Museum Support Center
Suitland, Maryland

MSC: Replace MSC Main Generator

Final Submission
(Issued For Construction)

Design Narrative

May 12, 2022

Smithsonian Institution

SF Project No: 2130103

URS|HCA

Contents

I. Project Overview

The Smithsonian Institution's Museum Support Center (MSC) located at 4210 Silver Hill Rd, Suitland, MD 20746, is a collections storage and conservation facility in Suitland, Maryland that houses Smithsonian (SI) collections which are not on display in the museums. Approximately 40 percent (about 54 million items) of the Smithsonian's collection are housed at MSC in a series of 5 storage facilities called “Pods”. Each Pod is paired with office space and research Labs. The function of the Labs is to provide collections management and research needs of the collections.

There are three (3) utility electrical services, as well as emergency generator systems, for the facility: i) MSC Main, ii) Pod 3, and iii) Pod 5. The MSC Main emergency system is still original to the building, constructed in 1983. The original emergency system includes a 420kW diesel generator, five (5) Automatic Transfer Switches (ATS), and panelboards. The emergency system equipment has reached the end of its typical service life; although the equipment continues to be able to power the building. Failure of the emergency system would affect life safety systems, such as emergency lighting, fire alarm, and fire protection system, as well as generator backup power to mechanical equipment for both the Pods and the Labs.

SI had previously engaged URS Group, Inc. /Hartman-Cox LLP, a Joint Venture Architect/Engineer, to complete a study of the existing MSC electrical system. URS Group, Inc. is now a part of AECOM. It is known that the MSC Main emergency system is undersized to handle the today’s electrical requirements. That study included performing load calculations to verify the minimum required size of the MSC Main generator to power all equipment that SI needs backed by generator. SI has now directed URS Group to proceed with the preparation of Construction Documents (CD) for the MSC Main generator replacement, as per the recommendations stated in the report.

The CD scope of work (SOW) requires that the architect/engineer of produce Construction Documents for the replacement of the MSC Main generator and associated ATSs. Specific mechanical equipment will be re-fed from the modernized emergency distribution system in order to provide partial heating and cooling throughout the facility when running on generator power. Additional scope includes adding a UPS system in MCI Room D1015 to the emergency system. Since the new generator was calculated to be 1500kW to handle all the SI-requested equipment, the generator will be relocated outdoors, since the existing generator room (M04) is too small to house a 1500kW generator. The former generator room will turn into an emergency distribution room and house most of the ATSs.

Since this project will be replacing the MSC Main generator, a temporary roll-up generator will be provided at the site during construction to maintain emergency generator power to the respective equipment and avoid power outages in the Pods and Labs at the time of construction.

II. Civil

A. Civil Existing Conditions

Per the site visit by AECOM team (dated 09/23/2021) and the GIS records, the selected site is north of the LAB 4. There are multiple asphalt and concrete pads for trailers being used for storage purposes. There is an existing access road north which loops around the LAB 4 facility, there is an existing 10-foot-wide concrete path from the access road north of the LAB 4 to provide access to the existing trailers. The site surface runoff drains east and west toward the north access road, the surface runoff is being captured through existing inlets and conveyed safely through the existing storm drain system. AECOM design team did not notice any erosion or surface ponding during the site visit.

There are following existing utilities north of the LAB 4 which services the facility such as.

- Existing Gas line with meters at the north-west corner of the (LAB 4) building
- Existing Communication manhole at the north-west corner of the (LAB 4) building
- Existing electrical manhole (vault) at the north-west corner of the (LAB 4) building
- Existing 10-inch water line north loops around the (LAB 4) building
- Existing two (2) underground fuel tanks approximately 20 feet west of the (LAB 4) building.
- Existing 18-inch storm pipe

For existing conditions, see plan sheet C-101.

B. Civil New Work

For the new work a section of the existing asphalt pavement north-west of LAB 4 will be removed and existing trailer shall be relocated with a new concrete pad, see existing and demolition plan sheet C-101. List of new work line items to be constructed (installed):

1. Construct a new concrete Generator Pad (38’-6” x 11’-4”) with five (5) prefabricated stairs to access the generator equipment.
2. Construct a new concrete pad for Electrical Manual Transfer switch for temporary generator connection, along with two (2) bollards to protect it.
3. Install approximately 50 linear feet of underground concrete duct bank (30”x30”) minimum 30” below grade, see electrical plans.
4. Install a new fuel pump with fuel oil service line, for sizing see mechanical plans.
5. Construct a new concrete pad (19’-10” x 16’-0”) for the relocation of the existing shed.

Per Maryland Stormwater Management and Erosion & Sediment Control Guidelines for State and Federal Projects, the new work falls under 3.2 Exemption for stormwater management criteria as the total land disturbance for the new work is less than 5,000 square feet, but is required to follow Maryland Erosion and Sediment Control criteria for the site as the total earth work is more than 100 cubic yards. See plan sheet C-102 and C-103.

III. Structural

A. Structural Existing Conditions

The existing generator is mounted to the existing ground floor slab inside the Generator Room M04. Existing intake and exhaust louvers are located in the north and east walls, and the exhaust stack is supported by the existing roof structure and penetrates the roof slab above. Based on the existing drawings, the existing floor slab consists of a 6 inch thick cast-in place concrete slab-on-grade reinforced with #3 bars spaced at 18 inches on center. The exterior walls consist of precast concrete wall panels and the building roof is a cast-in-placed reinforced concrete waffle slab supported by reinforced concrete columns.

B. Structural New Work

The existing generator will be removed and the concrete floor slab will be patched as required with a slab-on-grade matching the existing slab thickness. The new generator will be located outside of the existing building and will be supported by a reinforced concrete foundation bearing directly on the existing soil. The existing louvers will be removed and the openings will be infilled with 8 inch thick reinforced CMU.

IV. Architectural

A. Architectural Existing Conditions

Room M04 is currently being used to house the emergency generator and associated equipment. The existing enclosure walls consist of 2 hour rated concrete masonry units. The existing hollow metal door and frame are rated 90 minutes and a door closer is provided. There are mechanical louvers located in the exterior wall openings and mechanical ductwork travels from the generator to a flue in the roof. On the roof there is an existing flue assembly that serves the generator below.

B. Architectural New Work

The louvers in the exterior wall openings will be removed and the openings will be infilled with a composite wall assembly consisting of 8” colored smooth faced CMU, R13 rigid insulation and 8”

standard CMU. The walls, interior door and floor will be painted. At the roof, the existing flue will be removed leaving the roof penetration sleeve and roofing intact. The roof penetration sleeve will be capped to prevent water from entering the building. Galvanized metal stairs and railings will be provided at the new generator enclosure which is located outside of the building.

V. Mechanical

The detailed mechanical scope of work and design parameters is specified in this section of the design report.

A. Applicable Codes, Standards and Guidelines

- 2018 International Building Code (IBC)
- 2018 International Mechanical Code (IMC)
- 2018 International Plumbing Code (IPC)
- National Fire Protection Association (NFPA) Standards
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standards
- Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- Smithsonian Institution Facilities Design Standards, January 2012

B. Mechanical Existing Systems

There are two existing fuel oil storage underground tanks located outdoor at 15,000 gallons capacity each tank.

An existing packaged fuel transfer pump to remain in place in the existing generator room draws fuel oil from the existing storage tanks serving the three existing steam boilers for the heating system. The existing boiler returns the unused fuel through a fuel oil return pipe back to the underground fuel oil storage tank.

There is an existing day tank with built in transfer pumps (that will be demolished) serving the existing emergency generator. The transfer pump draws fuel oil from the existing underground fuel tank to fill the day tank. The existing emergency generator draws fuel oil from the day tank and the generator returns the unused fuel back to the day tank.

There is an existing steam unit heater in the existing generator room that will be demolished (including its existing steam and condensate piping back to main line) and permanently capped.

C. New Mechanical Equipment

Provide a new fuel oil outdoor packaged duplex transfer pump, one pump on duty and one pump on standby, that will draw fuel oil from the existing underground fuel tanks through existing underground fuel oil supply pipes, then transfer the fuel oil through new underground double wall supply oil pipe to the remotely positioned generator belly tank under the new emergency generator. The packaged transfer pump will be located outdoors with equipment support 24" above ground mounted on a 6" high concrete pad. Provide an automatic fill port to be used by a fuel delivery truck to fill the belly tank in case the packaged fuel transfer pump does not work.

The transfer packaged fuel oil pump will have the following parameters:

- Packaged pre-engineered fuel supply system.
- Suitable for outdoor installation consist of a powder-coated carbon steel weather-proof enclosure complete with hinged, lockable doors with a Type 3R control enclosure.
- The enclosure shall include a disconnect switch, that shall de-energize the system upon the opening the door. The panel shall include integrally mounted duplex pump controller, Hand-Off-Auto (HOA) switches for each pump, power available indicator, pump failure alarm and alarm indicators.
- The packaged transfer pump shall be interfaced and be able to communicate with existing Siemens BAS.

Provide new 4 pipe fan coil unit (FCU) to maintain the electrical distribution room (formerly generator room) at room temperature of 78 deg F 50%RH, 24/7. The chilled water and hot water pipes will be connected to existing pipes in the boiler room.

Provide new inline type exhaust fan to keep the electrical distribution room at negative pressure.

Provide new DDC control to interface with existing Siemens BAS.

VI. Fire Protection

A. Applicable Codes, Standards and Guidelines

- Smithsonian Institution Codes, Standards, and Guidelines, revised February 2012
- Smithsonian Institution Facilities Design Standards, January 2012
- International Building Code (IBC), 2018
- NFPA 13, Installation of Sprinkler Systems, 2019

- NFPA 70, National Electrical Code (NEC), 2020
- NFPA 72, National Fire Alarm and Signaling Code, 2019

B. Existing Conditions

A site survey was performed for the generator room that is being converted into an electrical equipment room. The space is protected by a wet pipe sprinkler system, and appears to be ordinary hazard sprinkler classification, based on existing sprinkler layout and room use. The space is fed by two 1¼" branch-lines. Each branch-line feeds two upright sprinklers in this room. All fire sprinkler components in this room will be demolished to allow space for equipment to be moved in and out of this room.

C. New Work

New branch-lines and sprinklers shall be installed in this room once electrical equipment has been moved into this space. The system shall be installed in accordance with NFPA 13 requirements for an ordinary hazard space. Sprinklers shall have a maximum area of coverage of 130 sqft.

VII. Fire Alarm

A. Applicable Codes, Standards and Guidelines

- Smithsonian Institution Codes, Standards, and Guidelines, revised February 2012
- Smithsonian Institution Facilities Design Standards, January 2012
- International Building Code (IBC), 2018
- NFPA 13, Installation of Sprinkler Systems, 2019
- NFPA 70, National Electrical Code (NEC), 2020
- NFPA 72, National Fire Alarm and Signaling Code, 2019

B. Existing Conditions

The generator room is currently outfitted with one wall mounted combination speaker/strobe (110 candela) near the door and two ceiling mounted smoke detectors. The main fire alarm control panel (Siemens FireFinder XLSV) is located in room G1101. The smoke detectors and wall mounted speaker/strobe shall be demolished.

C. New Work

The room shall be provided with a new smoke detector (only one is necessary to provide coverage for the entire space). A new wall mounted speaker/strobe (30 candela) shall be provided near the doorway. The FACP shall be reprogrammed to remove demolished devices and incorporate new fire alarm devices.

VIII. Electrical

The electrical design for this project uses the following list of Codes, Standards, and Guidelines.

A. Applicable Codes, Standards and Guidelines

- NFPA 70, National Electrical Code (NEC), 2020
- NFPA 70E, Standard for Electrical Safety in the Workplace, 2021
- NFPA 110, Standard for emergency and Standby Power
- Smithsonian Institution Facilities Design Standards, January 2012
- Smithsonian Institution Codes, Standards, and Guidelines, revised February 2012
- EPA Clean Air Act and National Ambient Air Quality Standards (NAAQS)
- Applicable Local and State Codes, Standards and Guidelines

B. Existing MSC Main Emergency System

A site survey was performed to verify the existing MSC Main emergency system. Note that there are three (3) total electrical systems for the MSC facility: i) MSC Main, ii) Pod 3, and iii) Pod 5. Hereinafter, any reference to a generator, automatic transfer switches, distribution panels, and branch panelboards is solely related to the MSC Main electrical system, unless specifically indicated the equipment belongs to either the Pod 3 or Pod 5 electrical system.

The survey included the existing 420kW generator, five (5) Automatic Transfer Switches (ATS), and four (4) emergency power distribution panels. The generator and associated day tank are located at the north side of the facility in the main Mechanical, Electrical, and Plumbing (MEP) room near the loading dock, in Generator Room M04. Three of the five ATSs are located in the main electrical Switchgear Room M02. The fourth ATS is located just outside of the main electrical room in the Boiler Room M05, behind the emergency MCC "EMCC". The fifth ATS is located in the Refrigeration Room M06 near the Fire Pump Controller; this fifth ATS serves the Fire Pump Controller and will not be replaced/relocated as part of this project. The distribution panels – EH1, EH2, and EH3 – are located in Switchgear Room M02. There is one set of branch panelboards, including a (small) step down transformer, also located in Switchgear Room M02. None of the other downstream emergency panelboards and transformers were surveyed as they will not be modified as part of this project.

Generator Room M04 also houses the packaged fuel oil pumping station for the boiler system. Due to incoming pipe connections, the boiler fuel pumping station is existing to remain at its current location. The new electrical equipment will be designed to coordinate with this equipment. While it is not ideal to have the diesel fuel pumping station inside the emergency equipment distribution room, relocating the fuel pumping station was not part of the scope of this project.

The exterior of the building, just outside of Generator Room M04, was also surveyed as that is the planned location for the replacement generator. The survey included looking at the underground diesel fuel storage tank locations, the exterior vehicle charging station, and the hazardous material storage containers at the north side of the building.

C. New Work MSC Main Emergency System

The scope of this project is to replace the generator, associated accessories, and ATSs. Since the replacement generator is significantly larger than the existing generator (3 times the capacity), the replacement generator will not fit inside the existing Generator Room M04; the replacement generator has to go outside. During the previous Electrical Study, performed in 2020, URS proposed one outdoor location for the replacement generator. This location is where the current "temporary" trailer is located. During the September 2021 site survey, SI expressed concern about placing the generator where the "temp" trailer is currently located. Therefore, URS investigated several options for where the generator can be located. The first proposed location was at the electrical vehicle charging station, adjacent to the temporary trailer. This location contains 2 parking spots and would be a good fit for the generator. The second proposed location was at the north side of the building where the existing hazmat storage containers are located. A third location was investigated to the east of the MEP room. These three options were presented to SI on October 27, 2021 to discuss the potential solutions. SI direction was to design the generator to be located at the north side of the building, at the existing hazmat storage containers. SI indicated that the hazmat storage containers would be moved prior to construction of this generator replacement project beginning.

The replacement generator will be located outdoors at the north side of the building. A new concrete equipment pad will be poured to set the generator on. A belly tank, sitting on top of the concrete pad and underneath the generator, will be provided for the generator. The belly tank will hold a small quantity of fuel to get the generator going, but the main fuel source will be coming from the existing underground diesel fuel storage tanks. The generator will have an outdoor, weatherproof, sound-attenuated enclosure to protect it from the elements as well as mitigate sound pollution to the neighboring areas.

The generator system will also have a load bank for generator testing. The load bank was initially sized at 50% of the generator rating, which is a typical industry design convention. As part of the 50% submission review, SI requested for a 100% rated load bank to match what was recently installed at the nearby Cultural Resources Center. URS agreed to provide a 100% rated load bank during the comment review meeting. However, during further design progressions, there was a need to increase the generator size to 2MW to handle all of the additional building load and have future spare capacity. As a result, the load bank would have to be rated at 2MW as well to be 100% rated. URS contacted several generator manufacturers to determine the feasibility of providing a 100% rated, 2MW radiator-mounted load bank. Most generator manufacturers indicated that radiator-mounted load banks of that size is

uncommon and that a 50% rated load bank is more conventional for larger generators. Due to physical size of the load bank, available space on the site, and increasing material costs, URS decided to decrease the load bank back to 50% of the generator rating, which is still 1MW and sizable for generator testing.

An underground, concrete-encased ductbank will be installed and route from the generator to a Manual Transfer Switch (MTS) located just south of the generator. The MTS is an NEC 700.3(F) requirement to that requires a means of being able to provide emergency power to the facility in the event the main emergency source fails or needs to be maintained. In the event that this new generator fails or requires maintenance, this MTS will allow a temporary roll-up generator to be brought on site and be connected to the building's emergency distribution system and provide generator back-up power when the permanent generator is out of service.

From this MTS, another underground, concrete-encased ductbank will be installed and route to the building to bring the conductors into the Emergency Distribution Room M04. For ease of installation and minimizing impact to the existing building structure/foundation wall, the underground conduits will turn up just outside of the facility and run surface mounted to the exterior façade of the building before turning in to Emergency Distribution Room M04. A pullbox will be required on the exterior of the building to facilitate cable pulling and meet NEC requirements.

Once inside Emergency Distribution Room M04, the conductors will terminate on an emergency switchboard "EHM". This "EHM" replaces the existing EHM currently located in Switchgear Room M02. From "EHM", conductors in conduit will route to the various ATSs, now located within this same room. There will be a total of 6 ATSs in the Emergency Distribution Room M04. Three of the ATS – ATS1, ATS2, and ATS3 – are relocated from Switchgear Room M02. One ATS – labeled T5.5 on the equipment or ATS4 on the single line diagram – is relocated from Boiler Room M05. The fifth ATS – ATS5 – is located near the Fire Pump Controller and will remain at the same location. The emergency side feeder will just be spliced/extended to the new "EHM" location. Two additional ATSs – ATS6 and ATS7 – will be added within Emergency Distribution Room M04 to feed a mechanical equipment distribution panel and Chiller 4 (CH4), respectively. Chiller 4, its associated Condenser Water Pump (CWP-4) and Chilled Water Pump (CHWP-4), and one cooling tower (CT-1) will be added to the emergency power system so that the Pods and Labs will have partial cooling during a utility power outage. Portions of the existing heating/boiler system is already on generator power.

The existing ATS normal feeders will be intercepted at their current location in Switchgear Room M02, spliced, and extended to the new ATS locations in Emergency Distribution Room M04. The load side of each ATS will be connected to the existing load side feeders, mainly located in Switchgear Room M02. ATS5 serving a Fire Pump controller will remain as is and re-fed on its emergency side.

An additional part of this project is to connect the UPS system located in MCI Room D1015 to the generator system. The UPS system is currently fed from panel "1L3" located in Elec. Clo. E12. The UPS

system will be disconnected from “1L3” and re-fed from a new generator-backed, transformer located in Storage Room E2113. Refer to the drawings for exact location of the equipment as well as the partial single line diagram for the new UPS system connections.

APPENDICES

Appendix A – Electrical Load Calculations

KOHLER Power Systems

Sizing Report

Project information

Project name: MSC
Customer's name: Smiths
Customer contact:

Site requirements

Voltage:	277/480
Phase:	3
Frequency:	60Hz
Alt. Temp. Rise Duty:	130°C Standby @40C
Qty of Gensets:	1
Fuel type:	Diesel
Country :	United States

Application:	US Govt Projects
Emissions Requirement:	Stationary emergency (US EPA)
Altitude:	500 Feet
Max. Ambient Temp.:	105 Degrees F
Min. Genset Loading :	25 %
Max. Genset Loading :	100 %

Site load requirements summary

Running kW:	1,704.65
Running kVA:	1,896.62
Running P.F.:	0.90

Max. Starting kW:	699.69 in step 6
Max. Starting kVA:	765.39 in step 6

Generator selection

Genset Model:	1750REOZMD
Engine:	S16R-Y2PTAW2-1
Emission level:	EPA Tier 2
BHP:	2,923.00
Displacement:	3,989.00
RPM:	1800

Alternator:	7M4052
Alternator Leads:	4
Alt. Starting kVA at 35% V dip:	5,600.00
Cal Alt Temp rise with site loads:	130C
Excitation System :	PMG

Rated kW :	1,750.00
Site Alt / Temp De-Rated kW :	1,750.00
UL 2200 Certified	

Generator Performance Summary

Voltage Dip Limit:	30.00 %
Frequency Dip Limit:	20.00 %
Harmonic Distortion Limit:	15.00 %

Calculated Voltage Dip:	7.16 %
Calculated Frequency Dip:	2.46 %
Calculated Harmonic Distortion:	9.85 %
Calculated Genset % Loaded:	97.41 %

Report prepared by: Justin Mundy

Software version: 1.0043.7.19

Thursday, February 3, 2022

Report prepared by: Justin Mundy

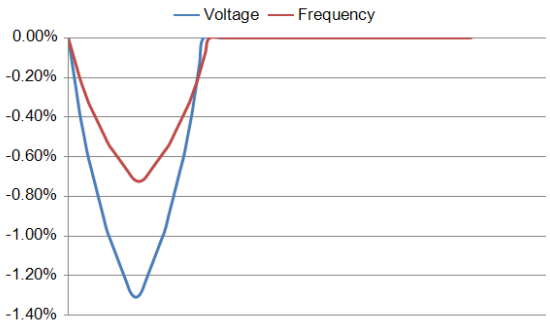
KOHLER Power Systems

Sizing Report

Model : 1750REOZMD, Alternator : 7M4052

Load Profile

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Misc. Linear Load REL1 3 Phase	1	10.80	12.00	0.90	12.00	12.00	1.00			
Misc. Linear Load REL2 3 Phase	1	10.80	12.00	0.90	12.00	12.00	1.00			
Misc. Linear Load REL4 3 Phase	1	10.80	12.00	0.90	12.00	12.00	1.00			
Misc. Linear Load 2EH3 3 Phase	1	23.94	26.60	0.90	26.60	26.60	1.00			
Misc. Linear Load 2EH2 3 Phase	1	23.94	26.60	0.90	26.60	26.60	1.00			
Misc. Linear Load 2HE1 3 Phase	1	23.94	26.60	0.90	26.60	26.60	1.00			
Misc. Linear Load 1EL1 3 Phase	1	20.00	22.22	0.90	20.00	20.00	1.00			
Motor HWP-2 0.00 HP 3 Phase Motor code : A Loaded NEMA Design across the line	1	0.00	0.00	0.00	0.00	0.00	0.00			



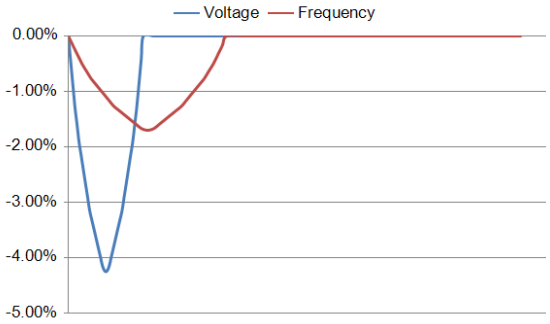
Report prepared by: Justin Mundy

TOTAL SYSTEM INTEGRATION
GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor HWP-3 0.00 HP 3 Phase Motor code : A Loaded NEMA Design across the line	1	0.00	0.00	0.00	0.00	0.00	0.00			
Step Total		124.22	138.02	0.90	135.80	135.80	1.00	1.31	0.72	0.00
Cum.Total		124.22	138.02	0.90						

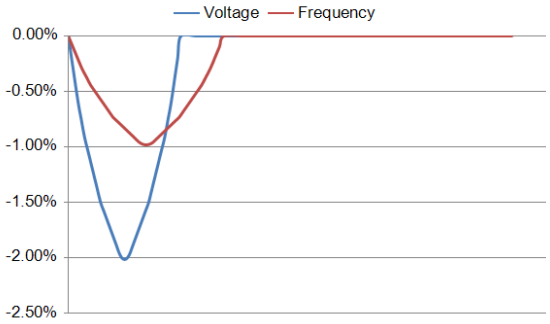
Report prepared by: Justin Mundy

Step # 2	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Misc. Linear Load REH4 3 Phase	1	166.68	185.20	0.90	185.20	185.20	1.00			
Misc. Linear Load REH1 3 Phase	1	231.64	257.38	0.90	257.38	257.38	1.00			
Misc. Linear Load SIPP PWR-3 3 Phase	1	28.80	32.00	0.90	32.00	32.00	1.00			
Step Total		427.12	474.58	0.90	474.58	474.58	1.00	4.24	1.70	0.00
Cum.Total		551.34	612.60	0.90						



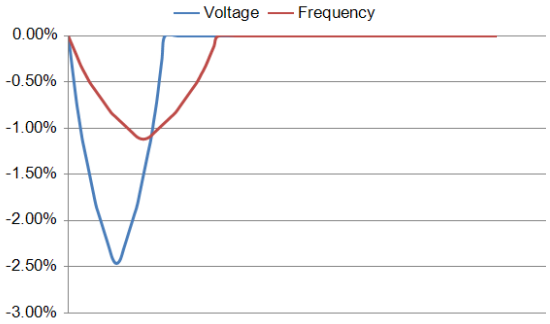
Report prepared by: Justin Mundy

Step # 3	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Misc. Linear Load EH3A 3 Phase	1	18.00	20.00	0.90	20.00	20.00	1.00			
Misc. Linear Load REH2 3 Phase	1	166.68	185.20	0.90	185.20	185.20	1.00			
Step Total		184.68	205.20	0.90	205.20	205.20	1.00	2.01	0.98	0.00
Cum.Total		736.02	817.80	0.90						



Report prepared by: Justin Mundy

Step # 4	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Misc. Linear Load 150A Feed 3 Phase	1	89.75	99.72	0.90	99.72	99.72	1.00			
Misc. Linear Load UPS 3 Phase	1	80.00	88.89	0.90	80.00	80.00	1.00			
Motor HWP-1 60.00 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	54.41	60.46	0.90	54.41	60.46	0.90			
Motor BLOWER-1 15.00 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	14.37	15.97	0.90	14.37	15.97	0.90			
Motor BLOWER-2 0.00 HP 3 Phase Motor code : L Loaded NEMA Design VFD	1	0.00	0.00	0.90	0.00	0.00	0.90			
Motor BLOWER-3 0.00 HP 3 Phase Motor code : L Loaded NEMA Design VFD	1	0.00	0.00	0.90	0.00	0.00	0.90			

