**Attachment G
Engineering Deliverables for Projects (Guidance)**

**Record of Revision**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rev** | **Date** | **Description** | **POC** | **RM** |
| 0 | 11/17/14 | Initial issue | Tobin Oruch, *ES-DO* | Larry Goen, *ES-DO* |

Purpose:

1. Provide project/design teams a list of final engineering deliverables that could result from/be associated with a project, including COE documents, design outputs, and other technical baseline requirements. The intent is not to capture every deliverable that might be required from an overall project point of view. The focus is on engineering products typically stemming from a project.
2. The list is intended to be completed early in the project design phase to determine what engineering deliverables will be provided, who is responsible, and act as a communication tool to ensure expectation agreement between facility customers, project teams, design agencies, subcontractors (if applicable), and other interfacing organizations.
3. List reflects a compilation from the following COE sources:
4. CoE Administrative Procedures
5. ESM Section Z10 Attachment A (technical baseline drawings)
6. ESM Section Z10 Attachment B (technical baseline deliverables)
7. ESM Section Z10 Attachment C (deliverables schedule 30-60-90/100)
8. ESM chapters, by discipline
9. ES-EPD Project Engineering Desktop Training Guide (on EPD-EPD webpage)

Directions for use:

1. To complete the form, check all applicable deliverables and assign organizational and/or personal responsibility.
2. Once approved, maintain form as a project record, update and reapprove if needed.
3. Issue approved form to customer, project team, subcontractors (if applicable) and other applicable interfacing organizations. If applicable, the list can be used to form the basis for the design agency SOW’s minimum deliverables (along with those mandated by the LANL Engineering Standards).

| **Project Engineering Deliverables List** | **Y/N or ✓** | **Responsibility****(org or name)** |
| --- | --- | --- |
|  |  |  |
| **Conduct of Engineering (CoE) Processes (APs) Documents** |  |  |
| Management Level Determination (MLD) initial |  |  |
| Management Level Determination (MLD) component/part level |  |  |
| Technical Evaluation of Replacement Items |  |  |
| Design Change Form |  |  |
| Requirements and Criteria Document |  |  |
| Functions & Requirements Document (complex and higher hazard only) |  |  |
| Alternative Studies |  |  |
| EDMS upload files and metadata (former MDL) |  |  |
| Qualification of Existing Data (nuclear and high hazard) |  |  |
| Determining Critical Characteristics for Design of Safety Related Items |  |  |
| Nuclear safety item acquisition plan, IESL requests, commercial grade dedications |  |  |
| Specifications for Non-Safety SSCs |  |  |
| Specifications for Safety Related SSCs |  |  |
| Design Coordination |  |  |
| Design Interface Control |  |  |
| Design Information Reconstitution |  |  |
| SSC Control Software Change Package |  |  |
| Master Equipment List (MEL) |  |  |
| Identification and Control of Critical Spare Parts during construction |  |  |
| Instrumentation Set Point Control |  |  |
| Facility Design Description (FDD) |  |  |
| System Design Description (SDD) |  |  |
| Statements of Work |  |  |
| Technical Baseline Change during Design |  |  |
|  |  |  |
| **Safety Basis Documents** |  |  |
| Major Mod Determination per SBP 114-1, *Safety Basis Development for Projects, Att 2* |  |  |
| Safety Basis - PDSA |  |  |
| Safety Basis - DSA |  |  |
| Safety Basis - TSR |  |  |
| Safety Basis - BIO |  |  |
| Safety Basis - HAR |  |  |
| Safety Basis - FSP |  |  |
| Safety Basis – update documentation |  |  |
|  |  |  |
| **General and General Design Documents** |  |  |
| ESR to ES-EPD for design in-house or outside (make or buy) |  |  |
| Project acquisition strategy e.g. design/bid/build or design/build (need Performance Specifications/Design Basis Document for latter |  |  |
