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1. Purpose

1.1. The purpose of this guide is to ensure the furnishing of an electrical vault for utility equipment. Once designed and constructed by the Customer and accepted by NES, the electrical vault will house utility transformers, and other equipment required to serve the Customer’s electrical needs.

1.2. It is intended that this document serve as a guide to the Customer in preparing a vault design rather than as a detailed specification. The Customer shall furnish complete descriptive information and specifications of the proposed vault.

2. Customer Responsibility

2.1. The word “Customer” in this document refers to the property owner or developer. Many steps will actually be completed by consultants or contractors (Customer’s Architectural Team), but the ultimate responsibility rests with the Customer.

2.2. Doors, vents, removable vault tops, and grating shall be designed, constructed, and maintained by the Customer per NES requirements.

2.3. The Customer shall reimburse NES for the cost of any maintenance or cleanup performed in the vault by NES once equipment in the vault is energized.

2.4. The Customer shall sign up for electric service before the vault design can be reviewed. At a minimum, the Customer shall provide a site plan, power distribution diagram, and service load calculations when signing up for service.

2.5. The vault shall pass final inspection by the NES Engineer including, but not limited to: Vault top removal and replacement before NES equipment can be installed.

2.6. Damage to existing NES facilities by the Customer shall be repaired by NES at the expense of the Customer.

2.7. Customer shall not locate vault below footprint of the street.

2.8. Customer shall obtain permit with Metro Public Works for Customer-owned vaults and vault tops located in sidewalks. Contact the Permit Office at 615-862-8762; NES Engineer can provide contact names if necessary. Customer shall provide easements indicated on property documents.

3. Drawings

3.1. Preliminary Design Drawings

3.1.1. Customer’s Architectural Team shall provide preliminary vault layout drawings for NES review and comment. It is recommended that the preliminary design drawings be included in the design development package.
3.2. Construction/Approval Drawings

3.2.1. The Customer’s Architectural Team shall submit a paper copy of the Vault Design Guide with the sheet numbers, note numbers, and details where each item as applicable is addressed. Reduced Set (half size or three quarter size) of all the drawings with the specifications indicated on the marked up Vault Design Guide shall be submitted for approval. The submittal shall illustrate compliance with ALL applicable requirements listed in this design guide. Architectural, Civil, Structural, Mechanical, Plumbing and Electrical shall review, not just Electrical. Application will be rejected without mark up.

3.2.2. Re-submittal shall be required if the construction drawings lack enough detail for the NES Engineer to confirm that all requirements are being satisfied.

3.2.3. It is recommended that the Customer submit construction drawings for review four (4) weeks before scheduled issue date of contract documents.

3.2.4. Structural, mechanical, architectural, civil and electrical drawings shall be sealed and signed by a Tennessee licensed engineer for each area of responsibility.

3.2.5. The Customer shall submit two printed copies of the construction drawings to the NES Engineer for final approval before construction. Electronic PDF copies shall be submitted when vault plans are approved.

3.2.6. The Customer shall notify the NES Engineer immediately of any proposed changes to the vault design after construction drawings have been approved.

3.3. As-Built Record Drawings

3.3.1. A printed copy and electronic copy (AutoCAD .dwg format) of the record drawings showing all As-Built revisions shall be provided to the NES Engineer before the permanent electric service will be energized.

3.3.2. As-Built drawings with significant revisions from the original construction/approval drawings shall be sealed and signed by a Tennessee licensed engineer for each area of responsibility.

3.3.3. The Customer’s Architectural Team shall provide as-built surveys in AutoCAD format and in plan view for infrastructure (ductbank and manholes) installed.

4. Architectural Required

4.1. Vault Inspection and Acceptance (Architect shall note 4.1.1 - 4.1.6 on Architectural drawings)

4.1.1. The Customer shall notify the NES Engineer at least five (5) working days before the grounding inspection. This must be done before the vault walls and floors are poured.

4.1.2. The Customer shall notify the NES Engineer at least five (5) working days before the proposed final vault inspection date.