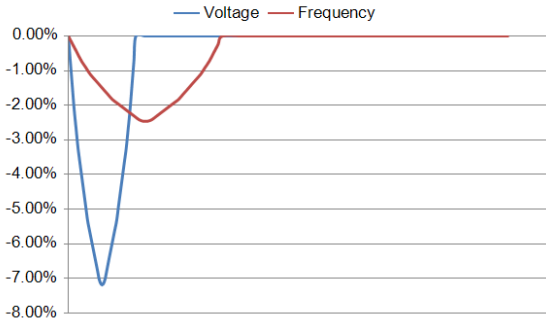


Report prepared by: Justin Mundy

Step # 4	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Step Total		238.53	265.04	0.90	248.51	250.73	0.99	2.46	1.11	0.96
Cum.Total		974.56	1,082.84	0.90						

Report prepared by: Justin Mundy

Step # 6	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Misc. Linear Load LAB 1 DDC 3 Phase	1	12.60	14.00	0.90	14.00	14.00	1.00			
Misc. Linear Load LAB 2 DDC 3 Phase	1	11.52	12.80	0.90	12.80	12.80	1.00			
Misc. Linear Load LAB 3 DDC 3 Phase	1	10.89	12.10	0.90	12.10	12.10	1.00			
Misc. Linear Load LAB 4 DDC 3 Phase	1	11.70	13.00	0.90	13.00	13.00	1.00			
Misc. Linear Load LAB 1 Heat Trace Phase A-N	1	1.62	1.80	0.90	1.80	1.80	1.00			
Misc. Linear Load LAB 2 Heat Trace Phase B-N	1	1.62	1.80	0.90	1.80	1.80	1.00			
Misc. Linear Load LAB 3 Heat Trace Phase C-N	1	1.62	1.80	0.90	1.80	1.80	1.00			
Misc. Linear Load LAB 4 Heat Trace Phase A-N	1	1.62	1.80	0.90	1.80	1.80	1.00			
Motor CH-4 554.41 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	473.27	525.86	0.90	473.27	525.86	0.90			

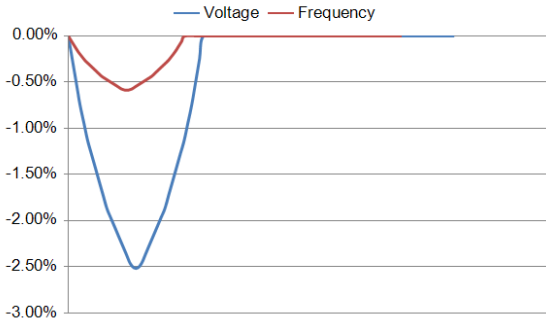


Report prepared by: Justin Mundy

Step # 6	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor CHWP-4 110.85 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	98.80	109.78	0.90	98.80	109.78	0.90			
Motor CT-1 17.46 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	16.73	18.59	0.90	16.73	18.59	0.90			
Motor CWP-4 56.86 HP 3 Phase Motor code : G Loaded NEMA Design VFD	1	51.79	57.54	0.90	51.79	57.54	0.90			
Step Total		693.78	770.87	0.90	699.69	765.39	0.91	7.16	2.46	9.85
Cum.Total		1,668.34	1,853.71	0.90						

Report prepared by: Justin Mundy

Step # 7	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Fire Pump PRI FIRE PUMP 43.81 HP 3 Phase Motor code : G Loaded NEMA Design across the line	1	36.31	43.23	0.84	104.27	260.67	0.40			
Step Total		36.31	43.23	0.84	104.27	260.67	0.40	2.51	0.58	9.85
Cum.Total		1,704.65	1,896.62	0.90						
Grand Total		1,704.65	1,896.62	0.90				7.16	2.46	9.85



Report prepared by: Justin Mundy

Appendix B – Thermal Underground Raceway Calculation

Electrical Transient Analyzer Program

Underground Cable Raceway Systems

Cable Temperature Analysis

Method: Neher-McGrath

U/G System ID	Number of Cable Raceways	Number of Ext. Heat Sources
15-Way - 600	1	0

Soil			Temperature Limits	
Type	RHO °C-cm/Watt	Ambient Temperature °C	Alarm °C	Warning °C
Clay Dry	90.0	20.0	90.0	88.0

Multiplying Factors (MF)

Application MF:	Not Considered
Individual Growth Factor:	Not Considered
Global Growth Factor:	100 %

Output File: L:\DCS\Projects\BDL\60666344_SI_MSCGeneratorDes\400_Technical\432_TechnicalArea_Electrical\Calculations\eTAP\MSC\15-Way - 600.CD1S

Underground Cable Raceway Systems (RW4)

Duct Bank Raceway Data:

ID	Reference Distance Horizontal inch	Reference Distance Vertical inch	Dimension Height inch	Dimension Width inch	Fill Type	Fill RHO °C-cm/Watt	Number of Conduits	Number of Cables	Average Distance Center-to-Center inch
RW4	30.00	24.00	30.00	47.50	Light Aggregate	90.0	15	11	9.00

Conduit Data:

ID	Reference Distance Horizontal inch	Reference Distance Vertical inch	Type	Size inch	Thickness inch	OD inch	RHO °C-cm/Watt	Thermal R Ohm-ft	Fill %
Cond41	5.00	5.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond42	14.00	5.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond43	23.00	5.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond44	32.00	5.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond45	41.00	5.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond46	5.00	14.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond47	14.00	14.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond48	23.00	23.00	PVC_40	5	0.258	5.563	600.0	0.303	2.23
Cond49	32.00	14.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond50	41.00	14.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond51	23.00	14.00	PVC_40	5	0.258	5.563	600.0	0.303	12.57
Cond52	14.00	23.00	PVC_40	5	0.258	5.563	600.0		
Cond53	23.00	23.00	PVC_40	5	0.258	5.563	600.0		
Cond54	34.45	25.35	PVC_40	5	0.258	5.563	600.0		
Cond55	41.00	23.00	PVC_40	5	0.258	5.563	600.0		

* Warning - Industry representatives recommend avoiding a jam ratio of 2.8 to 3.2.
\# Alarm - Cable jamming may occur when jam ratio is in between 2.74 and 2.8.

Cable Data:

ID	Size	Rated kV	Current Amp	Individual Growth Factor %	Load Factor %	Conductor No.	Conductor Type	Conductor Per Phase	Conductor Construction	Insulation Type	Insulation Thickness mil	Insulation Thermal R Ohm-ft
Cable30	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable31	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable32	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587

Cable Data:

ID	Size	Rated kV	Current Amp	Individual Growth Factor %	Load Factor %	Conductor No.	Conductor Type	Conductor Per Phase	Conductor Construction	Insulation Type	Insulation Thickness mil	Insulation Thermal R Ohm-ft
Cable32	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable33	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable34	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable35	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable36	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable37	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable38	1	0.600	75.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	55.0	1.009
Cable39	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587
Cable40	600	0.600	280.00	100	100	1/C	CU	1	ConRnd-NT	XHHW2	80.0	0.587

ID	Shielding Status	Shielding Type	Shielding Thickness mil	Sheath Type	Armor Type	End Connection*	Jacket Type	Jacket Thickness mil	Rdc @ 25°C µOhm/ft	Outside Diameter inch
Cable30	None						NONE		18.00	1.03
Cable31	None						NONE		18.00	1.03
Cable32	None						NONE		18.00	1.03
Cable33	None						NONE		18.00	1.03
Cable34	None						NONE		18.00	1.03
Cable35	None						NONE		18.00	1.03
Cable36	None						NONE		18.00	1.03
Cable37	None						NONE		18.00	1.03
Cable38	None						NONE		129.00	0.44
Cable39	None						NONE		18.00	1.03
Cable40	None						NONE		18.00	1.03

* End Connection is flagged as "Grounded" if any of the metallic layers (Shield/Sheath/Armor) is grounded at both ends.

Analysis Results (RW4)

No.	Cable ID	Conduit/Location ID	Conductor per Cable	Energized Conductor per Cable	Rdc @ Final Temp. µOhm/ft	Dielectric Losses Watt/ft	Yc	Ys	Conductor Losses Watt/ft	Current Amp	Temp. °C
1	Cable30-1A	Cond41	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
2	Cable30-1B	Cond41	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
3	Cable30-1C	Cond41	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
4	Cable31-1A	Cond42	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
5	Cable31-1B	Cond42	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
6	Cable31-1C	Cond42	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
7	Cable32-1A	Cond44	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
8	Cable32-1B	Cond44	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
9	Cable32-1C	Cond44	1	1	21.70	0.000	0.077	0.000	1.833	280.00	78.39
10	Cable33-1A	Cond45	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
11	Cable33-1B	Cond45	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
12	Cable33-1C	Cond45	1	1	21.27	0.000	0.080	0.000	1.801	280.00	72.10
13	Cable34-1A	Cond50	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
14	Cable34-1B	Cond50	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
15	Cable34-1C	Cond50	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
16	Cable35-1A	Cond51	1	1	22.14	0.000	0.074	0.000	1.865	280.00	84.72
17	Cable35-1B	Cond51	1	1	22.14	0.000	0.074	0.000	1.865	280.00	84.72
18	Cable35-1C	Cond51	1	1	22.14	0.000	0.074	0.000	1.865	280.00	84.72
19	Cable36-1A	Cond46	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
20	Cable36-1B	Cond46	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
21	Cable36-1C	Cond46	1	1	21.52	0.000	0.078	0.000	1.819	280.00	75.70
22	Cable37-1A	Cond43	1	1	21.84	0.000	0.076	0.000	1.843	280.00	80.36
23	Cable37-1B	Cond43	1	1	21.84	0.000	0.076	0.000	1.843	280.00	80.36
24	Cable37-1C	Cond43	1	1	21.84	0.000	0.076	0.000	1.843	280.00	80.36
25	Cable38-1C	Cond48	1	1	154.65	0.000	0.001	0.000	0.871	75.00	76.60
26	Cable38-1B	Cond48	1	1	154.65	0.000	0.001	0.000	0.871	75.00	76.60
27	Cable38-1A	Cond48	1	1	154.65	0.000	0.001	0.000	0.871	75.00	76.60
28	Cable39-1C	Cond47	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41
29	Cable39-1B	Cond47	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41
30	Cable39-1A	Cond47	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41
31	Cable40-1C	Cond49	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41
32	Cable40-1B	Cond49	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41
33	Cable40-1A	Cond49	1	1	21.98	0.000	0.075	0.000	1.853	280.00	82.41

Yc = Increment of AC/DC resistance ratio due to AC current skin and proximity effect

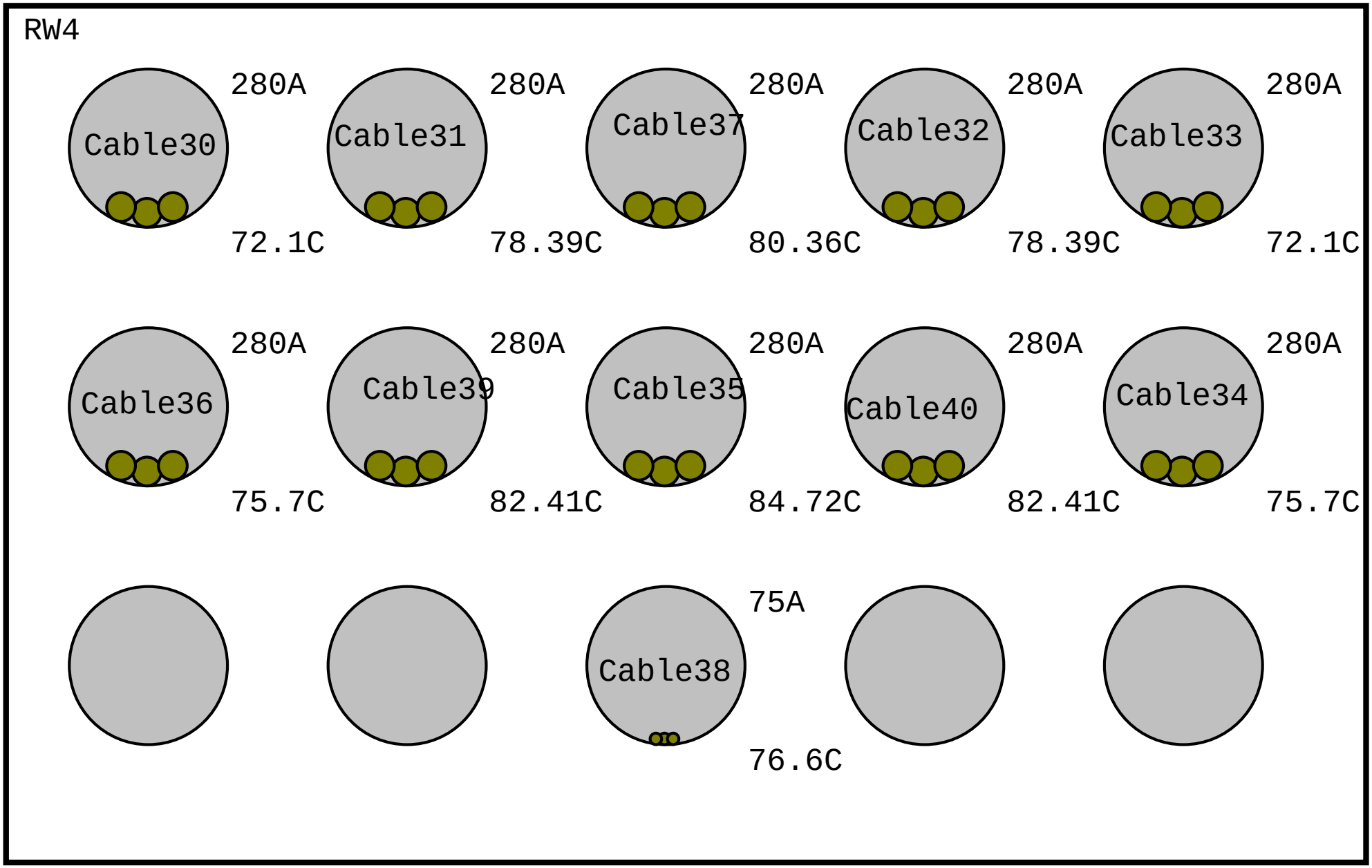
Ys = Increment of AC/DC resistance ratio due to losses of circulation and eddy current effect in shield , sheath and armor

Summary (RW4)

No.	Cable ID	Conduit/Location ID	Size	Current Amp	Temp. °C
1	Cable30-1A	Cond41	600	280.00	72.10
2	Cable30-1B	Cond41	600	280.00	72.10
3	Cable30-1C	Cond41	600	280.00	72.10
4	Cable31-1A	Cond42	600	280.00	78.39
5	Cable31-1B	Cond42	600	280.00	78.39
6	Cable31-1C	Cond42	600	280.00	78.39
7	Cable32-1A	Cond44	600	280.00	78.39
8	Cable32-1B	Cond44	600	280.00	78.39
9	Cable32-1C	Cond44	600	280.00	78.39
10	Cable33-1A	Cond45	600	280.00	72.10
11	Cable33-1B	Cond45	600	280.00	72.10
12	Cable33-1C	Cond45	600	280.00	72.10
13	Cable34-1A	Cond50	600	280.00	75.70
14	Cable34-1B	Cond50	600	280.00	75.70
15	Cable34-1C	Cond50	600	280.00	75.70
16	Cable35-1A	Cond51	600	280.00	84.72
17	Cable35-1B	Cond51	600	280.00	84.72
18	Cable35-1C	Cond51	600	280.00	84.72
19	Cable36-1A	Cond46	600	280.00	75.70
20	Cable36-1B	Cond46	600	280.00	75.70
21	Cable36-1C	Cond46	600	280.00	75.70
22	Cable37-1A	Cond43	600	280.00	80.36
23	Cable37-1B	Cond43	600	280.00	80.36
24	Cable37-1C	Cond43	600	280.00	80.36
25	Cable38-1C	Cond48	1	75.00	76.60
26	Cable38-1B	Cond48	1	75.00	76.60
27	Cable38-1A	Cond48	1	75.00	76.60
28	Cable39-1C	Cond47	600	280.00	82.41
29	Cable39-1B	Cond47	600	280.00	82.41
30	Cable39-1A	Cond47	600	280.00	82.41
31	Cable40-1C	Cond49	600	280.00	82.41
32	Cable40-1B	Cond49	600	280.00	82.41
33	Cable40-1A	Cond49	600	280.00	82.41

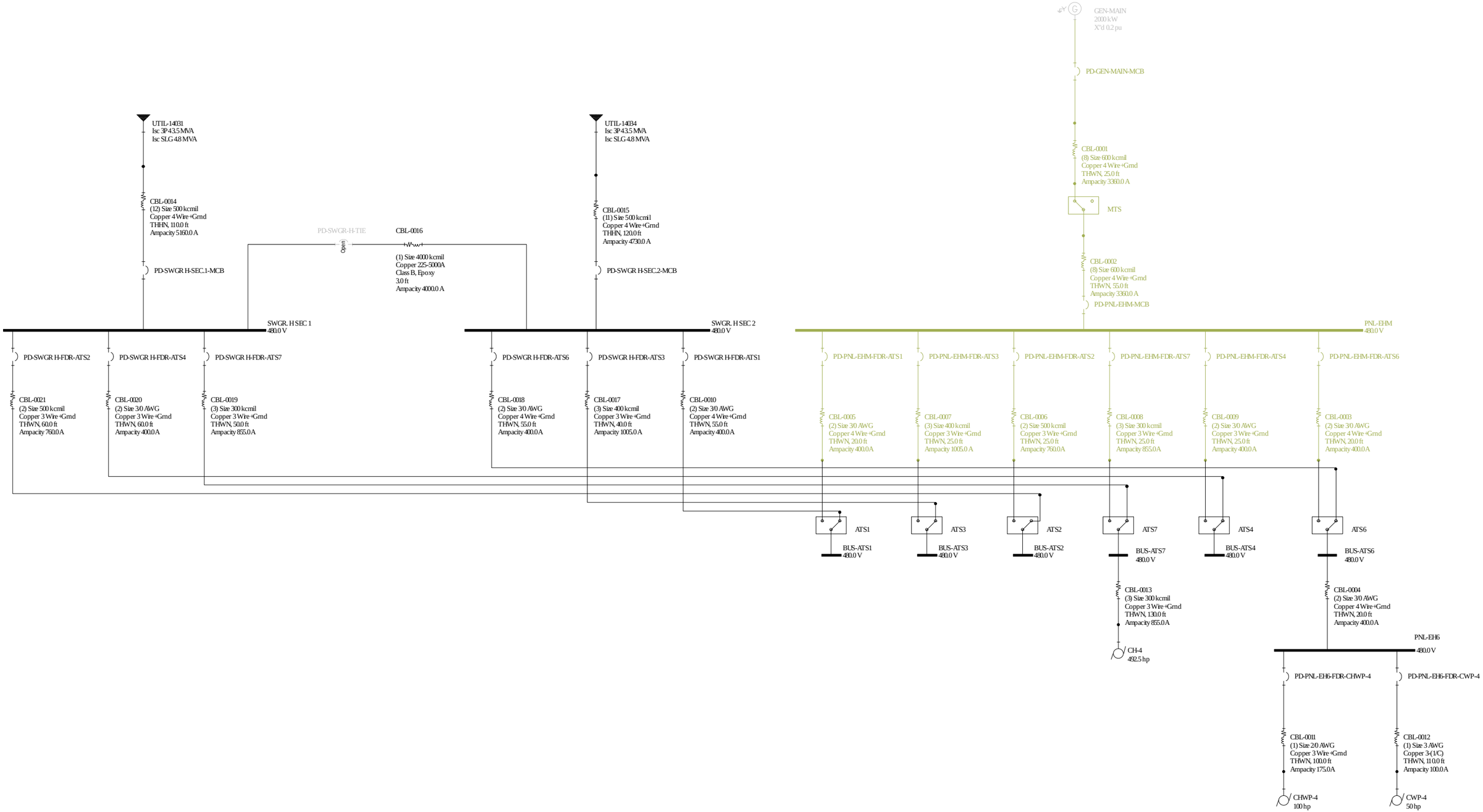
F Indicates fixed cable size in cable sizing calculations or fixed cable ampacity in uniform ampacity calculation
* Indicates a cable temperature exceeding its limit
# Indicates a cable temperature exceeding its marginal limit

Underground Diagram - 15-Way - 600 (Calculation Mode)



Appendix C – Short Circuit Calculations

Utility Short Circuit Calculation - Input Data


UTIL-14031
Isc 3P 43.5 MVA
Isc SLG 4.8 MVA
CBL-0014
(12) Size 500 kcmil
Copper 4 Wire +Grnd
THHN, 110.0 ft
Ampacity 5160.0 A
PD-SWGR H-SEC.1-MCB
PD-SWGR H-TIE
Open
CBL-0016
(1) Size 4000 kcmil
Copper 225-5000A
Class B, Epoxy
3.0 ft
Ampacity 4000.0 A
UTIL-14034
Isc 3P 43.5 MVA
Isc SLG 4.8 MVA
CBL-0015
(11) Size 500 kcmil
Copper 4 Wire +Grnd
THHN, 120.0 ft
Ampacity 4730.0 A
PD-SWGR H-SEC.2-MCB
SWGR. H SEC 1
480.0 V
SWGR. H SEC 2
480.0 V
PD-SWGR H-FDR-ATS2
PD-SWGR H-FDR-ATS4
PD-SWGR H-FDR-ATS7
PD-SWGR H-FDR-ATS6
PD-SWGR H-FDR-ATS3
PD-SWGR H-FDR-ATS1
CBL-0021
(2) Size 500 kcmil
Copper 3 Wire +Grnd
THWN, 60.0 ft
Ampacity 760.0 A
CBL-0020
(2) Size 3/0 AWG
Copper 3 Wire +Grnd
THWN, 60.0 ft
Ampacity 400.0 A
CBL-0019
(3) Size 300 kcmil
Copper 3 Wire +Grnd
THWN, 50.0 ft
Ampacity 855.0 A
CBL-0018
(2) Size 3/0 AWG
Copper 4 Wire +Grnd
THWN, 55.0 ft
Ampacity 400.0 A
CBL-0017
(3) Size 400 kcmil
Copper 3 Wire +Grnd
THWN, 40.0 ft
Ampacity 1005.0 A
CBL-0010
(2) Size 3/0 AWG
Copper 4 Wire +Grnd
THWN, 55.0 ft
Ampacity 400.0 A
GEN-MAIN
2000 kW
X"d 0.2 pu
PD-GEN-MAIN-MCB
CBL-0001
(8) Size 600 kcmil
Copper 4 Wire +Grnd
THWN, 25.0 ft
Ampacity 3360.0 A
MTS
CBL-0002
(8) Size 600 kcmil
Copper 4 Wire +Grnd
THWN, 55.0 ft
Ampacity 3360.0 A
PD-PNL-EHM-MCB
PNL-EHM
480.0 V
PD-PNL-EHM-FDR-ATS1
PD-PNL-EHM-FDR-ATS3
PD-PNL-EHM-FDR-ATS2
PD-PNL-EHM-FDR-ATS7
PD-PNL-EHM-FDR-ATS4
PD-PNL-EHM-FDR-ATS6
CBL-0005
(2) Size 3/0 AWG
Copper 4 Wire +Grnd
THWN, 20.0 ft
Ampacity 400.0 A
CBL-0007
(3) Size 400 kcmil
Copper 3 Wire +Grnd
THWN, 25.0 ft
Ampacity 1005.0 A
CBL-0006
(2) Size 500 kcmil
Copper 3 Wire +Grnd
THWN, 25.0 ft
Ampacity 760.0 A
CBL-0008
(3) Size 300 kcmil
Copper 3 Wire +Grnd
THWN, 25.0 ft
Ampacity 855.0 A
CBL-0009
(2) Size 3/0 AWG
Copper 3 Wire +Grnd
THWN, 25.0 ft
Ampacity 400.0 A
CBL-0003
(2) Size 3/0 AWG
Copper 4 Wire +Grnd
THWN, 20.0 ft
Ampacity 400.0 A
ATS1
ATS3
ATS2
ATS7
ATS4
ATS6
BUS-ATS1
480.0 V
BUS-ATS3
480.0 V
BUS-ATS2
480.0 V
BUS-ATS7
480.0 V
BUS-ATS4
480.0 V
BUS-ATS6
480.0 V
CBL-0013
(3) Size 300 kcmil
Copper 3 Wire +Grnd
THWN, 130.0 ft
Ampacity 855.0 A
CH-4
492.5 hp
CBL-0004
(2) Size 3/0 AWG
Copper 4 Wire +Grnd
THWN, 20.0 ft
Ampacity 400.0 A
PNL-EH6
480.0 V
PD-PNL-EH6-FDR-CHWP-4
PD-PNL-EH6-FDR-CWP-4
CBL-0011
(1) Size 2/0 AWG
Copper 3 Wire +Grnd
THWN, 100.0 ft
Ampacity 175.0 A
CBL-0012
(1) Size 3 AWG
Copper 3-(1/C)
THWN, 110.0 ft
Ampacity 100.0 A
CHWP-4
100 hp
CWP-4
50 hp

Project: MSCGenerator

DAPPER Fault Analysis Input Report (English)

Utilities

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage		Duty	Units	X/R	PU (100 MVA Base)	R PU	X PU
UTIL-14031	BUS-0026	In	480	3P:	44	MVA	10.00	Pos:	0.229	2.287
				SLG:	5	MVA	10.00	Zero:	1.616	16.155
UTIL-14034	BUS-0027	In	480	3P:	44	MVA	10.00	Pos:	0.229	2.287
				SLG:	5	MVA	10.00	Zero:	1.616	16.155

