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DISTRIBUTION ENGINEERING DEPARTMENT
SYSTEM DESIGN

EO-2080
REVISION 8

Design Of 120/208 Volt Network Installations

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TARGET AUDIENCE:	**CONTROL CENTER, FEEDER OPS, ELECTRIC CONSTRUCTION, ENERGY SERVICES, INSTALLATION & APPARATUS, CIVIL ENGINEERING, REGIONAL/ CUSTOMER ENGINEERING**
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Table of Contents

1.0 Purpose

This specification gives the general requirements for all 120/208 Volt Network installations supplying: Secondary network grids, Isolated networks, spot networks, modified secondary grids.

2.0 Application

This specification applies to all regions.

3.0 Definitions

3.1 **Transformer Manhole**: Structure housing a transformer with an attached submersible network protector (NWP), generally located on the roadway. Exception: the TM-11 manhole was adapted for sidewalk installation and is used for 500 kVA suspension type transformer installation.

3.2 **Transformer Vault**: Facility or structure to house/contain a transformer with or without network protector (Often installed under sidewalks or within buildings).

3.3 **Bus Vault:** Facility or structure to house/contain a paralleling bus and its associated cable connections.

3.4 **Diving Bell Bus Vault**: Vault intended for submersible operation. The diving bell vault is a monolithically poured concrete structure having a closed top and sides and with the bottom open. Its purpose is to effectively act as a water tight chamber in which the bus is mounted.

3.5 **Network Protector Compartment**: Structure housing/containing a network protector or a network protector supporting the paralleling bus assembly, as well as any associated cable connections . A service take off may also be included.

3.6 **Paralleling Bus:** Bus bars used for the interconnection of transformer secondaries.

3.7 **Bus Compartment:** The bus compartment is the structure housing the paralleling bus.

3.8 **Bus to Bus Tie**: Cables connecting two parallel buses or crab vaults.

3.9 **Inter-vault Tie**: Cables connecting a network protector and a

paralleling bus or crab vault.

3.10 Crab Joint: A multiple cable connector.

3.11 Crab Vault: Structure to house crab joints for the interconnection of transformers. Can also sometimes see the crab vault referred to as the Bus Compartment.

3.12 Set of Cables: One cable of each phase and the neutral cable (All cables are of the same size).

3.13 Phase Grouping: Cables of all three phases installed in the same duct with or without neutral cable. (All cables are of the same size).

3.14 Phase Isolated: Cables of the same phase only are installed in the same duct. (All cables are of the same size).

3.15 Unscramble: Rearrangement of phase grouped cables to phase isolated.

3.16 Gap Cable: Cables between transformer and a separately mounted network protector.

3.17 Street Ties: Cables between a network installation and the secondary network grid.

3.18 Service Take-Off: Bus or cable extension to Company's point of service termination.

3.19 Point-of-Service Termination: Point where the customer's cables or bus are connected to the Company's cables or bus.

3.20 Submersible: Generally, the complete equipment "package" to be installed in the vault including the transformer, network protector, and associated cable (including submersible bushing adapters as found in EO-10704) would need to be installed as submersible individual components in order for the whole package to be recognized as "submersible".

3.21 Equipment "Mount Types": As found in the DE Equipment utility approved "Line Items" catalog, this key characteristic is how the network protector would be identified with the transformer bank:

3.21.1 Separately Mounted (SEP MTD): Transformers that do not

have the network protector mounted with the transformer bank. These units rest on the ground/ floor in the vault and are not all equipped to be submersible. The associated network protector housing styles are detailed in EO-117000. **Ventilated** and **Frame** NWP Enclosure Types and Housing Styles are not submersible.

3.21.2 Side Mounted (SIDE MTD): Transformers that are the same as a VLT except the NWP is attached to the side of the transformer.

3.21.3 End Mounted (END MTD): Transformers that have the network protector end mounted on the width side of the transformer bank. These units are suspended or installed on the floor within the vault and are equipped to be submersible.

3.22 Vault Style: Transformer equipment can be Vault Type Transformer (VLT), Vault Type Transformer With Throat (V/THR), or Subway Suspension Type Transformer (Sub/E/M). These "Vault Styles" are described in EO-10502.

3.23 Interior Distribution System: An installation within the customer's premises that is not adjacent to the property line.

3.24 Climate Change Planning and Design Guideline: The procedure developed by the Company and referenced in CI-610-4 to provide standardized climate change projections to guide Company organizations in the design, construction, operation, and maintenance of company assets and planning and coordination for emergency response.