4.1.3. The vault must be complete, secure, clean, and accessible for inspection to take place.
4.1.4. The Customer shall connect a temporary feed (a generator is acceptable) to the vault disconnect switch (Network) or panelboard (Non-Network) so NES can confirm that the light and receptacle circuits are operational.

4.1.5. The Customer shall remove and replace the vault tops (Functionality Test) in the presence of NES to obtain the acceptance of NES (vault shall be cleaned after lift-out test before handing over to electrical contractor).

4.1.6. **All applicable components of this guide shall be satisfied before the vault can pass inspection and be accepted for use by NES. Vault shall be sprayed down to get rid of dust after electrical contractor completes work, before transition to NES. Installation of NES equipment is contingent on acceptance of the vault by NES.**

4.1.7. Architect to provide codes sheet or sheet index that indicate square footage of each level of structure and total square footage of occupied or unoccupied space.

4.2. General Requirements

4.2.1. NES Service Area Descriptions

(a) See Figure 1 (Appendix F) for Network Area.

(b) The Non-Network Area is outside of above.

(c) Confirm with NES if not sure.

4.2.2. Transformer Size

(a) How to estimate transformer size:

1. Determine total estimated watts (W) per square feet (sq-ft) of building:
   - Multiply 8W/sq-ft x total sq-ft for main structure, then divide by 1000 for kW.
   - Multiply 1W/sq-ft x total sq-ft for garage, then divide by 1000 for kW.

2. Divide total above load by .90 to get kVA required.

3. If the project is a data center contact NES Engineer.

4. If the project is a restaurant or bar less than 20,000 sq-ft:
   - Multiply 25W/sq-ft x total sq-ft for main structure, then divide by 1000 for kW.

(b) Transformer quantity

1. Non-Network see Table 1 (Appendix A).

2. Network see Table 7 (Appendix B).
(c) The NES Engineer shall select the appropriate quantity and rating of transformers for vault design. The method above will adequately size the vault room for this selection.

(d) Due to initial estimated demand, NES may elect to install a lesser quantity and/or smaller rating of transformers in the vault.

4.2.3. Working Clearance Around Transformers

(a) See Table 2 or 8 (Appendix A & B) for the maximum standard transformer dimensions. See Table 3 or 9 (Appendix A & B) for the minimum working clearance required for one transformer.

(b) The transformers shall be arranged in a vault such that three feet (3’) of working clearance is maintained around each unit once they are installed in the operating position. Two units can share common working space. There shall be no fixed objects located within the working space. (NETWORK ONLY); Note that the “door open” length shall be used to determine the working clearance footprint.

(c) Twenty feet (20’) horizontal clearance shall be provided between electrical utility vault and any above ground or underground generators, storage or fuel oil tank, fill valve, vent valve, vent exhaust (fumes), or air intake in case of vault fires.

4.2.4. Installation Provisions For Equipment

(a) The vault shall be designed in such a way as to allow replacement of any one unit without disturbing the other units in service.

(b) Approval drawings shall illustrate the equipment can maneuver into the operating position around any obstacle while maintaining minimum clearances through the path of travel.

(c) Transformer will likely be moved into position by NES using roller skids or roller dollies. Therefore, the vault floor shall be clean and smooth without any irregularities in the finish (slick machine/trowel finish preferred).

(d) Customer installed hoists will not be allowed.

(e) Vault floors shall all be one level. Multi-height vaults are not allowed.

4.2.5. Working Clearances around Equipment Access Requirement

(a) The equipment access should be located in the sidewalk or building wall along a main street. Alleys less than thirty feet (30’) wide will not be used for equipment access due to the limited space for trucks and cranes to set equipment. NES may consider equipment access locations other than main streets when an easement is recorded to provide the thirty feet (30’) wide corridor for truck and crane access.
(b) The equipment access shall not be located within an area that, if blocked for an extended period of time, would negatively affect operations of the Customer’s facility or other surrounding facilities. An example would be a parking area entry ramp.

(c) Provide six feet (6’) horizontal working space on each side of the access door for Street Level Vaults or on at least three sides of the vault lid for Below Grade Vaults.

(d) Working space shall extend vertically from the surface of the sidewalk to forty feet (40’) above the surface for all vaults.

