APPENDIX 9D

SPU Electrical Design Checklist

1. INTRODUCTION

This appendix presents a SPU checklist and a typical sequence for electrical design.

2. ELECTRICAL DESIGN CHECKLIST

Preliminary Design Phase

	Design Activity	✓
1.0 Power Supply and Distribution		
1.1	Identify electric utility, usually Seattle City Light (SCL), and obtain contact name, address, and telephone number. For facilities outside the SCL service area contact Puget Sound Energy (PSE). Make initial contact to establish general service requirements, service voltage, and basis for cost of service. Determine scope of work required to provide service to the site.	☐
1.2	Establish the need for stand-by power source.	☐
1.3	For existing facilities where capacity is a concern, arrange for service or feeder data monitoring to determine existing loading.	☐
2.0 Electrical Code Review		
2.1	Identify the authority having jurisdiction (AHJ) for electrical and fire alarm systems.	☐
2.2	Identify any local codes such as noise, light pollution, and energy codes.	☐
2.3	Conduct initial survey of existing system to determine condition, code compliance, capacity, short circuit capacity. Determine scope of potential upgrades.	☐
2.4	Determine if additional ventilation or related changes are needed to meet NFPA 820 requirements in wastewater and combined sewer vaults and pump stations.	☐
2.5	Coordinate with project manager regarding stamping and signing electrical drawings. Ensure engineer in responsible charge is on project team.	☐
3.0 Power and Lighting Concepts		
3.1	Review SPU design standards, standard specifications, and standard details.	☐
3.2	Identify any electrical sustainable development goals for the project.	☐
4.0 Special System Concepts		
4.1	Determine if fire alarm, security, telephone and data, CCTV, or lightning protection systems are required.	☐
5.0 Preliminary Engineering Deliverables		
5.1	Document overall electrical concepts.	☐
5.2	Check project electrical scope, effort, and schedule. Qualify scope as required, and coordinate with project manager.	☐
5.3	Identify design tools to be used on the project.	☐

	In addition to above, provide the following to the QC reviewer: Project specific design checklists modified to indicate items not applicable to the project and any additional project requirements.	☐

30% Design Phase

	Design Activity	✓
1.0 Power Supply and Distribution		
1.1	Coordinate with Electric Utility to determine number of electrical feeds to be provided to the facility, location of power feeds, voltage, billing details (peak usage rates), requirements for reduced voltage starters, metering location and requirements, etc. per DSG Chapter 9, and any document requirements.	☐
1.2	Establish preferred voltages for power distribution and utilization equipment.	☐
1.3	Prepare preliminary electrical system load calculations for sizing service.	☐
1.4	Determine redundancy requirements for power supplies and power distribution.	☐
1.5	Verify the need for onsite standby and/or emergency power; generators and/or UPS; if entire facility isn't supplied, identify the critical loads; determine preliminary size.	☐
1.6	Coordinate with the utility and project I&C engineer to determine modes of generator operation. Verify utility interconnection requirements and any possible need for load shedding.	☐
1.7	Check state air pollutant emission standards to determine if emission study is required for generator (usually depends on size, type, and hours of operation). A study will not be required for most SPU projects since the preferred generator manufacturers design to meet emission standards; verify with manufacturers.	☐
1.8	Check EPA Spill Prevention, Control, and Countermeasure (SPCC) regulations to determine if containment and spill prevention is required for fuel tanks or transformers. Double wall containment is an SPU standard for diesel fuel tanks.	☐
2.0 Electrical Code Review		
2.1	Contact the authority having jurisdiction for electrical and fire alarm systems to confirm applicable codes, standards, and local requirements; requirements for plan review; their preferred level of involvement.	☐
2.2	Perform an electrical code review of existing facilities to identify facilities that do not meet current codes, do not have capacity for new loads, have inadequate short circuit rating, or are in poor condition. Develop a plan to upgrade existing facilities when necessary. Coordinate with other disciplines (e.g., architectural, mechanical) to resolve code compliance issues specific to those disciplines.	☐
2.3	Determine how local codes for noise, light pollution, or energy, if any, will be addressed. Determine how LEED certification, if required, will be addressed.	☐
2.4	Develop a preliminary schedule of hazardous and corrosive locations.	☐
3.0 Power and Lighting Concepts		
3.1	Coordinate with the lead process, mechanical, and HVAC engineers to provide electrical information (hp/load, voltage, phase, constant or adjustable speed, non-critical or critical, regular duty or standby unit) to the Equipment List.	☐
3.2	Determine provisions to be made for future loads, if any.	☐