| Cost estimate |  |  |
| Schedule |  |  |
| Project Requirements Identification (PRID) and Excavation Permits (EXID) initiation/upkeep |  |  |
| International Existing Building Code (IEBC) Modification Determination Checklist |  |  |
| ESR to ES-EPD for Engineering Studies; Engineering Estimates for Design Services; Design Project Management Plans; Engineering Design Services; Engineering Design Reviews; Submittal Reviews; LANL Building Official Review and Approvals; External Engineering Design Subcontracts; External Geotechnical Services; Facility Design Support Services |  |  |
| Bill of Material (BOM) |  |  |
| Installation Instructions |  |  |
| Operating Instructions |  |  |
| Quality Inspection Plan |  |  |
| Post Modification Testing (PMT) |  |  |
| Field Change Notice (FCN) Criteria |  |  |
| Vendor Information |  |  |
| Engineering Studies |  |  |
| Technical Reports |  |  |
| RFI log |  |  |
| NCR log |  |  |
|  |  |  |
| **Fire Protection** |  |  |
|  **Fire Protection Calculations** |  |  |
| Fire alarm system voltage drop calculations |  |  |
| Fire alarm system battery backup calculations |  |  |
| Fire water flow test initiation |  |  |
| Fire sprinkler system hydraulic calculations |  |  |
|  **Fire Protection Drawings** |  |  |
| Building plan showing building layout, fire areas, and fire walls |  |  |
| Site plan showing size, type and location of underground water mains and location of hydrants, sprinkler system lead-ins, and sectional valves |  |  |
|  Building drawingsThe architect’s life safety analysis with applicable codes of record, IBC construction type, and NFPA 101 occupancy typeEgress routes, common paths of travel, dead ends, exit widths, exit doors, etc.Location and rating of all fire walls, barriers, doors and dampersLocation of all HVAC ducts with cfm ratings for intake and exhaust ducts for each HVAC unitAll areas to be sprinklered, including features of construction and HVAC that could present obstructions of which the sprinkler contractor must be awareAll fire alarm system areas of coverageLocation and rating of emergency lights |  |  |
| Fire alarm connection diagrams |  |  |
| Fire alarm location drawings |  |  |
| Fire alarm logic diagrams |  |  |
| Fire area boundary drawings |  |  |
| Fire detection drawings |  |  |
| Fire protection conduit/block diagrams |  |  |
| Fire protection drawings |  |  |
| Fire suppression system design |  |  |
| Sprinkler standpipe/piping layout |  |  |
| **Fire Protection Specifications** |  |  |
| **Fire Hazards Analysis (FHA)** |  |  |
| **Fire Protection Closeout** |  |  |
| NFPA 13 Preliminary Record of Completion |  |  |
| NFPA 13 Final Record of Completion |  |  |
| NFPA 13 Inspection and Test Form |  |  |
| NFPA 72 System Record of Completion |  |  |
| NFPA 72 System Record of Inspection and Testing |  |  |
|  |  |  |
| **Civil** |  |  |
| Site survey to establish existing site grading, drainage, structure locations, existing overhead and underground utilities, and special site conditions and/or constraints |  |  |
| Existing site conditions plan with locations of existing buildings, structures, existing contours, and drainage features |  |  |
| Site grading and drainage plan with establish building location and orientation, access roads, parking location, and finish floor elevations |  |  |
| Provide an analysis of the proposed projects effect on the surrounding existing facilities (buildings, roadways, sidewalks, utilities, traffic signals) and the adequacy of the existing facilities to serve and be functional with the additional infrastructure |  |  |
| Plan to properly install Best Management Practices (BMPs) and install perimeter sediment controls around disturbed areas per the Storm Water Pollution Prevention Plan |  |  |
| **Civil Calculations** |  |  |
| Drainage calculation and hydrologic analysis, where applicable |  |  |
| Earthwork calculation of cut and fill volumes with applicable cross sections |  |  |