(e) Working space shall extend from the back edge (building side) of the vault access to the street/curb (or other area where the truck or crane will be positioned).

(f) Fixed objects of any kind (fire hydrants, trees, planters, street light poles, building signs etc.) shall not be located within the working space detailed above.

(g) NES will not approve an overhang inside the working space unless it is fully retractable. Fixed awnings, signs, or balconies within the working space are not acceptable.

4.2.6. Street Level Vaults Equipment Access Requirements

(a) Provide a roll-up door or a set of hinged doors for equipment installation.

1. Roll-Up Door Requirements:

   (i) Roll-up door “Drum Assembly” to be installed on the inside of the vault. Manual operation of the roll-up door is required in power outage situations.

   (ii) The width of a roll-up door shall be a minimum of ten feet (10’) wide.

   (iii) The height of a roll-up door shall be fourteen feet (14’). However, twelve foot (12’) doors are acceptable if:

        a. The vault floor is at least as high as the external grade.

        b. The area outside the vault is at finished grade at the time of transformer delivery

2. Hinged Door Requirements:

   (i) All hinged doors shall meet the requirements of a personnel access door. See Section 4.2.8 for details.

   (ii) Each hinged door shall be a min. four feet (4’) wide x min. eight feet (8’) high and open outward, not to interfere with the eight feet (8’) wide doorframe required. If doors can only open 90°, the minimum clearance between set of door’s panic hardware shall be min. eight feet (8’).
(iii) The vault floor is at least as high as the external grade.

(iv) Approximately ten feet (10’) x ten feet (10’) reinforced concrete pad will need to be installed outside the vault at the same height as the vault floor. The concrete pad shall be clean and smooth without any irregularities in the finish (slick machine/trowel finish preferred).

(b) Transformers shall not be installed through any access other than the roll-up or hinged door mentioned above.

(c) Fixed removable wall panels shall not be accepted.

4.2.7. Below Grade Vaults Equipment Access Requirements

(a) Vault depth should not be greater than nineteen feet (19’) from the elevation of the sidewalk at the sidewalk personnel access.

(b) Vault can be located entirely under the sidewalk or on the first level of a basement. Basement vaults shall extend under the sidewalk for equipment access.

(c) Vault tops can be located within a public right-of-way or any other area subject to occasional non-deliberate vehicular traffic.

4.2.8. Personnel Access General Requirements

(a) Vaults require at least two personnel entrances, one at each end of the vault.

(b) Access for personnel shall be located such that the path of egress leads to an exit that does not open into an unsafe condition such as a driveway. Personnel doors typically lead to the exterior of the facility, electrical room, basement, parking garage, or other common space.

(c) Each door (if provided) shall open in the direction of egress (doors open to outside of vault room) and be equipped with a flat bar exit device (panic door) with door closer on the vault side of the door. See Appendix E for required door hardware. The lock set shall be set up to operate as “storeroom” (ANSI 09) function. Hardware manufacturer notes that an easy field change is required to achieve the “storeroom” function with this trim kit. Details should be discussed with manufacturer’s representative. Lock core shall be provided and installed by NES. The Customer shall not have access to the vault after equipment has been energized. This hardware is mandatory, no substitutions accepted.

(d) Each doorway (if provided) leading into a vault from the building interior shall be provided with a tight-fitting UL listed door that has a minimum fire rating of 3 hours (Type A).

(e) Stairs shall not be permitted inside a vault. If stairs are required in the path of egress, they must be located outside the vault with no less than a 4’ by 8’ landing between the vault door and stairs.
(f) (Non-Network) Each doorway (if provided) leading out of a vault shall have a lit emergency exit sign with two (2) LED heads. Exit sign shall be installed next to the door, one foot (1’) above the floor.

(g) Each doorway (if provided) leading into a vault shall have OSHA approved permanent and conspicuous safety signs installed outside the door (min. 8.5” x 11”) reading: DANGER – HIGH VOLTAGE – KEEP OUT.

(h) An additional safety sign (min. 8.5” x 11”) shall be posted below (g) at each doorway, outside the door, reading: WARNING – EMERGENCY EXIT – DO NOT BLOCK.

(i) All access locations and details shall be subject to NES approval.

