City of Denton
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City of Denton Lake Lewisville Water Treatment Plant Upgrade

Electrical
Design Basis Summary

November 2010

Prepared By:

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1. Introduction

This design basis summary presents design criteria and assumptions for the proposed electrical design approach for the City of Denton Lake Lewisville Water Treatment Plant (LLWTP) Upgrade Project.

1.1. Existing Facilities

The LLWTP is served by dual 13.2 kv primary power lines from Denton Municipal Electric (DME). There are two main substations that serve the plant. Two of these primary lines go through a DME auto-transfer switch (ATS) to a meter and a pad-mounted transformer. Figure 1-1 shows a photograph of this ATS and pad mount transformer.

Figure 1-1: ATS and Pad Mount Transformer

A second feeder from this ATS goes to a second transformer that is installed inside a chain link fence. See Figure 1-2 for a photo of this fenced transformer. Figure 1-3 (Drawing 0E-08) presents the existing plant one-line diagram.

Figure 1-2: Fenced Transformer

There are two 138kv overhead electrical lines that are located at the borders of the plant. In some cases, proposed electrical and process equipment will be located within the easements for the 138kv lines. The project team has submitted an application for permission to install this equipment in the 138kv easements. The application was approved in October 2010.

The raw water pump station pumps are served by two 13.2kv-2.4kv transformers. Three smaller utility transformers serve the 480v and 240/120v requirements of the station. The raw water pumps are 2300v and there are two 700HP pumps, one 800HP pump, and one 600HP pump.

Additional details regarding the existing facilities and discussion regarding drivers for the required improvements are provided in the Lake Lewisville Water Treatment Plant Upgrade Technical Design Memorandum (Malcolm Pirnie, March 2007).

1.2. Proposed Improvements

The project includes proposed electrical improvements related to the following facilities:

- Raw Water Pumping Station and Permanganate System
- Incoming Power Service
- Rapid Mix
- Flocculation
- Sedimentation
- Filters, Air-Scour Blower Building, and Non-chloraminated Backwash Tank Supply Pumps
- Chemical Buildings (including Hypochlorite System), Fluoride / Liquid Ammonium Sulfate (LAS) Facility, and Caustic Mixing and Feed System

- Ozone Facility and Low Lift Pump Station
- Washwater Equalization
- Operations Building

The ozone and blower buildings are significant new loads. New 13.2kv-480v unit substations are proposed for each of these facilities.

The original design scope included upgrading the high service pump station electrical service. While this upgrade has been deferred to facilitate budgetary requirements, the incoming power upgrade has been enhanced to include an additional 13.2-2.4kv transformer and 2.4kv switchgear. This will facilitate the high service pump station upgrade in a future project.

1.3. Applicable Codes and Standards

The design will be based on the following codes and standards:

- National Electric Code
- NFPA 820

Section 2 presents the design criteria details and key assumptions related to the proposed electrical design.

POWER POLE #13190

POLE MOUNTED TRANSFORMERS 3–15KVA 13.2KV,1ø,3W– 120/208V,3ø,4W

DENTON MUNICIPAL ELECTRIC OVERHEAD DISTRIBUTION LINES (13.2KV)

#13194

HSO

#13196

HSO

N.O.

N.C.

S&C PAD MOUNTED ATO #517–6

PRIMARY METERING CABINET METER #084310960

TO DME OPERATION CENTER TRANSFORMER #10778

PRIMARY CONNECTION CABINET

FENCED SUBSTATION

PAD MOUNTED TRANSFORMER #7713 2500KVA, 13200V/7620, 3ø,4W– 2400V,3ø,3W

TRANSFORMER #10350 500KVA, 13200V/7620,3ø,4W– 480/277V,3ø,4W

MAIN 2400V MCC

METER LOCATED NEAR TRANSFORMER #1

PANEL A1

PANEL A2

PANEL PA

TRANSFORMER 75KVA, 480V,3ø,3W– 120/208V,3ø,4W

PANEL PD

TRANSFORMER 75KVA, 480V,1ø,3W– 120/240V,1ø,3W

MOTOR TEST CENTER

PANEL LA

TRANSFORMER 50KVA, 480V,1ø,3W– 120/240V,1ø,3W

PANEL PB

PANEL LB

TRANSFORMER 25KVA, 480V,1ø,3W– 120/240V,1ø,3W

PANEL 'S1'