| Pressure, demand, and capacity analysis for sizing and material proposed in the utility system improvements |  |  |
| Pavement design calculation |  |  |
| Road design calculation including horizontal and vertical alignment, curve data, super elevation, minimum sight distances, and pavement thickness  |  |  |
| Traffic counts and future volume projections to a traffic impact analysis and to establish design parameters |  |  |
| **Civil Drawings** |  |  |
| Plan view of proposed site grading and drainage improvements identifying locations of roads, curb and gutter, parking areas, sidewalks, buildings and structures |  |  |
| Roadway, parking lot or drainage structure plan and profile sheets with appropriate horizontal and vertical design information |  |  |
| Utility plan sheets identifying the proposed improvements with existing utilities clearly identified |  |  |
| Roadway, parking lot, sidewalks, and building access plans to include guardrails, striping, signage, handicap access, vehicle turning movements, traffic signal plans, and traffic control plans. Traffic control plans by a registered Professional Engineer (PE) who is certified as a Professional Traffic Operations Engineer |  |  |
| A temporary traffic control plan (to include Phasing), with provisions for pedestrians and bicycles, shall be prepared by a registered Professional Engineer (PE) who is certified as a Professional Traffic Operations Engineer. |  |  |
| Plan and profile for water, natural gas, or steam and condensate lines |  |  |
| Plan and profile for (gravity and force main) sanitary sewer and storm drainage |  |  |
| Submit Impediments To Vehicular Traffic and/or Requirements for Moving Heavy Equipment and Oversized Loads Forms as applicable |  |  |
| **Civil Specifications** |  |  |
| **Civil Record Documents** |  |  |
| Building plan |  |  |
| Duct banks |  |  |
| Erosion control drawings |  |  |
| Fencing/parking/laydown |  |  |
| Grading |  |  |
| Landscaping drawings |  |  |
| Manholes |  |  |
| Profiles drawings |  |  |
| Roads/railroads drawings |  |  |
| Sanitary/storm sewers drawings |  |  |
| Settling basins |  |  |
| Sheet piling and dewatering |  |  |
| Shoring drawings |  |  |
| Site and plot plans |  |  |
| Survey drawing |  |  |
| Wells |  |  |
| Yard utility drawings |  |  |
| Material submittal reports required per specifications |  |  |
| Testing, disinfection, and inspection reports required per specifications |  |  |
|  |  |  |
| **Architectural** |  |  |
| **Architectural Calculations** |  |  |
| Design criteria (Including life safety and IBC code analysis) |  |  |
| **Architectural Drawings** |  |  |
| Plan layouts and exterior elevations |  |  |
| Plans, elevations, sections, details, interior elevations, and schedules |  |  |
| Architectural details |  |  |
| Architectural plans and elevations |  |  |
| Architectural renderings and models |  |  |
| Architectural sections |  |  |
| Architectural schedules and index |  |  |
| Emergency evacuation drawings |  |  |
| Fencing and site security drawings |  |  |
| Floor Plan of Record |  |  |
| Penetration seals |  |  |
| Radiological zone drawings |  |  |
| Roof Plan of Record |  |  |
| **Architectural Plans/Schedules** |  |  |
| Life Safety Plan |  |  |
| Planting plan |  |  |
| Planting list schedule |  |  |
| Planting details |  |  |
| Seeding schedule |  |  |
| **Architectural Specifications** |  |  |
|  |  |  |
| **Structural** |  |  |
| **Design Basis Document** (ref LANL ESM Chapter 5, Sect I) |  |  |
| **QA Plan for Structural Design** (ref LANL ESM Chapter 5, Sect I) |  |  |
| **Structural Calculations** (ref LANL ESM Chapter 5, Sect I) |  |  |
| Foundation description and preliminary sizing (e.g., footings, mats, slabs, piles, tie-beams, etc.) |  |  |
| Superstructure description and preliminary sizing (e.g., concrete or steel, cast-in-place vs. precast/pre-stress, lateral force resisting system, demonstration of complete load path, etc.) |  |  |
