



Department of Energy
National Nuclear Security Administration
Washington, DC 20585



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MEMORANDUM FOR DISTRIBUTION

FROM: ROBERT B. RAINES
ASSOCIATE ADMINISTRATOR
FOR ACQUISITION AND PROJECT MANAGEMENT

SUBJECT: Conceptual and Preliminary Design Implementation Guidance for
National Nuclear Security Administration (NNSA) Capital Line Item
Projects

Conceptual and preliminary designs are key deliverables that provide essential feedback to the integrated project team (IPT) to ensure that the project meets requirements, fulfills the mission need, and is safely delivered on budget. Experience demonstrates that significant risks and opportunities are best managed during the process of conceptual and preliminary design development while the cost to implement change is minimal. The best opportunity to resolve applicable risks, which will allow for more accurate cost estimates and performance baselines, fewer cost increases, and minimal schedule delays, is early in the design process. Many of these typical project problems can be mitigated by providing sufficient funding for conceptual and preliminary designs. To better manage our capital line item projects, the following implementation guidance is provided to standardize the minimum required deliverables for conceptual and preliminary designs.

The goal of this implementation guidance is to provide consistency for the conceptual and preliminary design package deliverables. This will ensure that the design of systems, structures, components, and other facility attributes are sufficiently mature for meaningful conceptual and preliminary designs and their associated cost estimates. This guidance also provides key cost relationships to ensure sufficient funding is provided to deliver these design packages. This guidance is effective immediately for all capital line item projects executed under DOE O 413.3B.

Federal Project Directors, as leaders of IPTs, are responsible for the implementation of this guidance. Questions should be directed to Mr. Cameron Manning, Director, Office of Enterprise Project Management (NA-APM-20) at 202-586-6567.

Attachments (3)

1. General Conceptual and Preliminary Design Guidance
2. Conceptual Design Deliverables
3. Preliminary Design Deliverables



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Attachment 1 – Conceptual and Preliminary Design General Guidance

Item	Project Type	Conceptual Design	Preliminary Design
General Definition	Hazard Category 1, 2, or 3 Nuclear Facility	A design milestone at which efforts are refocused from alternative comparisons and selection to the production of an initial design that integrates safety-in-design in accordance with DOE-STD-1189 and DOE Order 413.3B project management processes.	A design milestone that occurs between conceptual design and the final design. Preliminary design advances the conceptual design to reflect a more mature safety basis in accordance with DOE-STD-1189 and other DOE Order 413.3B project management processes. The preliminary design transitions to formal configuration control to ensure the final design fulfills the mission need.
	All Other Facilities	The design milestone at which efforts are refocused from alternative comparisons and selection to the production of an initial design that integrates project requirements and DOE Order 413.3B project management processes.	The design milestone that occurs between conceptual design and the final design. Preliminary design advances the conceptual design complying with project requirements, DOE Order 413.3B project management processes, and transitions to formal configuration control to ensure the final design fulfills the mission need.
Design Maturity	Hazard Category 1, 2, or 3 Nuclear Facility	30%	60%
	All Other Facilities	15%	40%
Estimate Class ¹	Hazard Category 1, 2, or 3 Nuclear Facility	AACEI Class 4	AACEI Class 3
	All Other Facilities	AACEI Class 3	AACEI Class 2
Design Cost Relationships²			
As a percentage of total project cost	Hazard Category 1, 2, or 3 Nuclear Facility	5%	15%
	All Other Facilities	1%	2%
As a percentage of total construction costs	Hazard Category 1, 2, or 3 Nuclear Facility	7%	20%
	All Other Facilities	1%	3%
As a percentage of total design costs	Hazard Category 1, 2, or 3 Nuclear Facility	25%	75%
	All Other Facilities	15%	30%

1. Reference AACEI Recommended Practice 18-R-97, *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries*, dated 1 March 2016, for additional information on AACEI estimating classes.
2. Design cost relationships include “all-in” costs except for the DOE-held contingency and DOE other direct costs. The cost relationships for preliminary design are cumulative values.