Generators

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	Base kVA	X"	X/R	PU (100 MVA Base) R PU	X PU
GEN-MAIN	BUS-0001	Out	480	2,500.00	0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00

Motors

Contribution From Name	# of Motors	Bus Name	In/Out Service	Nominal Voltage	Base kVA	Xd"	X/R	PU (100 MVA Base) R PU	X PU
CH-4	1	BUS-0023	In	480	493.84	0.1507	4.90	6.231	30.524
CHWP-4	1	BUS-0015	In	480	100.27	0.1507	4.90	30.687	150.334
CWP-4	1	BUS-0016	In	480	50.13	0.1507	4.90	61.373	300.667

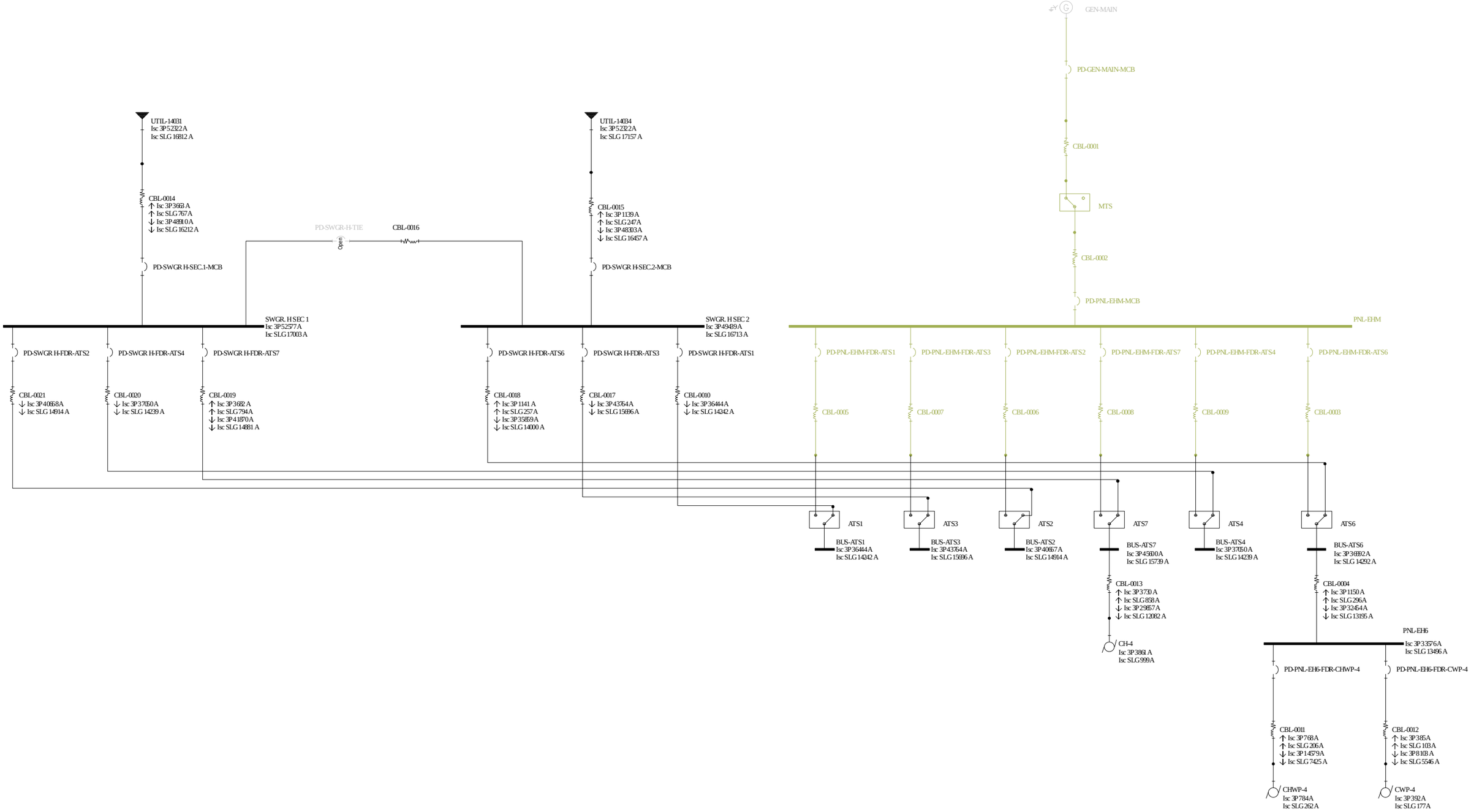
Cables

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0001	BUS-0001	In	8	25	600	Copper	Magnetic		Pos:	0.0349	0.0628
									Zero:	0.1097	0.1546
	BUS-0002										
CBL-0002	BUS-0003	In	8	55	600	Copper	Magnetic		Pos:	0.0767	0.1382
									Zero:	0.2414	0.3402
	PNL-EHM										
CBL-0003	PNL-EHM	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	BUS-ATS6-NODE										
CBL-0004	BUS-ATS6	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	PNL-EH6										
CBL-0005	PNL-EHM	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	BUS-ATS1-NODE										
CBL-0006	PNL-EHM	In	2	25	500	Copper	Magnetic		Pos:	0.1595	0.2528
									Zero:	0.5024	0.6223
	BUS-ATS2-NODE										
CBL-0007	PNL-EHM	In	3	25	400	Copper	Magnetic		Pos:	0.1288	0.1772
									Zero:	0.4058	0.4362
	BUS-ATS3-NODE										

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0008	PNL-EHM	In	3	25	300	Copper	Magnetic		Pos:	0.1678	0.1783
									Zero:	0.5288	0.4391
	BUS-ATS7-NODE										
CBL-0009	PNL-EHM	In	2	25	3/0	Copper	Magnetic		Pos:	0.4367	0.2816
									Zero:	1.3764	0.6934
	BUS-ATS4-NODE										
CBL-0010	SWGR. H SEC 2	In	2	55	3/0	Copper	Magnetic		Pos:	0.9608	0.6195
									Zero:	3.0281	1.5254
	BUS-0030										
CBL-0011	PNL-EH6	In	1	100	2/0	Copper	Magnetic		Pos:	4.4271	2.3134
									Zero:	13.9497	5.6944
	BUS-0015										
CBL-0012	PNL-EH6	In	1	110	3	Copper	Magnetic		Pos:	11.9358	2.8168
									Zero:	18.9779	7.1662
	BUS-0016										
CBL-0013	BUS-ATS7	In	3	130	300	Copper	Magnetic		Pos:	0.8727	0.9272
									Zero:	2.7497	2.2833
	BUS-0023										
CBL-0014	BUS-0026	In	12	110	500	Copper	Non-Magnetic		Pos:	0.1098	0.1484
									Zero:	0.1743	0.3975
	SWGR. H SEC 1										

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0015	BUS-0027	In	11	120	500	Copper	Non-Magnetic		Pos:	0.1307	0.1766
									Zero:	0.2074	0.4730
	SWGR. H SEC 2										
CBL-0016	SWGR. H SEC 1	In	1	3	4000	Copper	Busway	Epoxy	Pos:	0.0043	0.0025
									Zero:	0.0255	0.0132
	SWGR. H SEC 2										
CBL-0017	SWGR. H SEC 2	In	3	40	400	Copper	Magnetic		Pos:	0.2060	0.2836
									Zero:	0.6493	0.6979
	BUS-0031										
CBL-0018	SWGR. H SEC 2	In	2	55	3/0	Copper	Magnetic		Pos:	0.9608	0.6195
									Zero:	3.0281	1.5254
	BUS-0029										
CBL-0019	SWGR. H SEC 1	In	3	50	300	Copper	Magnetic		Pos:	0.3356	0.3566
									Zero:	1.0576	0.8782
	BUS-0028										
CBL-0020	SWGR. H SEC 1	In	2	60	3/0	Copper	Magnetic		Pos:	1.0482	0.6758
									Zero:	3.3034	1.6641
	BUS-0033										
CBL-0021	SWGR. H SEC 1	In	2	60	500	Copper	Magnetic		Pos:	0.3828	0.6068
									Zero:	1.2057	1.4935
	BUS-0032										

Utility Short Circuit Calculation - Short Circuit Results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PD-SWGR H-TIE
Open
CBL-0016
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SWGR. H SEC 1
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SWGR. H SEC 2
Isc 3P 49439 A
Isc SLG 16713 A
PD-SWGR H-FDR-ATS2
PD-SWGR H-FDR-ATS4
PD-SWGR H-FDR-ATS7
PD-SWGR H-FDR-ATS6
PD-SWGR H-FDR-ATS3
PD-SWGR H-FDR-ATS1
CBL-0021
Isc 3P 40668 A
Isc SLG 14914 A
CBL-0020
Isc 3P 37050 A
Isc SLG 14239 A
CBL-0019
Isc 3P 3682 A
Isc SLG 794 A
Isc 3P 41870 A
Isc SLG 14881 A
CBL-0018
Isc 3P 1141 A
Isc SLG 257 A
Isc 3P 35859 A
Isc SLG 14000 A
CBL-0017
Isc 3P 43764 A
Isc SLG 15696 A
CBL-0010
Isc 3P 36444 A
Isc SLG 14242 A
GEN-MAIN
PD-GEN-MAIN-MCB
CBL-0001
MTS
CBL-0002
PD-PNL-EHM-MCB
PNL-EHM
PD-PNL-EHM-FDR-ATS1
PD-PNL-EHM-FDR-ATS3
PD-PNL-EHM-FDR-ATS2
PD-PNL-EHM-FDR-ATS7
PD-PNL-EHM-FDR-ATS4
PD-PNL-EHM-FDR-ATS6
CBL-0005
CBL-0007
CBL-0006
CBL-0008
CBL-0009
CBL-0003
ATS1
ATS3
ATS2
ATS7
ATS4
ATS6
BUS-ATS1
Isc 3P 36444 A
Isc SLG 14242 A
BUS-ATS3
Isc 3P 43764 A
Isc SLG 15696 A
BUS-ATS2
Isc 3P 40667 A
Isc SLG 14914 A
BUS-ATS7
Isc 3P 45600 A
Isc SLG 15739 A
BUS-ATS4
Isc 3P 37050 A
Isc SLG 14239 A
BUS-ATS6
Isc 3P 36892 A
Isc SLG 14292 A
CBL-0013
Isc 3P 3730 A
Isc SLG 858 A
Isc 3P 29857 A
Isc SLG 12082 A
CBL-0004
Isc 3P 1150 A
Isc SLG 296 A
Isc 3P 32454 A
Isc SLG 13195 A
CH-4
Isc 3P 3861 A
Isc SLG 999 A
PNL-EH6
Isc 3P 33576 A
Isc SLG 13496 A
PD-PNL-EH6-FDR-CHWP-4
PD-PNL-EH6-FDR-CWP-4
CBL-0011
Isc 3P 768 A
Isc SLG 206 A
Isc 3P 14579 A
Isc SLG 7425 A
CBL-0012
Isc 3P 385 A
Isc SLG 103 A
Isc 3P 8103 A
Isc SLG 5546 A
CHWP-4
Isc 3P 784 A
Isc SLG 262 A
CWP-4
Isc 3P 392 A
Isc SLG 177 A

Project: MSCGenerator

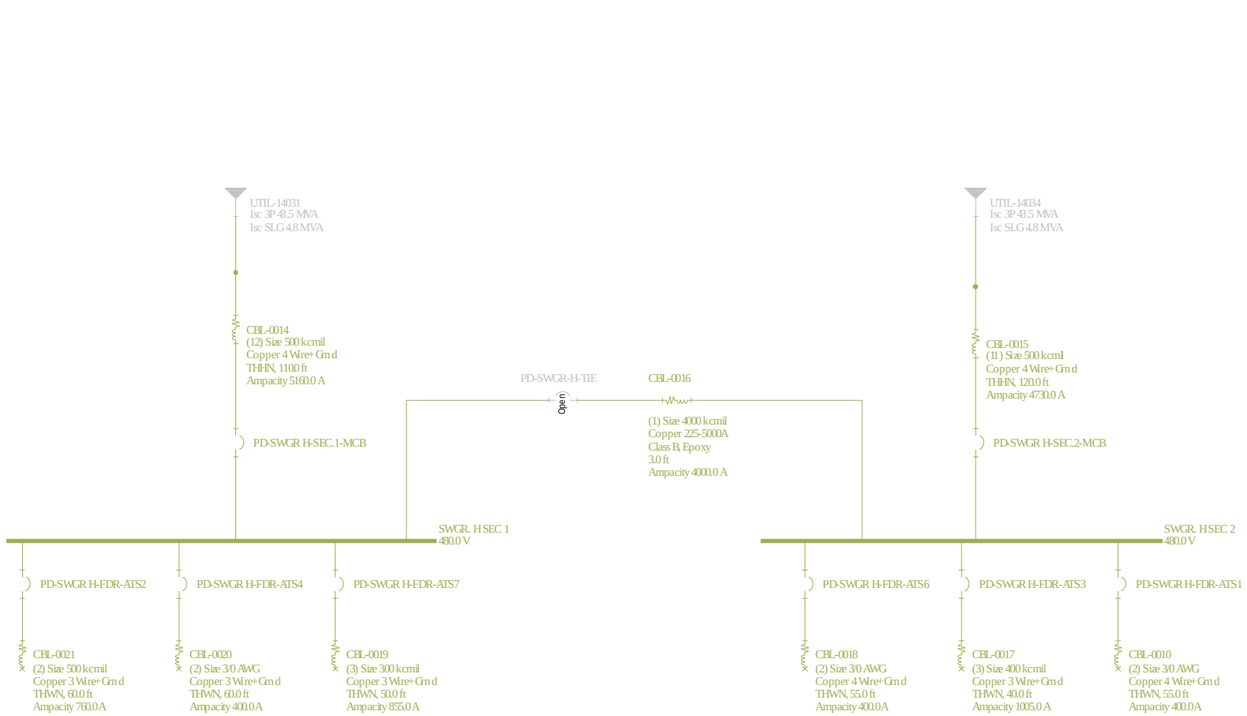
DAPPER Fault Contribution Complete Report

Comprehensive Short Circuit Study Settings

Three Phase Fault	Yes	**Faulted Bus**	All Buses
Single Line to Ground	Yes	**Bus Voltages**	First Bus From Fault
Line to Line Fault	No	**Branch Currents**	First Branch From Fault
Line to Line to Ground	No	**Phase or Sequence**	Report phase quantities
Motor Contribution	Yes	**Fault Current Calculation**	Asymmetrical RMS (with DC offset and Decay)
Transformer Tap	Yes	**Asym Fault Current at Time**	0.50 **Cycles**
Xformer Phase Shift	Yes		

				Initial Symmetrical Amps				Asymmetrical Amps				Init Sym Neutral Amps	
Bus Name	**Contributions**			**3 Phase**	**SLG**	**LLG**	**LL**	**3 Phase**	**SLG**	**LLG**	**LL**	**SLG**	**LLG**
BUS-ATS1				**36,444**	**14,242**	**0**	**0**	**38,737**	**16,154**	**0**	**0**		
BUS-ATS2				**40,667**	**14,914**	**0**	**0**	**48,473**	**18,996**	**0**	**0**		
BUS-ATS3				**43,764**	**15,696**	**0**	**0**	**54,268**	**20,699**	**0**	**0**		
BUS-ATS4				**37,050**	**14,239**	**0**	**0**	**38,951**	**15,973**	**0**	**0**		
BUS-ATS6				**36,992**	**14,292**	**0**	**0**	**39,518**	**16,253**	**0**	**0**		
	CBL-0004	CABLE	In	1,150	296	0	0	1,228	337	0	0		
BUS-ATS7				**45,600**	**15,739**	**0**	**0**	**54,764**	**20,169**	**0**	**0**		
	CBL-0013	CABLE	In	3,730	858	0	0	4,480	1,100	0	0		
PNL-EH6				**33,576**	**13,496**	**0**	**0**	**35,046**	**14,810**	**0**	**0**		
	CBL-0012	CABLE	In	385	103	0	0	402	113	0	0		
	CBL-0011	CABLE	In	768	206	0	0	802	226	0	0		
	CBL-0004	CABLE	In	32,454	13,195	0	0	33,875	14,480	0	0	13,496	

Generator Short Circuit Calculation - Input Data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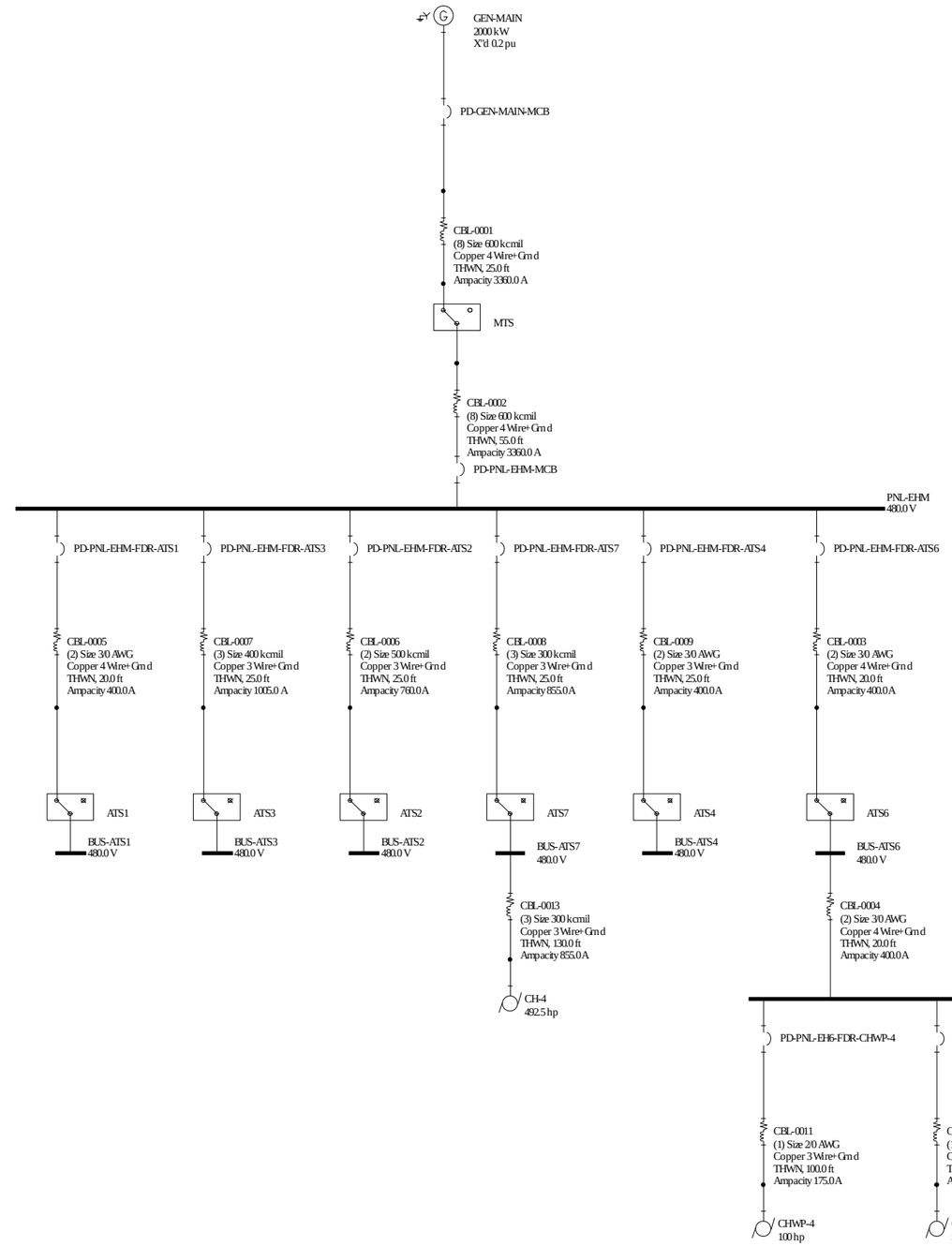
Isc 3P 43.5 MVA
Isc SLG 4.8 MVA
CBL-0014
(12) Size 500 kcmil
Copper 4 Wire+ Grnd
THHN, 1100 ft
Ampacity 5160.0 A
PD-SWGR H-SEC.1-MCB
PD-SWGR H-TIE
Open
CBL-0016
(1) Size 4000 kcmil
Copper 225-5000A
Class B, Epoxy
3.0 ft
Ampacity 4000.0 A
UTIL-14034
Isc 3P 43.5 MVA
Isc SLG 4.8 MVA
CBL-0015
(11) Size 500 kcmil
Copper 4 Wire+ Grnd
THHN, 120.0 ft
Ampacity 4730.0 A
PD-SWGR H-SEC.2-MCB
SWGR. H SEC 1
480.0 V
SWGR. H SEC 2
480.0 V
PD-SWGR H-FDR-ATS2
PD-SWGR H-FDR-ATS4
PD-SWGR H-FDR-ATS7
PD-SWGR H-FDR-ATS6
PD-SWGR H-FDR-ATS3
PD-SWGR H-FDR-ATS1
CBL-0021
(2) Size 500 kcmil
Copper 3 Wire+ Grnd
THWN, 60.0 ft
Ampacity 760.0 A
CBL-0020
(2) Size 3/0 AWG
Copper 3 Wire+ Grnd
THWN, 60.0 ft
Ampacity 400.0 A
CBL-0019
(3) Size 300 kcmil
Copper 3 Wire+ Grnd
THWN, 50.0 ft
Ampacity 855.0 A
CBL-0018
(2) Size 3/0 AWG
Copper 4 Wire+ Grnd
THWN, 55.0 ft
Ampacity 400.0 A
CBL-0017
(3) Size 400 kcmil
Copper 3 Wire+ Grnd
THWN, 40.0 ft
Ampacity 1005.0 A
CBL-0010
(2) Size 3/0 AWG
Copper 4 Wire+ Grnd
THWN, 55.0 ft
Ampacity 400.0 A


GEN-MAIN
2000 kW
X'd 0.2 pu
PD-GEN-MAIN-MCB
CBL-0001
(8) Size 600 kcmil
Copper 4 Wire+ Grnd
THWN, 25.0 ft
Ampacity 3360.0 A
MTS
CBL-0002
(8) Size 600 kcmil
Copper 4 Wire+ Grnd
THWN, 55.0 ft
Ampacity 3360.0 A
PD-PNL-EHM-MCB
PNL-EHM
480.0 V
PD-PNL-EHM-FDR-ATS1
PD-PNL-EHM-FDR-ATS3
PD-PNL-EHM-FDR-ATS2
PD-PNL-EHM-FDR-ATS7
PD-PNL-EHM-FDR-ATS4
PD-PNL-EHM-FDR-ATS6
CBL-0005
(2) Size 3/0 AWG
Copper 4 Wire+ Grnd
THWN, 20.0 ft
Ampacity 400.0 A
CBL-0007
(3) Size 400 kcmil
Copper 3 Wire+ Grnd
THWN, 25.0 ft
Ampacity 1005.0 A
CBL-0006
(2) Size 500 kcmil
Copper 3 Wire+ Grnd
THWN, 25.0 ft
Ampacity 760.0 A
CBL-0008
(3) Size 300 kcmil
Copper 3 Wire+ Grnd
THWN, 25.0 ft
Ampacity 855.0 A
CBL-0009
(2) Size 3/0 AWG
Copper 3 Wire+ Grnd
THWN, 25.0 ft
Ampacity 400.0 A
CBL-0003
(2) Size 3/0 AWG
Copper 4 Wire+ Grnd
THWN, 20.0 ft
Ampacity 400.0 A
ATS1
ATS3
ATS2
ATS7
ATS4
ATS6
BUS-ATS1
480.0 V
BUS-ATS3
480.0 V
BUS-ATS2
480.0 V
BUS-ATS7
480.0 V
BUS-ATS4
480.0 V
BUS-ATS6
480.0 V
CBL-0013
(3) Size 300 kcmil
Copper 3 Wire+ Grnd
THWN, 130.0 ft
Ampacity 855.0 A
CH-4
492.5 hp
CBL-0004
(2) Size 3/0 AWG
Copper 4 Wire+ Grnd
THWN, 20.0 ft
Ampacity 400.0 A
PNL-EH6
480.0 V
PD-PNL-EH6-FDR-CHWP-4
PD-PNL-EH6-FDR-CWP-4
CBL-0011
(1) Size 2/0 AWG
Copper 3 Wire+ Grnd
THWN, 100.0 ft
Ampacity 175.0 A
CBL-0012
(1) Size 3 AWG
Copper 3-(1/C)
THWN, 110.0 ft
Ampacity 100.0 A
CHWP-4
100 hp
CWP-4
50 hp

Project: MSCGenerator

DAPPER Fault Analysis Input Report (English)

Utilities

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage		Duty	Units	X/R	PU (100 MVA Base)	R PU	X PU
UTIL-14031	BUS-0026	Out	480	3P:	44	MVA	10.00	Pos:	0.229	2.287
				SLG:	5	MVA	10.00	Zero:	1.616	16.155
UTIL-14034	BUS-0027	Out	480	3P:	44	MVA	10.00	Pos:	0.229	2.287
				SLG:	5	MVA	10.00	Zero:	1.616	16.155

Generators

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	Base kVA	X"	X/R	PU (100 MVA Base) R PU	X PU
GEN-MAIN	BUS-0001	In	480	2,500.00	0.15	20.00	0.30	6.00
					0.15	20.00	0.30	6.00
					0.15	20.00	0.30	6.00

Motors

Contribution From Name	# of Motors	Bus Name	In/Out Service	Nominal Voltage	Base kVA	Xd"	X/R	PU (100 MVA Base) R PU	X PU
CH-4	1	BUS-0023	In	480	493.84	0.1507	4.90	6.231	30.524
CHWP-4	1	BUS-0015	In	480	100.27	0.1507	4.90	30.687	150.334
CWP-4	1	BUS-0016	In	480	50.13	0.1507	4.90	61.373	300.667