FLUORIDE PUMP BUILDING PANEL

TRANSFORMER 37.5KVA, 480V,1ø,3W– 120/240V,1ø,3W

PANEL 'G'

TRANSFORMER 30KVA, 2400V,3ø,3W– 120/208,3ø,4W

PANEL B

PANEL PC

PANEL C

PANEL D

PFCC 500 PUMP NO.1

PFCC 250 PUMP NO.2

PFCC 350 PUMP NO.3

PFCC 500 PUMP NO.4

PFCC 125 BACK WASH PUMP

TRANSFORMER 75KVA, 2400V,3ø,3W– 480/277V,3ø,4W

PANEL A

PANEL E

PANEL F

PANEL LC

TRANSFORMER 30KVA, 480V,3ø,3W– 120/208,3ø,4W

TRANSFORMER 15KVA, 480V, 3ø,3W– 240/120V, 1ø,3W

PUMP #5 MCC SECTION

PUMP #6 MCC SECTION

PFCC 500 PUMP NO.5

PFCC 500 PUMP NO.6

EXISTING EQUIPMENT AT THE LEWISVILLE WATER TREATMENT PLANT ONE–LINE DIAGRAM

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CITY OF DENTON, TEXAS

LAKE LEWISVILLE WTP UPGRADE

ELECTRICAL

PLANT EXISTING ONE–LINE DIAGRAM

SCALE: NONE

DATE OCTOBER 2010

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2. Design Criteria

This section presents the preliminary design criteria and key assumptions used to establish the basis of design for the LLWTP electrical requirements.

2.1. Raw Water Pump Station

The raw water pump station pump motor starters are obsolete. All four will be replaced. In addition, all wire for these starters, particularly the 2300v wire, is nearing the end of its useful lifetime. Therefore, the pump motor starters and associated wiring will be replaced. In addition, the QMB MCC has also reached the end of its useful lifetime and will also be replaced. Modifications will be made in the permanganate building to accommodate heat trace and a new metering pump skid for permanganate feed improvements.

2.2. Power System

Improvements are required for the incoming power service at the LLWTP to account for changes in existing loads and new loads for the new facilities. A new outdoor pad-mounted distribution unit (OPDU) will be installed at the incoming service point. The existing ATS will provide service to this (ODPU-A). A primary voltage circuit from each of this ODPU will be installed via underground ductbank to each of the major load centers.

