr><td colspan="3">Candidate’s Name: Z Number:</td></tr>
<tr><td>☐ DE Checkout Evaluation Sheet Packages completed and attached</td><td colspan="2"></td></tr>
<tr><td>☐ DE Oral Checkout Evaluation Master Sheet</td><td colspan="2">☐ UTrain report verifying completion of Curricula WQ4R100A-4803: Core Design Engineer Training.</td></tr>
<tr><td>☐ DE Education and Experience Validation Tool Transcripts/PE/EIT/FE verified on _____</td><td colspan="2">☐ UTrain report verifying completion of Curricula 11075 Design Engineer Required Reading.
☐ UTrain report verifying completion of Curricula 14192 Instrumentation and Controls – BAS
☐ UTrain report verifying completion of Curricula 14191 Safety Systems (ML-1 and 2)
☐ UTrain report verifying completion of Curricula 14190 Safety Systems (ML-1 to 4)
☐ UTrain report verifying completion of Curricula 14189 Fire Detection and Alarm
☐ UTrain report verifying completion of Curricula 14188 Fire Suppression
☐ UTrain report verifying completion of Curricula 14187 Mechanical
☐ UTrain report verifying completion of Curricula 14186 Electrical
☐ UTrain report verifying completion of Curricula 14185 Structural
☐ UTrain report verifying completion of Curricula 14184 Civil
☐ UTrain report verifying completion of Curricula 14183 Architectural</td></tr>
<tr><td>☐ DE Requalification Memo</td><td colspan="2">☐ “Look Ups” from DE Oral Checkout Evaluation completed and documented</td></tr>
<tr><td>☐ Resume attached</td><td colspan="2"></td></tr>
<tr><td colspan="3">Oral Checkout members’ individual evaluation sheets completed and attached. Use as many lines below as required.
☐ Oral Checkout member name/Z Number | ☐ Oral Checkout member name/Z Number
☐ Oral Checkout member name/Z Number | ☐ Oral Checkout member name/Z Number</td></tr>
</table>

The quality control review and “Qualification Package” are complete as per the above requirements.			
QC Reviewer Name	Signature	Z Number	Date
QC Reviewer Name	Signature	Z Number	Date
ES-EPD Group Leader	Signature	Z Number	Date

☐ Qualification of candidate entered into WQAS.	☐ WQAS report attached showing entry of candidate.

Attachment 8.4

Design Engineer Oral Checkout Process

Successful completion of the oral checkout is the final requirement for qualification. Below are key points for conducting an oral checkout.

Mentor and the Design Engineer Candidate

- Mentor ensures the DE Candidate receives a copy of the *Design Engineer Qualification Standard* and the *Design Engineer Oral Checkout Study Guide*.
- Mentor and DE Candidate follow the goals as entered in the Mentoring Plan and keep track of mentoring progress using the fillable forms (by discipline) found on the COE website.
- Mentor and DE Candidate should meet a minimum of once a week and use the mentoring sheets to guide all mentoring sessions.
- During mentoring session's discussion, coaching, simulation or performance are encouraged.
- After mentoring is completed and when the DE Candidate is ready to attempt the Oral Checkout contact the COE office to schedule an Oral Checkout.

Conducting the Design Engineer Oral Checkout

- ES-EPD, or Engineering and FDAR for FOD, is responsible for chairing and managing the oral checkout.
- The Manager and the candidate's associated manager will conduct the DE Oral Checkout and may include other DEs and/or other functional SMEs or the DE Mentor to be part of the oral checkout.
- The Manager requests the COE Office to notify the DE candidate and other SME members of the DE Oral Checkout as far in advance as possible.
- Once the candidate is fully prepared, the Oral Checkout is conducted using the *Design Engineer's Oral Checkout Sheet*.
- Additional questions asked but not listed in the *Design Engineer Oral Checkout Sheet* must be documented.

Scoring for the Oral Checkout

When a question is asked, the DE candidate answers the question. The Manager or oral checkout member can ask follow-on questions.

When the candidate has finished with an answer the oral checkout member then scores the candidate's answer with either an "up" arrow indicating a "Pass" or a "down" arrow indicating "Fail," a "dash" – indicates that the candidate provided a marginal answer. If the answer is a "Fail" the candidate may be given another opportunity to answer the question at the end of the checkout. If the candidate still cannot answer the question correctly then the score given is a "Fail" for the individual question.