Cables

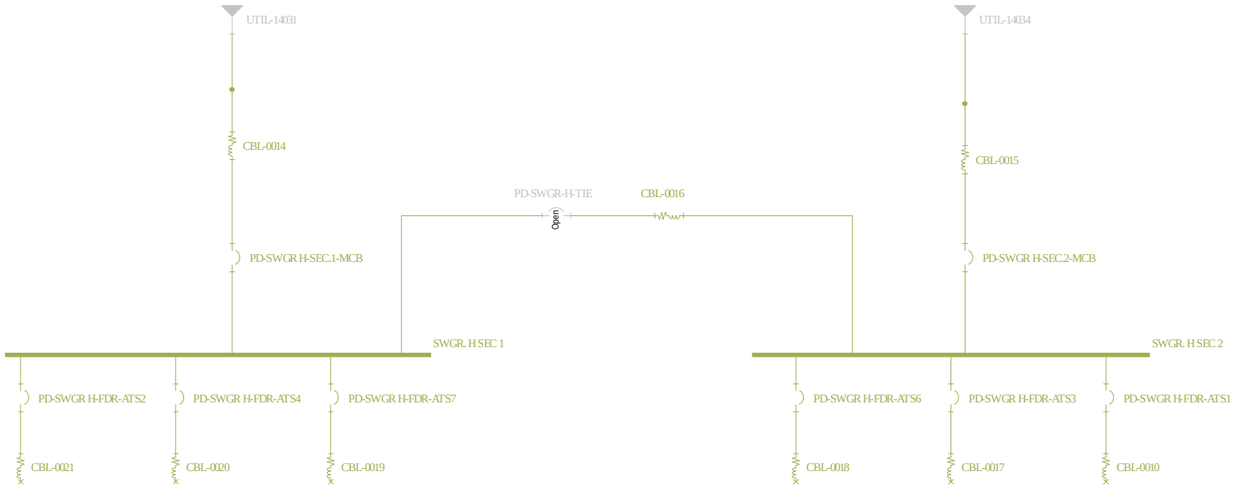
Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0001	BUS-0001	In	8	25	600	Copper	Magnetic		Pos:	0.0349	0.0628
									Zero:	0.1097	0.1546
	BUS-0002										
CBL-0002	BUS-0003	In	8	55	600	Copper	Magnetic		Pos:	0.0767	0.1382
									Zero:	0.2414	0.3402
	PNL-EHM										
CBL-0003	PNL-EHM	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	BUS-ATS6-NODE										
CBL-0004	BUS-ATS6	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	PNL-EH6										
CBL-0005	PNL-EHM	In	2	20	3/0	Copper	Magnetic		Pos:	0.3494	0.2253
									Zero:	1.1011	0.5547
	BUS-ATS1-NODE										
CBL-0006	PNL-EHM	In	2	25	500	Copper	Magnetic		Pos:	0.1595	0.2528
									Zero:	0.5024	0.6223
	BUS-ATS2-NODE										
CBL-0007	PNL-EHM	In	3	25	400	Copper	Magnetic		Pos:	0.1288	0.1772
									Zero:	0.4058	0.4362
	BUS-ATS3-NODE										

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0008	PNL-EHM	In	3	25	300	Copper	Magnetic		Pos:	0.1678	0.1783
									Zero:	0.5288	0.4391
	BUS-ATS7-NODE										
CBL-0009	PNL-EHM	In	2	25	3/0	Copper	Magnetic		Pos:	0.4367	0.2816
									Zero:	1.3764	0.6934
	BUS-ATS4-NODE										
CBL-0010	SWGR. H SEC 2	In	2	55	3/0	Copper	Magnetic		Pos:	0.9608	0.6195
									Zero:	3.0281	1.5254
	BUS-0030										
CBL-0011	PNL-EH6	In	1	100	2/0	Copper	Magnetic		Pos:	4.4271	2.3134
									Zero:	13.9497	5.6944
	BUS-0015										
CBL-0012	PNL-EH6	In	1	110	3	Copper	Magnetic		Pos:	11.9358	2.8168
									Zero:	18.9779	7.1662
	BUS-0016										
CBL-0013	BUS-ATS7	In	3	130	300	Copper	Magnetic		Pos:	0.8727	0.9272
									Zero:	2.7497	2.2833
	BUS-0023										
CBL-0014	BUS-0026	In	12	110	500	Copper	Non-Magnetic		Pos:	0.1098	0.1484
									Zero:	0.1743	0.3975
	SWGR. H SEC 1										

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	------ Cable Description ------ Size	Cond. Type	Duct Type	Insul	Per Unit (100 MVA Base)	R pu	jX pu
CBL-0015	BUS-0027	In	11	120	500	Copper	Non-Magnetic		Pos:	0.1307	0.1766
									Zero:	0.2074	0.4730
	SWGR. H SEC 2										
CBL-0016	SWGR. H SEC 1	In	1	3	4000	Copper	Busway	Epoxy	Pos:	0.0043	0.0025
									Zero:	0.0255	0.0132
	SWGR. H SEC 2										
CBL-0017	SWGR. H SEC 2	In	3	40	400	Copper	Magnetic		Pos:	0.2060	0.2836
									Zero:	0.6493	0.6979
	BUS-0031										
CBL-0018	SWGR. H SEC 2	In	2	55	3/0	Copper	Magnetic		Pos:	0.9608	0.6195
									Zero:	3.0281	1.5254
	BUS-0029										
CBL-0019	SWGR. H SEC 1	In	3	50	300	Copper	Magnetic		Pos:	0.3356	0.3566
									Zero:	1.0576	0.8782
	BUS-0028										
CBL-0020	SWGR. H SEC 1	In	2	60	3/0	Copper	Magnetic		Pos:	1.0482	0.6758
									Zero:	3.3034	1.6641
	BUS-0033										
CBL-0021	SWGR. H SEC 1	In	2	60	500	Copper	Magnetic		Pos:	0.3828	0.6068
									Zero:	1.2057	1.4935
	BUS-0032										

Generator Short Circuit Calculation -

Short Circuit Results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PD-SWGR H-TIE
Open
CBL-0016
SWGR. H SEC 1
PD-SWGR H-FDR-ATS2
PD-SWGR H-FDR-ATS4
PD-SWGR H-FDR-ATS7
CBL-0021
CBL-0020
CBL-0019
UTIL-14034
CBL-0015
PD-SWGR H-SEC.2-MCB
SWGR. H SEC 2
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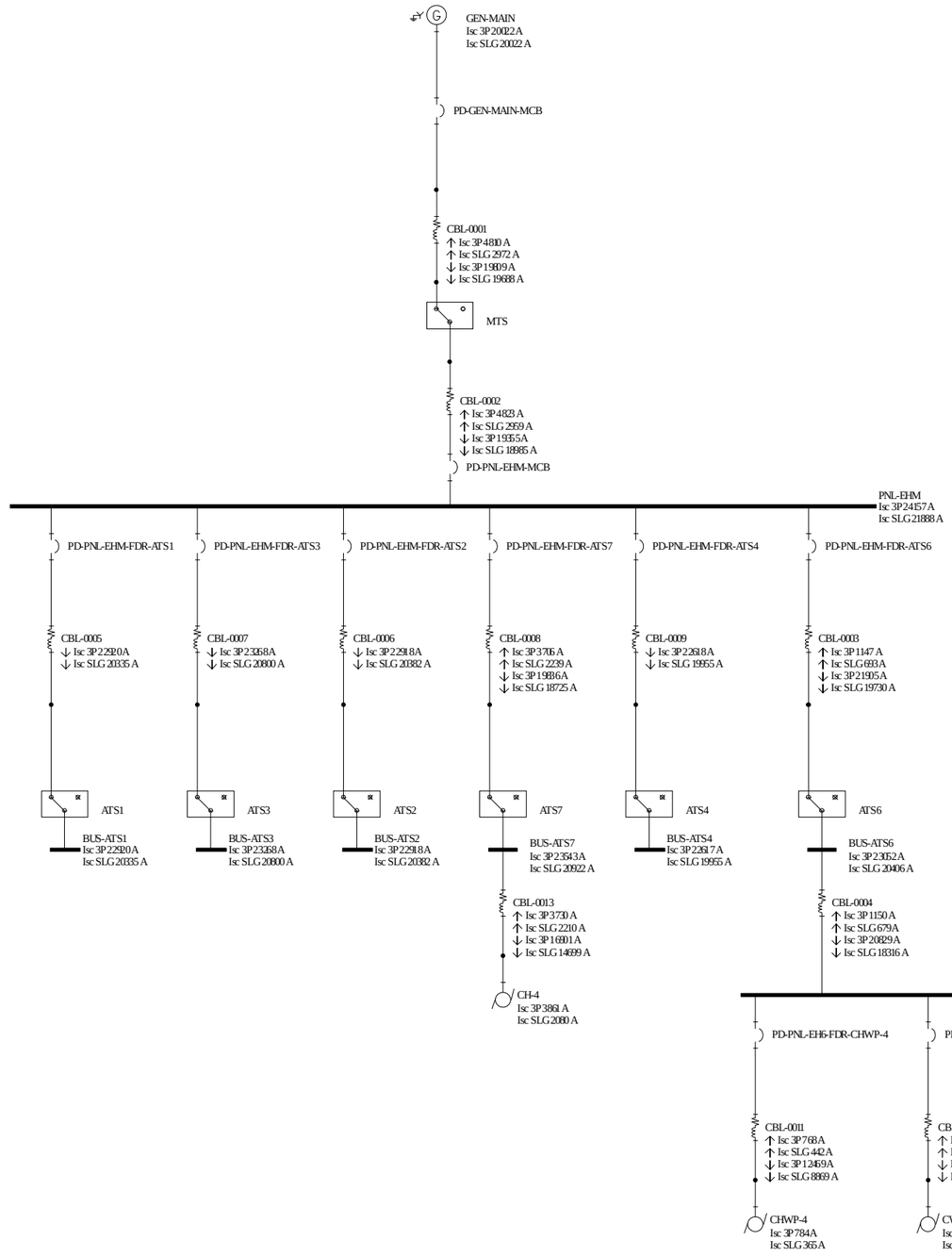
CBL-0018
CBL-0017
CBL-0010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CBL-0001
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Isc 3P 19809 A
Isc SLG 19688 A
MTS
CBL-0002
Isc 3P 4823 A
Isc SLG 2959 A
Isc 3P 19365 A
Isc SLG 18885 A
PD-PNL-EHM-MCB
PNL-EHM
Isc 3P 24157 A
Isc SLG 21888 A
PD-PNL-EHM-FDR-ATS1
PD-PNL-EHM-FDR-ATS3
PD-PNL-EHM-FDR-ATS2
PD-PNL-EHM-FDR-ATS7
PD-PNL-EHM-FDR-ATS4
PD-PNL-EHM-FDR-ATS6
CBL-0005
Isc 3P 22920 A
Isc SLG 20335 A
CBL-0007
Isc 3P 23058 A
Isc SLG 20800 A
CBL-0006
Isc 3P 22918 A
Isc SLG 20382 A
CBL-0008
Isc 3P 3706 A
Isc SLG 2239 A
Isc 3P 19836 A
Isc SLG 18725 A
CBL-0009
Isc 3P 22618 A
Isc SLG 19955 A
CBL-0003
Isc 3P 1147 A
Isc SLG 693 A
Isc 3P 21905 A
Isc SLG 19730 A
ATS1
BUS-ATS1
Isc 3P 22920 A
Isc SLG 20335 A
ATS3
BUS-ATS3
Isc 3P 23058 A
Isc SLG 20800 A
ATS2
BUS-ATS2
Isc 3P 22918 A
Isc SLG 20382 A
ATS7
BUS-ATS7
Isc 3P 23543 A
Isc SLG 20922 A
CBL-0013
Isc 3P 3730 A
Isc SLG 2210 A
Isc 3P 16901 A
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CH-4
Isc 3P 3861 A
Isc SLG 2080 A
ATS4
BUS-ATS4
Isc 3P 22617 A
Isc SLG 19955 A
ATS6
BUS-ATS6
Isc 3P 23052 A
Isc SLG 20406 A
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CHWP-4
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CWP-4
Isc 3P 392 A
Isc SLG 208 A

Project: MSCGenerator

DAPPER Fault Contribution Complete Report

Comprehensive Short Circuit Study Settings

Three Phase Fault	Yes	**Faulted Bus**	All Buses
Single Line to Ground	Yes	**Bus Voltages**	First Bus From Fault
Line to Line Fault	No	**Branch Currents**	First Branch From Fault
Line to Line to Ground	No	**Phase or Sequence**	Report phase quantities
Motor Contribution	Yes	**Fault Current Calculation**	Asymmetrical RMS (with DC offset and Decay)
Transformer Tap	Yes	**Asym Fault Current at Time**	0.50 **Cycles**
Xformer Phase Shift	Yes		

			Initial Symmetrical Amps				Asymmetrical Amps				Init Sym Neutral Amps	
Bus Name	**Contributions**		**3 Phase**	**SLG**	**LLG**	**LL**	**3 Phase**	**SLG**	**LLG**	**LL**	**SLG**	**LLG**
BUS-ATS1			**22,920**	**20,335**	**0**	**0**	**30,078**	**25,557**	**0**	**0**		
BUS-ATS2			**22,918**	**20,382**	**0**	**0**	**31,699**	**27,574**	**0**	**0**		
BUS-ATS3			**23,268**	**20,800**	**0**	**0**	**32,384**	**28,402**	**0**	**0**		
BUS-ATS4			**22,617**	**19,955**	**0**	**0**	**29,118**	**24,461**	**0**	**0**		
BUS-ATS6			**23,052**	**20,406**	**0**	**0**	**30,465**	**25,738**	**0**	**0**		
	CBL-0004 CABLE	In	1,150	679	0	0	1,520	856	0	0		
BUS-ATS7			**23,543**	**20,922**	**0**	**0**	**32,761**	**28,269**	**0**	**0**		
	CBL-0013 CABLE	In	3,730	2,210	0	0	5,191	2,986	0	0		
PNL-EH6			**21,982**	**18,980**	**0**	**0**	**27,238**	**22,034**	**0**	**0**		
	CBL-0012 CABLE	In	385	222	0	0	477	257	0	0		
	CBL-0011 CABLE	In	768	442	0	0	952	513	0	0		
	CBL-0004 CABLE	In	20,829	18,316	0	0	25,810	21,264	0	0	18,980	
PNL-EHM			**24,157**	**21,888**	**0**	**0**	**34,788**	**31,495**	**0**	**0**		
	CBL-0006 CABLE	In	0	0	0	0	0	0	0	0		

Bus Name	---------Contributions---------		----------Initial Symmetrical Amps---------- 3 Phase	SLG	LLG	LL	----------Asymmetrical Amps---------- 3 Phase	SLG	LLG	LL	---Init Sym Neutral Amps--- SLG	LLG
	CBL-0005 CABLE	In	0	0	0	0	0	0	0	0		
	CBL-0009 CABLE	In	0	0	0	0	0	0	0	0		
	CBL-0007 CABLE	In	0	0	0	0	0	0	0	0		
	CBL-0003 CABLE	In	1,147	693	0	0	1,651	997	0	0		
	CBL-0008 CABLE	In	3,706	2,239	0	0	5,337	3,221	0	0		
	CBL-0002 CABLE	In	19,355	18,985	0	0	27,872	27,318	0	0	21,888	

Appendix D – Mechanical Calculations

Cooling and Heating Load Calculation

Design Weather Parameters & MSHGs

Design Parameters:

City Name	**Baltimore**	
Location	**Maryland**	
Latitude	**39.2**	Deg.
Longitude	**76.7**	Deg.
Elevation	**154.0**	ft
Summer Design Dry-Bulb	**93.0**	°F
Summer Coincident Wet-Bulb	**75.0**	°F
Summer Daily Range	**18.8**	°F
Winter Design Dry-Bulb	**11.0**	°F
Winter Design Wet-Bulb	**8.6**	°F
Atmospheric Clearness Number	**1.00**	
Average Ground Reflectance	**0.20**	
Soil Conductivity	**0.800**	BTU/(hr·ft·°F)
Local Time Zone (GMT +/- N hours)	**5.0**	hours
Consider Daylight Savings Time	**No**	
Simulation Weather Data	**N/A**	
Current Data is	**2001 ASHRAE Handbook**	
Design Cooling Months	**January to December**	

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in BTU/(hr·ft²))

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	19.9	19.9	19.9	83.1	153.9	210.8	240.9	250.7	253.7
February	24.3	24.3	47.8	131.8	190.2	234.0	248.2	244.2	239.0
March	29.1	29.1	102.3	166.2	219.3	238.4	236.0	215.6	202.9
April	33.8	67.9	142.1	194.8	219.4	224.8	200.1	167.9	149.0
May	37.1	103.1	163.5	206.7	219.0	206.8	170.1	128.8	107.0
June	46.7	113.7	171.1	208.4	214.5	197.7	156.5	112.2	90.7
July	38.1	99.0	163.2	202.4	212.3	202.8	167.1	125.8	104.7
August	35.5	66.2	138.6	186.6	213.6	216.8	193.9	162.4	144.4
September	30.1	30.1	96.7	156.2	206.1	229.2	225.8	208.3	195.5
October	25.1	25.1	53.4	118.9	186.2	223.8	241.4	237.6	231.1
November	20.2	20.2	20.2	84.1	150.2	205.2	237.5	249.4	248.6
December	17.9	17.9	17.9	65.8	135.4	196.6	231.7	248.4	252.0
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	253.6	243.0	205.2	156.3	81.7	19.9	19.9	137.1	1.00
February	243.9	248.3	235.2	191.0	128.3	54.4	24.3	183.6	1.00
March	213.9	232.4	240.5	214.0	171.2	100.0	29.1	225.2	1.00
April	166.9	199.0	224.0	221.6	195.6	139.7	72.0	252.4	1.00
May	128.1	171.1	206.0	220.1	206.4	161.8	104.3	265.0	1.00
June	110.8	158.3	195.4	216.7	207.0	168.6	116.0	267.7	1.00
July	124.3	167.8	199.8	216.3	201.6	159.1	104.4	262.8	1.00
August	160.9	192.3	215.9	213.9	188.9	135.6	71.3	248.2	1.00
September	208.4	226.0	228.9	206.5	155.1	96.7	30.1	216.2	1.00
October	237.5	240.9	223.1	185.1	125.2	46.8	25.1	179.5	1.00
November	248.3	234.2	207.1	147.2	84.6	20.2	20.2	135.4	1.00
December	250.0	230.6	196.4	130.6	67.7	17.9	17.9	116.0	1.00

Mult. = User-defined solar multiplier factor.

Zone Sizing Summary for Electrical Distribution rm FCU

Project Name: MSC_Generator
Prepared by: AECOM

11/11/2021
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Air System Information

Air System Name ..... **Electrical Distribution rm FCU**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **275.0** ft²
Location ..... **Baltimore, Maryland**

Sizing Calculation Information

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone CFM Sizing ..... **Sum of space airflow rates**
Space CFM Sizing ..... **Individual peak space loads**

Terminal Unit Sizing Data - Cooling

Zone Name	Total Coil Load (MBH)	Sens Coil Load (MBH)	Coil Entering DB / WB (°F)	Coil Leaving DB / WB (°F)	Water Flow @ 10.0 °F (gpm)	Time of Peak Coil Load	Zone CFM/ft²
Main Elect Rm M02	8.6	8.6	77.0 / 46.8	58.9 / 37.7	1.73	Jul 2000	1.61

Terminal Unit Sizing Data - Heating, Fan, Ventilation

Zone Name	Heating Coil Load (MBH)	Heating Coil Ent/Lvg DB (°F)	Htg Coil Water Flow @20.0 °F (gpm)	Fan Design Airflow (CFM)	Fan Motor (BHP)	Fan Motor (kW)	OA Vent Design Airflow (CFM)
Main Elect Rm M02	4.1	70.8 / 79.4	0.41	443	n/a	0.133	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
Main Elect Rm M02	8.1	Jul 2100	4.4	275.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Main Elect Rm M02							
M04 Distribution room	1	8.1	Jul 2100	443	4.4	275.0	1.61

Air System Design Load Summary for Electrical Distribution rm FCU

Project Name: MSC_Generator
Prepared by: AECOM

11/11/2021
06:26PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 2000 COOLING OA DB / WB 84.2 °F / 72.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 11.0 °F / 8.6 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	668 ft²	695	-	668 ft²	2301	-
Roof Transmission	275 ft²	600	-	275 ft²	1013	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	275 ft²	0	-	275 ft²	658	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	275 W	938	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1500 W	5118	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	735	0	10%	397	0
>> Total Zone Loads	**-**	**8086**	**0**	**-**	**4369**	**0**
Zone Conditioning	-	8176	0	-	4566	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	0 CFM	0	0	0 CFM	0	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	454	-	-	-454	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**8630**	**0**	**-**	**4112**	**0**
Terminal Unit Cooling	-	8630	0	-	0	0
Terminal Unit Heating	-	0	-	-	4112	-
>> Total Conditioning	**-**	**8630**	**0**	**-**	**4112**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

M04 Distribution room

1. General Details:

Floor Area ..... **275.0** ft²
Avg. Ceiling Height ..... **9.0** ft
Building Weight ..... **70.0** lb/ft²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **0.0** CFM/person
OA Requirement 2 ..... **0.00** CFM/ft²
Space Usage Defaults ..... **ASHRAE Standard 62.1-2010**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Recessed (Unvented)**
Wattage ..... **1.00** W/ft²
Ballast Multiplier **1.00**
Schedule ..... **Lighrting**

2.2. Task Lighting:

Wattage ..... **0.00** W/ft²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **1500.0** Watts
Schedule ..... **Equipment**

2.4. People:

Occupancy ..... **0.0** Person
Activity Level ..... **Office Work**
Sensible ..... **245.0** BTU/hr/person
Latent ..... **205.0** BTU/hr/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** BTU/hr
Schedule ..... **None**
Latent ..... **0** BTU/hr
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
W	380.0	0	0	0
N	288.0	0	0	0

3.1. Construction Types for Exposure W

Wall Type ..... **Existing Wall Assembly**

3.2. Construction Types for Exposure N

Wall Type ..... **Existing Wall Assembly**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	275.0	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Existing Roof Assembly**

5. Infiltration:

Design Cooling ..... **0.00** CFM
Design Heating ..... **0.00** CFM
Energy Analysis ..... **0.00** CFM
Infiltration occurs only when the fan is off.

6. Floors:

Type ..... **Slab Floor On Grade**
Floor Area ..... **275.0** ft²
Total Floor U-Value ..... **0.100** BTU/(hr·ft²·°F)
Exposed Perimeter ..... **33.0** ft
Edge Insulation R-Value ..... **0.00** (hr·ft²·°F)/BTU

7. Partitions:

(No partition data).

Wall Constructions

Existing Wall Assembly

Wall Details

Outside Surface Color ..... **Medium**
Absorptivity **0.675**
Overall U-Value ..... **0.058** BTU/(hr·ft²·°F)

Wall Layers Details (Inside to Outside)

Layers	Thickness in	Density lb/ft³	Specific Ht. BTU / (lb·°F)	R-Value (hr·ft²·°F)/BTU	Weight lb/ft²
Inside surface resistance	0.000	0.0	0.00	0.68500	0.0
8-in HW concrete block	8.000	61.0	0.20	1.11111	40.7
R-14 board insulation	2.000	2.0	0.22	13.88889	0.3
8-in HW concrete block	8.000	61.0	0.20	1.11111	40.7
Outside surface resistance	0.000	0.0	0.00	0.33300	0.0
Totals	**18.000**	**-**		**17.12911**	**81.7**

FUEL OIL PUMP AND PIPING SIZING CALCULATION

Preferred Utilities Mfg Corp

Prepared for: AECOM
Project: MSC GENERATOR DESIGN
Contact: VENEFREDO DE LEON
Email: venefredo.deleon@aecom.com

Pump:	Custom Application Actual: 600 GPH
Altitude:	0 Ft.
Fluid:	#2 Fuel Oil
S.G.	0.887

Suction

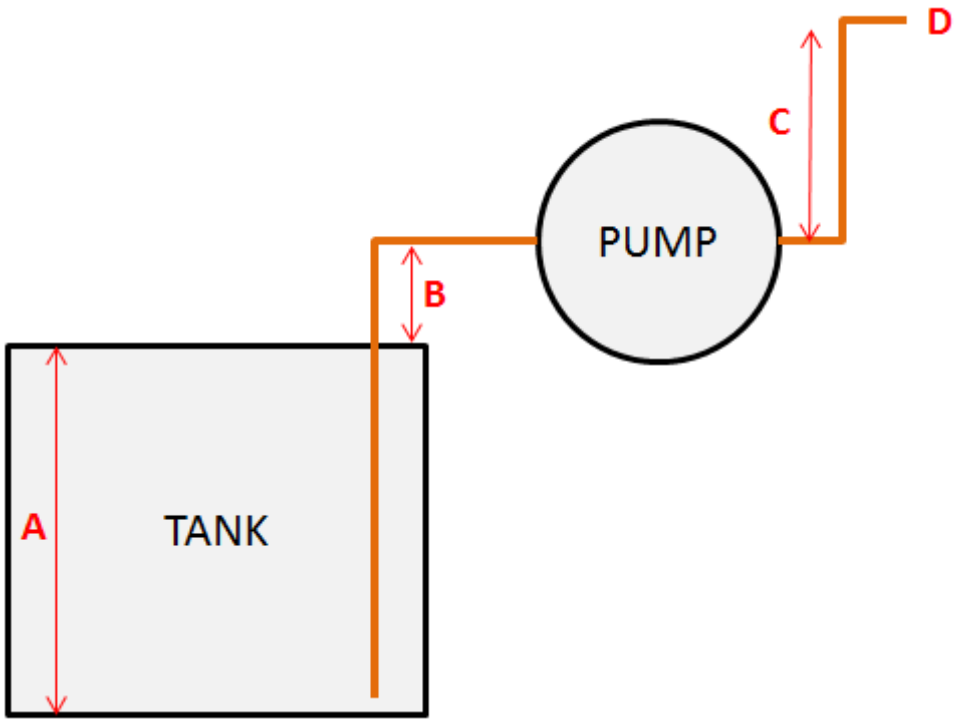
Temp:	60°F
Viscosity:	45 SSU

Discharge

Temp:	60°F
Viscosity:	45 SSU

Tank Below Pump

The storage tank is below the centerline of the pump. The piping never runs above the centerline of the pump, before connecting to the pump.



