APPENDIX 9E

Basis of Electrical Design Memorandum

1. INTRODUCTION

This appendix describes the basis of electrical design memo. A sample memo template is included.

A basis of electrical design memo must be prepared for each project that has electrical components. It promotes the following:

- Narrative description – by ensuring the designers and contractors to understand the project requirements in the process of identification and evaluation for solutions to design issues. It provides the participants access to the original design intent and assumptions when verifying the acceptance criteria of project performance during construction. Consistency – by providing electrical design engineers with both a form and procedures. The form summarizes actual electrical design criteria. The procedures are those to be followed on a project.
- Continuity – by orienting non-SPU and new facility staff to make more informed decisions in regard to equipment operations, maintenance, and replacement while retaining the original intent of performance criteria. The memo can keep colleagues and project managers informed of design assumptions. It also summarizes and communicates electrical design information necessary for electrical review process.
- Quality Control – by defining and distributing project-specific electrical design criteria and requirements that can be reviewed easily and modified when necessary. The memo helps document and manage changes in scope.
- Completeness/Documentation – by consolidating and summarizing all electrical aspects of the project.

1.1 CONTENT

The basis-of-design is a living document of the primary decision-making process based on the project requirements. This document must be updated to reflect changes throughout the project. Changes must be made in track changes mode, redistributed, and filed with the date of the changes. The memo should be tailored to project needs and contain the following:

- **Title.** Provide project name, description, location, project number, lead designer, revision number, and date printed.
- **Introduction.** Provide sufficient information so that individuals reviewing the report have a general understanding of the project and its electrical components.
- **Project Description.** List facilities, project constraints, type of contract, owner(s), description of drawings for existing structures (source, date), and other existing information (electric utility bills or records, maintenance records, etc). Describe the scope of the project, including negative items (specific conditions) and assumptions that impact scope.
- **Codes, Regulations, Standards, and References.** List applicable codes, regulations, standards, and references used in design. Include code version and date. Identify the

specific edition/year of applicable codes. Identify the AHJ for electrical and fire alarm systems.

- **Design Presentation.** Describe the drawings to be provided. In most cases, a reference to SPU Drawing Content Standards (see **Appendix 9B - Standard Drawings for Electrical Design**) should suffice.
- **Hazardous and Corrosive Area Definition.** Identify and define the extent of the hazardous and corrosive area. Where applicable (such as hazardous areas defined by NFPA 820), include a specific code or standard reference.
- **Design Approach.** Describe the system design approach for the facility electrical distribution system. Where applicable, include a description of the existing distribution system and changes to be made to that system. Describe the system in terms of reliability and redundancy, including alternate power sources and system configuration.
- **Design Criteria.** Document engineering choices and decisions to allow for modifications to the electrical system during the life of the facility, consistent with the original design. Topics in design criteria may include material selection for conduit, recommended cable insulation, wiring methods, and lighting requirements.

Supporting drawings (preliminary one-line diagram and site plan) may be included in the memo or bound separately with other project drawings.

1.2 RECORDS

The basis of electrical design memo must be located and maintained electronically in the project directory, within the electrical discipline folder. Clear definition of revisions must be provided so that team members can be sure they have the latest version.

2. MEMO TEMPLATE EXAMPLE

The following is an example template for a basis of electrical design memo for a typical project to upgrade a wastewater pump station. Other project-specific categories of information may be added to the memo. Some of these include load calculation, distribution system design, etc.

Basis of Electrical Design Memorandum:
Name of Wastewater Pump Station

Prepared for:	File:
Prepared by:	Electrical engineer/SPU:
Project number:	
Date:	

1. INTRODUCTION

The purpose of this Basis of Design Memorandum is to outline the electrical design approach, the acceptance criteria of project requirements to be verified during construction, and design decisions made behind assumptions for Name of Wastewater Pump Station. It will ensure designers and the project participants to understand the process of identification and evaluation for solutions to design issues, equipment operations and selections, maintenance and replacement while retaining the original intent of project requirements. The one-line diagram, control wiring diagram, electrical site plan, and electrical building plan are bound with the project drawings.

2. PROJECT DESCRIPTION

The project was conceived to serve a new light industrial development area with growth expected over the next 20 years. Some existing nearby residential areas would be the main source of wastewater for the first few years. To meet the immediate and expected flows, the lift station was designed for at least two stages of expansion. The first would involve replacing the original pumps with larger pumps and the second stage would involve adding two more pumps, for a total of four.

3. APPLICABLE CODES, STANDARDS, AND REGULATIONS

The design will be based on the most current codes and standards adopted by the Authority Having Jurisdiction (AHJ):

3.1 CODES

- National Electrical Code (NEC)
- Life Safety Code (NFPA-101-HB85)
- International Fire Code (IFC)
- National Electrical Safety Code (ANSI C2-1987)

3.2 STANDARDS

- American National Standards Association (ANSI)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Instrument Society of America (ISA)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Administration (OSHA)
- American Society for Testing Materials (ASTM)
- Underwriters Laboratory (UL)
- Illuminating Engineering Society (IES)
- National Fire Protection Association (NFPA)

3.3 REGULATIONS

- Puget Sound Clean Air Agency
- U.S. Environmental Protection Agency (EPA)

4. HAZARDOUS AND CORROSIVE AREA CLASSIFICATION

The following are Class I, Division 1 hazardous areas in accordance with NFPA 820:

- Inside the wet well and associated areas of ventilation outlets
- Inside conduits containing cables connected to the equipment in the wet well
- Inlet maintenance holes

The following are Class I, Division 2 hazardous areas in accordance with NFPA 820:

- Area 18 inches above and extending 3 feet from the outside ends of the conduits and components connected to the wet well
- Areas within 3 feet of odor control leakage sources, such as fans and dampers, flexible connections, flanges, etc.
- Underground valve vaults for pressure sewer lines
- Underground vault/dry well adjacent to wet well without a continuous ventilation system

The following areas are classified nonhazardous, wet and corrosive:

- None

The following areas are classified nonhazardous and wet:

- Outdoor above grade areas not covered elsewhere

The following areas are classified indoor and dry:

- Electrical Building

5. DESIGN APPROACH

The design approach for the project will be based on the following.