4.0 Electrical Characteristics of 120/208 V Installations

4.1 Single transformer installations are paralleled to the network grid by means of secondary street ties.

4.2 Single and multibank 120/208 V installations can be tied together by means of bus to bus ties. Sometimes the multiple installations will form a "multiple building grid." There are various examples of single and multibank installations tied together including EO-1118 or EO-2150. For single transformers, if there is no bus associated to the transformer, then the cable connection between the network protector and a paralleling bus can be called an inter-vault tie.

4.3 A group of network distribution transformers installed in the field, or in isolated and spot networks within buildings, is called a "'multibank installation" and has the low voltage windings paralleled by means of the paralleling bus, crab joints or secondary street mains. The primary windings of the transformers are supplied by different feeders that emanate from the same Area Substation. For definitions of isolated and spot networks refer to EO-4007.

4.4 Network transformer winding connections for single and multibank installations are delta-wye when supplied by 13, 27 or 33 kV feeders and wye-wye when fed by 4 kV feeders. They all step down the voltage to 125/216 V.

4.5 The service voltage for all network installations is referred to as "120/208 V nominal" and the design operating limits are stipulated in Specification EO-2065. Company policy for A.C. Services is detailed in EO-2055 .

4.6 Each multibank installation is limited to a maximum of six (6) transformers so that a possible solid three (3) phase fault at the 120/208 V paralleling bus would not exceed 200,000 Amperes RMS Symmetrical.

5.0 Electrical Equipment

5.1 Transformers

5.1.1 The following electrical characteristics apply to 120/208 V network installations. The tables below apply to 3 Phase transformers that are post 1991 vintage.

Table 1: Liquid Filled Network Transformer Equipment

kVA	kV	Equip Mount Type	Submersible Transf
500	13, 27, 33	SEP MTD	No*
500	4	END MTD	Yes
500	13, 27, 33	END MTD	Yes
750	13, 27	END MTD	Yes
1000	13, 27	SEP MTD	No*
1000	13, 27, 33	SIDE MTD	Yes
1000	4, 13, 27, 33	END MTD	Yes

*** See Section 3.20 and Section 7 of this specification for additional details on submersible criteria and how non-submersible units can be made**

submersible

Table 2: Dry Type Network Transformer Equipment

kVA	kV	Equip Mount Type	Submersible Transf
500	13	SEP MTD	Yes**
1000	13	SEP MTD	Yes**
500	13	END MTD	Yes**
1000	13	END MTD	Yes**

****Line Items (LI) with the suffix of "D" denote transformers that can be made submersible while those denoted as "DRY" without the LI suffix are non-submersible ventilated units**

5.1.2 The above transformers are self-cooled and available as dry or liquid filled units. Detailed description of network transformers are given in EO-5025 (Dry Type) and EO-5031 (Liquid filled).

5.2 Autotransformers

5.2.1 An autotransformer may be used to connect a 265/ 460 V spot network to the 120/208 V network grid. If such an application is planned and installed, consultation with the appropriate Distribution Engineering System Design Department would be required.

5.2.2 Autotransformers are self-cooled, liquid-filled, vault type units purchased on the following standard sizes

- 500 kVA, 3-phase 480/277 to 216/125 V
- 1000 kVA, 3-phase 480/277 to 216/125 V

5.2.3 Autotransformers are described in EO-5011 with complementing operation instructions in EO-11206.

5.3 Network Protectors

5.3.1 The following network protectors are used on the 120/208 V installations:

Table 3: NWP Amp Rating & Transformer Size

Network Protector Maximum Continuous Rating (Amp)	Associated Transformer (kVA)*
2250	500
3400	750
4500	1000

(*) Post 1991 vintage transformers

5.3.2 These units are available in open ventilated frames (dust proof) or submersible housings. Submersible housings shall be used for all new 120/208 V secondary network equipment installations with a priority targeted with storm hardening installations, replacements of 120/208 V equipment, or detailed criteria discussed in EO-2168. Submersible equipment shall be used when required for Climate Change impact (Section 3.24) with submersible criteria and how non-submersible units can be made submersible described in Section 3.20 and Section 7 of this specification. Refer to EO-5103 for detailed description for network protectors and to EO-117000 for specific roll-out and enclosure information.

5.4 Fuses

5.4.1 The fuses used with 120/208 V installations are found in various specifications including EO-117000 for network protectors and in EO-5317 for service take offs. Network protector fuses and bus stab service take-off fuses are applied on the system according to Specification EO-5400 and EO-5402.