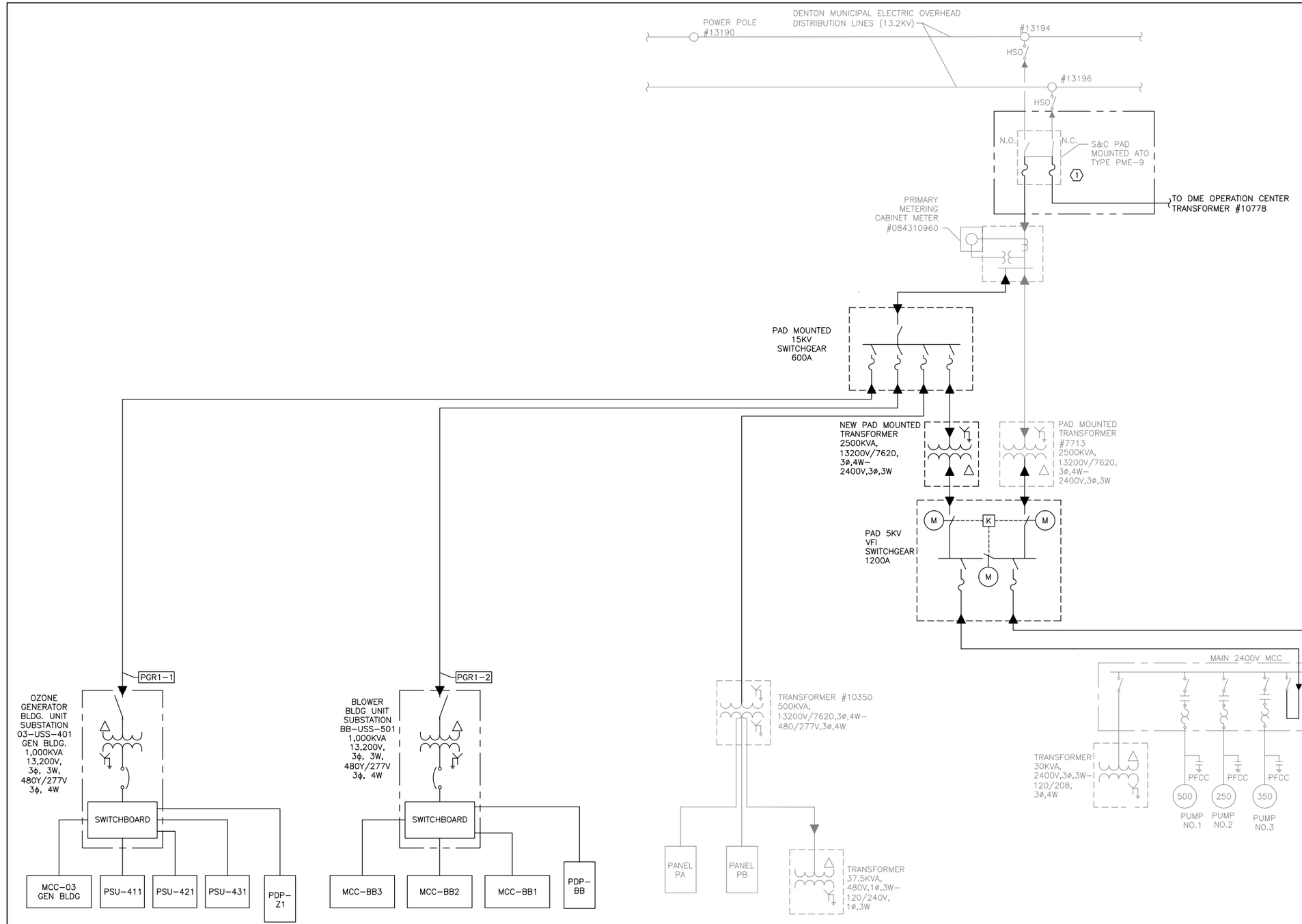
A new 13.2kv-2.4kv transformer and a 2.4kv ODPU will be installed for the high service pumps. The existing pad-mounted transformer and the chain link fenced substation will be removed. See Figure 2-1 (Drawing 0E-10A) for a one-line diagram of the proposed incoming electric service.

2.3. Rapid Mix

All electrical work will be driven by the process modifications being made. Three 3 HP, 480 Volt/3 phase vertical rapid mix units will be installed at the new rapid mix.

2.4. Flocculation

All electrical work will be driven by the process modifications being made. The existing flocculators in each of the eight basins will be replaced with three, 1 HP vertical flocculators driven by variable frequency drives (VFDs). All VFDs will be installed in the new motor control centers in the new Blower Building.



NOTES:

1. PAD MOUNTED ATO AND ALL WORK AHEAD OF PRIMARY METERING BY DME. NOT IN CONTRACT.

PROPOSED
ONE-LINE DIAGRAM

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LAKE LEWISVILLE
WTP UPGRADE

ELECTRICAL

PLANT ONE-LINE DIAGRAM MODIFICATIONS ALTERNATIVE

SCALE: NONE

DATE OCTOBER 2010

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CAD REF. NO. 5673006-0E10A

2.5. Sedimentation

All electrical work will be driven by the process modifications being made. Eight existing ¾ HP scraper motors will be replaced with new motors associated with the new sludge collector equipment. Eight new ¾ HP scraper motors will be installed with the new collectors to be installed in Zone 2 of each basin.

All existing motors and controls will be replaced and all new service will be installed. Power for these will come from circuit breakers in the new Blower Building.

2.6. Filter Gallery

Much of the existing electrical and instrumentation and controls (I&C) facilities will be replaced while certain process modifications are being made. With the replacement of the instrumentation and controls, all new wire and conduit to the new and existing end devices will be required. All new equipment in the gallery will be NEMA 4X or corrosion resistant.

The existing panel boards are badly corroded and will be replaced (see Figure 2-2). To minimize downtime it is not practical to replace these panel boards in exactly the same place. Therefore, new wire and conduit will be required from these panels to the remaining electrical equipment (lights, receptacles, etc.). The upstairs lighting fixtures will be replaced and the downstairs lighting fixtures will remain as the downstairs fixtures are generally in better condition than those upstairs. There is some lighting work required downstairs due to recent piping work that can be handled as a maintenance item.