A. Tank Height, feet	8
B. Top of Tank to Pump centerline, feet	10
C. Pump Discharge to User Elevation, feet	12
D. Pressure required at User, PSIG	3

SUCTION

Primary Pipe:	2" Type 40 Commercial or Welded Steel Pipe
Temperature:	60°F
Viscosity:	45 SSU
Specific Gravity:	0.887
Altitude:	0 ft.
Piping Friction Loss:	0.11 "Hg
Fitting Friction Loss:	0.60 "Hg
Strainer Friction Loss:	0.06 "Hg
Anti-Siphon Loss:	0.00 "Hg
Static Lift:	14.07 "Hg
Pump Suction:	14.84 "Hg
Priming Static Lift:	14.07 "Hg
Primary Velocity:	0.96 ft/s
NPSHa (Available):	18.02 ft of oil
NPSHa (Required):	unkown ft of oil

DISCHARGE

Primary Pipe:	2" Type 40 Commercial or Welded Steel Pipe
Temperature:	60°F
Viscosity:	45 SSU
Required End Pressure:	3.00 psig
Piping Friction Loss:	0.13 psig
Fitting Friction Loss:	0.28 psig
Strainer Loss:	0.30 psig
Static Head:	4.61 psig
Pump Pressure:	8.32 psig
Primary Velocity:	0.96 ft/s

Pipe & Fitting Data

Suction

Pipe:	Primary	Secondary
Size (in.)	2"	
Type	40	
Length (ft.)	40	
Strainer:		

Size	Simplex	
Mesh	40 Mesh	
Fittings:		
90 deg Elbow	10	0
45 deg Elbow	0	0
Tee-flow thru run	0	0
Tee-flow thru branch	0	0
Single Poppet Foot Valve	1	0
Double Poppet Foot Valve	0	0
Hinged Foot Valve	0	0
Lever Gate Valve	0	0
Tank Selector Valve	0	0
Fusomatic Valve 3/4" or 1"	0	0
Gate Valve	2	0
Globe Valve	0	0
Ball Valve	0	0
Swing Check Valve	0	0
Lift Check Valve	1	0

Discharge

Pipe:	Primary	Secondary
Size (in.)	2"	
Type	40	
Length (ft.)	100	
Strainer:		
Size	Simplex	
Mesh	40 Mesh	
Fittings:		
90 deg Elbow	10	0
45 deg Elbow	0	0
Tee-flow thru run	1	0
Tee-flow thru branch	0	0
Single Poppet Foot Valve		
Double Poppet Foot Valve		
Hinged Foot Valve		
Lever Gate Valve	0	0
Tank Selector Valve	0	0
Fusomatic Valve 3/4" or 1"	0	0
Gate Valve	0	0
Globe Valve	1	0

Ball Valve	1	0
Swing Check Valve	0	0
Lift Check Valve	1	0

Appendix E – Cutsheets

ELECTRICAL CUTSHEETS

GENERATOR CUTSHEET

Model: 2000REOZMD

KOHLER. Power Systems

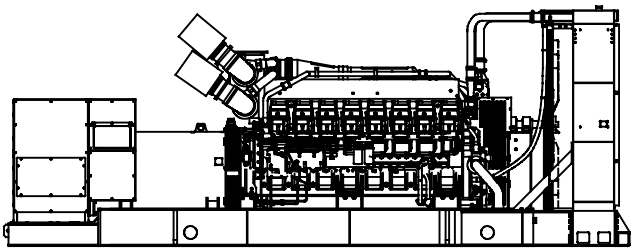
380–4160 V **Diesel**

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

Tier 2 EPA-Certified for Stationary Emergency Applications

Ratings Range

		60 Hz
Standby:	**kW**	1590–2000
	kVA	1988–2500
Prime:	**kW**	1440–1820
	kVA	1800–2275



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A standard one-year limited warranty covers all systems and components. Two-, five-, and ten-year extended warranties are also available.
- Alternator features:
  - The pilot-excited, permanent magnet (PM) alternator provides superior short-circuit capability.
  - Additional alternator voltages are available including 12.47 kV, 13.2 kV, and 13.8 kV medium voltages. Contact your local distributor for more detailed information.
  - The brushless, rotating-field alternator has broadrange reconnectability.
- Other features:
  - Kohler designed controllers for guaranteed system integration and remote communication. See Controllers on page 3.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).
  - An electronic, isochronous governor delivers precise frequency regulation.
  - Multiple circuit breaker configurations.

Generator Set Ratings

				150°C Rise Standby Rating		130°C Rise Standby Rating		125°C Rise Prime Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
	220/380	3	60	1590/1988	3020	1590/1988	3020	1440/1800	2735	1440/1800	2735
7M4054	240/416	3	60	1840/2300	3192	1840/2300	3192	1800/2250	3123	1680/2100	2915
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
	220/380	3	60	1850/2313	3513	1790/2238	3400	1750/2188	3324	1650/2063	3134
7M4056	240/416	3	60	2000/2500	3470	1950/2438	3383	1820/2275	3157	1780/2225	3088
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
	220/380	3	60	2000/2500	3798	1950/2438	3703	1820/2275	3457	1790/2238	3400
7M4058	240/416	3	60	2000/2500	3470	2000/2500	3470	1820/2275	3157	1820/2275	3157
	277/480	3	60	2000/2500	3007	2000/2500	3007	1820/2275	2736	1820/2275	2736
7M4176	220/380	3	60	2000/2500	3798	2000/2500	3798	1820/2275	3457	1820/2275	3457
7M4292	347/600	3	60	2000/2500	2406	2000/2500	2406	1820/2275	2189	1820/2275	2189
7M4374	2400/4160	3	60	2000/2500	347	2000/2500	347	1820/2275	316	1820/2275	316

RATINGS: All three-phase units are rated at 0.8 power factor. *Standby Ratings:* The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Alternator Specifications

Specifications		Alternator
Type		4-Pole, Rotating-Field
Exciter type		Brushless, Permanent-Magnet Pilot Exciter
Voltage regulator		Solid State, Volts/Hz
Insulation:		NEMA MG1
Material		Class H, Synthetic, Nonhygroscopic
Temperature rise		130°C, 150°C Standby
Bearing: quantity, type		1, Sealed
Coupling		Flexible Disc
Amortisseur windings		Full
Rotor balancing		125%
Voltage regulation, no-load to full-load		Controller Dependent
One-step load acceptance		100% of Rating
Unbalanced load capability		100% of Rated Standby Current
Peak motor starting kVA:		(35% dip for voltages below)
480 V	7M4054 (4 bus bar)	7000
480 V	7M4056 (4 bus bar)	7200
480 V	7M4058 (4 bus bar)	11000
380 V	7M4176 (4 bus bar)	5400
600 V	7M4292 (4 bus bar)	4250
4160 V	7M4374 (6 lead)	6200

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from two-thirds pitch windings and skewed stator.
- Digital solid-state, volts-per-hertz voltage regulator with ±0.25% no-load to full-load regulation.
- Brushless alternator with brushless pilot exciter for excellent load response.

Application Data

Engine

Engine Specifications	
Manufacturer	Mitsubishi
Engine model	S16R-Y2PTAW2-1
Engine type	4-Cycle, Turbocharged
Cylinder arrangement	16 V
Displacement, L (cu. in.)	65.4 (3989)
Bore and stroke, mm (in.)	170 x 180 (6.69 x 7.09)
Compression ratio	14.0:1
Piston speed, m/min. (ft./min.)	648 (2126)
Main bearings: quantity, type	9, Precision Half-Shell
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	2180 (2923)
Cylinder head material	Cast Iron
Crankshaft material	Forged Steel
Governor type	Electronic
Frequency regulation, no-load to full-load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Exhaust

Exhaust System	
Exhaust manifold type	Dry
Exhaust flow at rated kW, m^3/min. (cfm)	544 (19209)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	526 (979)
Maximum allowable back pressure, kPa (in. Hg)	5.1 (1.5)
Exhaust outlet size at engine hookup, mm (in.)	See ADV drawing

Engine Electrical

Engine Electrical System	
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	24
Ampere rating	30
Starter motor rated voltage (DC)	Dual, 24
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating each	Four, 1150
Battery voltage (DC)	12

Fuel

Fuel System	
Fuel supply line, min. ID, mm (in.)	19 (0.75)
Fuel return line, min. ID, mm (in.)	19 (0.75)
Max. lift, engine-driven fuel pump, m (ft.)	1.0 (3.0)
Max. fuel flow, Lph (gph)	660 (174)
Max. fuel pump restriction, kPa (in. Hg)	10 (3.0)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel filter: quantity, type	4, Secondary
Recommended fuel	#2 Diesel

Lubrication

Lubricating System	
Type	Full Pressure
Oil pan capacity, L (qt.)	200 (211)
Oil pan capacity with filter, L (qt.)	230 (243)
Oil filter: quantity, type	4, Cartridge
Oil cooler	Water-Cooled

Application Data

Cooling

Radiator System	
Ambient temperature, °C (°F)*	40 (104)
Engine jacket water capacity, L (gal.)	170 (44.9)
Radiator system capacity, including engine, L (gal.)	367 (96.9)
Engine jacket water flow, Lpm (gpm)	1850 (489)
Charge cooler water flow, Lpm (gpm)	920 (243)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Heat rejected to charge cooler water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2057 (81)
Fan kWm (HP)	81 (109)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

High Ambient Radiator System	
Ambient temperature, °C (°F)*	50 (122)
Engine jacket water capacity, L (gal.)	170 (44.9)
Radiator system capacity, including engine, L (gal.)	386 (102)
Engine jacket water flow, Lpm (gpm)	1850 (489)
Charge cooler water flow, Lpm (gpm)	920 (243)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Heat rejected to charge cooler water at rated kW, dry exhaust, kW (Btu/min.)	780 (44374)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	2362 (93)
Fan kWm (HP)	63 (84)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure with enclosed silencer reduces ambient temperature capability by 5°C (9°F).

Remote Radiator System†	
Exhaust manifold type	Dry
Connection sizes:	
Jacket water engine inlet, mm (in.)	95 (3.75)
Jacket water engine outlet, mm (in.)	95 (3.75)
Intercooler water engine inlet, mm (in.)	83 (3.25)
Intercooler water engine outlet, mm (in.)	83 (3.25)
Static head allowable above engine, kPa (ft. H_2O)	98 (32.8)

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

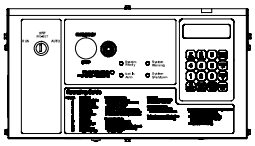
Operation Requirements

Air Requirements	
Radiator-cooled cooling air, m^3/min. (scfm)‡	2209 (78000)
High ambient radiator-cooled cooling air, m^3/min. (scfm)‡	2718 (96000)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise, m^3/min. (scfm)‡	991 (35100)
Combustion air, m^3/min. (cfm)	206 (7274)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	180 (10240)
Alternator, kW (Btu/min.)	97 (5516)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Fuel Consumption	
Diesel, Lph (gph) at % load	**Standby Rating**
100%	606 (160.1)
75%	442 (116.8)
50%	299 (79.0)
25%	164 (43.2)
Diesel, Lph (gph) at % load	**Prime Rating**
100%	536 (141.6)
75%	403 (106.6)
50%	271 (71.6)
25%	154 (40.6)

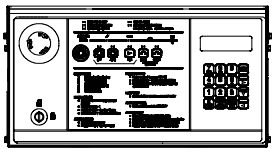
Controllers



Decision-Maker® 550 Controller
Provides advanced control, system monitoring, and system diagnostics with remote monitoring capabilities.

- Digital display and keypad provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or modem configuration
- Controller supports Modbus® protocol
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-46 for additional controller features and accessories.



Decision-Maker® 6000 Paralleling Controller
Provides advanced control, system monitoring, and system diagnostics with remote monitoring capabilities for paralleling multiple generator sets.

- Paralleling capability with first-on logic, synchronizer, kW and kVAR load sharing, and protective relays
- Digital display and keypad provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or modem configuration
- Controller supports Modbus® protocol
- Integrated voltage regulator with ±0.25% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-107 for additional controller features and accessories.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the
US and Canada, phone 1-800-544-2444
KOHLERPower.com

Kohler Power Systems
Asia Pacific Headquarters
7 Jurong Pier Road
Singapore 619159
Phone (65) 6264-6422, Fax (65) 6264-6455

Standard Features

- Alternator Protection
- Alternator Strip Heater (standard on 3300 volt and above)
- Customer Connection
  (standard with Decision-Maker® 6000 controller only)
- Local Emergency Stop Switch
- Oil Drain Extension
- Operation and Installation Literature
- Radiator Core Guard

Available Options

Approvals and Listings

- ❑ California OSHPD Approval
- ❑ CSA Approval
- ❑ IBC Seismic Certification
- ❑ UL 2200 Listing

Enclosed Unit

- ❑ Sound Enclosure/Fuel Tank Package
- ❑ Weather Enclosure/Fuel Tank Package

Open Unit

- ❑ Exhaust Silencer, Hospital (kit: PA-361627)
- ❑ Exhaust Silencer, Critical (kit: PA-361625)
- ❑ Flexible Exhaust Connector, Stainless Steel

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Fuel Pressure Gauge
- ❑ Fuel/Water Separator
- ❑ High Altitude Kit
  Required for Operating in Altitudes Above 1500 m (4921 ft.)

Controller

- ❑ Common Failure Relay
- ❑ Communication Products and PC Software
- ❑ Customer Connection
  (Decision-Maker® 550 controller only)
- ❑ Decision-Maker® Paralleling System (DPS)
  (Decision-Maker® 6000 controller only)
- ❑ Dry Contact (isolated alarm)
- ❑ Prime Power Switch
- ❑ Remote Audiovisual Alarm Panel
  (Decision-Maker® 550 controller only)
- ❑ Remote Emergency Stop
- ❑ Remote Mounting Cable
- ❑ Remote Serial Annunciator Panel
- ❑ Run Relay

Cooling System

- ❑ Block Heater; 9000 W, 208 V, 1 Ph
- ❑ Block Heater; 9000 W, 240 V, (Select 1 Ph or 3 Ph)
- ❑ Block Heater; 9000 W, 380 V, 3 Ph
- ❑ Block Heater; 9000 W, 480 V, (Select 1 Ph or 3 Ph)
  Recommended for Ambient Temperatures Below 20°C (68°F)
- ❑ High Ambient Radiator
- ❑ Remote Radiator Cooling Setup

Electrical System

- ❑ Alternator Strip Heater (available up to 600 volt)
- ❑ Battery
- ❑ Battery Charger, Equalize/Float Type
- ❑ Battery Heater
- ❑ Battery Rack and Cables
- ❑ Line Circuit Breaker (NEMA type 1 enclosure)
- ❑ Line Circuit Breaker with Shunt Trip (NEMA type 1 enclosure)

Paralleling System

- ❑ Remote Voltage Adjustment Control
- ❑ Voltage Sensing (Decision-Maker® 6000 controller only)

Miscellaneous

- ❑ Air Cleaner, Heavy Duty
- ❑ Air Cleaner Restriction Indicator
- ❑ Crankcase Emission Canister
- ❑ Engine Fluids (oil and coolant) Added
- ❑ Oil Temperature Gauge
- ❑ Rated Power Factor Testing
- ❑ Spring Isolators

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Warranty

- ❑ 2-Year Basic
- ❑ 2-Year Prime
- ❑ 5-Year Basic
- ❑ 5-Year Comprehensive
- ❑ 10-Year Major Components

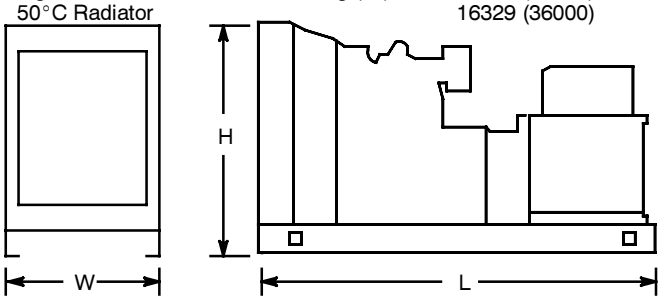
Other Options

- ❑ _____
- ❑ _____

Dimensions and Weights

Overall Size, L x W x H, max., mm (in.):

40°C Radiator	6790 x 2426 x 2602 (267.3 x 95.5 x 102.4)
50°C Radiator	6831 x 2766 x 3091 (268.9 x 108.9 x 121.7)
Weight 40°C Radiator, wet, max., kg (lb.):	15422 (34000)
50°C Radiator	16329 (36000)



Note: This drawing is provided for reference only and should not be used for planning the installation. Contact your local distributor for more detailed information.

DISTRIBUTED BY:

GENERATOR LOAD BANK

ASCO Power Technologies™

4000 SERIES
Data Sheet

Model 4800

The ASCO Model 4800 are resistive, AC load banks designed for outdoor installation when up to 3000 kW of resistive load is required.

LOAD BANK RATINGS

Standard capacity ratings of:

- 450 kW
- 500 kW
- 600 kW
- 750 kW
- 1000 kW
- 1250 kW
- 1500 kW
- 1750 kW
- 2000 kW
- 2500 kW
- 3000 kW

Standard load step resolution of either 5 or 50 kW.

Select from standard three phase voltage ratings of:

- 208-60Hz
- 240-60Hz
- 480-60Hz
- 600-60Hz
- 400-50Hz
- 240/480-60Hz*

*NOTE: available up to 1500 kW

Please consult factory for non-standard ratings.

Short Circuit Rating

Standard at 10kA or 100kA

Blower Motor Control

The blower motor(s) are factory wired to the main load bus. If external blower connection is required, the factory installed wired must be removed. Refer to the load bank schematic for specific details.

An external 120V, 1 Phase, 60 Hz supply is required for control circuit operation.

An optional step-down transformer is available to provide the required control power. The transformer receives its power from the blower motor circuit described above.

Cooling System

Approximately 20,000 CFM cooling per individual vertical frame is provided by integral TEFC or TEAO motor which is direct coupled to the cooling fan blade.

The fan motor is fully protected with fuses, motor starter contractor, and overload relay.

Operator Controls

The standard load control for the 4800 is a manual 19" rack mount panel. Controls include: Power On/Off switch, Blower Start/Stop push buttons, Master Load On/Off switch, and Individual Load Step switches. Visual indicators include: Power On, Blower On, and Blower/Air Failure.

Other control options are available, please consult factory.

Construction

The 4800 is constructed using heavy gauge aluminized steel per ASTM A463. It is designed for continuous outdoor weatherproof operation. Forklift channels are provided in the base for lifting.

All exterior fasteners are stainless steel. The main input bus, load step relays, fuses, and blower/control relays are located in the main enclosure. The 4800 load bank is listed to UL standard 508A.

Finish

The 4800 has a high quality baked polyester powder coated finish with a film thickness of 2.8 +/- 0.4 mils per coat. The standard color is gray (ANSI 61).

Two Year Warranty Included

The equipment is covered by an industry exclusive 24-month parts and labor warranty.

Life Is On | Schneider Electric

Model 4800 Specifications

Resistor Elements

ASCO load banks use helically wound chromium alloy Helidyne elements. Elements are fully supported across their entire length by segmented ceramic insulators on stainless steel rods. These elements are designed to operate at approximately 1/2 of their maximum continuous wire rating.

Elements are positioned within the cooling airstream for optimal performance. Changes in resistance due to temperature are minimized by maintaining conservative watt densities.

The overall load tolerance of the 4800 load bank is -0, +5%. This ensures that advertised kW is delivered at rated voltage.

The elements are continuously rated at the specific voltage. Tests at lower voltages, with a corresponding reduction in overall rating, may be carried out.

Safety Features

A differential pressure switch is interlocked with the load application controls to prevent load from being supplied if cooling air is not present.

An overtemperature switch is provide to sense the load bank exhaust. The switch is interlocked with the load application controls to disable load from being supplied if an over-temperature condition is present.

The fan motors are protected with fuses and overloads.

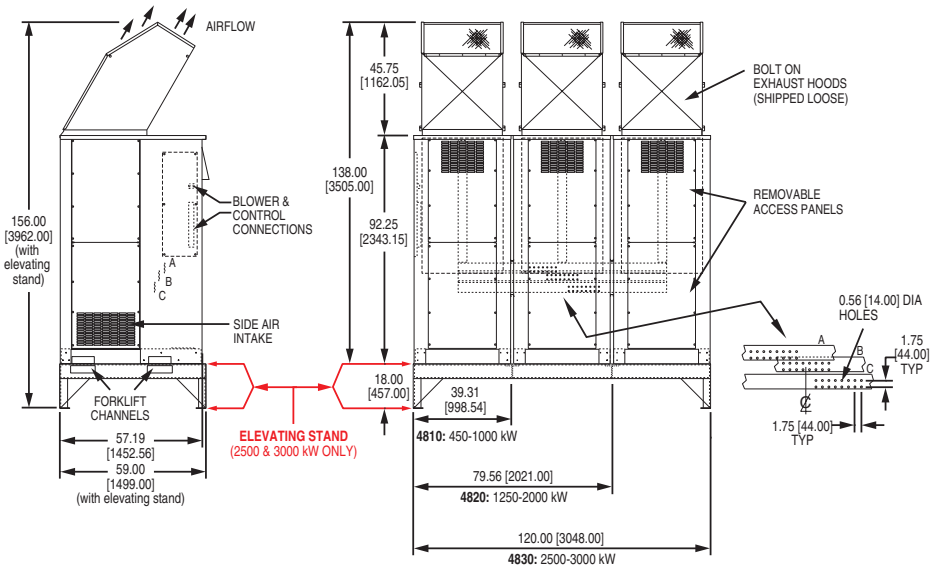
Major fault protection is provided by branch circuit fuse protection. Fuse protection is provided on all load steps.

The exterior of the load bank has appropriate warning and caution statements on access panels.

Internal access is restricted by bolt on exterior panels.

The air intake on the 4800 is designed to prevent objects greater than 0.50" diameter from being ingested into the unit.

Vertical air discharge is provided and exhaust air is directed downward away from personnel.



Model 4810: is a single stack (1 bay) 450 - 1000 kW unit.

Model 4820: is a double stack (2 bay) 1250 - 2000 kW unit.

Model 4830: is a triple stack (3 bay) 2500 - 3000 kW unit, which includes the elevating stand.

All dimensions are in inches [millimeters].
Specifications subject to change without notice.

Ambient Temperature

The 4800 load bank is designed for continuous duty cycle with no limitations. The ambient temperatures range is -20°F to 120°F (-28°C to 50°C).

Mounting

The 4800 is designed for outdoor installation on a concrete pad or structural base.

Power Terminals and Cable Entry

The power terminals are located behind a removable, bolt on access panel. The 4800 has a recommended conduit entry area underneath the power terminal assembly to facilitate load cable installation.

Optional Accessories

- Control Power Transformer
- NEMA 4 Type Control Panel Enclosure
- Automatic Load Control
- Digital Metering with Data Logging
- SIGMA 2 Digital Controls
- Remote I/O Control
- Pilot Relay Control
- PLC Control
- Arctic Rating (low temperature)

Weight and Dimensions

Capacity (kW)	Dimensions (approx. in/mm)			Weight (approx. lb/kg)
	Length	Width	Height	
450-1000	57/1453	40/999	138/3505	1500/680
1250-2000	57/1453	80/2021	138/3505	3000/1360
2500-3000	59/1499	120/3048	156/3962	5500/2495

Documentation - Operating Manual

A comprehensive operator's manual is supplied electronically via a USB drive.

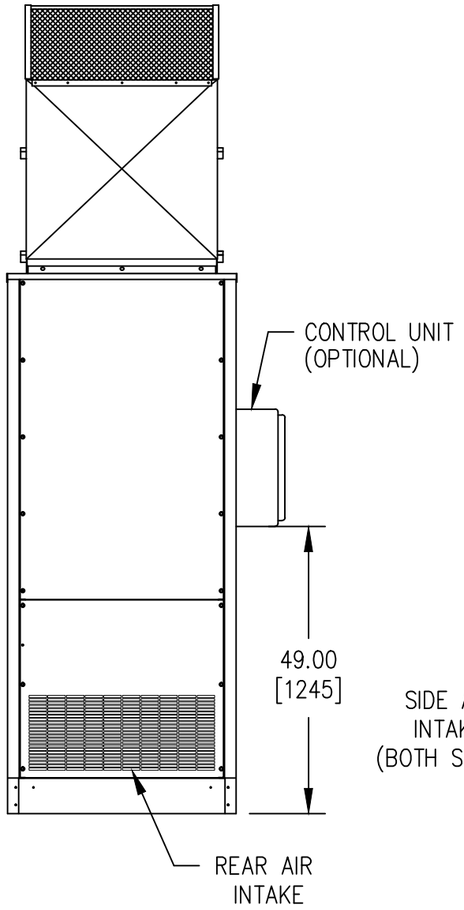
Sections include: Safety, Installation, Operation, Maintenance, and Troubleshooting.