5.5 Limiters

5.5.1 Limiters employed on 120/208 V installations are listed in EO-5414 and applied on the system according to EO-5400.

5.6 Bus Bars

5.6.1 Rectangular ventilated copper tube is used as the standard for paralleling bus bar of phase conductors and service take-offs, with dimensions of 5" x 6" x 1/4". Copper tubes are purchased according to EO-100049 and their standard ratings are given in EO-5415.

5.6.2 Rubber-insulated rectangular copper bus bar is to be used in Flood Zone locations. For paralleling bus bar of phase conductors, use dimension 8” x ¾”.

5.7 Cables

5.7.1 The following Ethylene Propylene Rubber (EPR) 600 V rated cables are listed in EO-18 and used on 120/208 V installations.

a) 500 kcmil, EPR (EAM), Copper, Cable EO-7654
b) 750 kcmil, EPR (EAM), Copper, Cable EO-7655

5.7.2 No aluminum cables shall be used on such installations.

5.8 Crab Joints

5.8.1 Crab joints used on 120/208 V installations are listed in the various specifications associated to the Purchase & Test Manual No. 6.

5.9 Low-Voltage Switch

5.9.1 The Low-Voltage Switch (LVS) is a 125 V single-phase underground switch. The main purpose of the switch is to provide for a less intrusive means of isolation and ease of restoration of the low voltage distribution grid.

5.9.2 The switch is installed in conjunction with 500 kcmil cable limiters in accordance with 506487, on either side of the switch. Cable limiter installation is not necessary if secondary crabs are located in the next closest structure and are in series with the switch.

5.9.3 For details on the operation and installation of the Low-Voltage Switch (LVS) refer to specification EO-4380.

6.0 Structural Equipment Housings

6.1 Construction requirements for transformer vaults, bus vaults and network protector or paralleling bus compartments, on 120/208 V installations, are described in EO-5024 and EO-5230.

6.2 EO-2107 lists all types of manholes and vaults and describes their application in forming various arrangements of single or multibank

installations on the 120/208 V System.

7.0 Design Considerations

7.1 "Suitable Space" Requirements:

7.1.1 As per the tariff posted as CECONY's Schedule For Electricity Service as stated in the Section titled "Installation and Maintenance of Overhead and Underground Facilities > Transformers and Associated Equipment > Space for Transforming Apparatus", the utility is seeking from customers and internal planning specific criteria related to an environmentally effective and safe design for vault and compartment location and construction.

7.1.2 When determining the transformer location's "suitable space", the area of work shall be free from any obstructions that may impede the process of installation. When Survey encounters any obstructions in the proposed area of work, it is to remove or relocate any street furniture and utility associated equipment. It will be deemed unsuitable space if the obstructions cannot be removed or relocated.

7.1.3 As stated in the Company's Specifications for Electric Installations aka Electric Blue Book "Specials Services at Cost" section, highlighted environmental hazards of significance with vault construction include:

7.1.4 **Environmental remediation work**: When a geotechnical engineer discovers contamination in soil during an assessment, it is crucial to remediate the soil. Contamination can occur from a variety of sources, such as industrial waste, chemicals, or pollutants, and can pose a serious risk to human health and the environment. The remediation process may involve excavation and removal of the contaminated soil, treatment of the soil with chemicals, or other methods to isolate or contain the contamination. Failure to remediate contaminated soil within the area of work will be deemed unsuitable space. It is essential to implement the geotechnical engineer's plan to remediate and to ensure that all applicable regulations and guidelines are followed.

7.1.5 **Tidal Wetlands and/or Tidal water Restrictions**: If a tidal water and/or tidal wetland has been identified, then utility facilities and/or

equipment shall not be constructed within the affected area and will be considered “unsuitable space” by the utility.

7.1.6 **NWP Gap Cables**: When locating the transformer vault(s), there shall be a clear path for the secondary cables (gap cables) to connect to the network protector (NWP) Compartment(s). For example, if a column is obstructing the path of the gap cables, then the Company’s design specifications of the cable cannot be met. The customer or building owner shall provide an alternative location that the gap cables can adequately connect the transformer(s) to the NWP(s).

7.1.7 As stated in EO-2035, the distance between transformer vault(s) and the NWP compartment(s) shall not exceed 25 feet. Cables on the 120/208 Volt system may be installed "phase isolated" if their lengths do not exceed 25 feet to avoid voltage regulation problems. Cables shall be "phase grouped" for longer runs. "Phase grouped" distances will be limited to practical voltage drop calculated to ensure safe and reliable power to the customer inclusive of interior distribution plans. For information of cable impedance related to “phase grouped” and “phase isolated” configurations, see EO-2057.