Figure 2-2: Existing Panel Boards

2.7. Chemical Buildings, Fluoride / LAS Facility, and Caustic Mixing and Feed System

All electrical work will be driven by the process modifications being made. Power for the existing chemical buildings, relocated fluoride facility, LAS system, and caustic mixing system will now come from the Ozone Facility MCC. This work will include:

- New service to the relocated fluoride facility with LAS system.
- New service to two, 5 HP 480 Volt / 3-phase jet mixer pumps at the caustic mixing box.
- New service to power proposed equipment associated with the hypochlorite storage and feed system including HVAC equipment to be installed for temperature control of the storage and feed room in the chemical building.
- Replacement of a caustic tank and re-labeling of the ferric and caustic pumps.
- New eyewash stations will be installed and their flow switches will be connected to the SCADA system.

In initiating detailed design, it was determined with the City that the following work is not required:

- Removal of the existing pad mounted 500 kvA transformer #10350.
- New service to the existing panel PA (Shop Area).
- New service to the existing panel PB (Chemical Building).
- New service to the existing pad mounted 37.5 kvA transformer (Chemical Building).

2.8. High Service Pump Station

The largest existing concentration of load at the LLWTP is the High Service Pump Station (HSPS). Table 2-1 presents the existing pump equipment characteristics.

Table 2-1.
Existing HSPS Pump Characteristics

Description	HP	Voltage
High Service Pump #1	500	2300 Volt / 3 Phase
High Service Pump #2	250	2300 Volt / 3 Phase
High Service Pump #3	350	2300 Volt / 3 Phase
High Service Pump #4	500	2300 Volt / 3 Phase

Description	HP	Voltage
High Service Pump #5	500	2300 Volt / 3 Phase
High Service Pump #6	500	2300 Volt / 3 Phase
Backwash Pump #1	125	2300 Volt / 3 Phase

Two of the pumps (Pump #5 and Pump #6) are outdoors and the other pumps are indoors. All of the motor controllers are inside the HSPS. There is a motor control center (MCC) that includes the motor controllers for HSP #1 - #4, Backwash Pump #1, and two circuit breaker load panels. Figure 2-3 shows this MCC lineup.

Figure 2-3: MCC Lineup

The motor starters for HSP #5 and #6 are also in the same room, but located separate from the other starters. Figure 2-4 shows the motor controllers for Pumps #5 and #6.

Figure 2-4: Motor Controller for Pumps #5 and #6

2.8.1. Existing Reliability and Safety Issues

The existing motor controllers at the HSPS were considered for replacement for the following reasons:

- The motor controllers are in poor condition due to age and corrosion.
- The motor controllers are old and repair parts are becoming more difficult to obtain.
- There is a water line directly above the existing MCC which is in violation of the National Electric Code (NEC). There have been issues with water leaks from this line near the MCC posing a safety and operational risk. This line should be relocated.

Figure 2-5 shows the close proximity of the motor starters to the pumps.

Figure 2-5: Proximity of the Motor Starters to the Pumps

There are a various options that can address the issues associated with the HSPS. These options include a number of similar features such as:

- Replacing the HSPS motor controllers with new switchgear utilizing a Main-Tie-Main configuration. This switchgear would be served by redundant transformers.
- Constructing a new building to house the new HSPS gear.

The need for the building is driven by the requirements and recommendations associated with replacing the motor controllers. The existing equipment could be replaced in the current location, but this is not recommended as a long-term solution. The work associated with a new building is not included in the construction budget and therefore, HSPS electrical improvements will not be made at this time, but rather, deferred for a future project. This will provide the best opportunity for a solid long term installation without serious compromises to the budget. In the future, motor starters should be serviced by a main-tie-main switchgear and installed in an air conditioned building.

2.9. Ozone Facility

All electrical work will be driven by the process improvements being made. A new unit substation will be installed near the ozone generation building. A new motor control center will be installed in the Ozone Generation Building electrical room. The unit substation and MCC will provide power to the items shown in Table 2-2.