| Descriptions of special structural considerations |  |  |
| Completed structural scheme with all members sized |  |  |
| Calculation or manufacturer’s catalog data validating sizing and selection of all components |  |  |
| Secondary component designs (e.g., base-plates, seismic bracing, support stands, etc.) |  |  |
| Foundation design(s)  |  |  |
| Anchorage designs including R&D equipment when required by ESM Chapter 5 Sect I App A |  |  |
| **Structural Drawings** |  |  |
| Floor plans and cross-sections |  |  |
| Beam, column and footing schedules as applicable |  |  |
| Secondary component details  |  |  |
| Foundation details |  |  |
| Anchorage details |  |  |
| Reinforcement and connection details, including bolt and weld sizes |  |  |
| **Test and Inspection Requirements** |  |  |
| **Structural Specifications** |  |  |
| **Structural Record Documents** |  |  |
| Equipment supports drawings |  |  |
| Fabrication details |  |  |
| Foundation drawings |  |  |
| HVAC support drawings |  |  |
| Instrumentation support drawings |  |  |
| Miscellaneous steel grating, handrails, plate drawings  |  |  |
| Miscellaneous steel, plans, sections, details |  |  |
| Pipe support/pipe rack drawings |  |  |
| Structural concrete plans |  |  |
| Structural concrete sections and details |  |  |
| Structural masonry |  |  |
| Structural steel drawings  |  |  |
| Tray and conduit support drawings |  |  |
|  |  |  |
| **Mechanical**  |  |  |
| **HVAC Calculations** |  |  |
| HVAC heating and cooling loads corrected for altitude |  |  |
| ASHRAE 62 ventilation calculation with exhaust, outside air and building pressurization requirements |  |  |
| Duct sizing calculation including system pressure drops |  |  |
| Energy conservation/sustainable design analysis |  |  |
| **HVAC Drawings** |  |  |
| Mechanical symbols and legend |  |  |
| HVAC floor plans showing major equipment, duct runs, and VAVs/heating coils |  |  |
| HVAC roof plans showing office layout and equipment room, major equipment, penetrations, and pipe/duct runs |  |  |
| Airflow diagrams including major equipment, supply & return diffusers, transfer grills, dampers, VAV/ reheat coils, airflow rates, and facility/room pressurization requirements  |  |  |
| P&IDs including major system equipment, control devices, control wiring & logic, and sequence of operation |  |  |
| Equipment schedule including all major equipment with significant operating parameters and equipment specs |  |  |
| Mechanical sections, elevations, and details |  |  |
| P&IDs |  |  |
| **HVAC Specifications** |  |  |
| **Piping Calculations**  |  |  |
| Piping system calculation including flow rates, pipe sizing with friction factors, velocities, expansion/contraction and system equipment pressure drops for pump selection |  |  |
| Plumbing systems calculation including the water supply and drainage fixture unit requirements per the UPC |  |  |
| Roof drainage system calculation sized per the requirements of ESM, Chapter 6 §10A in Section D2040 |  |  |
| Natural gas system calculation including flow rates and pipe sizing per the requirements of UPC, UMC, ASME 31.8 and NFPA 54 |  |  |
| Steam/condensate system calculation including flow rates and pipe sizing |  |  |
| Plumbing equipment schedule including all major equipment and fixtures |  |  |
| **Piping Drawings** |  |  |
| Plumbing symbols and legend (see app. E1 to E3 of the LANL Drafting Manual) |  |  |
| Plumbing floor plans |  |  |
| Plumbing isometric diagrams including riser diagrams for the potable water system, sanitary waste/vent system, roof drainage, and make-up water system. Major equipment, fixtures, and piping included on the riser diagrams |  |  |
| Enlarged plans required to show the systems in certain areas, e.g. equipment rooms (if needed) |  |  |
| Plumbing details include major equipment requirements and specialties, e.g. backflow preventer |  |  |
| Process Piping Plans including all major equipment, pipe runs and pipe sizes |  |  |