7.1.8 **Structural/ Gratings Load Limitation:** Vaults shall not be located in front of driveways, parking lots, and high traffic entrances. Utility gratings are not designed for consistent wheel load. If a hardship is present, it is under the discretion of the Engineering and Planning design team to determine if the location is suitable under EO-5024 or EO-5230 guidance.

7.1.9 Additional space requirements, ventilation, access, and draining details are outlined in EO-2107, EO-5024 and EO-5230.

7.2 Equipment Elevation

7.2.1 In accordance with Corporate Climate Change Planning and Design Guideline and CI-610-4, the planned installation of 120/208 V vaults would require a Flood Risk assessment to identify if the equipment locations is in an effective location whereas the elevation at the bottom of the transformer shall be at least five (5) feet above depending on what is shown on the current New York City or Westchester County FEMA FIRM map for the current 1% annual

chance floodplain (also known as the 100-year floodplain) applicable to the chosen location.

7.2.2 Above grade - Bottom entry conduits need to extend to at least the bottom plane of the transformer equipment to stay above this minimum height. The transformer equipment is allowed to be elevated above grade to clear this minimum height using a grounded structure.

7.2.3 Below grade - If the below-grade asset is not in the future 1% annual chance floodplain within the determined useful life, there is no coastal flood protection required for the asset. These locations shall have to prove that adequate drainage, pumping, and spill containment facilities are present to prevent liquid from any source, including nearby tank leaks, from rising above the bottom of the transformer equipment and vault. If the below-grade asset is within the future floodplain map, the appropriate design interventions shall be determined to mitigate flooding risks, such as upgrading to submersible equipment.

7.2.4 All non-submersible 120/208 V secondary network equipment contained in existing vault structures shall be replaced with submersible equipment if the grating elevation is located within the FEMA+5 flood zone, as per corporate guidelines. If units are located in the FEMA+5 flood zone, then the replacement job must meet all the requirements as seen in Sections 3.20, 7.2.6, and **Table 4** below.

7.2.5 120/208 V Transformer(s) and NWP(s) can be designed and installed within the FEMA+5 Flood Zone if the requirements of Section 7.2.6 and **Table 4** are met.

7.2.6 The grating elevation shall be above the FEMA+5 elevation if the NWP is not submersible. Submersible boots (submersible bushing adapters) are required for the transformer secondary bushings for installations requiring a gap cable in order for complete transformer and NWP system to be recognized as “submersible” (see EO-10704). Guidance with regards to submersible equipment designs with **Transformer Styles,** (outlined in EO-10502 Section 3), **NWP Housing Styles** (outlined in EO-5103 Section 2.6). Additionally, 120/208 V installations may include the addition of submersible

fuses and SCADA. EO-117000 can be referenced for specific roll-out and enclosure information.

Table 4: Install of Transformer & NWP Styles in Flood Zone

Transformer Type	Network Protector (NWP) Housing Style	Installation in Flood Zone
End Mounted or Side Mounted	Submersible	Both Transformer and NWP can be installed
End Mounted or Side Mount	Ventilated	Cannot be installed; May be installed at a specified elevation following a design discussion
Separately Mounted	Submersible (Separately mounted)	Transformer shall be installed with submersible boots. NWP can be installed, no elevation requirements.
Separately Mounted	Frame (Separately mounted)	Transformer shall be installed with submersible boots. NWP is required to be at raised elevation.

7.3 Transformers

7.3.1 Detailed criteria for network transformer replacements or new installation and selecting between dry type air cooled or liquid filled and fill type (mineral oil, natural ester, or silicone) are outlined in EO-2120.

7.3.2 In general, liquid filled transformers are used on all outdoor installations, where stock availability of certain types may become the leading criteria. Transformers installed within buildings shall be natural ester (preferred) or dry type units based on the criteria provided in EO-2120 with space availability, structural limitations, ventilation exposure and economics.

7.3.3 For additional details of the application of 750 kVA transformers refer to EO-2107 and EO-2168.

7.3.4 Only one network transformer shall be installed in each vault.

7.4 Autotransformers

7.4.1 Autotransformers that may be used to connect 265/460 V spot networks to 120/208 V network grids are liquid filled units.