Table 2-2.
Ozone Facility Unit Substation and MCC Requirements

Description	Load	Voltage
Ozone Generator #1	110 kW	480 Volt
Ozone Generator #2	110 kW	480 Volt
Ozone Generator #3	110 kW	480 Volt
Closed Loop Cooling Water Pump #1	3 HP	480 Volt
Closed Loop Cooling Water Pump #2	3 HP	480 Volt
Closed Loop Cooling Water Pump #3	3 HP	480 Volt
Ozone Destruct Blower #1	5 HP	480 Volt

Description	Load	Voltage
Ozone Destruct Blower #2	5 HP	480 Volt
Ozone Residual Sample Pump #1	1 HP	480 Volt
Ozone Residual Sample Pump #2	1 HP	480 Volt
Ozone Contactor Tank Drain Pump	5 HP	480 Volt
Low Lift Pump 1	60HP	480 Volt
Low Lift Pump 2	60HP	480 Volt
Low Lift Pump 3	60HP	480 Volt
Low Lift Pump 4	60HP	480 Volt
Miscellaneous Lighting	5 kW	120 Volt

Power will also be required for the building HVAC and miscellaneous items. This switchboard will service the ozone generators, 480v panelboard and MCC. This MCC will also include circuit breakers for other new loads outside the Ozone Facility, such as the new fluoride building. This MCC and its associated PLC will be installed indoors in an air conditioned environment. Figure 2-6 (drawing 0E-11A) at the end of this section presents the one-line diagram of the Ozone Facility unit substation. A separate room is required for the PLC and operator interface controls.

2.10. Backwash Tank Supply Pumps

All electrical work will be driven by the process modifications being made. Two, 50 HP, 480 Volt / 3 phase backwash tank supply pumps will be provided as part of the backwash system. The motor starters for these will be in the new Blower Building MCC.

2.11. Blower Building

All electrical work will be driven by the process improvements being made. Two, 60 HP, 480 Volt / 3 phase positive displacement air blowers will be provided as part of the filter air-scour system. A new unit substation will be installed at the blower building. See Figure 2-6 (drawing 0E-11A) at the end of this section. A new MCC will serve the blower building, flocculation basins, sedimentation basins, filter building, and other

nearby loads. This MCC and its associated PLC will be installed indoors in an air conditioned environment.

The unit substation and MCC will provide power to the items shown in Table 2-3.

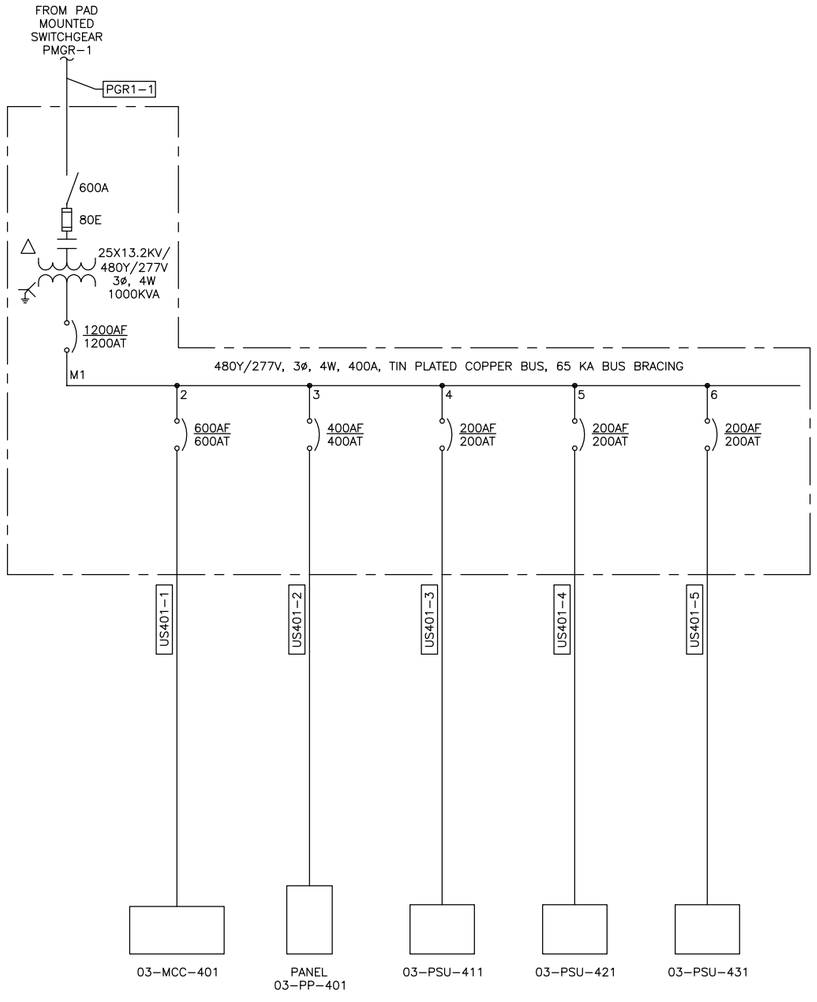
Table 2-3.
Blower Building Unit Substation and MCC Requirements