4.2.9. Street Level Vaults Personnel Access
   (a) Street level vaults require at least two personnel doors. The doors shall be on opposite ends of the vault.
   (b) If hinged doors are utilized for equipment installation/removal, one of the required personnel doors may be deleted.
   (c) At least one of the doors shall provide unrestricted access to NES personnel 24 hours a day/7 days a week. Access shall not be restricted by doors or gates locked with a key other than NES vault key.

4.2.10. Below Grade Vaults Personnel Grating Access
   (a) Below grade vaults shall have at least one sidewalk personnel access as described below. NES Engineer may require additional points of access for multiple transformer vaults.
(b) Access for personnel shall be located such that it is not directly above electric equipment or conductors in the vault.

(c) Customer must obtain Metro approval and Metro ADA Compliance Division approval for gratings installed in a public sidewalk.

(d) Clear opening for personnel access through gratings shall be at least 28” (edge of ladder to hinge) x 28”.

(e) Each personnel access grating section shall weigh 100-150 pounds.

(f) If gratings have elongated openings, then they shall be placed such that the long dimension of the opening is perpendicular to the dominant direction of travel. There shall be no gaps greater than half inch (½”) on all sides of the grating.

(g) Detailed design/shop drawings shall be submitted to NES Engineer for approval. Drawings shall include grating dimensions, weights, and lifting provisions.

(h) A corrosion resistant fixed ladder meeting all current OSHA requirements shall be installed at a personnel access through the sidewalk. The ladder shall be installed with a 4:1 slope. Refer to OSHA Standard 1926.1053, for “fixed ladders” (Appendix E).

(i) Fixed ladder shall have an OSHA approved telescoping ladder extension post that locks in place to guide and provide stability to the user, see Appendix E for NES approved ladder extension. Customer shall make certain that the extension post is installed in such a way as to satisfy the applicable OSHA requirements.

(j) The ladder shall not interfere with clearances required to move transformers into operating position or working clearances around transformers once they are placed into the operating position.

(k) Provide three feet (3’) clear working space around all sides of personnel access through a sidewalk.

(l) Protect all exposed steel items from corrosion by hot dipped galvanizing.

5. Structural Engineer And Architectural Requirements

5.1. Fire Rating

5.1.1. The vault shall be designed and constructed in such a manner as to provide a 4-hour separation between the vault and the building (this includes the fan room if required). Two permitted exceptions to this 4-hour separation are listed below.

(a) One UL listed (Type A) 3-hour rated door is permitted into the interior of the building.
(b) Electric service entrance may be permitted to pass through the 4-hour wall, provided a UL listed firestop system with a 3-hour rating is installed by the Customer. Detailed drawings and specifications shall be submitted to NES for approval of system selected to maintain 3-hour fire rating.

5.1.2. The vault shall be constructed of 5000 psi concrete, **a block-filled vault room will not be accepted**.

5.1.3. Thermal insulation or fireproofing materials shall not be installed on the ceiling or wall of a vault.

5.1.4. Contractor to include fire caulking on both sides of seams between walls and structural beams, and around both sides of door frames.

6. **Structural Required General Notes**

6.1. Vault Inspection and Acceptance (structural engineer shall note 6.1.1 - 6.1.5 on structural drawings)

6.1.1. The Customer shall notify the NES Engineer at least five (5) working days before the underground grounding inspection. This must be done before the vault walls and floors are poured.

6.1.2. The Customer shall remove and replace the vault tops (Functionality Test) in the presence of NES to obtain the acceptance of NES (vault shall be cleaned after lift-out test before handing over to the electrical contractor).

6.1.3. **All applicable components of this guide shall be satisfied before the vault can pass inspection and be accepted for use by NES. Installation of NES equipment is contingent on acceptance of the vault by NES.**

6.1.4. If vault lift off slabs are required, contractor to clean vault after demonstration to NES before turning vault over to Electrical Contractor to install electrical items.

6.1.5. It is recommended that the contractor orders inserts for the lift off slabs as early as possible. NES will **not** provide the required inserts. See Appendix E for the required inserts. See section 6.6 for insert details.