7.4.2 Only one autotransformer shall be installed in each vault.

7.5 Network Protectors

7.5.1 Network protectors (NWP) shall be installed in accordance with design considerations in Sections 7.1 and 7.2.

7.5.2 Network protectors shall be installed in vaults or network protector/bus compartments. Submersible type housings shall be used for all new 120/208 V below-grade secondary network equipment installations. In addition, submersible type housings shall be used for all targeted storm hardening installations or at locations with criteria outlined in Section 7.2, or replacements of ventilated 120/208 V cabinets, where space permits.

7.5.3 Only one protector shall be installed in a vault or NWP/ bus compartment.

7.5.4 Network protector modes of operation are described in EO-5411.

7.6 Fuses

7.6.1 Fuses shall be used on every network protector and on every bus stab service take-off with additional details found in EO-5317 and EO-10901.

7.6.2 Network protectors shall be fused according to EO-5400 by using the low loss fuses listed in EO-12696-B.

7.6.3 Service take-off bus stabs shall be fused according to EO-5402 by using the low loss fuses listed in EO-9689-D.

7.6.4 Service take-offs consisting of cables need not be fused but should be limited.

7.7 Limiters

7.7.1 Limiters should be provided at both ends of every phase cable on street ties connecting a single or multibank 120/208 V installation to the network grid.

7.7.2 Service take offs at multibank installations consisting of cables should have cable limiters at both the company and the customer end of the cable with details concerning the use of limiters and

limiter lugs on service cables supplying Customers from the secondary network systems described in EO-3019.

7.7.3 A service supplied from the network grid should have cable limiters if it consists of 3 or more sets of cables.

7.8 Bus Bars

7.8.1 The rectangular ventilated copper tube that is used for paralleling bus phase conductors on 120/208 V installations, shall be placed at 10" center to center horizontal spacing among the phases. Rubber-insulated rectangular copper bus bar is to be used in Flood Zone location. The rectangular insulated copper bus for paralleling bus phase shall be placed 13" center-to-center horizontal spacing among phases. Exception is V15-6 Drawing 510634 which shows 11½" center-to-center spacing.

7.8.2 Buses of 120/208 V multibank installations are designed to withstand a maximum solid 3-phase fault of 200,000 amperes RMS Symmetrical. Standard design of bus bar installations, bus ampere ratings and provision for service take-offs are described in EO-5415.

7.8.3 All buses shall be constructed to provide spare terminations for future cable connections. Each connection shall be equivalent to the full capacity of one 1000 KVA network transformer.

7.8.4 Buses of 120/208 V multibank installations are designed to with Network bus installations and bus support assemblies are detailed in Construction Standards Manual No. 3 (whereas a drawings list of bus installations appears in the References Section of EO-5102).

7.9 Secondary Cables

7.9.1 The EO-2035 covers all secondary cable vault installations on the 120/208 V network system, such as: secondary cables within or between transformer vaults and bus vaults (bus compartments); and street ties and service cables associated with the vault installation.

7.10 Crab Joints

7.10.1 The Crab joints are used to connect multiple sets of cables together. Typical installations of crab joints are found in EO-5403

Construction Standards Manual No. 3 with other specifications identifying materials such as EO-6240 from the Purchase & Test Manual No. 6.

7.11 Vaults and Ventilation

7.11.1 Vaults on the 120/208 V System constructed on the sidewalk or within buildings and containing liquid filled transformers, shall be reinforced concrete structures. Transformer vaults containing dry type transformers may be constructed of 100 percent filled concrete block. Both vault types are described in EO-5024.

7.11.2 Transformer vaults, bus vaults and crab vaults are detailed in EO-2107.

7.11.3 Transformer vaults shall have the following net clear ventilation area as specified in EO-2032.

7.11.4 The following combinations of equipment may be installed within a single vault:
(a) One network transformer with or without its associated network protector.
(b) Same as (a), with one autotransformer in the vault.

7.11.5 When a network transformer and an autotransformer are placed in the same vault space, the total of their respective ventilation requirements must be considered.

7.11.6 Transformer vaults and network protector compartments within buildings may be forced exhaust ventilated according to the design criteria of EO-2032. (Forced ventilation for new transformer vaults is not permitted but is grandfathered where used in existing installations).

8.0 Grounding

8.1 The neutrals of the sets of cables that connect a network installation to the secondary grid (street ties) provide an adequate ground for such installations.