Description	Load	Voltage
Blower #1	100HP	480 Volt
Blower #2	100HP	480 Volt
Backwash Pump #1	50HP	480 Volt
Backwash Pump #2	50HP	480 Volt
Caustic Jet Mixer Pump #1	10HP	480 Volt
Caustic Jet Mixer Pump #2	10HP	480 Volt
Flocculators	24@1HP each	480 Volt
Sedimentation Basin Sludge Collectors	16@1HP each	480 Volt
Miscellaneous Lighting	5 kW	120 Volt

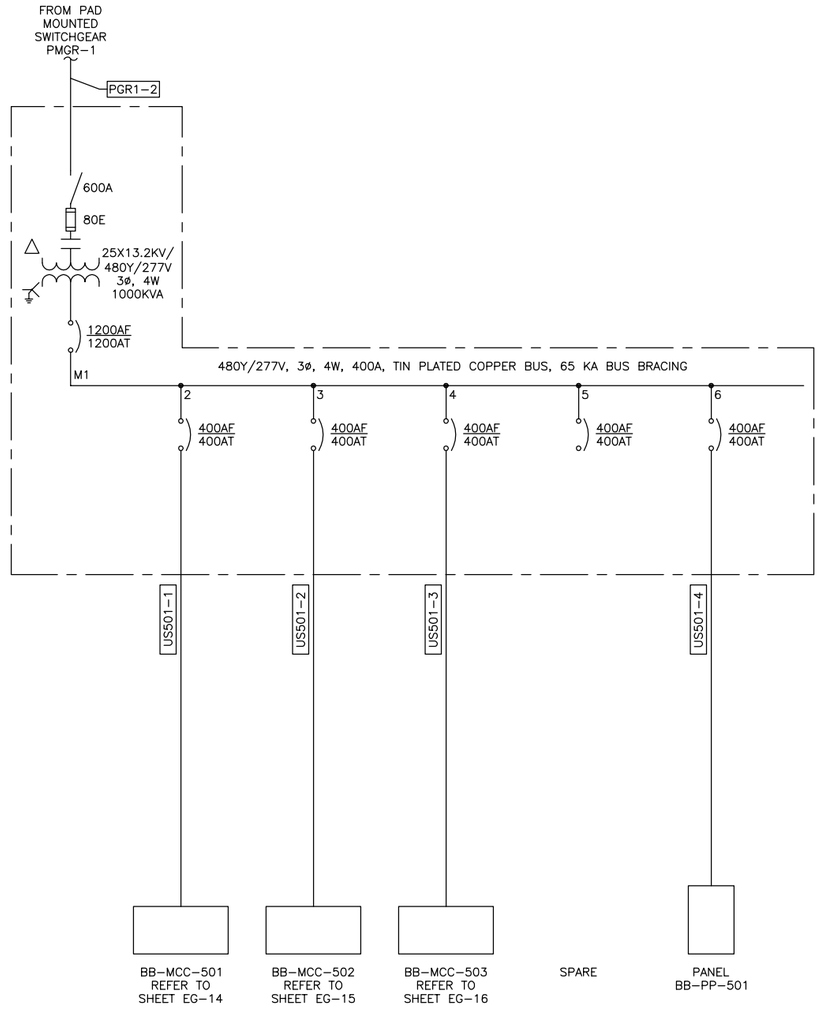
2.12. Operations Building / Miscellaneous

New service or modifications will be provided as necessary at the existing Operations Building to address proposed HVAC system improvements and the addition of a sprinkler system with monitoring and controls.

Various existing vaults and facilities on the plant site will either be demolished or re-powered electrically. Various motor actuated valve operators will require power. Power for these items will come from circuit breakers in the new Ozone Generation Building or Blower Building.



UNIT SUBSTATION 03-USS-401 ONE-LINE DIAGRAM



UNIT SUBSTATION BB-USS-501 ONE-LINE DIAGRAM

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CITY OF DENTON, TEXAS

LAKE LEWISVILLE WTP UPGRADE

ELECTRICAL

UNIT SUBSTATION 03-USS-401 & BB-USS-501 ONE-LINE DIAGRAM

SCALE: NONE

DATE OCTOBER 2010

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CAD REF. NO. 5673006-0E11