6.2. **Street Level Vaults**

6.2.1. Protect all exposed steel items from corrosion by hot dipped galvanizing.

6.2.2. Floor shall be sloped 1.0% to liquid containment pit. Containment pit shall include a 12” long x 12” wide x 6” deep sump for (Non-Network) vaults, 18” x 18” wide x 6” deep for (Network) vaults. 1% slope elevations shall be constant. There shall be no need for steps in vault.

6.2.3. Containment pit shall be covered with grating of sufficient strength to support expected loads. Each section of grating shall weigh less than 150 pounds. There may be multiple pits connected by 4” PVC below slab if required.

6.2.4. Liquid containment capacity shall be greater than or equal to 110% of the volume of liquid in the largest transformer.
6.2.5. Where a doorway leads into the vault, a door sill or curb that is of sufficient height to confine the liquid from the largest transformer within the vault shall be provided. In no case shall the height of the sill or curb be less than four inches (4”) or greater than eight inches (8"). Door sill or curb (shall be painted yellow) shall be removable if the doorway is used for equipment installation or removal. Angled iron is suggested for removable curb. Sealant shall be installed between the door sill and the vault floor.

6.3. Pulling Irons (all vaults)

6.3.1. Structural Engineer shall show details and sections for compliance

6.3.2. Pulling irons used to position transformers shall be located on each wall, one foot (1’) above finished floor, recessed and centered on each transformer.

6.3.3. Additional pulling irons may be required by NES Engineer.

6.3.4. Pulling irons shall be designed and installed to withstand 12,000 pound load.

6.3.5. Standard pulling iron details are shown in NES drawing #UN-10386 (provided by NES Engineer). Drawing shown to indicate size of pulling iron expected (detail will not show how to obtain 12,000lb of load). These pulling irons are typically cast into a concrete wall. Other pulling iron designs shall be subject to approval by NES Engineer.

6.3.6. Pulling irons shall be recessed into the face of the wall. Pulling irons shall not extend into clear working space around each transformer.

6.3.7. Pulling irons shall be protected from corrosion by hot dipped galvanizing.

6.3.8. Pulling iron inserts shall be provided in the ceiling above any conduits that enter through the floor. Coordinate with Electrical Engineer. These irons do not need to be treated.

6.3.9. Pulling irons are required to be placed at 9’ above finished floor across from any wall “Bayouts” of conduit entrances (opposite wall or near column for cable pull leverage). Coordinate with Electrical Engineer. Location shall be in line with center layout pipes. These are not required to be recessed.

6.3.10. One (1) pulling iron shall be located above NES primary conduit entrance.

6.4. Concrete Support Beams (all vaults)

6.4.1. Once transformers are in position, they shall be placed on portable concrete support beams.

6.4.2. The customer shall provide three (3) portable concrete support beams per transformer.

6.4.3. Support beam details are shown in NES drawing #UN-22304 (provided by NES Engineer).
6.5. Maximum transformer equipment weights are listed in Table 5 & 11 (Appendix A & B)

6.6. Lift Off Slabs and Grating (below grade vaults)

6.6.1. A typical vault layout for NES constructed single-transformer (Network) vault is illustrated in NES drawing #UN-41178 (provided by NES Engineer). A typical single-transformer (Non-Network) vault is illustrated in NES drawing #UGS-00034 (provided by NES Engineer).

6.6.2. NES expects a design with “grating, cast in place concrete slabs, grating” (gratings on ends) design. Equipment must not be directly under gratings. Coordinate this with Electrical Engineer or NES Engineer.

6.6.3. Gratings may be accepted for equipment access if they are required for ventilation and site conditions will not allow for ventilation separate from the vault equipment access. Refer to Section 7 for additional information.

6.6.4. Vault tops located within a public right-of-way or any other area subject to occasional non-deliberate vehicular traffic.

   (a) Designs created by use of Allowable Stress Design (Structural Steel) or Working Stress Design (Concrete) shall use AASHTO H-20 or HS-20 Design Loading (Engineer shall indicate on contract documents).

   (b) Designs created by use of Load and Resistance Factor Design (Structural Steel) or Ultimate Strength Design (Concrete) shall use HL-93 (Engineer shall indicate on contract documents).