3.3	Develop the concept for the location of electrical equipment (i.e., indoors versus outdoors, close to major loads, location of service disconnect and utility metering, location of pad-mounted equipment, etc).	☐
3.4	Determine the number of motor control centers (MCCs) to be provided, location of MCCs, and equipment to be powered out of each MCC.	☐
	30% Design Phase	☐
3.5	Prepare reasonable, but conservative, preliminary electrical equipment room/space layouts. Determine the space required for electrical equipment, I&C equipment, security/access control panels, fire alarm panels, and HVAC panels in the electrical room; egress; and whether electrical rooms should be air conditioned.	☐
3.6	Coordinate with I&C discipline to determine where control system components will be installed and component sizes. Be conservative on space estimates.	☐
3.7	Coordinate the overall control philosophy with I&C including standards for local control switch operation and location.	☐
3.8	Review SPU electrical equipment standards for types and installation requirements.	☐
4.0 Special System Concepts		
4.1	Prepare reasonable, but conservative, preliminary communication room/space layouts. Determine the space required for communication equipment, security system equipment, and UPS.	☐
4.2	Define/document requirements and concepts for special systems.	☐
	4.2.1 – Telephone (e.g., incoming service location, scope of supply).	☐
	4.2.2 – Data highway (e.g., control system).	☐
	4.2.3 – Data highway (e.g., LAN, office automation).	☐
	4.2.4 – Fire alarm system.	☐
	4.2.6 – Security system (coordinate with Vulnerability Assessment).	☐
	4.2.7 – Closed-circuit television (CCTV) system.	☐
5.0 Drawings		
5.1	Prepare a preliminary overall one-line diagram for the facilities.	☐
6.0 Specifications		
6.1	Prepare preliminary specification list.	☐
7.0 30& Design Deliverables		
7.1	Document design approach and criteria in Basis of Electrical Design Memorandum.	☐
7.2	Check project electrical scope and schedule. Coordinate with project manager.	☐
7.3	In addition to the above, provide the following to the QC reviewer:	☐
	Preliminary service load calculation and one-line	☐
	Equipment List	☐
	Preliminary specifications list	☐