8.2 Grounding in isolated and spot networks (with no street ties) is achieved by using the concentric neutral/lead sheaths of the primary cables and insulated 4/0 copper cable to connect the neutral bus in the paralleling bus vault to the system ground. For future installations one insulated 4/0 copper

cable from the bonding tree to the neutral bus for each network transformer should be installed for safety and reliability reasons. If the above requirement cannot be met a minimum of two insulated 4/0 copper cables in separate ducts are required for each installation if approved by the DE System Design Department Manager or the designee. In addition, one 500 kcmil copper cable shall be used to connect the neutral bus of the installation to the building steel frame.

9.0 Exceptions

9.1 Any exceptions to the stipulations of this Specification shall be forwarded to the System Design Department Manager of the Distribution Engineering Department.

10.0 References

Document #	Title
EO-18	Ethylene Propylene Rubber Cables - 600 Volts
EO-1118	Method Of Connecting 1000 kVA Transformers To The 120/208 Volt Secondary Grid
EO-2002	Loading Limits for Network Transformer Bank Installations
EO-2008	Service Voltage Flicker Limits
EO-2032	Design Criteria for Ventilation of Transformer Vaults and Network Protector Compartments
EO-2035	Secondary Cable Installations for 120/208 Volt Network System Vaults
EO-2055	A.C. Services
EO-2057	Impedances For Underground Secondary Mains And Service Cables And Impedances For Phase Isolated Or Phase Grouped Underground Secondary Tie Cables
EO-2065	Low Tension A.C. Service Voltage Limits
EO-2107	Arrangements of Standard Transformer and Bus Vaults for 208 Volt Network Installations
EO-2120	Criteria for Network Transformer Usage
EO-2150	Modified Design of Distributed Networks
EO-2168	Prioritization of Banks Off, OOE2s, and CFRs
EO-3019	The Use of Limiters on Services
EO-4007	Operation of Isolated Networks
EO-4380	Operation of 125V Low Voltage Single Phase Underground Switch
EO-5011	Detailed Specification for 480/277 to 216/125 Volt Autotransformer

Document #	Title
EO-5024	Requirements for Construction of 120/208 Volt Network Installations
EO-5025	Specification for 13 kV Dry Type Transformers
EO-5031	Detailed Specification for Secondary Network Transformers
EO-5083	General Specification for Submersible Distribution Transformers
EO-5102	Safety Signs For 120/208 Volt And 265/460 Volt Bus Vault Installations
EO-5103	Purchase Requirements for Network Protectors and Network Protector Housings/Enclosures
EO-5230	Installation Of 120/208 Volt Transf. & Bus Compartments By Customer's Contractors
EO-5400	Network Protector Fusing and Selectivity with Cable Limiters on 120/208 Volt Networks
EO-5402	Fuses for Service Take-offs and Services
EO-5411	Network Protector Relaying
EO-5415	Standard Design and Ratings of Alum/Copper Bus
EO-6043	Tagging of Cable
EO-9689-D	Type W4 Fuse for 4000 Ampere 120/208 Volt Service Take-Off
EO-10502	Class Code Identification For Distribution Transformers And Reactors Post 1971 Manufacture
EO-10704	Installation Of Submersible Bushing Adapters (Submersible Boots)
EO-117000	General Specification On Replacement Information For Network Protectors
EO-11206	Instructions for 480/216 Volt Autotransformers
EO-12696-B	Low Loss Fuses for Network Protectors
EO-100049	Copper Bus (For Electrical Distribution Buses)
506487	Installation of Low Voltage Load Break Switch
EO-2163	Application of Secondary Low Voltage Switches
EO-5155	125 V Single Phase Underground Switch
CI-610-4	Climate Change Adaptation & Resiliency; **Climate Change Planning and Design Guideline**

Revision 8: Updated format; Included 750 kVA transformer; Added “Suitable Space” and “Equipment Elevation” into Design Criteria with Bus & Vault Design and DE Equipment B-361 input; Incorporated Corporate Instruction for Climate Change Adaptation & Resiliency; and strengthened guidance described in **Climate Change Planning and Design Guideline**; Added details regarding below grade; above grade and defined “submersible” equipment installations; Establish Mount Type transformer details. **Revision 7:** Added Par. 5.6.2, 7.2.3 and expanded Pars. 7.5.1 and 7.8.6 for implementation of submersible bus on 120/208 Volt Network Installations. Added Sub-Section 5.9 on LV Switch. 1. Deleted Appendix 1 – NWP Relay Trip & Close Settings moved to an updated spec EO-5411.	**FILE:** Engineering Manual No. 4: Application and Design