6.6.5. Removable concrete slabs should be provided for equipment installation and removal. Slabs should be poured in place. At a minimum, the top one third (1/3) of the vault shall be poured in place.

6.6.6. Maximum weight of lift-off slab shall be 14,000 pounds. Maximum length of lift-off slab shall be fourteen feet (14’) (Engineer shall indicate on contract documents).

6.6.7. Four (4) embed inserts (with brass plugs) shall be installed in each slab for lifting, see Appendix E for required inserts.

6.6.8. Indicate to contractor to provide quarter inch (½”) expansion around slabs for tight gaps.

6.7. Electrical Bayout Wall Structural Details

6.7.1. Structural Engineer shall coordinate with Electrical Engineer for location of primary and secondary conduit/cable entrances. If expected to be in the wall, a bayout shall be required.

6.7.2. Bottom of bayout shall be 7’ above finished floor.

6.7.3. Bottom row of conduits shall be 8’ above finished floor.

6.7.4. Refer to NES drawing #UN-41535 (provided by NES Engineer).
6.8. Below Grade Vaults

6.8.1. Floor shall be sloped 1.0% to sump pit for removal of water that may enter the vault through the ventilation gratings. The preferred location of sump is across from the access ladder.

1% slope elevation shall be constant. There shall be no need for steps in vault.

6.8.2. (Network & Non-Network) Sump pit shall be 18” long x 18” wide x 18” deep with a grating cover of sufficient strength to support expected loads.

6.8.3. NES may install a sump pump in the vault to pump water to the nearest storm structure. NES installed pump will be equipped with an oil sensing switch to prevent oil from being pumped into public storm water system.

6.8.4. Provide a two inch (2”) conduit stubbed out through the vault wall to the nearest storm drainage structure for sump pump discharge. This conduit shall be installed with no bends or elbows unless approved in writing by NES Engineer. Conduit shall extend six inches (6”) past the vault wall into the vault above the sump pump on the vault end. Civil Engineer shall submit signed/sealed drawings showing these details.

7. Mechanical Engineer Requirements

7.1. Ventilation and Equipment Cooling

7.1.1. Vaults shall be located where they can be ventilated to the outside environment without using flues or ducts wherever such an arrangement is practical.

7.1.2. Ventilation adequate to dispose of the transformer full-load losses (heat output) without creating a temperature rise that is in excess of the transformer rating shall be provided.

7.1.3. Ventilation outlets shall be located as far as possible from doors, windows, fire escapes, and combustible materials.

7.1.4. Ventilation inlet and outlet shall be at opposite ends of the vault room so ventilation system directs airflow across the vault to ensure uniform temperature and no hot spots.

7.1.5. Louvers utilized for ventilation shall include bird screens. Detailed drawings shall be submitted for approval. Louvers shall be fixed in the open position and shall not be controlled by fire or smoke detectors. Steel hot dipped galvanized bars will be required behind the louvers to prevent access to vault.

7.1.6. Gratings (coordinate with Structural and Electrical)

(a) Customer must obtain Metro approval and Metro ADA Compliance Division approval for ventilation gratings installed in a public sidewalk.

(b) See Appendix E for required gratings.

(c) Gratings shall not be located above cable racking or other NES equipment to be installed in the vault.
(d) Ventilation gratings that will be used for personnel access through the sidewalk shall weigh 100-150 pounds.

(e) “Electric” Identification plate required on grating if access is for ladder. Identification plate shall be installed flush with top of grating, centered on opening edge (non-hinge side).

(f) If a section of grating (other than personnel access) weighs more than 150 pounds, some type of lifting provisions shall be provided.

(g) Detailed design and shop drawings shall be submitted to NES for approval. These drawings shall include all grating dimensions, weights, and lifting provisions.

7.1.7. Protect all exposed steel items from corrosion by hot dipped galvanizing.

7.2. Ventilation by Natural Circulation

7.2.1. A vault ventilated by natural circulation of air shall be permitted to have roughly half of the total area of openings required for ventilation in one or more openings near the floor and the remainder in one or more openings in or near the roof, or all of the area required for ventilation shall be permitted in one or more openings in or near the roof.