| P&IDs |  |  |
| **Piping Specifications** |  |  |
| **Mechanical Record Documents** |  |  |
| Dimensional record drawings |  |  |
| Equipment details |  |  |
| Equipment requirements drawing (vendor) |  |  |
| Process flow diagrams |  |  |
| General and miscellaneous drawings |  |  |
| Piping & Instrumentation Diagrams (P&ID) |  |  |
| Piping details |  |  |
| Piping flexibility |  |  |
|  |  |  |
| **Electrical** |  |  |
| **Electrical Calculations** |  |  |
| Electrical load analysis |  |  |
| Voltage drop calculation |  |  |
| Short circuit fault analysis |  |  |
| Arc-flash analysis |  |  |
| Breaker coordination study |  |  |
| Interior lighting calculation |  |  |
| Exterior lighting calculation to include building area and access, parking lots, and roadways. |  |  |
| Paging system calculation |  |  |
| **Electrical Drawings** |  |  |
| Site plan includes power and telephone service connection points and routing to project |  |  |
| One-line diagram portrays service and distribution system arrangement |  |  |
| Power plans include electrical rooms and major electrical equipment locations |  |  |
| Enlarged electrical room plans show electrical service and distribution equipment and NEC required working spaces |  |  |
| Lighting plans include luminaire locations, type designators, and control device locations |  |  |
| Luminaire schedule |  |  |
| Telcom plans to include telecom room locations and cable tray routing |  |  |
| Paging system plans |  |  |
| Site plan developed to include site lighting |  |  |
| One-line diagram developed to show all component sizes and calculated fault currents |  |  |
| Power plans developed to show receptacles, mechanical equipment, building equipment, user equipment, and complete branch circuiting |  |  |
| Paging system riser diagram include paging controllers, amplifiers, speakers, and interconnections |  |  |
| Fire alarm system plans show locations of FACP, pull stations, and horn/strobe units |  |  |
| Fire alarm riser diagram includes all components and an input/output matrix |  |  |
| Lightning protection system plans include locations of air terminals, main conductors, down conductors, ground ring, test wells, and surge protective devices (cannot delegate to construction Subcontractor) |  |  |
| Grounding diagram include main grounding electrode, main electrode ground bar, supplemental ground bars, and bonding locations for piping and structural steel |  |  |
| Telecom system riser diagram includes system from service to station outlets |  |  |
| Motor control diagram created for each specific motor control configuration |  |  |
| Security system riser diagram |  |  |
| Panel schedules created for each panel not detailed on the one-line. Include load descriptions and values. |  |  |
| Nameplate schedules include equipment ID tags, category I nameplates, and arc-flash warning labels |  |  |
| **Electrical Specifications** |  |  |
| **Electrical Investigation Worksheets** |  |  |
| **Electrical Record Documents** |  |  |
| Area classification drawings |  |  |
| Cable schedule |  |  |
| Cathodic protection drawings |  |  |
| Communication drawings |  |  |
| Conduit schedule |  |  |
| Coordination study drawings |  |  |
| Demolition and removal drawings |  |  |
| Electrical equipment sizing drawings |  |  |
| Grounding drawings |  |  |
| Heat trace drawings |  |  |
| Interconnection/wiring diagrams |  |  |
| Lighting drawings |  |  |
| Emergency light location drawings |  |  |
| Overhead pole line drawings |  |  |
| Panel schedules |  |  |
| Raceway layout drawings |  |  |
| Riser diagrams |  |  |
| Schematic diagrams |  |  |
| Single line diagrams (support when required to comply with lockout and tag out requirements for worker safety)  |  |  |
| Other single line diagrams |  |  |
| Three line meter and relay diagrams |  |  |
| Underground utility duct banks/manholes |  |  |
|  |  |  |
| **Instrumentation and Controls** |  |  |
| **I&C Calculations** |  |  |