All questions do not have to be asked, however a representative sampling of questions must be asked to ensure the candidate is ready to perform as a fully qualified DE. Once questions have been asked and members of the oral checkout are satisfied, an overall score is arrived at by the oral checkout members. There are four possible overall scores for the DE Oral Checkout:

- **Pass ↑**
- **Pass with Lookups —**
- **Fail ↓ Re-take certain portions of checkout or Re-take entire checkout**

After the completion of the Oral Checkout the members of the oral checkout review the overall score with the Candidate.

Pass- All questions were answered satisfactorily. The oral checkout member indicates that the candidate has satisfactorily answered each question as per the required answer. The knowledge level was acceptable. The examinee demonstrated the requisite amount of understanding of DE skills and knowledge. Standard references normally available were referred to, where appropriate. No critical items were missed. Weak points were minor and did not substantially detract from satisfactory knowledge. Responses indicated that the candidate would be able to perform assigned responsibilities.

Pass-with-Lookups- A “Pass-with-Lookups” score may be given when the oral checkout member determines the answer given is correct but the DE candidate will be required to provide more in-depth knowledge on the subject matter. The DE candidate was familiar with the subject area but failed to provide sufficient detailed information. The DE candidate must perform and document research to gain additional information on identified weak points.

“Lookup” researched information must be documented and reviewed by the DE candidate with the Manager or mentor at a later scheduled date. If response(s) are found to be satisfactory, this documentation must be maintained as part of the qualification records.

Fail- The score assigned if the candidate responded with an unsatisfactory answer or was unable to explain acceptably in his or her words the answer to more than one question. The candidate did not have an adequate understanding of the required DE skills and knowledge. The candidate could not effectively answer the items (questions) without assistance. Responses indicated that the candidate would not be able to perform his or her assigned responsibilities. A failing grade for an oral checkout must be given if the candidate demonstrates, through action or inaction that he/she would cause damage to equipment or the environment, violate regulations or procedures, or has unsatisfactory knowledge or judgment to act independently in the qualified position. If the candidate receives a Fail, ES-EPD must make the determination to have the candidate re-take those portions of the evaluation that the candidate failed OR have the candidate complete the entire checkout.

Documenting Initial Qualification and Qualification Verification

Final qualification documents are processed through the COE Office, using the *DE Qualification Package Review Form*, a qualification package is developed with all required UTrain reports and documents included. Based on this documentation, the DE is then qualified. Completion of these requirements is documented in UTrain and WQAS as applicable.

The Manager for DEs who enter a facility to perform work is responsible for verifying and ensuring that DEs are trained and qualified on the WQAS activity being performed. ESD Management is responsible for verifying the qualification of a DE before assigning work.

Attachment 8.5

Design Engineer Oral Checkout Study Guide

These are the questions that may be asked of you during the oral checkout, use this study guide to prepare yourself. All candidates must complete the core oral checkout sections 1 – 5. Discipline specific areas of this oral checkout must be completed as required to be qualified in a specific discipline. Oral checkout members will ask a representative sample of questions from a topical area and allow the candidate's responses to guide the depth to which the questioning proceeds. Oral checkout members may ask questions outside the topical areas to allow follow-up to the candidate's responses.

1.0 General Roles and Responsibilities

Question No.	Question	Satisfactory Answer
1.	Describe importance of an Integrated Project Team and the roles and responsibilities of each member.	
2.	Describe and identify the roles and responsibilities of the different ES groups.	
3.	What function does the FOD provide?	
4.	What function does the Facility Design Authority Representative (FDAR) provide?	
5.	What function does the System Engineer provide?	
6.	Discuss how you manage an Engineering Service Request from Open to Complete using Footprints.	

7.	What is the DE's authority in communication and design and how do you identify your stakeholders?	
8.	Define the following tribal terms in LANL Engineering Services (board members provide terms).	
9.	Identify where LANL Engineering Procedures and Standards are located and describe the organization of these documents. Discuss the importance of the Engineering Procedures and Standards.	
10.	Describe the hierarchy of CoE documents at LANL.	

2.0 Preliminary Design

Question No.	Question	Satisfactory Answer
1.	Discuss the development of engineering support proposals to include man hours and schedules.	
2.	What is an SSC? How is the term used at LANL?	
3.	Describe the purpose of field walk down.	
4.	How would you provide discipline specific input into a project Statement of Work?	