60% Design Phase

1.0 Power Supply and Distribution		
1.1	Update electrical system load calculation and perform short circuit calculations for service and main distribution equipment. .	☐
1.2	Submit load calculations and one-line diagrams to electric utility for review. Coordinate all service/metering requirements with electrical utility. Write letter documenting requirements.	☐
1.3	Finalize generator size.	☐
2.0 Electrical Code Review		
2.1	Verify compliance with electrical code requirements.	☐
2.2	For wastewater facilities update area classifications in accordance with NFPA. Coordinate with process/mechanical and HVAC.	☐
3.0 One-Line Diagrams		
3.1	Verify equipment motor sizes and other loads with lead process, mechanical, and HVAC engineers.	☐
3.2	Finalize overall one-line diagram.	☐
3.3	Prepare preliminary one-line diagrams for each facility.	☐
4.0 Site Electrical		
4.1	Locate and identify outdoor electrical equipment, such as transformers, engine generator, and switchgear. Coordinate locations with site/ civil discipline.	☐
4.2	Lay out duct bank system, including major runs, manholes and handholes. Coordinate with site/civil disciplines for site piping and other utilities.	☐
5.0 Preliminary Process Plans		
5.1	Confirm electrical equipment dimensions and layout with vendors, if required.	☐
5.2	Finalize size of electrical rooms and update layout of the major electrical equipment located in each electrical room.	☐
5.3	Locate major input/output (I/O) termination locations, terminal junction boxes (TJBs), and control panels.	☐
5.4	Identify rights-of-way and routing methods for electrical conduit and trays.	☐
5.5	Determine equipment requiring uninterruptible power supplies (UPS) and locations of UPS equipment.	☐
5.6	Verify division of responsibility with HVAC design (starter, disconnect, power and control responsibilities) and I&C design (disconnect, power, and control requirements).	☐
5.7	Check for physical conflicts with structural, mechanical, and other electrical components. Check door opening and clearances.	☐
6.0 Lighting Design		
6.1	Develop detailed lighting concepts; select luminaire types in conjunction with architect.	☐
6.2	Do preliminary lighting layouts and initial lighting calculations.	☐
6.3	Prepare preliminary site lighting layout.	☐

7.0 Specifications		
7.1	Prepare preliminary major electrical equipment specifications that require manufacturer review and input.	☐
7.2	Review other discipline specifications including process equipment, mechanical equipment, and I&C.	☐
8.0 60% Design Deliverables		
8.1	Preliminary Drawings.	☐
8.2	Drawing list.	☐
8.3	Specifications list.	☐
8.4	Check project electrical scope and schedule. Coordinate with project manager.	☐
8.5	In addition to the above, provide the following to the QC reviewer:	☐
	Calculations to date	☐
	Signed 30% Checklist, unsigned 60% Checklist.	☐

90% Design Phase

1.0 Power Supply and Distribution		
1.1	Update electrical system calculations. Perform remaining required calculations such as voltage drop and motor starting voltage dip. Populate and size circuit breaker panels.	☐
1.2	Size feeders, circuits, and raceway per code. Populate conductor and raceway schedule, if used.	☐
1.3	Finalize utility coordination.	☐
2.0 Electrical Code Review		
2.1	Resolve any outstanding issues with the Authority Having Jurisdiction.	☐
2.2	Specify or call out hazardous and corrosive locations on drawings. Review material selection for corrosive locations and consulate with the corrosion engineer and or manufacturers when in doubt.	☐
3.0 Lighting Design		
3.1	Complete lighting calculations	☐
4.0 Drawings		
4. 1	Finalize the following electrical drawings in accordance with DSG Chapter 9 Appendix B:	☐
	Electrical Legend and Abbreviations	☐
	Site Plan(s)	☐
	One-Line Diagram(s)	☐
	Control Diagrams	☐
	Demolition Plans (if required)	☐
	Process Plans	☐
	Facility Plans	☐

	Grounding Plans	☐
	Hazardous Area Definition Plans and Sections (where needed for clarity)	☐
	Cable Block Diagrams (in lieu of Process Plan wiring information, if desired)	☐
	Riser Diagrams (for telephone, data, fire alarms, security, paging)	☐
	Electrical Schedules	☐
	Standard Details.	☐
5.0 Specifications		
5.1	Finalize electrical and special system specifications.	☐
5.2	Review other discipline specifications including process and mechanical equipment and I&C.	☐
6.0 Design Coordination		
6.1	Check that legend includes all symbols and abbreviations used on drawings.	☐
6.2	Check site plans for the following:	☐
	Conformity and consistency with other site plans including equipment/facility location, names, north arrow, scale	☐
	Physical conflicts with other underground systems, roadways, structures	☐
	Major feeder sizes against the one-line diagram	☐
	Duct bank size adequate for proposed and future circuits	☐
	Coordinate all circuits and raceways entering and leaving facilities with the circuit and raceway schedules.	☐
	All field equipment and devices, including heat trace, have power and control wiring	☐
6.3	Check electrical one-line diagrams for the following:	☐
	Motor hp, voltage, phase, name, and number against equipment specifications and P&IDs.	☐
	Bus ampacity and short circuit rating against the electrical system calculations and equipment specifications	☐
	All electrical distribution equipment (including disconnects) shown , sized, and labeled	☐
6.4	Check motor control diagrams for the following:	☐
	All motors have a control diagram, all diagrams are properly labeled	☐
	Motor features against equipment specifications	☐
	Motor control against P&IDs and HVAC specifications	☐
6.5	Check plans (and Cable Block Diagrams when provided) for the following:	☐
control control	Process equipment number, location, disconnect requirements, power, and wiring against P&IDs, specifications, mechanical plans, one-line diagram, and diagrams	☐
	I&C component number, location, power, and control wiring against P&IDs, s specifications, mechanical plans, and control diagrams	☐