| Device sizing calculation |  |  |
|  Calculation for all engineered instrumentation devices |  |  |
| **I&C Drawings** |  |  |
| Network drawing |  |  |
|  Block diagrams |  |  |
| Sequence of operations |  |  |
| BAS I/O list |  |  |
| Instrument list |  |  |
| Control schematics (as required)  |  |  |
| Major control panels shown on mechanical and electrical drawings |  |  |
| Control power feeds shown on electrical floor plans and panel schedules |  |  |
| **I&C Specifications** |  |  |
| **I&C Record Documents** |  |  |
| Software QA documentation |  |  |
| Instrumentation set point calculations |  |  |
| Control panel layout |  |  |
| Control room layout |  |  |
| General and miscellaneous |  |  |
| Input/output summary |  |  |
| Instrument diagrams |  |  |
| Instrument data sheets with calibration ranges or tolerances |  |  |
| Instrument index |  |  |
| Instrument installation detail |  |  |
| Instrument location drawing |  |  |
| Instrument rack drawing |  |  |
| Level setting diagram |  |  |
| Logic diagram |  |  |
| Loop diagram |  |  |
| Setpoint index |  |  |
| System block diagram |  |  |
| System process graphics layout |  |  |
|  |  |  |
| **Sustainable Design** |  |  |
| LEED registration copy of application or USGBC webpage printout showing registered (when LEED is mandated) |  |  |
| LEED certification proposed credits worksheet (when LEED is mandated) |  |  |
| Energy calculation showing 30% better than ASHRAE 90.1-2004 (ESM Ch 14) |  |  |
| Energy Efficiency and Sustainability Report (ESM Ch 14) |  |  |
|  |  |  |
| **Commissioning** |  |  |
| Commissioning plan |  |  |
| Commissioning specifications |  |  |
| Commissioning schedule |  |  |
| Commissioning procedure |  |  |
| Commissioning test deficiency reports |  |  |
|  |  |  |
| **IBC Program** |  |  |
| Preliminary Project Determination Form (and HazMat Det Form as needed) |  |  |
| Design Professional in Responsible Charge designation |  |  |
| Statement of Special Inspections (SSI) when required by ESM Chapter 16 IBC Program |  |  |
| Test and Inspection Plan (TIP) when required by ESM Chapter 16 IBC Program |  |  |
| Occupancy Permit and Final Inspection checklist |  |  |
| Inspection documentation (includes materials, welding, structural supports, bolt installation) |  |  |
|  |  |  |
| **Pressure Safety** |  |  |
| Designer/installation qualifications |  |  |
| Design documentation |  |  |
| Calculations |  |  |
| Pressure test plans/criteria |  |  |
| Inspection and examination documentation |  |  |
| Approved pressure safety package for certification |  |  |
|  |  |  |
| **R&D/Programmatic** |  |  |
| Anchorage designs equipment when required by ESM Chapter 5 Section I App A |  |  |
| Services hookup design |  |  |
|  |  |  |
| **Demolition** |  |  |
| **Demolition Drawings**Demolition drawings, if applicable, shall be prepared using digital photographs of existing facility structures, systems & components as base drawings to the maximum extent practicable. Items to be removed or demolished to be indicated by annotation or editing of photographs |  |  |
| Fully annotated drawings with details for demolition and/or temporary support of critical SSCs |  |  |
| **Demolition Calculations** |  |  |
| Complete structural calculations for any temporary shoring or structures required |  |  |
| **Demolition Specifications** |  |  |
| **Demolition Record Documents** |  |  |
| Post demolition drawings showing SSCs removed, final system/equipment disposition |  |  |
| Demolition plan of existing features within the project area and affected surrounding areas |  |  |
| Submit Impediments To Vehicular Traffic and/or Requirements for Moving Heavy Equipment and Oversized Loads Forms as applicable |  |  |

Approvals

Design Authority Representative \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Project Engineering Function \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Design Agency \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_