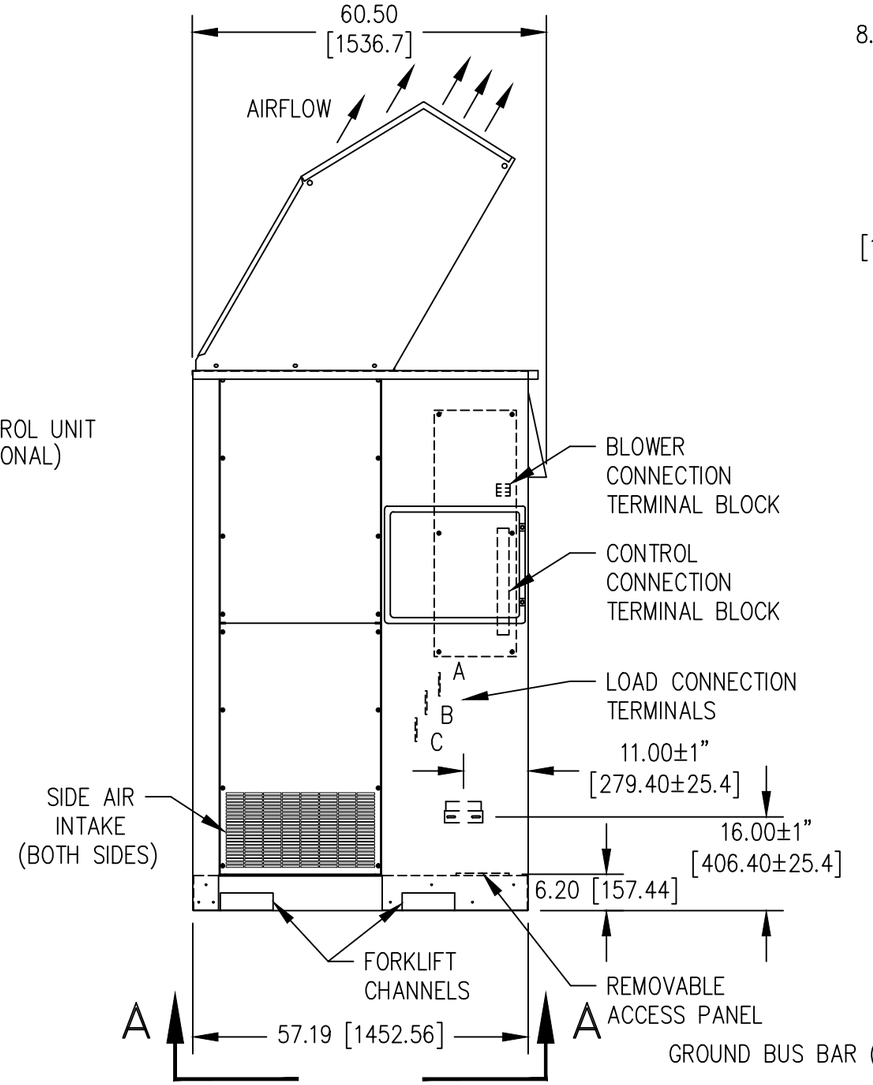
Testing and Standards

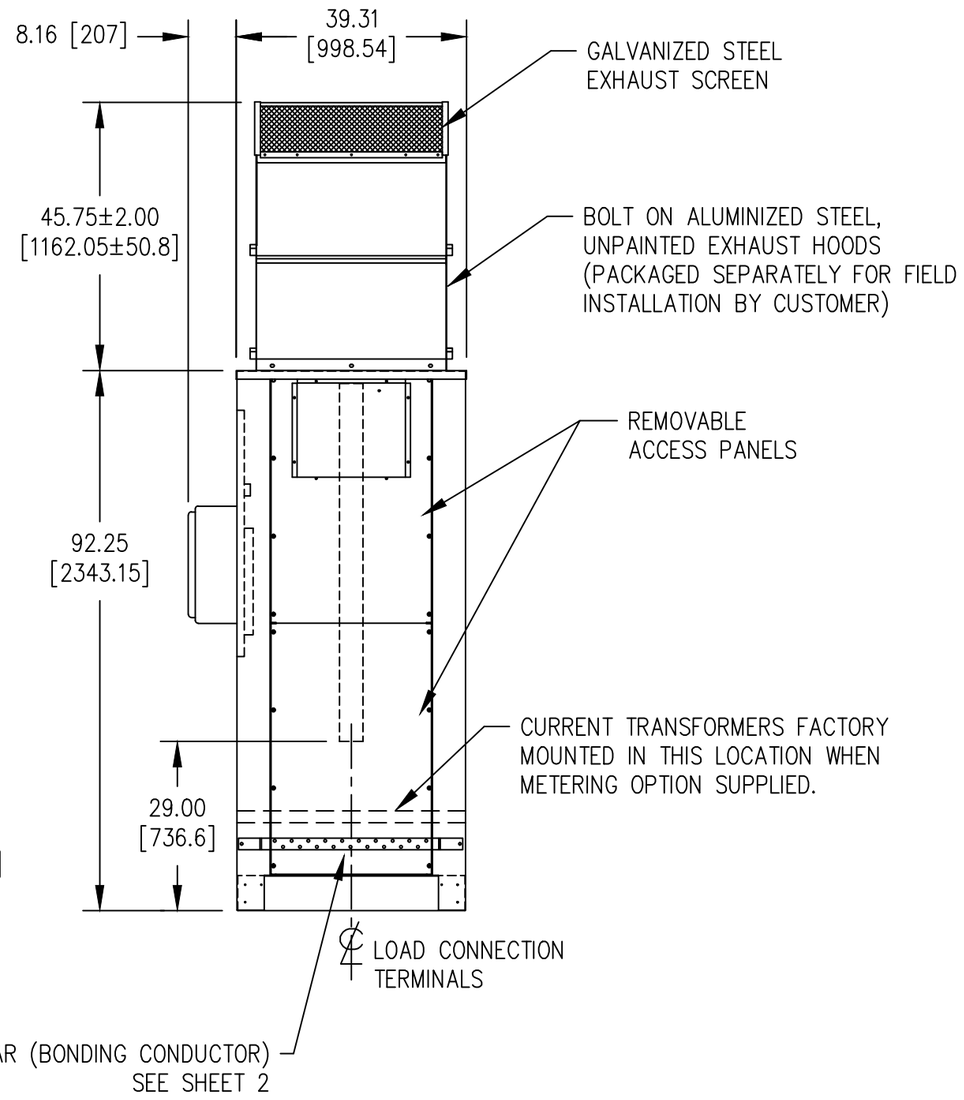
ASCO load banks comply with NEMA, NEC, and ANSI standards. Quality control system is certified to ISO9001 standards.

ASCO Power Technologies
6255 Halle Drive, Cleveland, Ohio 44125, U.S.A.

loadbanks.ascopower.com • LBsales@ascopower.com
customercare@ascopower.com • 1-216-573-7600





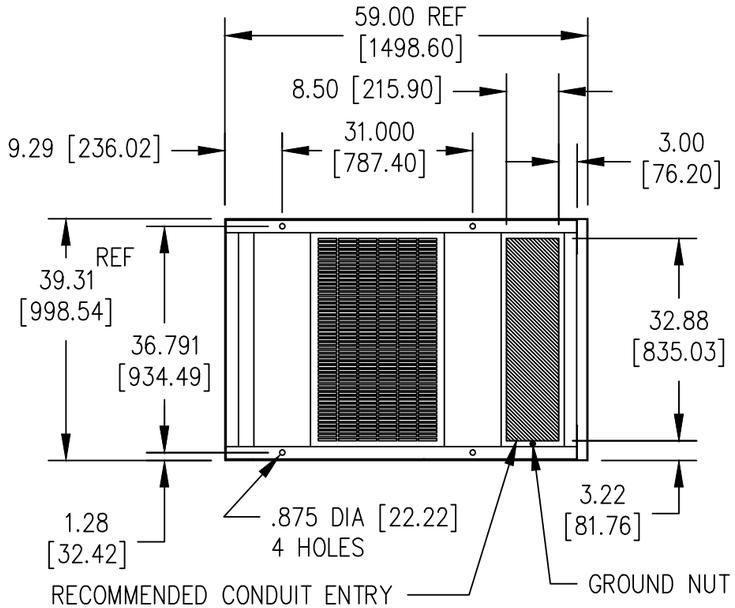


5. AS A GENERAL GUIDE, THE MINIMUM CLEARANCE REQUIRED FROM ANY OBSTRUCTION IS 6 FEET.
4. PROVIDE A CLEAR VERTICAL EXHAUST FIELD. REVIEW MANUAL FOR DETAILED INSTALLATION AND SITE CONDITIONS.
3. MAXIMUM INTAKE AIR TEMPERATURE IS 120°F. INTAKE AIR IS DRAWN IN FROM SIDES, END AND BOTTOM OF UNIT.
2. ALL DIMENSIONS ARE APPROX. IN INCHES [mm]
1. WEIGHT: 1500 LBS APPROX [680 Kg]

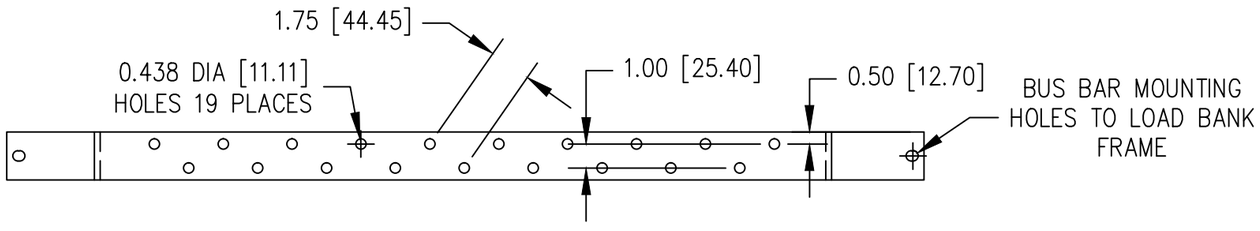
ASCO Power Technologies®

PERMANENT LOAD BANK - SINGLE BAY UNIT
GENERAL REFERENCE OUTLINE DRAWING

Model 4810 1 OF 2 Rev. G



VIEW A—A



GROUND BUS BAR DETAIL

GROUND BUS BAR IS
0.25 [6.35] THICK COPPER

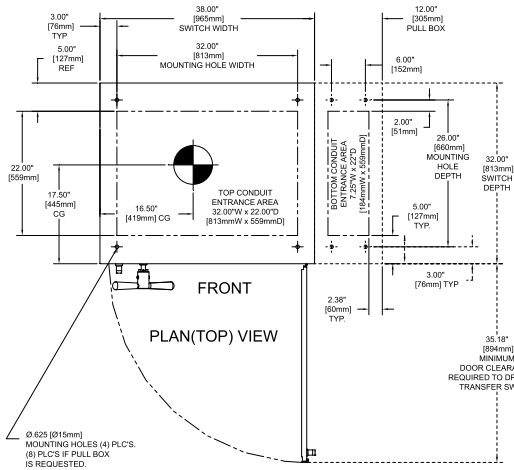
ASCO Power Technologies®

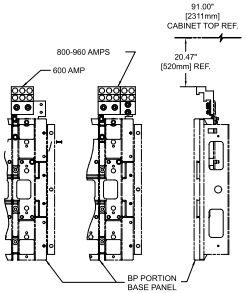
PERMANENT LOAD BANK - SINGLE BAY UNIT
GENERAL REFERENCE OUTLINE DRAWING

Model 4810 2 OF 2 Rev. G

400A – 800A AUTOMATIC TRANSFER SWITCH

OUTLINE & MOUNTING FOR ASCO® 7000 SERIES FRONT CONNECTED AUTOMATIC TRANSFER & BYPASS-ISOLATION SWITCHES TYPES H7ATB, H7ACTB & H7ADTB RATED 600-960 AMPS





800-960 AMPS UTILIZE ONE (6) BARREL AND ONE (4) BARREL 750 MCM MECHANICAL LUGS. THE 600 AMP UTILIZES JUST ONE (6) BARREL 750 MCM MECHANICAL LUG.

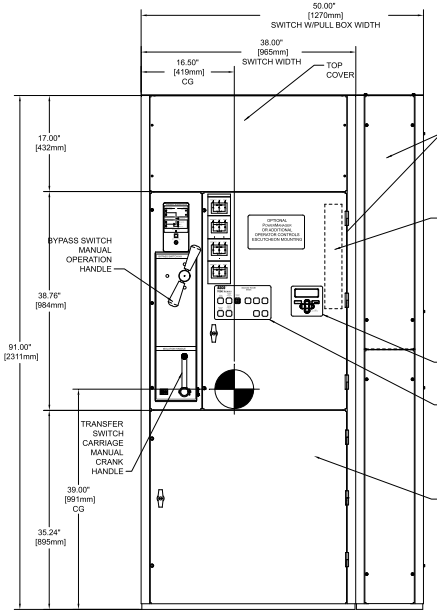
DETAIL "A"
SOLID NEUTRAL

GENERAL NOTES

1. TYPE 1 ENCLOSURE. FREE STANDING. FLOOR MOUNTED. 12 GAUGE FORMED FRAME CONSTRUCTION.
2. NEC STANDARD GAUGE PAN TYPE DOORS WITH LOCKABLE HANDLES AND REMOVABLE COVERS.
3. FINISH: ASA 61 GRAY, POLYESTER POWDER. UL RECOGNIZED.
4. CONSTRUCTION IS IN ACCORDANCE WITH UL 1008.
5. PADLOCKING PROVISIONS ARE INCLUDED:
   ISOLATION HANDLE: THE TRANSFER SWITCH ISOLATION HANDLE MAY BE PADLOCKED WITH THE TRANSFER SWITCH IN THE FULLY ISOLATED (DISCONNECTED POSITION).
6. UNIT CAN BE ADAPTED FOR CONNECTION OF BUS DUCT FLANGES. (CONSULT FACTORY)
7. RECOMMENDED FRONT CLEARANCE: 36.00" [914mm] MINIMUM.
8. A 20% RATED GROUND BUS IS PROVIDED.
9. A FULL RATED NEUTRAL CONNECTION FOR EACH SOURCE AND THE LOAD IS OPTIONAL. WHEN PROVIDED IT IS IN ONE OF THE FOLLOWING FORMATS AS SPECIFIED BY THE CATALOG NO. NEUTRAL TYPE:
   TYPE A: SOLID NEUTRAL BUS
   TYPE B: SWITCHED NEUTRAL POLE
   TYPE C: OVERLAPPING NEUTRAL POLE (NOT AVAILABLE ON 7ATDB & 7ACTB UNITS)
10. APPROXIMATE WEIGHT: 1400 LBS [635 Kg].
11. STANDARD OUTLINE FOR A FOUR POLE TRANSFER WITH BYPASS/ISOLATION SWITCH.
    SHOWN WITH LUG CONFIGURATION FOR FOUR POLE, OR THREE POLE WITH OVERLAPPING NEUTRAL.
    SEE DETAIL "A" FOR LUG CONFIGURATION OF SOLID NEUTRAL.
12. IF A PULL BOX IS PROVIDED THE RIGHT OR LEFT SIDE SKINS ARE REMOVED FROM SWITCH ENCLOSURE AND (4) MOUNTING BLOCKS P/N 757047 ARE USED TO CONNECT THE TWO SECTIONS TOGETHER. REFER TO DRAWING 549379 FOR PULL BOX DETAILS. PULL BOX AND SWITCH ENCLOSURE CAN BE SHIPPED AS ONE UNIT OR PULL BOX CAN BE SUPPLIED INDEPENDENTLY. (PULL BOX MOUNTING SHOWN ON RIGHT SIDE FOR REFERENCE ONLY)
13. STANDARD OUTLINE FOR 4 POLE (B3) 400 AMP 7ADTB.
14. THE STANDARD EMERGENCY, NORMAL CONFIGURATION IS SHOWN.
    OPTIONALLY, THE SWITCH MAY BE SUPPLIED WITH REVERSE SOURCES.
    (REFER TO THE WIRING DIAGRAM FURNISHED WITH EACH TRANSFER SWITCH TO DETERMINE TERMINATION POSITIONS).

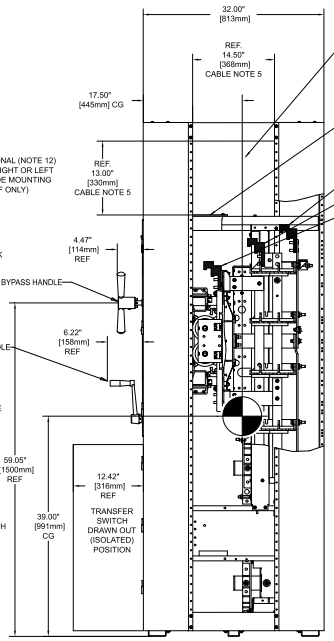
CABLING NOTES

1. ALL SIZES SUPPLIED STANDARD WITH MECHANICAL (SCREW TYPE) LUGS ON THE NORMAL, EMERGENCY & LOAD. ONE (1) LUG PER PHASE AND NEUTRAL EACH SUITABLE FOR CONNECTION OF:
   TWO (2) #2-600 MCM CU/AL CABLE FOR 600 AMP SWITCH.
   THREE (3) 1/0-600 MCM CU/AL CABLE FOR 800-960 AMP SWITCH.
   A. LUG MATERIAL: ALUMINUM ALLOY 6061-T6 WITH ELECTRO TIN PLATED FINISH.
   B. SCREW MATERIAL: ALUMINUM ALLOY 6262-T9 WITH ELECTRO TIN PLATED FINISH.
   C. UL LISTED, CSA CERTIFIED.
   D. LUG SCREW TIGHTENING TORQUE PER UL 486B: 375 IN-LBS.
   E. SUITABLE WIRE BENDING SPACE IS PROVIDED FOR UP TO TWO (2) 600MCM CABLES PER TERMINAL FOR THE 600 AMP SWITCH & THREE (3) 600 MCM CABLES PER TERMINAL FOR THE 800-960 AMP
2. OPTIONAL COPPER CRIMP LUGS MAY BE SUPPLIED. UP TO THREE (3) TWO HOLE, LONG BARREL CU CRIMP LUGS RATED FOR UP TO 750MCM. (REFER TO CRIMP LUG INSTALLATION DATA PROVIDED WITH UNIT FOR FULL INSTALLATION DETAILS).
   A. LUG MATERIAL: HIGH CONDUCTIVITY WROUGHT COPPER FINISH, ELECTRO TIN PLATED.
   B. UL LISTED, CSA CERTIFIED.
   C. LUG MOUNTING HARDWARE TIGHTENING TORQUE: (REFER TO WITHSTAND CURRENT RATING LABEL PROVIDED ON EACH TRANSFER SWITCH).
   D. SUITABLE WIRE BENDING SPACE IS PROVIDED FOR UP TO THREE (3) 750MCM CABLES PER TERMINAL.
3. MECHANICAL GROUNDING LUG FOR UP TO (6) 750MCM - 1/0 CU/AL CABLES IS PROVIDED AS STANDARD.
4. FRONT CONNECTED TOP SERVICE CABLE ENTRY CONFIGURATION IS STANDARD.
   CONSULT FACTORY FOR OTHER TERMINATION REQUIREMENTS.
5. CABLE ENTRANCE AREA 13.OO" [330mm] HIGH x 14.50" [368mm] WIDE WHEN USING OPTIONAL BOTTOM SERVICE ENTRANCE PULL BOX.

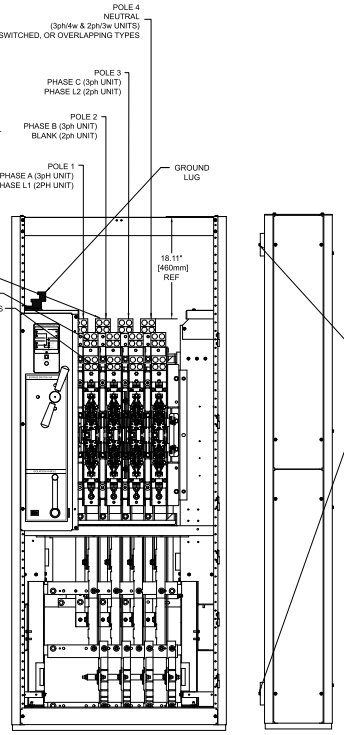


FRONT VIEW
(DOORS AND TOP COVER INSTALLED)

NOTE:
TRANSFER SWITCH CAN BE IN FULLY ISOLATED (DISCONNECTED) POSITION WITH DOOR CLOSED.



RIGHT SIDE VIEW
(COVERS REMOVED AND SECTIONED FOR CLARITY)



SEE NOTE #12
FOR PULL BOX
OPTION.

FRONT VIEW
(SWITCH, DOORS, AND TOP COVER REMOVED)

Autodesk Revit MEP Families avaliable on

ASCO Power Technologies web site

REV	ECN NO.	BY	APP	DATE
K	289897 SEE ECN	MM	TR	06/14/21
J	288494 SEE ECN	MM	MM	03/05/21
H	268541 SEE ECN	SMC	BK	08/11/17
G	247875 SEE ECN	BYS	JPB	04/30/14
F	235627 SEE ECN	NS	BK	02/10/12
E	218032 SEE ECN	TR	WK	04/18/08
D	215830 SEE ECN	TR	BK	11/06/07
C	211078 SEE ECN	BK	BK	11/29/06
B	167016 SEE ECN	AJM	WK	05/12/04
A	166773 SEE ECN	TR	WK	04/12/04
-	165459 NEW ISSUE	SAB	RKJ	11/25/03

PROJECT NAME:

OUTLINE | MOUNTING

H7ATB 600A-960A FRONT CONNECTED
TYPE 1 91 x 38 x 32

THIRD ANGLE PROJECTION

	BY	DATE
DRAWN BY	SAB	11/24/03
CHECKED	BK	11/24/03
PROJECT APPROVAL		
FINAL APPROVAL	RKJ	11/25/03

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP-I-003. FOR PLASTIC PARTS SEE MP-I-005

ASSEM. REF. NO.

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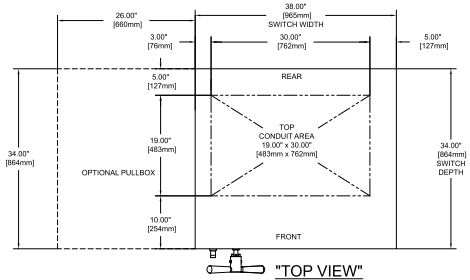
COMPUTER GENERATED DRAWING

SCALE NONE SIZE DS

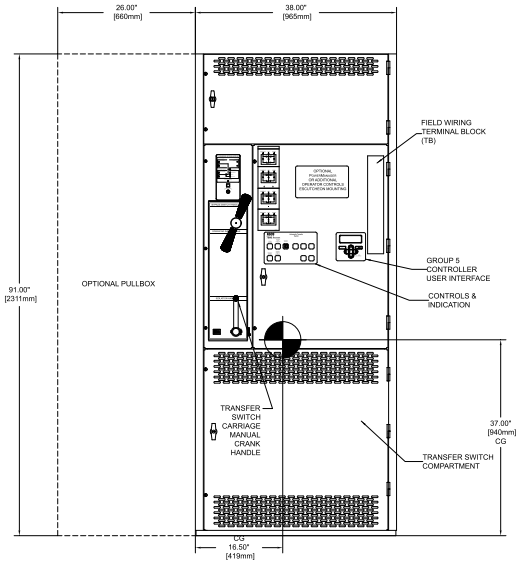
DWG. NO. 748664

DRAWING REV. K ECN NO. 289897 SHEET 1 OF 1

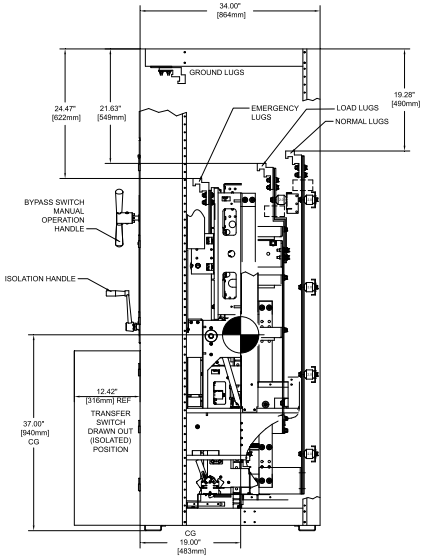
1000A – 1200A AUTOMATIC TRANSFER SWITCH



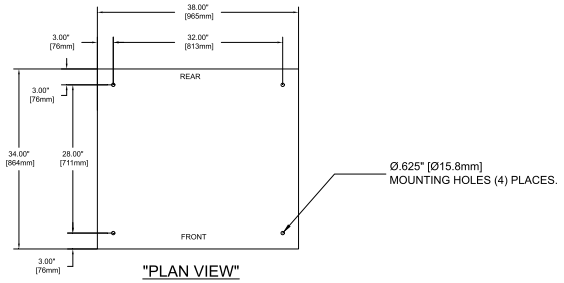
"TOP VIEW"



"FRONT VIEW"



"RIGHT SIDE VIEW"
(COVERS REMOVED)



"PLAN VIEW"

GENERAL NOTES

1. FLOOR MOUNTED ENCLOSURE.
   TYPE 1 CONSTRUCTED FROM CODE GAUGE STEEL.
   FINISH: ANSI 61 GRAY POLYESTER SEMI GLOSS ELECTROSTATIC POWDER.
2. DOORS EQUIPPED WITH KEY LOCKABLE HANDLE AND CAPTIVE SCREWS.
3. DESIGNED FOR FRONT ACCESS ONLY.
4. RECOMMENDED CLEARANCES: FRONT: 36.00" [914mm]. Min. REAR: 5.00" [127mm].
5. OPTIONAL PULLBOX
6. CENTER OF GRAVITY

TRANSFER SWITCH

1. H FRAME AUTOMATIC TRANSFER SWITCH 1000A - 1200A.
2. TRANSFER SWITCH RATING: 1000 AMPS, 1200 AMPS.
   SHORT CIRCUIT RATING WHEN PROTECTED BY A CIRCUIT BREAKER
   TIME RESPONSE, MAXIMUM 0.05 SECONDS: 50,000 RMS SYM @ 480V.
   SPECIFIC BREAKER RATING: 65,000 RMS SYM @ 480V.
3. A FULL RATED NEUTRAL CONNECTION FOR EACH SOURCE AND THE LOAD IS OPTIONAL.
   WHEN PROVIDED IT IS IN ONE OF THE FOLLOWING FORMATS.
   A. SOLID NEUTRAL
   B. SWITCHED NEUTRAL POLE
   C. OVERLAPPING NEUTRAL POLE
4. UL 1008

TERMINATIONS 1000A-1200A

1. SUPPLIED WITH MECHANICAL (SCREW TYPE) LUGS FOR CU/AL CABLE.
   NORMAL: (4) 1/0 - 600MCM PER PHASE & NEUTRAL
   EMERGENCY: (4) 1/0 - 600MCM PER PHASE & NEUTRAL
   LOAD: (4) 1/0 - 600MCM PER PHASE & NEUTRAL.
   GROUND: (12) 1/0 - 600MCM

   A. SUITABLE WIRE BENDING SPACE IS PROVIDED AS PER NEC.
2. OPTIONAL LUGS MAY BE SUPPLIED.

REV TO SHEET	ECN NO.	BY	APP.	DATE
H	288494	MM	MM	03/05/21
	SEE ECN			
G	271533	NC	RN	3/19/18
	SEE ECN			
F	251886	TR	BK	11/20/14
	SEE ECN			
E	249865	SM	RN	
	SEE ECN			
D	218028	TR	WK	04/18/08
	SEE ECN			
C	210729	MJB	WK	11/06/06
	SEE ECN			
B	205144	RN		7-12-05
	SEE ECN			
A	202575	RN		11-30-04
	SEE ECN			
-	202569	RN		11/29/04
	ISSUE			

PROJECT NAME:

OUTLINE | MOUNTING

HATB 1000A- 1200A FRONT CONNECTED
TYPE 1, 91" x 38" x 34" [2438mm x 965mm x 864mm]

THIRD ANGLE PROJECTION

	BY	DATE
DRAWN BY	RN	11-29-04
CHECKED		
PROJECT APPROVAL		
FINAL APPROVAL		

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP-1.003.
FOR PLASTIC PARTS SEE MP-1.005.