	HVAC equipment number, location, disconnect requirements, power, and control wiring against specifications, HVAC plans, one-line diagram, and control diagrams	☐
	Electrical equipment is shown to proper scale and has code required clearance	☐
	Physical conflicts	☐
	Luminaires are accessible for maintenance	☐
	Conduit corridor routing with mechanical and structural designs, especially embedded conduits.	☐
	Coordinate with package system specifications regarding electrical and I&C interfaces.	☐
	Check special system devices are shown appropriately on plans and riser diagrams.	☐
6.6	Check electrical details for the following:	☐
	All details are appropriately referenced on drawings or w/ notes to indicate their use	☐
	All referenced details are included.	☐
6.7	Review all electrical equipment specifications such as motors, motor data sheets, package system electrical and controls, valve and gate actuators, HVAC, I&C, and other equipment with electrical or control requirements by other disciplines.	☐
6.8	Review electrical and special system specifications for completeness and conformance with Owner requirements and preferences	☐
6.9	Check that hazardous and corrosive areas are clearly defined. Verify, where necessary, that equipment is explosion-proof or non-sparking.	☐
6.9	Review and sign-off all electrical calculations.	☐
7.0 Design Fix-Up		
7.1	Adjudicate all QC comments received.	☐
7.2	Respond in writing to all major review comments.	☐
7.3	Incorporate accepted comments and coordinate with other affected leads.	☐
8.0 Project Closeout		
8.1	Purge notebooks of extraneous information and outdated calculations.	☐
8.2	Archive any electronic and hard copy files according to SPU standard practice.	☐
8.3	Provide input to the project post mortem report.	☐

3. TYPICAL ELECTRICAL DESIGN SEQUENCE

(Most items are iterated at least once)

- Start Electrical Design Notebook
- Prepare/Review project definition per Predesign checklist
- Request Loads
- Prepare Basis of Design Memorandum
- Start Equipment List
- Calculate Utility Service Required
- Determine Likely Service Location
- Determine Emergency Power Requirements
- Calculate Genset/Alternate Power Source Size
- Size Electrical Equipment
- Start Panel Schedules
- Determine Environmental Conditions
- Start Environmental Conditions and Materials Application Spreadsheet
- Determine Starting and Control Requirements (adjustable frequency drive [AFD], Softstarter, Devicenet, etc.)
- Select Electrical Equipment
- Start Specifications
- Ascertain Size of Auxiliary Systems Electrical Equipment
- Negotiate Equipment Space and Layout Equipment
- Lay Out Grounding System
- Lay Out Instruments and Control Stations
- Negotiate Possible Conduit Routes
- Start Raceway and Conductor Schedule
- Select and Lay Out Lighting
- Lay Out Receptacles and Switches
- Lay Out Auxiliary System Components (Smoke Detectors, Intrusion Sensors, etc.)
- Add Control Diagrams and Standard Details
- Coordinate Design
- Finalize Specifications