Attachment 2 provides a list of conceptual design deliverables for capital line item projects. All deliverables are assumed to be based on best available information and unsuitable for issuance for final design, procurement, or construction. The degree of completion for the deliverables are defined as outlined below.

- **N/A** – Deliverable is not applicable and/or required.
- **Conceptual** – Work on the deliverable is not advanced with interim and cross-functional reviews typically completed. Often the deliverable is assigned an “alpha” revision number rather than a “numeric” revision number to designate that it is not under a formal configuration control system.
- **Complete** – Work on the deliverable is complete and the final configuration has been reviewed (both intra- and inter-discipline) and approved. The deliverable is assigned a “numeric” revision number to designate that it is under a formal configuration management process because changes to the deliverable may result in major schedule and cost impacts. The deliverable will continue to be revised under a formal configuration management process if impacted as the design matures to 100%.

Attachment 2 – Conceptual Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Architectural	<ul style="list-style-type: none"> • Elevation drawings • General (finished floor plan, reflected ceiling plan, finish schedule) • Life safety plan/reports/drawings • Plan and section drawings • Select typical details 	Conceptual	Conceptual
Basis of Design	<ul style="list-style-type: none"> • Code of Record • System design descriptions (or alternative) 	Conceptual	N/A
	<ul style="list-style-type: none"> • Design criteria • Operations, maintenance, and radiation protection requirements • Scope of facilities/interface control documents • Security design requirements document • System requirements identified 	Conceptual	Conceptual
Civil	<ul style="list-style-type: none"> • Construction specifications • Excavation and structural fill plan • Studies/analyses/drawings/plans 	Conceptual	Conceptual
	<ul style="list-style-type: none"> • Qualitative geotechnical comparison of site alternatives • Geotechnical review and evaluation of past projects and proposed use area 	Complete	Complete
	<ul style="list-style-type: none"> • Geotechnical Report 	Complete	Conceptual
Electrical	<ul style="list-style-type: none"> • Drawings and plans • Electrical load list • Identify applicable codes and standards • One-line diagram • Power distribution system layout (load centers, switchgear, MCCs, panel boards) Substation layout drawings (as applicable, include distribution system to new facility ductbank, overhead lines) 	Conceptual	Conceptual
Environmental Management	<ul style="list-style-type: none"> • Environmental compliance strategy • National Environmental Policy Act strategy determination 	Complete	Complete

Attachment 2 – Conceptual Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Fire Protection	<ul style="list-style-type: none"> Identify applicable codes and standards Commodity lists (e.g., valve list, equipment list) Major equipment sizing design analysis calculations P&IDs Piping diagrams (including sprinkler heads) 	Conceptual	Conceptual
	<ul style="list-style-type: none"> System design descriptions 	Complete	Complete
Heating, Ventilation, and Air Conditioning (HVAC)	<ul style="list-style-type: none"> Identify applicable codes and standards Air flow diagrams Preliminary duct routing (major runs) Preliminary equipment list Preliminary heating/cooling loads Ventilation and instrument diagrams 	Conceptual	Conceptual
	<ul style="list-style-type: none"> System design description 	Complete	Complete
Instrumentation & Controls (I&C)	<ul style="list-style-type: none"> Control requirement general strategy (manual, semi, automatic) for safety instrumented system (SIS) & basic process control system (BPCS) requirements 	Conceptual (BPCS & SIS)	Conceptual (BPCS only)
	<ul style="list-style-type: none"> Control system architecture (implementation strategy for compliance with requirements) Input/output list Identify applicable codes and standards Issue drawings depicting I&C sensors and end devices. These may be drawings that are owned by others (e.g., process engineering, mechanical, HVAC) 	Conceptual	Conceptual
Mechanical, Process, Piping	<ul style="list-style-type: none"> Calculations/ analysis/reviews for commodities such as gloveboxes, skids Identify applicable codes and standards Major equipment sizing design analysis calculations Mechanical equipment list (MEL) Preliminary P&IDs Process flow diagrams (PFDs); material and energy balance, utility flow diagrams Reliability, availability, and maintainability parameters identified for key systems Throughput analysis Utility demand 	Conceptual	Conceptual
	<ul style="list-style-type: none"> System design descriptions 	Complete	Complete
Plant Design	<ul style="list-style-type: none"> 3D model software 3D model: major commodities Space allocation plan implemented General arrangement drawings Plot plan Select piping specifications/piping class sheets 	Conceptual	Conceptual