ASSEM. REF. NO.

COMPUTER GENERATED DRAWING

SCALE 3/32 = 1" | SIZE DS

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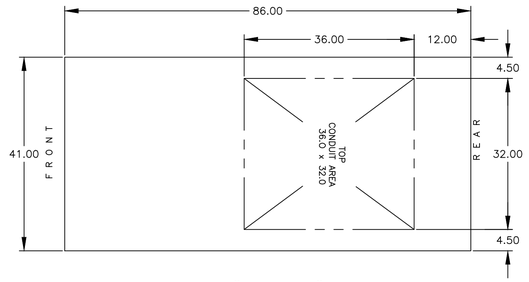
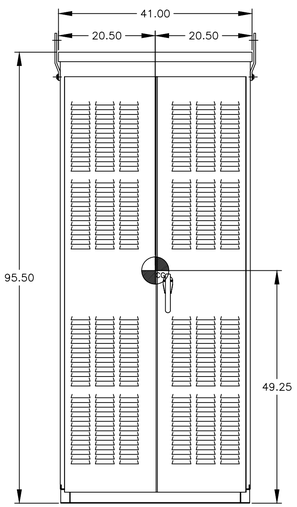
DWG. NO. 736939-010

DRAWING REV. H | SCH. NO. 288494 | SHEET 1 OF 1

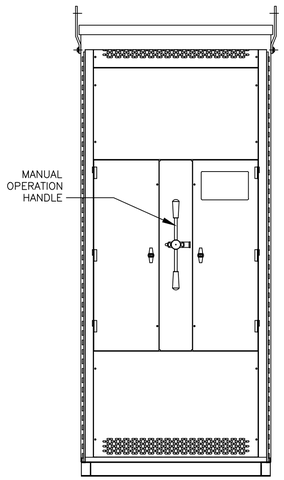
MANUAL TRANSFER SWITCH



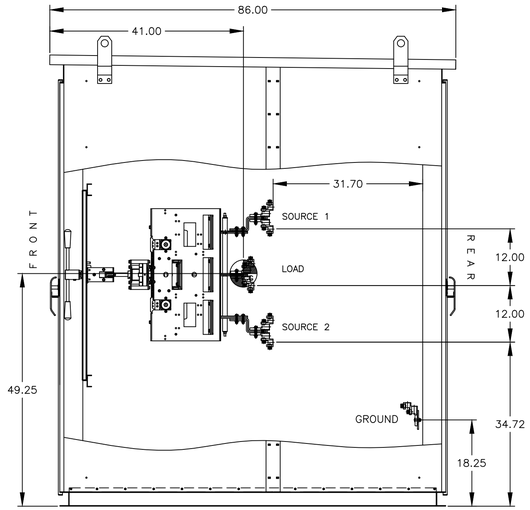
"TOP VIEW"



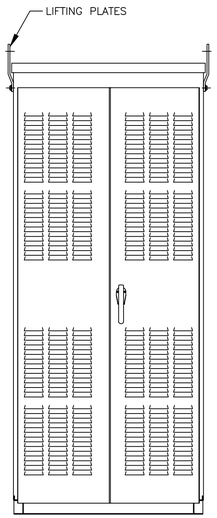
"FRONT VIEW"



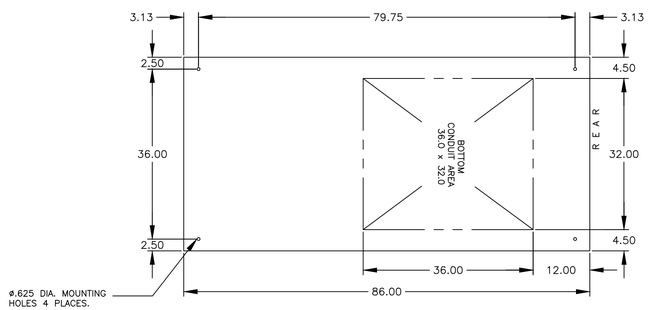
"FRONT VIEW WITHOUT"
"EXTERIOR DOORS"



"RIGHT SIDE VIEW"



"REAR VIEW"



"PLAN VIEW"

GENERAL NOTES

1. FLOOR MOUNTED ENCLOSURE.
   TYPE 3R CONSTRUCTED FROM CODE GAUGE STEEL.
   FINISH: TYPE 3R, ANSI 61 GRAY POLYESTER SEMI GLOSS ELECTROSTATIC POWDER.
   TYPE 3RX EXTERIOR CONSTRUCTED FROM CODE GAUGE STAINLESS STEEL.
   (R) EXTERIOR CONSTRUCTED FROM TYPE 304 STAINLESS STEEL.
   (S) EXTERIOR CONSTRUCTED FROM TYPE 316 STAINLESS STEEL.
2. EXTERIOR DOORS HAVE PADLOCKABLE HANDLES WITH 3–POINT LATCH.
3. DESIGNED FOR FRONT ACCESS & REAR ACCESS.
4. RECOMMENDED CLEARANCES: FRONT: 38" REAR: 36".
5. EXTERIOR VENTS ARE SUPPLIED WITH POLYESTER DUST FILTERS.
6. ⊕ CENTER OF GRAVITY
7. APPROXIMATE WEIGHT: 2000 LBS.
8. LIFTING PLATES: SECTIONS ARE SUPPLIED WITH LIFTING PLATES. INSPECT PLATES FOR DAMAGE AND TORQUE BOLTS TO 45 FT LBS BEFORE USE. REFER TO ANSI/NEMA PB 2.1 FOR PROPER HANDLING OF EQUIPMENT. AFTER INSTALLATION OF SECTION, REMOVE LIFTING PLATES. REINSTALL BOLTS INTO EXTERIOR HOLES AND TORQUE TO APPROXIMATELY 20 FT LBS.

TRANSFER SWITCH

1. G FRAME TRANSFER SWITCH 2600A – 3000A.
2. TRANSFER SWITCH RATING: 2600 AMPS, 3000 AMPS.
   SHORT CIRCUIT RATING WHEN PROTECTED BY A CIRCUIT BREAKER
   TIME RESPONSE, MAXIMUM 0.05 SECONDS: 100,000 RMS SYM @ 480V.
   THE SOURCES MUST BE PROTECTED BY A REMOTE OVERCURRENT
   PROTECTION DEVICE AS LISTED ON THE MARKINGS ON THE TRANSFER SWITCH.
3. A FULL RATED NEUTRAL CONNECTION FOR EACH SOURCE AND THE LOAD IS OPTIONAL.
   WHEN PROVIDED IT IS IN ONE OF THE FOLLOWING FORMATS.
   A. SOLID NEUTRAL
   B. SWITCHED NEUTRAL POLE
4. UL 1008

TERMINATIONS 2600–3000 AMPS

1. SUPPLIED WITH STANDARD MECHANICAL (SCREW TYPE) LUGS .
   SOURCE 1: (10) 1/0 AWG – 600MCM PER PHASE & NEUTRAL
   LOAD: (10) 1/0 AWG – 600MCM PER PHASE & NEUTRAL
   SOURCE 2: (10) 1/0 AWG – 600MCM PER PHASE & NEUTRAL
   GROUND: (30) 1/0 –750MCM
   A. SUITABLE WIRE BENDING SPACE IS PROVIDED AS PER THE NEC
2. OPTIONAL LUGS MAY BE SUPPLIED.

REV. TO SHEET	ECN NO.	BY	APP.	DATE
A	272969	SG	RN	06/15/18
	SEE ECN			
—	271820	SV	RN	04–09–18
	NEW ISSUE			

PROJECT NAME:

OUTLINE | MOUNTING

GMTS 2600A – 3000A
TYPE 3R 96 X 41 X 86

THIRD ANGLE PROJECTION

	BY	DATE
DRAWN BY	SV	04–04–18
CHECKED	RN	
PROJECT APPROVAL		
FINAL APPROVAL		

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP–1–003. FOR PLASTIC PARTS SEE MP–1–055

ASSEM. REF. NO.

ASCO® ASCO POWER TECHNOLOGIES, L.P.
FLORHAM PARK, NEW JERSEY 07932 U.S.A.

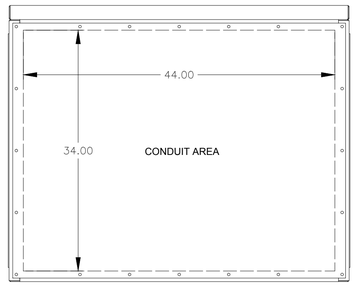
COMPUTER GENERATED DRAWING

SCALE 1/16" = 1" | SIZE DS

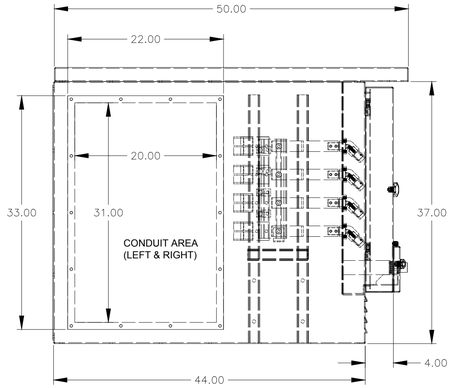
DWG. NO. 977106–004

DRAWING REV. A | ECN NO. 272969 | SHEET 1 OF 1

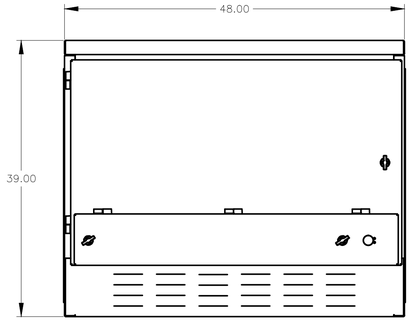
CAM LOCK QUICK CONNECTION BOX



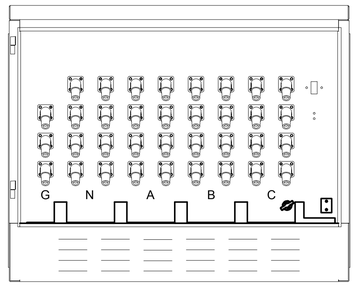
REAR VIEW



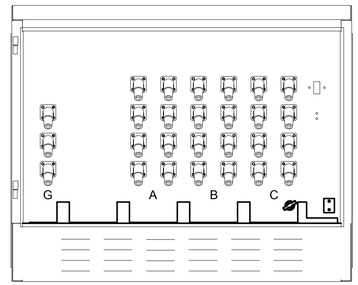
LEFT VIEW



FRONT VIEW



FRONT VIEW
3P + N + G
WITHOUT OUTER DOORS



FRONT VIEW
3P + G
WITHOUT OUTER DOORS

NOTES:

1. INLET PANELS:
   - FOR USE ONLY FOR CONNECTION OF A GENERATOR TO THE SOURCE TERMINALS OF A TRANSFER SWITCH SUCH THAT THE INLETS ARE ENERGIZED FROM THE GENERATOR
   - UL 1008 LISTED AS TRANSFER SWITCH ACCESSORY
   - 16 SERIES RECESSED MALE CONNECTORS

2. OUTLET PANELS:
   - FOR CONNECTION OF A LOAD BANK TO A POWER SOURCE
   - LISTED TO UL891
   - 16 SERIES RECESSED FEMALE CONNECTORS WITH FLIP COVERS

3. PANEL RATINGS:
   - 600VAC MAX, 50-60HZ, 3200A, 3PH/3W OR 3PH/4W

4. SHORT CIRCUIT CURRENT RATING:
   - 100K RMS SYMMETRICAL AMPS, 600 VAC MAX.

5. ENCLOSURE:
   - TYPE 3R CONSTRUCTION, FOR OUTDOOR USE ONLY
   - REMOVABLE HINGED DOOR WITH PADLOCK PROVISIONS
   - FINISH, ANSI 61 GRAY POWDER COAT

6. REMOVABLE GASKETED SIDE ACCESS PANELS FOR ADDITIONAL CONDUIT ENTRY AREAS.

7. RECOMMENDED CLEARANCES:
   - FRONT 24 TO 30 INCHES

8. REMOVABLE GROUNDING STRAP(S) ARE INCLUDED CONNECTING THE GREEN CAMLOCKS TO THE ENCLOSURE.

9. NO NEUTRAL TO GROUND BONDING PROVISIONS INCLUDED.

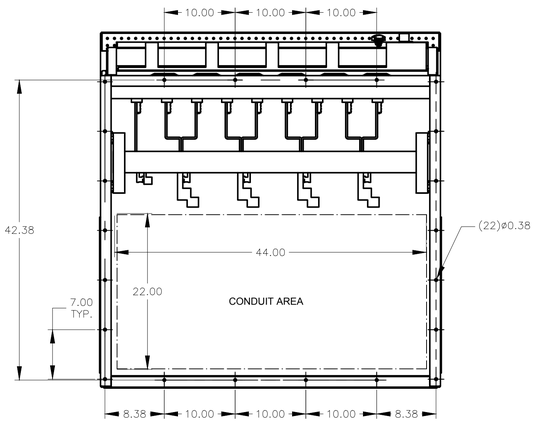
10. CAMLOCK CONNECTORS ARE SERIES 16 COMPATIBLE. 400A RATED.

INSTALLATION:
- SURFACE TO WHICH THE PANEL IS TO BE INSTALLED AND THE INSTALLATION METHOD / HARDWARE MUST BE CAPABLE OF SUPPORTING THE WEIGHT OF THE PANEL AS WELL AS THE WEIGHT OF THE TEMPORARY CABLES TO BE ATTACHED TO IT. WEIGHTS SHOWN IN TABLE BELOW.
- INSTALLATION IS TO BE DONE BY QUALIFIED PERSONNEL IN ACCORDANCE WITH LOCAL AND NATIONAL CODES AND GOOD ENGINEERING PRACTICES.
- PANEL MUST BE LEVEL AND PLUMB TO ALLOW FOR PROPER DRAINAGE / WATER RUNOFF.

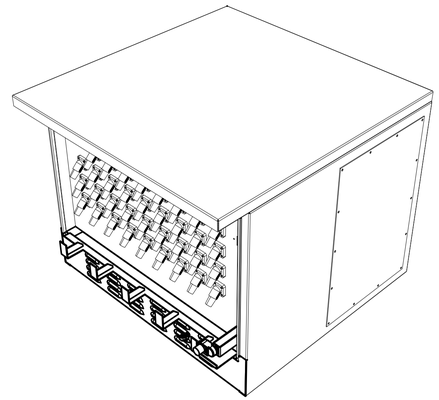
AMPS	SYSTEM CONFIGURATION	MATERIAL		WEIGHT (lbs)		CAMLOCK QUANTITY			LUG QUANTITY			LUG RANGE OF AL-CU CONDUCTOR SIZES
		ALUM.	SS	ALUM.	SS	PHASE	NEUTRAL	GROUND	PHASE	NEUTRAL	GROUND	
3200A	3P + G	1/8"	11 GA.	306	520	8	0	3	10	0	3	#2 TO 600 MCM
	3P + N +G			335	549	8	8	3	10	10	3	

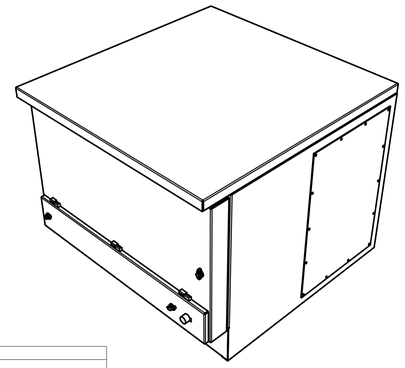
CABLING:
- ALL UNITS SUPPLIED WITH ONE SET OF MECHANICAL (SCREW TYPE) LUGS AS SHOWN IN TABLE ABOVE.
- LUGS ARE UL LISTED, TIN PLATED, ALUMINUM ALLOY COMPATIBLE WITH COPPER OR ALUMINUM CABLES.
- LUG SCREWS ARE TIN PLATED, TORQUE TO 19 FT-LBS PER UL4868.
- LUGS ARE ATTACHED TO COPPER PLATED OR FLASHED BUS WITH FACTORY SUPPLIED BOLTS, TORQUED TO 30 FT-LBS.

STANDARD FEATURES:
1. PROVISIONS FOR KIRK™ OR CASTELL™ TRAPPED KEY INTERLOCK. KEY AND TUMBLER NOT PROVIDED.
2. PHASE ROTATION MONITOR FOR TEMPORARY POWER CONNECTION.
3. TAMPER RESISTANT DOOR WHILE IN USE.
4. TWO WIRE AUTO START TERMINALS.



BOTTOM VIEW





CATALOG NUMBER										
CATALOG TYPE	INPUT/ OUTPUT	CONNECTOR TYPE	GROUND	NEUTRAL TYPE	POLES	AMPS	VOLT CODE	BLANK	OPTIONAL ACCESSORY	ENCLOSURE CODE
3QC	N U	C	A N	O A	3	3200	F N R	0	0 X Z	F S

EXPLANATION OF CATALOG NUMBER CODES												
INPUT/ OUTPUT	CONNECTOR TYPE	GROUND TYPE		NEUTRAL TYPE		VOLTAGE CODES			OPTIONAL ACCESSORY	ENCLOSURE CODES		
CODE	CODE	CODE	COLOR	CODE	COLOR	CODE	NOMINAL VOLTAGE	COLOR CODE	CODE	CODE	TYPE	DESCRIPTION
N=INPUT U=OUTPUT	C=CAMLOCK	A=100% N=25%	GREEN	0=NONE A=100%	NONE WHITE	F N R	240 480 600	BLK, RED, BLU BRN, ORG, YEL BLK, BLK, BLK	0=STANDARD X=ACCESSORY Z=SPECIAL	F S	3R 3RX	SECURE ENCLOSURE OUTDOOR, RAINPROOF, SLEET & ICE RESISTANT (ALUMINUM) SECURE ENCLOSURE OUTDOOR, RAINPROOF, SLEET & ICE RESISTANT (316 STAINLESS STEEL)

REV.	REV. TO SHEET	ECN NO.	BY	APP.	DATE
A		271386	MKA	JPB	03/05/18
		SEE ECN			
—		270603	JPB	JPB	01/08/18
		ISSUE			

PROJECT NAME:

PADMOUNT | QUICK CONNECT PANEL

3200 AMPS
600 VAC MAX, 3PH/3W OR 3PH/4W

THIRD ANGLE PROJECTION

	BY	DATE
DRAWN BY	JPB	01/08/18
CHECKED		
PROJECT APPROVAL		
FINAL APPROVAL	JPB	01/08/18

MANUFACTURING TOLERANCES TO BE IN ACCORDANCE WITH ASCO PROCEDURE MP-I-003. FOR PLASTIC PARTS SEE MP-I-055

ASSEM. REF. NO.

COMPUTER GENERATED DRAWING

SCALE 3/32" = 1" | SIZE DS

DWG. NO. 1184356

DRAWING REV. A | ECN NO. 271386 | SHEET 1 OF 1

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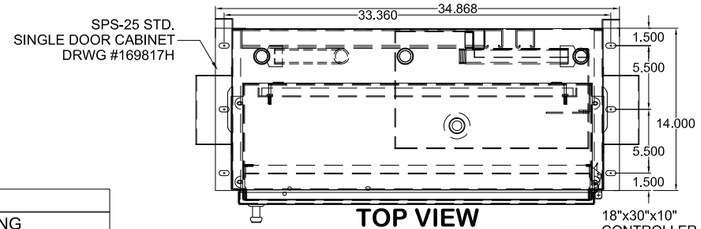
FLORHAM PARK, NEW JERSEY 07932 U.S.A.

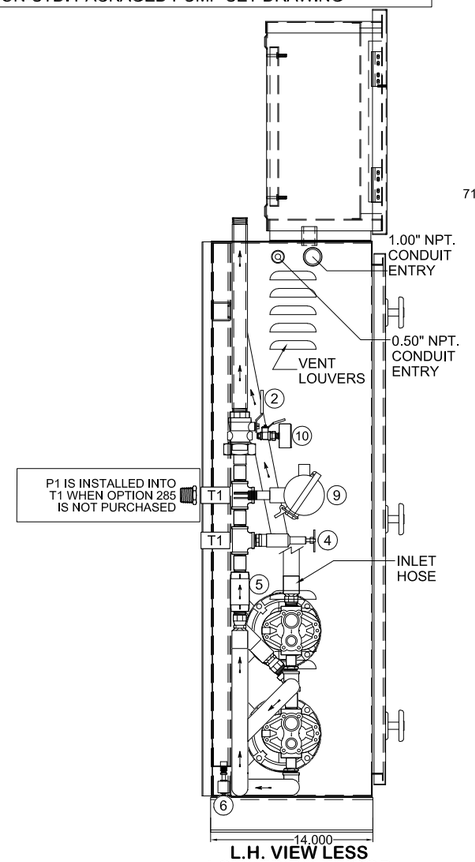
MECHANICAL CUTSHEETS

NOTES
1) ALL DIMENSIONS ±.125
2) DUE TO SYSTEM COMPLEXITY SOME COMPONENTS MAY NOT BE VISIBLE IN ALL VIEWS
3) CONSTRUCTION SEAM WELDED 14 GA. H.R.S.
4) CABINET COLOR:**WHITE**
DOOR COLOR:**BLUE**

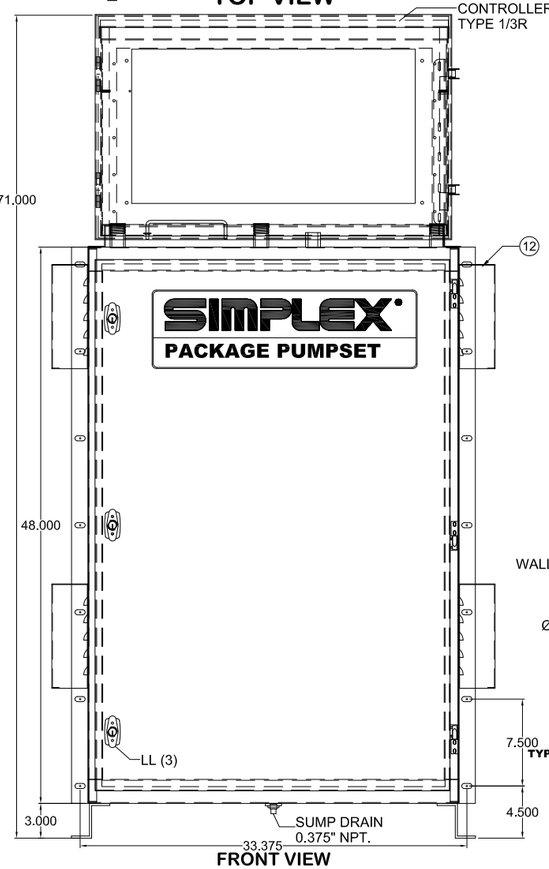
✓	STD. PACKAGED PUMP SET DRAWING
	NON-STD. PACKAGED PUMP SET DRAWING



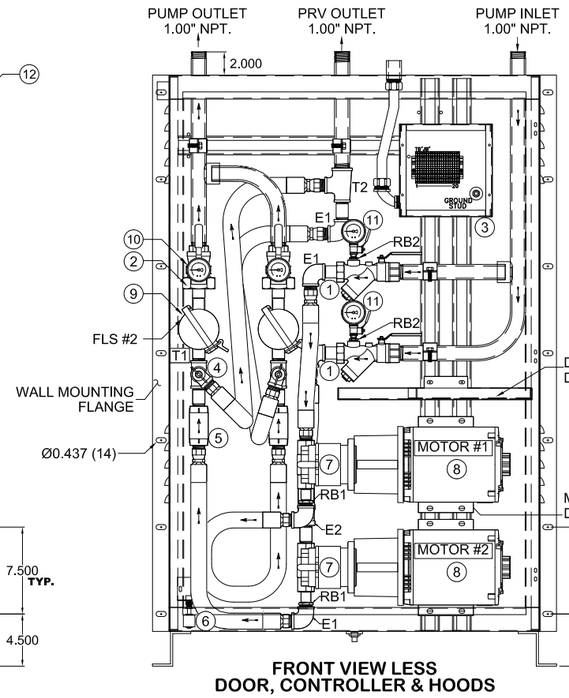
TOP VIEW



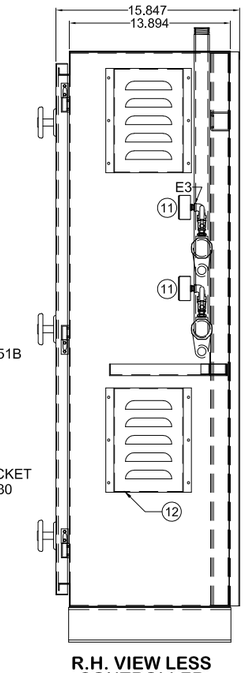
L.H. VIEW LESS LOUVER RAIN HOOD



FRONT VIEW



FRONT VIEW LESS DOOR, CONTROLLER & HOODS



R.H. VIEW LESS CONTROLLER

ITEM	PUMP SET STANDARD PARTS (FS ASS'Y)	PART #	QTY:
①	**BV/FSR-** BALL VALVE/FUEL STRAINER COMBO, 1.00" NPT. FEMALE BODY	24010020	2
	0.75" NPT. MALE TAILPIECE	24010106	2
②	**BV1-** BALL VALVE W/ UNION END & SHORT HANDLE, 1.00" NPT. FEMALE BODY	24010040	2
	0.75" NPT. FEMALE TAILPIECE	24010104	2
③	**JB-** JUNCTION BOX 8"x8"x4" W/ SCREW COVER, TYPE 1	13819100	1
	TERMINAL BLOCK, 4-WIRE, 20A, 600V, GRAY	25678536	20
	TERMINAL BLOCK, 4-WIRE, END PLATE	25678538	1
④	**PRV-** PRESSURE RELIEF VALVE, 0.75" NPT. 0-300 PSI RANGE, SET @ 65 PSI		
⑤	**CV-** CHECK VALVE, 0.75" NPT. SPRING TYPE, BRONZE BODY, VITON O-RING		
⑥	**LS-** CABINET FUEL LINE LEAK SENSOR, BUNA-N FLOAT		

T1 0.75" NPT. TEE, 304 S.S.
T2 1.00"x0.75"x0.75" NPT. REDUCING TEE, BLK.
P1 0.75" NPT. PLUG 304 S.S.
RB1 0.75"x0.50" NPT. REDUCER BUSHING 304 S.S.
RB2 0.50"x0.25" NPT. REDUCER BUSHING 304 S.S.
E1 0.75" NPT. ELBOW 90°D 304 S.S.
E2 0.75" NPT. ELBOW 45°D 304 S.S.
E3 0.25" NPT. STEET ELBOW 90°D 304 S.S.