5.1 ELECTRICAL POWER DISTRIBUTION SYSTEM

The local utility will size and provide a 12-kilovolt (kV)/480-volt (V), three-phase, delta/wye padmount transformer. The expected size will be 225 kilovolt-amperes (kVA), which will be large enough to provide for the first upgrade. Only one of two underground service conduits will have conductors. The service equipment, current transformer (CT) enclosure, service rated disconnect, automatic transfer switch (ATS), and motor control center (MCC) will be electrically sized for utility available fault current (AIC) and the ultimate load, but with only those

components necessary for the initial load. Space will be provided for the future load components.

Since the facility is not critical at the initial wastewater flows, a plug for a mobile generator will be adequate. However, the physical layout of the facility will provide for a future on-site diesel engine-generator in an attached room.

All conduits (both power and control) will be sized for the ultimate pump sizes, with spare conduits provided for the pumps to be added.

5.1.1 Distribution Voltage

- 480Y/277V, 3-phase, 4-wire
- 480V delta, 3-phase, 3-wire
- 208Y/120V solidly grounded, 3-phase, 4-wire

5.1.2 Service Voltage

480Y/277V solidly grounded wye, 3-phase, 4-wire.

208Y/120V solidly grounded, 3-phase, 4-wire.

240/120V Hi Leg, open delta, 3-phase, 4-wire

5.1.3 Metering

- Electric utility metering per Seattle City Light (SCL) requirements
- Power monitor in MCC
- Utility available fault current to be provided by SCL

5.1.4 Utilization Voltages

Table 1
Equipment Utilization Voltages

Interior Lighting	120V, 1-phase
Site Lighting	120V (or 208 volts), 1-phase
Convenience Outlets	120V, 1-phase
Motor Control	120V, 1-phase
Motors, less than 1/2 horsepower	115V, 1-phase
Motors, 1/2 horsepower to 1	240V, 1 phase
Motors, 1 horsepower and larger	240V, 208V, or 480V, 3-phase

5.1.5 Motor Control Centers

Power will be distributed from an MCC—even though the largest loads require only circuit breakers—because it allows for easier future upgrades. The MCC will be rated at 480V with a braced three-phase, three-wire main bus and neutral pad and a short circuit current rating (SCCR) of 42,000 amperes (A) symmetrical. The MCC will have motor circuit protector-type motor starters with electronic overloads. The controls will be rated at 120V and each starter will have a control transformer. The MCC will have:

- Tinned copper bus
- NEMA Type 2B with NEMA rated starters
- Thermal-magnetic breakers for mains and feeders, magnetic-only for motor starters
- Electronic overloads, Class 20
- Typical OOA switch with ON, OFF, AUTO contacts and AUTO status contact

5.1.6 Voltage Drop

Maximum motor voltage drop 3 percent for full load current, 10% for starting current

5.1.7 Design Criteria

Criteria are based on SPU facility type standards.

5.1.8 Raceway Systems

Raceway criteria as follows:

- Rigid galvanized steel (RGS) for exposed interior non-corrosive area.
- PVC coated RGS conduits for corrosive environment.
- Polyvinyl chloride (PVC) conduits for direct buried conduits except under traffic roadways and electrical building, where RGS shall be used.
- Minimum size ¾ inch, except 1 inch for buried conduits

5.1.9 AC Induction Motors

- High-efficiency type in accordance with NEMA Standards
- Disconnect switches located in sight from the motors for heating, ventilation, and air conditioning (HVAC) units and motors remote from the buildings

5.1.10 Wire and Cable

- Stranded copper with XHHW-2 insulation for all circuits
- #12 American Wire Gauge (AWG) minimum for power, #14 AWG minimum for control

5.1.11 Enclosures

- NEMA 1A gasketed enclosures will be used for equipment in the electrical building
- NEMA 12 enclosures will be used for electrical equipment in dry industrial locations
- NEMA 4x stainless steel enclosures will be used outdoors in corrosive environment
- NEMA 3R stainless steel or aluminum enclosure will be used outdoors

5.1.12 Grounding

- Copper-clad ground rods ¾ inch in diameter, 10 feet long
- Exothermic weld connections
- Ground ring with rods around electrical building connected to main electrical equipment and as required by NEC

5.1.13 Exterior and Interior Lighting

Exterior lighting under photocell control will be minimal, with manually switched area lighting for outside and wet well night work. Exterior lighting will be LED with fixtures suitable for environmental classification.

Interior lighting will be LED with fixtures suitable for the environment, with high-efficiency. Egress emergency lighting will be provided as needed.

5.1.14 Lightning Protection

No lightning protection system will be provided.

5.1.15 Telephone and Communication

Telephone service will be provided to the facility for communicating with the wastewater supervisory control and data acquisition (SCADA).

5.1.16 Fire Alarm System

No fire alarm system will be provided, but a smoke detector will be installed in the electrical vault and connected to the SCADA for remotely monitoring.

Fire extinguisher will be provided in the electrical room.

5.1.17 Security System

An intrusion switch at each door will be the only form of security provided.