Attachment 2 – Conceptual Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Safety in Design and Safety Basis	<ul style="list-style-type: none"> • Conceptual Design Report • Configuration management process • Integrated Safety Management Plan • Major modification determination (for any modification requiring design) • Preliminary Fire Hazard Analysis for the preferred alternative • Risk and opportunities assessments 	Complete	Complete
	<ul style="list-style-type: none"> • Preliminary security vulnerability assessment • Conceptual Safety Design Report • Criticality safety program document and studies/analyses (e.g., nuclear criticality safety assessments/evaluations and criticality safety process studies) • DOE prepares a Conceptual Safety Validation Report • Safety design strategy • Specify safety functions & classifications for structures and facility level systems 	Complete	N/A
	<ul style="list-style-type: none"> • Preliminary Hazard Analysis Report 	N/A	Complete
Structural	<ul style="list-style-type: none"> • Basemat drawings • Concrete/steel drawings • Framing plans/sections • Preliminary finite element model for structural analysis • Scoping calculations (preliminary) • Structural design drawings/plans 	Conceptual	Conceptual

Attachment 3 provides a list of preliminary design deliverables for capital line item projects. All deliverables are based on best available information and unsuitable for issuance for final design, procurement, or construction. The degree of completion for the deliverables are defined as outlined below.

- **N/A** – Deliverable is not applicable and/or required.
- **Preliminary** – Work on the deliverable is matured beyond conceptual with interim and cross-functional reviews typically completed, but not approved as final. A minimum of 2 reviews is typical if the deliverable was initially developed in the conceptual design phase. Some deliverables (e.g., selected enlarged floor plans, lightning protection drawings, etc.) may be issued for the first time in preliminary design. The deliverable is assigned a “numeric” revision identifier to designate that it is under a formal configuration management process because changes to the deliverable may result in major schedule and cost impacts. This is particularly true for design media and safety basis documents. Deliverable will continue to be revised, under a formal configuration management process, as the design matures to 100%.
- **Complete** – Work on the deliverable is complete and has been reviewed (both intra- and inter-discipline) and approved as final. The deliverable is assigned a “numeric” revision identifier to designate that it is under a formal configuration management process because changes to the deliverable may result in major schedule and cost impacts. The deliverable will continue to be revised under a formal configuration management process if impacted as the design matures to 100%.

Attachment 3 – Preliminary Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Architectural	<ul style="list-style-type: none"> • LEED scorecards 	Complete	Complete
	<ul style="list-style-type: none"> • Drawings (general) • Finish schedule; door schedule • Interior design • Life safety plan/reports/drawings • Major floor plans • Major sections and elevation drawings • Remaining typical detail and select specific detail drawings, if required • Selected enlarged floor plans 	Preliminary	Preliminary
Basis of Design	<ul style="list-style-type: none"> • Preliminary reliability, availability, maintainability, and inspectability analysis • Scope of facilities/interface control documents 	Preliminary	Preliminary
	<ul style="list-style-type: none"> • Code of Record 	Complete	N/A
	<ul style="list-style-type: none"> • Design criteria • System requirements identified 	Complete	Complete
Civil	<ul style="list-style-type: none"> • Studies/analyses/drawings/plans 	Preliminary	Preliminary
	<ul style="list-style-type: none"> • Geotechnical Report 	Complete	Complete