5.	What is the Purpose of the Requirements and Criteria Document	
6.	When is an RCD required	
7.	How would you provide discipline specific input into a Requirements Criteria Document?	
8.	What is the purpose of the Functions and Requirements Document (FRD) (Nuclear)	
9.	What review and approvals are required for each LANL Alteration Level?	
10.	Discuss preparation and implementation of a Design Change Form (DCF).	
11.	What is the technical baseline? What's the difference between a Project As-Built and a technical baseline?	
12.	Where do you go to locate existing Technical Baseline Drawings?	
13.	What is configuration management?	

3.0 Detailed Design

Question No.	Question	Satisfactory Answer
1.	How do you acquire Project Numbers, C#s, and DCF numbers?	
2.	How do you acquire unique equipment names from the MEL?	
3.	Discuss the differences between a sketch and drawing. How does ES authorize the use of sketches? What approvals are required for a sketch vs a drawing?	
4.	Discuss the proper method for coordinating design development with other disciplines.	
5.	Describe the purpose of design information reconstitution.	
6.	Identify methods of design reconstitution	
7.	Describe the development of specifications.	
8.	When should a requirement be captured in the specifications vs. the drawings?	
9.	Discuss the development of a Test and Inspection Plan.	

10.	Discuss the development of a Submittal List.	
11.	Discuss the development of a Post Modification/Post Maintenance Test.	
12.	Discuss development of a Statement of Special Inspections. When is this required?	
13.	Discuss Installation and Demolition Instructions.	
14.	What is the process for qualifying software when used for calculations?	
15.	How do you implement ES CAD Standards and the National CAD Standards when reviewing and developing designs?	
16.	Describe the level of detail expected at each design submittal.	
17.	Which review procedure is used for LANL generated designs and documents and why?	
18.	Describe design verification methods.	

19.	What is the difference between a Verifier and an Interdisciplinary Reviewer when reviewing a design?	
20.	How do you identify Seismic Category D design impacts within your discipline?	
21.	What is the purpose of a Squad Check and how is it performed?	
22.	What is the method you use to track time spent on a project?	
23.	Describe effective engineering via a graded approach. How is this used in the development of drawings, specifications, and calculations? How is this used during design reviews? How does our level of rigor change depending on ML level, Hazard Category, and Alteration Level?	
24.	What is Management Level?	
25.	When is a formal calculation not necessary?	
26.	Which calculations require independent review in addition to checking?	

4.0 Construction Support and Closeout

Question No.	Question	Satisfactory Answer
1.	Describe the purpose of the design revision control AP?	
2.	Describe a Field Change Request. How do you disposition an FCR?	
3.	Describe a Design Revision Notice. How do you disposition a DRN?	
4.	Discuss/describe the development of As-built, As-designed and As-found drawings and the differences between each type.	
5.	What is the process used to created and update Technical Baseline Drawings?	
6.	What approvals are required for a drawings revision?	
7.	How do disposition RFIs?	
8.	How do you disposition NCRs?	

9.	Describe the process used to revise and markup design packages.	
10.	Describe the process used to review and approve vendor submittals.	

5.0 Relevant Codes and Standards

Question No.	Question	Satisfactory Answer
1.	What DOE Orders or Standards are applicable to facility design?	
2.	Give 2 purposes of DOE Order 414.1D.	
3.	How does LANL Implement the requirements of DOE Order414.1D?	
4.	What is ASME NQA-1?	
5.	Who is the LANL Design Authority?	
6.	Describe the scope and applicability of the following codes and standards. How are these codes and standards enforced? • ICC IBC • ICC IEBC	
7.	What is the process for submission of a variance request?	

8.	How do you disposition a Variance request?	

6.0 Architectural

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your disciple. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Architectural Drawings?	
3.	How would you calculate the following? • Maximum total exit travel distance • Minimum required exit width • Number of exits per story / building • Common path of travel distance	
4.	What type of Architectural codes and standards do you need to reference during design?	

7.0 Civil

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs typically encountered in the civil discipline and discuss the critical characteristics of one of these systems.	
2.	Where do you find the proper symbology for Civil Drawings?	
3.	Discuss the methodology you would use to validate the results of hydraulic analysis performed using software.	

4.	How do you interpret results of a deformation/bending moments calculation? Describe the process used to determine the optimum moisture content and maximum density in soil compaction	
5.	How would you perform the following calculations? Storm Drainage Culvert	
6.	Discuss the state and federal codes applicable to civil work at Los Alamos.	