****ONLY ITEMS CHECKED ARE INCLUDED IN THE PUMP SET PACKAGE*****

ITEM	✓	PUMP SET OPTIONAL PUMP PARTS (PUMP/MOTOR ASS'Y)	PART #	QTY:
⑦		**407-** 7 G.P.M. PUMP, 0.75" NPT. INLET/0.50" OUTLET, CAST ALUM.	24743100	2
		0.75" PUMP SHAFT COUPLER HUB (L090)	24649530	2
		SHAFT COUPLER SPIDER (L090)	24650010	2
		7-17 G.P.M. PUMP/MOTOR ADAPTER, SAE-A, 2-BOLT	24745000	2
		410- 10 G.P.M. PUMP, 0.75" NPT. INLET/0.50" OUTLET, CAST ALUM.	24747250	2
		0.75" PUMP SHAFT COUPLER HUB (L090)	24649530	2
		SHAFT COUPLER SPIDER (L090)	24650010	2
		7-17 G.P.M. PUMP/MOTOR ADAPTER, SAE-A, 2-BOLT	24745000	2
		505- 5 G.P.M. PUMP, 0.75" NPT. INLET/0.75" OUTLET, CAST IRON	24740005	2

ITEM	✓	PUMP SET OPTIONAL PARTS (FS ASS'Y)	PART #	QTY:
⑨		**285-** FLOW SWITCH, 0.75" NPT. CONNECTION, 24VDC W/ 1.2" PROBE	25242908	2
⑩		**100-** PRESSURE GAUGE 0-200PSI, 2" S.S. DIA. 0.25" NPT.	15050500	2
		CENTER BACK CONNECTION W/ 0.25" NPT. ISOLATION VALVE		
⑪		**101-** VACUUM GAUGE 0-30HG, 2" S.S. DIA. 0.25" NPT.	15050400	2
		CENTER BACK CONNECTION W/ 0.25" NPT. ISOLATION VALVE		
⑫		**181-** WEATHERPROOF MODIFICATION, LOUVER RAIN HOOD DRWG #200695B (QTY: 4)		

ITEM	✓	PUMP SET OPTIONAL MOTOR PARTS (PUMP/MOTOR ASS'Y)	PART #	QTY:
⑧		**700-** 0.50HP MOTOR,115VAC,1PH,60HZ,1750RPM,ODP, 9.2FLA.	24630000A	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		705- 0.50HP MOTOR,115/208/230VAC,1PH,60HZ,1750RPM,ODP, 4.4/2.5/2.2FLA.	24634011	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		721- 0.50HP MOTOR,208/230/460VAC,3PH,60HZ,1750RPM,ODP 2.1/1.6/0.8FLA.	24634015A	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		722- 0.50HP MOTOR,208/230/460VAC,3PH,60HZ,1750RPM,TEFC 2.5/2.0/1.0FLA.	24634000B	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		745- 0.50HP MOTOR,115/208/230VAC,1PH,60HZ,1750RPM,TEFC 7.4/4.3/3.7FLA.	24631000B	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		822- 0.75HP MOTOR,208/230/460VAC,3PH,60HZ,1750RPM,TEFC 3.6/3.0/1.5FLA.	24639000B	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		825- 0.75HP MOTOR,208/230/460VAC,3PH,60HZ,1750RPM,ODP 3.3/3.0/1.5FLA.	24639011	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2
		845- 0.75HP MOTOR,115/208/230VAC,1PH,60HZ,1750RPM,TEFC 8.4/5.4/4.2FLA.	24636500B	2
		0.625" MOTOR SHAFT COUPLER HUB (L090)	24649525	2

SIMPLEX, INC.
5300 RISING MOON ROAD
SPRINGFIELD, ILLINOIS 62711-6228

THIRD ANGLE PROJECTION

REVISIONS & UPDATES

REV	DATE	DESCRIPTION	INT	APPR
F	06/01/2021	UPDATED MOTOR PART NUMBERS	AA	AA
E	10/20/2020	UPDATED OPTIONS 722 & 822	AA	AA
D	08/31/2020	UPDATED PART NUMBERS FOR OPT. 845&745	AA	AA
C	08/30/2018	ADDED OPTION 722	AA	AA
B	05/16/2018	UPDATED STANDARD DRWG	AA	AA
A	08/24/2016	ORIGINAL DESIGN	AA	AA

TOLERANCES
X.XXX ± 0.005"
X.XX ± 0.010"
X.X ± 0.020"
FRACTIONAL ± 1/32"
ANGLES ± 1°
SURFACES 125

APPROVED BY:	AA
DRAWN BY:	AA
SCALE:	1:12.8772
SHEET SIZE:	ANSI B

JOB NUMBER
NA

DESCRIPTION
PACKAGED PUMP SET
SPS25 STD. CABINET
7-10 GPM PARKER/5 GPM VIKING

Approved 06/01/2021

DRAWING NUMBER
ACD-00023671

SHEET NUMBER	REVISION
1/1	F

Compact Automatic FuelPort
for Petroleum Products

The Simplex Automatic FuelPort is a factory packaged system for control of filling operations of aboveground tanks that are filled from pumper trucks. The Automatic FuelPort provides a ready means of ground level connection of the fill hose, and captures spills that may occur at the fill point during filling operations. The Automatic FuelPort alerts the operator at Tank Full with filling operations locked out at High Level. A leak detection circuit prevents filling of leaking tanks. Visual and audible level and leak alarms are provided.

The Simplex Automatic Fuel-Port is available for use with fuel oil (Class-II liquids) multi-tank units and units for use with gasoline (Class-I liquids) available through Simplex.

Contact Simplex or your Simplex representative for information on the full line of Simplex Tank Filling Systems.

Top outlet shown (bottom outlet available)

Float Set

How It Works:

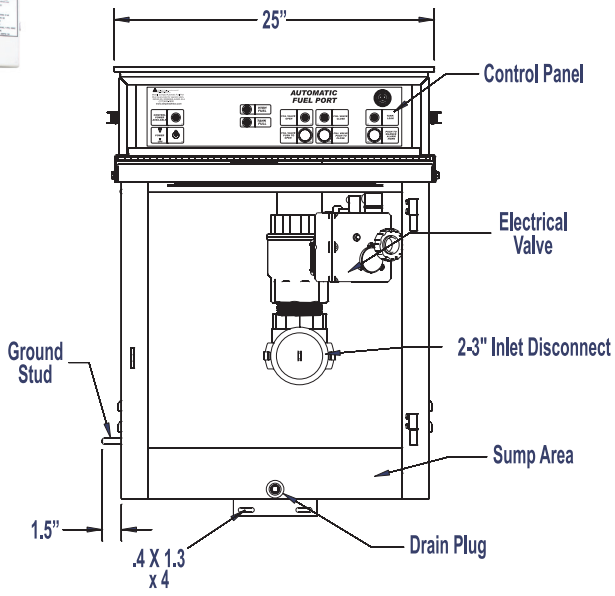
1. Delivery truck arrives and driver proceeds to Automatic FuelPort to make fuel delivery.
2. Connect ground cable
3. Unlock fill box and control box
4. Turn on controller
5. Connect delivery hose to hose coupling
6. Open valve on truck
7. Start delivery pump on truck
8. Press Valve Open pushbutton on controller
9. Automatic FuelPort valve opens
10. Fuel is delivered to tank
11. At Tank Full level, audible and visual alarm activates and alerts driver
12. Driver may stop delivery by pressing the Valve Close pushbutton and proceed to step #16
13. Driver tops off to Tank Full
14. At High Level, audible and visual alarm activates and Automatic FuelPort valve closes (valve may not be reopened)
15. Stop fill pump
16. Drain delivery hose
17. Close truck valve
18. Disconnect delivery hose from Automatic FuelPort
19. Turn controller off
20. Close and lock Automatic FuelPort doors
21. Proceed to next delivery, where, hopefully, the owner has had the foresight to install a Simplex Automatic FuelPort

Includes:

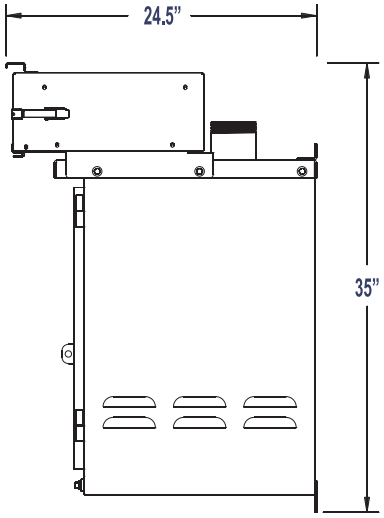
- Freestanding, pad or tank mountable, weatherproof and lockable enclosure
- Quick disconnect hose coupling with dust plug
- Check valve
- Electrically operated shutoff valve
- Automatic controller
- Ground stud
- Optional post assembly available
- Available with top or bottom outlet

Compact Automatic FuelPort
for Petroleum Products • Page 2

SIMPLEX®



FRONT VIEW
SHOWN WITHOUT DOOR



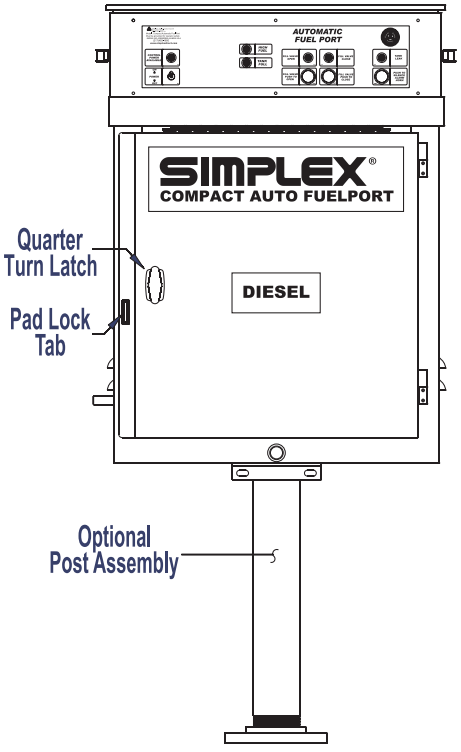
RIGHT VIEW

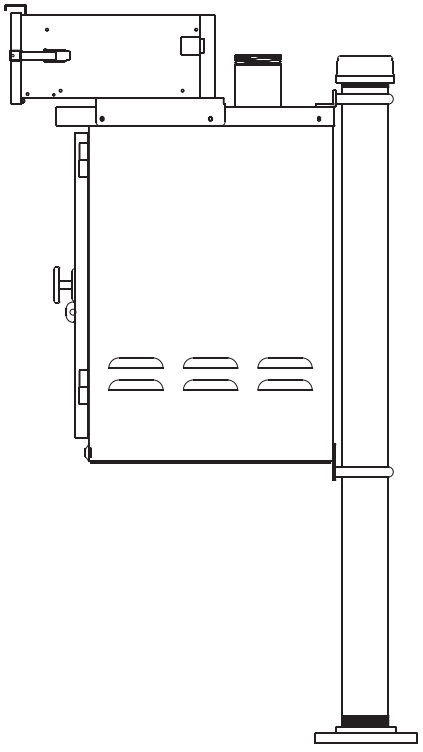
Controller Includes:

- Level sensors for installation in a 2" tank fitting (minimum)
- Tank Full visual alarm
- High Level visual alarm
- Tank Leak alarm
- Audible alarm horn activated by alarms above
- Power available indicator
- Control power On-Off switch
- Valve Open/Close push-buttons
- Type 3R enclosure

Specifications:

Fitting size: 2" or 3"
Spill containment: 7 gallons
Paint: white with blue doors
Net Weight: 313 lbs.
Control power: 115-1-60v
Level transmitter fitting: 2" min.





Order Checklist

- ☐ How many tanks to fill?
- ☐ Tank leak sensing required?
- ☐ Size fill fittings: 2" or 3"?
- ☐ Accurate tank dimensions required, 2" or 4" fitting required for transmitter (specify)
- ☐ Specify options

SIMPLEX INC.
5300 Rising Moon Road, Springfield, IL 62711 • simplexdirect.com • 800-637-8603
Nationwide Manufacturing (ISO9001: 2015 certified)

Printed in the USA • 1503-01.02
Design subject to change without notice.

Unit Overview

Model Number	Cabinet Style	Unit Cabinet Size	Design Airflow	Elevation	External Dimensions			Weight	
					Length	Width	Height	Shipping	Operating
FCDB030	Horizontal cabinet	Size 030	400 cfm	0.00 ft	33.000 in	26.000 in	10.000 in	84.0 lb	97.0 lb

Unit Features

Inlet Style	Back duct collar inlet
Outlet Style	Front quad grille outlet
Unit Mounted Disconnect Switch	With disconnect switch
Filter Type	1" throwaway
Piping System/Placement	W/o pipe, rt hand, w/ aux drn pan
Drain Pan	Stainless steel
Cabinet Color	Deluxe beige
Tamperproof Locks/ Leveling Feet	W/o tamperproof locks or leveling ft

Motor/Electrical Information

Unit voltage	115v/60hz/1ph
Short circuit current rating	5 kA RMS Symmetrical, 115V Maximum
ESP	0.100 in H2O
Motor type	High static ECM
Motor speed	High
Motor power	163.0 W
Min circuit ampacity	2.75 A
Max fuse size	15.00 A

	Nameplate	Calculated BHP	Max BHP
Motor #1 HP	0.130 hp	0.137 hp	0.149 hp
Speed	**CFM**	**TSP**	**RPM**
High	400 cfm	0.775 in H2O	1813 rpm
Medium	340 cfm	0.560 in H2O	1541 rpm
Low	264 cfm	0.338 in H2O	1197 rpm

Coil Information

Main Coil Type	3 row cooling, 1 row preheat	**Cooling Fluid Type**	Water
Coil Air Vent	Manual	**Preheat Fluid Type**	Water

Coil Performance - Cooling			
Total Capacity	13.42 MBh	**Entering Fluid Temp**	42.00 F
Sensible Capacity	9.83 MBh	**Leaving Fluid Temp**	54.00 F
Entering Dry Bulb	85.00 F	**Fluid Pressure Drop**	6.82 ft H2O
Entering Wet Bulb	70.00 F	**Fluid Flow Rate**	2.23 gpm
Leaving Dry Bulb	62.48 F	**Fluid Delta T**	12.00 F
Leaving Wet Bulb	59.94 F		

Coil Performance - Preheat			
Total Capacity	6.96 MBh	**Fluid Pressure Drop**	0.61 ft H2O
Entering Dry Bulb	65.00 F	**Fluid Flow Rate**	0.47 gpm
Leaving Dry Bulb	81.05 F	**Fluid Delta T**	30.00 F
Entering Fluid Temp	140.00 F		
Leaving Fluid Temp	110.00 F		

Controls, Sensors and Valves

Zone Sensor Type	Unit mounted variable speed control

Acoustics

Sound Path	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Total Sound - High	62 dB	73 dB	73 dB	69 dB	68 dB	67 dB	66 dB	55 dB
Total Sound - Medium	59 dB	70 dB	69 dB	65 dB	63 dB	61 dB	60 dB	50 dB

Note: Sound power level data in dB (re 1pW).

Note: Acoustical data has been obtained from tests in accordance with AHRI Standard 350-2000.

Job Name: MSC Generator
Tag: EF-1
Quantity: 1
Printed Date: November 18, 2021

Model: SP-A390-VG

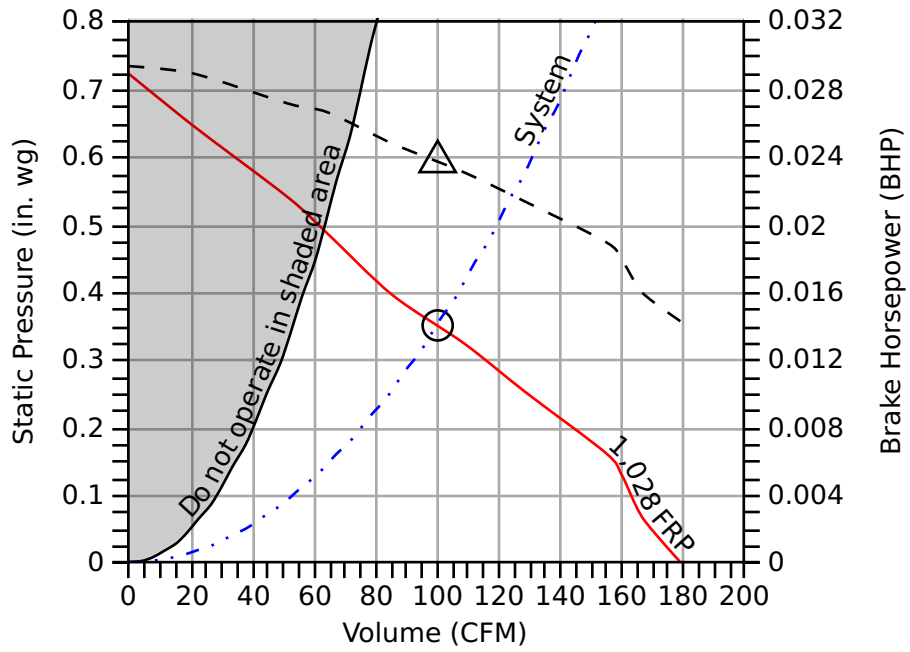
Direct Drive Bathroom Exhaust Fan

Standard Construction Features: Galvanized steel housing and grille. Centrifugal forward curved wheel. Direct driven motor in the air stream.

Fan Configuration	
Drive type	Direct

Performance	
Requested Volume (CFM)	100
Actual Volume (CFM)	100
Total External SP (in. wg)	0.35
Fan RPM	1,028
Operating Power (bhp)	0.02
Startup Power (bhp)	0.02
Air Stream Temp (F)	70
Start-up Temp (F)	70
Air Density (lbs/ft^3)	0.075
Watts (W)	18
Static Efficiency (%)	23
Outlet Velocity (ft/min)	93

Motor	
V/C/P	115/60/1
NEC FLA (Amps)	1.5



- Fan curve
- Brake horsepower curve
- Operating Point SP
- Operating Bhp point
- Max system curve
- System curve

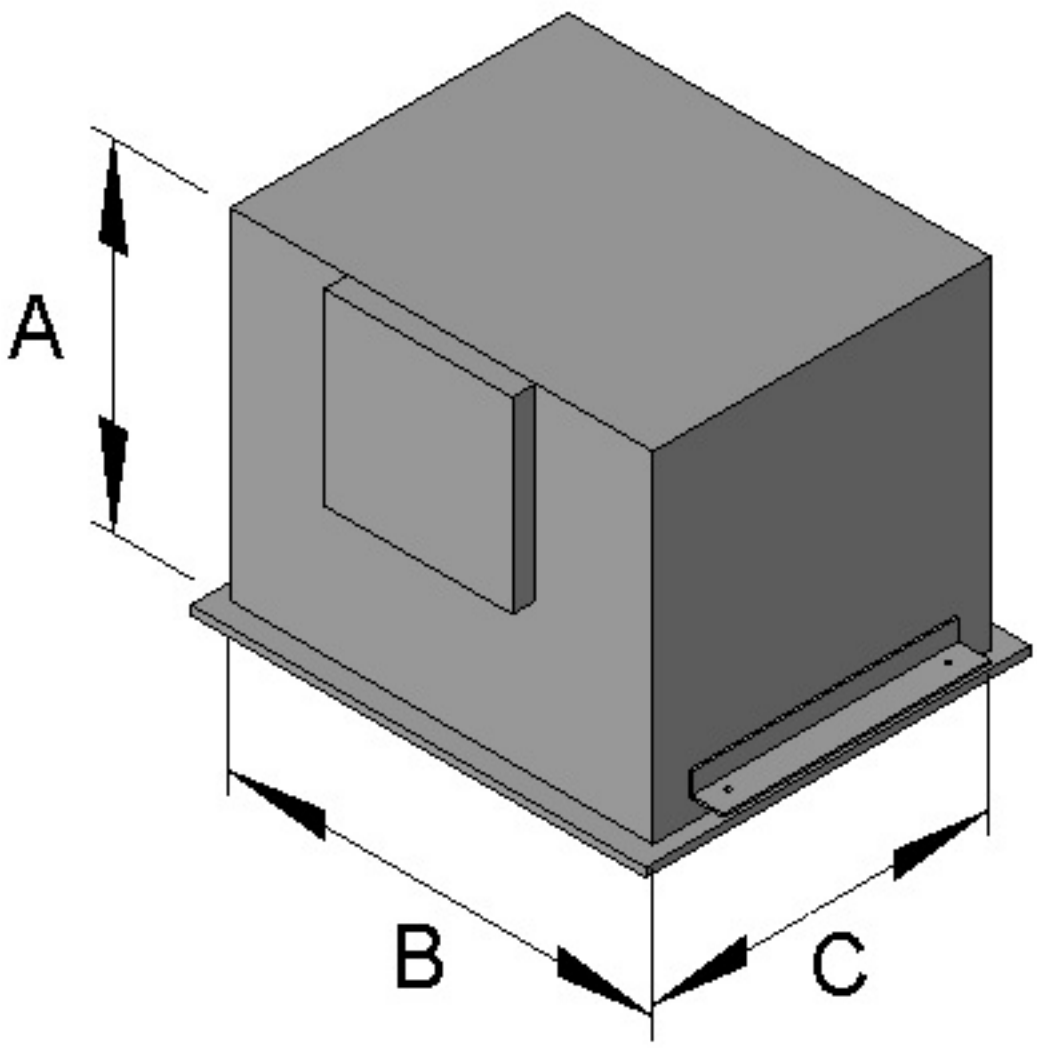
Static Pressure Calculations	
External SP	0.35 in. wg
Direct Drive RPM Adjustment	0 in. wg
Total External SP	0.35 in. wg

Sound

	Octave Bands (hz)								LwA	dBA	Spherical Sones
	62.5	125	250	500	1000	2000	4000	8000			
Inlet	65	58	63	56	53	44	37	27	59	44	3.0

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.The AMCA certified ratings seal applies to sound and air performance ratings only.Performance certified is for installation type B: Free inlet, ducted outlet.Power rating does not include transmission losses.Performance ratings include the effects of an inlet grille and backdraft damper.Speed (RPM) shown is nominal. Performance is based on actual speed of test.The sound ratings shown are loudness values in spherical sones at 1.5 m (5 ft) in a spherical free field calculated per ANSI/AMCA 301.Values shown are for Installation Type B: free inlet spherical sone levels.dBA levels are not licensed by AMCA International. The AMCA Certified Ratings Seal for Sound applies to sone ratings only.

Dimensions and Weights		
Label	**Value**	**Description**
-	24	Weight w/o accessories (lbs)
A	11	Overall Height (in)
B	14	Overall Width (in)
C	12	Overall Length (in)
-	8	Outlet Width (in)
-	8	Outlet Height (in)
-	14.875	Grille Width (in)
-	13.25	Grille Length (in)



*All dimensions are in inches.