Attachment 3 – Preliminary Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Electrical	<ul style="list-style-type: none"> • Drawings (general) • Electrical load list • Electrical load study design analysis calculations • Equipment grounding plans • Heat load design analysis calculations issued (electrical equipment and power cabling) • Lightning protection drawings and details • Overall ground grid plan • Panel/MCC/switchgear schedules • Single-line diagrams 	Preliminary	Preliminary
Environmental Management	• Environmental qualification for safety SSCs	Complete	N/A
	• NEPA Strategy	Complete	Complete
Fire Protection	<ul style="list-style-type: none"> • Exemptions and equivalencies for fire protection • Fire protection system design description • Fire protection utility flow diagrams, P&IDs, Sprinkler distribution drawings and alternative fire protection/suppression systems • Section and detail drawings • Design analysis calculations 	Preliminary	Preliminary
General	<ul style="list-style-type: none"> • Construction specifications, if applicable • Equipment and material service requisitions, if applicable 	Complete	Complete
Heating, Ventilation, and Air Conditioning (HVAC)	<ul style="list-style-type: none"> • Air flow diagrams • V&IDs and associated lists 	Complete	Complete
	<ul style="list-style-type: none"> • Air flow design analysis calculations • Confinement zone drawings • Duct sizing and fan supply/exhaust design analysis calculations • Heating/cooling load calculations • System design descriptions 	Preliminary	Preliminary
Instrumentation & Controls	<ul style="list-style-type: none"> • Cabinet/panel layouts • Control strategy for process and safety systems • Instrument/panel location drawings • Instrument installation details • Instrument list/equipment list • Instrument specifications • Security systems layouts • Telecommunication systems architectural drawings 	Preliminary	Preliminary
	• Major equipment specifications	Complete	Complete
	• Safety integrity level (SIL) calculations in schedule OR compliant with IEEE 379	Complete	N/A
Mechanical, Process Piping	<ul style="list-style-type: none"> • Equipment and fabrication specifications for specialty equipment, if applicable • Material energy balance (MEB) • Mechanical handling diagrams (MHDs) • P&ID Lists (equipment, valve, line, specialty items) • P&IDs for process and utility systems • PFDs for process and utility systems • Throughput analysis • System design descriptions for process systems • System design descriptions for utilities 	Complete	Complete
	• Environmental qualification for Safety SSCs	Complete	N/A

Attachment 3 – Preliminary Design Deliverables

Category	Requirement / Deliverable	Degree of Completion	
		Haz Cat 1, 2, or 3 Nuclear Facility	All Other Facilities
Mechanical, Process Piping	<ul style="list-style-type: none"> • Common component drawings for commodities such as gloveboxes and process skids • Drain sizing design analysis calculations • Electrical load tabulations • Equipment requirement reports (e.g., ergonomic analysis, time and motion studies, corrosion/erosion evaluations) • Hydraulic evaluation/line sizing/equipment sizing design analysis calculations • Mechanical assembly layout drawings • Pipe loading design analysis calculations • Process gas flow design analysis calculations 	Preliminary	Preliminary
Plant Design	<ul style="list-style-type: none"> • 3D model: major commodities (HVAC, pipe, gloveboxes, radio hoods) • 3D model: major equipment modeled 	Complete	Complete
	<ul style="list-style-type: none"> • 3D model: process equipment and supports are modeled, if applicable for CD-3A • Equipment location drawings • General arrangement drawings • Material specifications • Piping specifications/piping class sheets • Plot plan 	Preliminary	Preliminary
Safety in Design and Safety Basis	<ul style="list-style-type: none"> • Preliminary fire hazards analysis • Checkout/Testing/Commissioning Plan • Hazard analysis report • Preliminary security vulnerability assessment • Risk and opportunities assessment 	Complete	Complete
	<ul style="list-style-type: none"> • Summary of key design activities • Functional classification and Natural Phenomena Hazard Design Category categorization for all Safety Class, Safety Significant, and Defense-in-Depth SSCs • Preliminary safety and design results • Safety design strategy 	Complete	N/A
	<ul style="list-style-type: none"> • Criticality safety studies (e.g., nuclear criticality safety assessments/evaluations and criticality safety process studies) • Hazard analysis documents • Hazard and accident analysis • Preliminary quality level determinations or functional classifications for all systems 	Preliminary	N/A
Structural	<ul style="list-style-type: none"> • Anchor force and member sizing design analysis calculations for mechanical equipment and large electrical equipment, including electrical/instrument trays or racks • Material specifications • Selected material requisitions • Structural design analysis calculations 	Preliminary	Preliminary
	<ul style="list-style-type: none"> • Seismic evaluation study 	Complete	Complete