8.0 Structural

Question No.	Question	Satisfactory Answer
1.	Describe the design philosophy for non-structural components as discussed in ASCE chapter 13.	
2.	Where do you find the proper symbology for Structural Drawings?	
3.	Explain the process you go use to verify the results of a computer analysis	
4.	Discuss the failure mechanisms of a post installed expansion anchor bolt.	
5.	Describe the local and global coordinate systems used in finite element analysis	
6.	Discuss the importance of a hot weather and cold weather concreting plan.	

9.0 Electrical

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your disciple. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Electrical Drawings?	
3.	How would you perform the following calculations? • Short circuit • (covered by i.e. below) • Incident energy • Coordination Study	
4.	Design Principles • What are the three types of Overcurrent? • What is a continuous load? (NEC) • Difference between GFCI and GFPE? • What is the difference between	
5.	What type of Electrical codes and standards do you need to reference during design?	

10.0 Mechanical

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your discipline. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Mechanical Drawings?	
3.	How would you perform the following calculations? • Pipe friction loss calculations for liquids and gases • HVAC duct pressure loss • Describe impacts of altitude on	

4.	What type of Mechanical codes and standards do you need to reference during design?	
5.	How could Pressure Safety impact a Mechanical Design?	
6.	Describe how you would create a pressure safety implementation plan.	
7.	Depict the following on a psychrometric chart; • Sensible Cooling • Cooling and dehumidification • Heating	
8.	Define the term “Relative Humidity”	
9.	When making a centrifugal pump selection, would you choose a pump with the “best efficiency point” to the right or the left of the calculated operating point? Why?	

11.0 Fire Suppression

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your discipline. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Fire Suppression Drawings?	
3.	Describe the principles beind how to perform the following calculations? • Hydraulic calculations • Clean agent concentration	
4.	What type of Fire Protection codes and standards do you need to reference during design?	
5.	What does it mean when fire water demand pressure significantly exceeds fire water supply.	
6.	By NFPA definition, is a fire pump considered a water source?	
7.	Scenario: What water based fire suppression systems would you apply in a ten story building with an exterior stair (in Los Alamos)?	
8.	Define margin as it applies to water based fire suppression.	

9.	What is the min design density and min design area for Ordinary Hazard Group 2? Same question with a dry pipe system? Same question with both a dry pipe system and a 30 degree sloped ceiling?	
10.	Explain the difference between single and double interlock preaction systems	

12.0 Fire Detection and Alarm

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your discipline. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Fire Detection and Alarm Drawings?	
3.	How would you perform the following calculations? • Voltage drop • Battery capacity	
4.	What type of Fire Detection and Alarm codes and standards do you need to reference during design?	
5.	What is the difference between an IDC circuit and a SLC circuit?	
6.	When are strobes required in a building?	
7.	What is a class N circuit and when would it be used?	

13.0 Instrumentation and Controls - General (ML-1 to 4)

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your discipline. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for Instrumentation and Controls Drawings?	
3.	How would you perform the following calculations? Voltage drop Battery capacity	
4.	Describe two basic PLC programming languages to include their strengths and weaknesses.	
5.	What type of Instrumentation and Control codes and standards do you need to reference during design?	

14.0 Instrumentation and Controls - Safety Systems (ML-1 and 2)

Question No.	Question	Satisfactory Answer
1.	Properly identify when safety instrumented systems are required based on LANL and industry standards.	
2.	Where do you find the proper symbology for Instrumentation and Controls Drawings?	
3.	How would you perform the following calculations? SIL verification calculations SIL determination based on properly selected IPLs Nuclear setpoint calculations	

4.	Describe two basic PLC programming languages to include their strengths and weaknesses.	
5.	What type of Instrumentation and Control codes and standards for ML-1 and 2 do you need to reference during design?	

15.0 Instrumentation and Controls - BAS

Question No.	Question	Satisfactory Answer
1.	Describe the type of SSCs required within your discipline. What SSC characteristics do you need to account for during design?	
2.	Where do you find the proper symbology for BAS Drawings?	
3.	How would you perform the following calculations? SIL verification calculations SIL determination based on properly selected IPLs Nuclear setpoint calculations	
4.	Describe two basic PLC programming languages to include their strengths and weaknesses.	
5.	What type of Instrumentation and Control codes and standards for ML-1 and 2 do you need to reference during design?	