7.2.2. The combined net area of all ventilating openings, after deducting the area occupied by screens, gratings, or louvers, shall not be less than three square inches (3 sq-in) per kVA of transformer capacity. For vaults with multiple transformers (usually Network), the number of transformers equal (N-1), where N equals the total number of transformers installed in the vault.

7.3. Ventilation by Forced Air

7.3.1. The full load heat loss (heat output) for each transformer is listed in Table 5 & 11 (Appendix A & B).

7.3.2. Total full load heat loss of a vault with one transformer (usually Non-Network vault) installed equals the full load heat loss of that transformer.

7.3.3. (Network) Total full load heat loss of a vault with multiple transformers equals (N-1) multiplied by (full load heat loss of one transformer), where N equals the total number of transformers installed in the vault.

7.3.4. Vault Temperature

(a) (Network and Non-Network) The temperature of the cooling air (ambient vault temperature) shall not exceed 122°F (50°C), and the average temperature of the cooling air for any 24-hour period shall not exceed 104°F (40°C).

7.3.5. Vault shall only be accessible to qualified NES personnel.

7.3.6. Mechanical equipment (filters, fans) shall not be located within the vault structure, they shall be located such that they can be maintained by the customer from outside the vault.
7.3.7. A transformer fan room (adjacent to the transformer vault) will need to be 4-hour rated with 3-hour doors unless the room opens to the exterior of the building. Steel hot dipped galvanized bars will be required to separate this fan from the transformer vault room.

7.3.8. Ventilation registers/grilles shall not be located over electric equipment.

7.3.9. Ventilation equipment shall be standalone. Building heat, smoke, or fire detectors shall not interfere with the operation of the ventilation system. Fire dampers in the ducts are not allowed.

7.3.10. Fans shall be controlled by one thermostat located within the vault. The thermostat shall be rated for installation in a damp environment. Engineer to advise location of thermostat and set point to satisfy 7.3.4.

7.3.11. The exhaust should exit above grade in an area that does not interfere with pedestrian traffic. If the exhaust must exit through gratings in the sidewalk, care should be taken to ensure air velocities are low enough not to interfere with pedestrian traffic. It is recommended that these installations be approved by Metro Public Works.

7.3.12. If use of ventilation duct work cannot be avoided, the applicable requirements detailed below shall be satisfied.

(a) Ventilation duct shall be 4-hour rated construction.

(b) Ventilation ductwork that passes through the interior of the building (or parking garage) shall be routed through a 4-hour fire rated enclosure in order to maintain a 4-hour separation between the building and vault.

(c) Detailed drawings and specifications shall be submitted to NES for approval of system selected to maintain 4-hour fire rating.

(d) Customer shall provide drawings sealed and signed by a Tennessee licensed mechanical engineer as described in Section 3.

8. Plumbing Engineer, Fire Protection, Mechanical

8.1. Provide drawing(s) to show compliance with following concerning the vault:

8.1.1. Piping unrelated to the functions of the electrical service shall not be routed through the vault.

8.1.2. Fire detection or suppression equipment shall not be located in the transformer vault.

8.1.3. Drawings shall clearly indicate compliance with this section.

9. Electrical Engineer

9.1. Required General Notes

9.1.1. The Customer shall notify the NES Engineer at least five (5) working days before the underground grounding inspection. This must be done before the vault walls and floors are poured.
9.1.2. The Customer shall connect a temporary feed (a generator is acceptable) to the vault disconnect switch so NES can confirm that the light and receptacle circuits are operational.

9.1.3. The location and quantities is for design intent and pricing only. Exact location of light fixtures and devices shall be spot located by NES personnel prior to installation. Contact NES C&M Supervisor five (5) working days prior to installation.

9.1.4. Listed rigid non-metallic conduit, fittings, and boxes shall be used throughout the installation. The entire conduit system shall be installed and equipped so as to prevent water from entering the conduit system. All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or be protected against corrosion by approved corrosion-resistant materials.

9.1.5. All components of vault electrical system shall be surface mounted. Components of the vault electrical system shall not extend into path of egress or clear working space.

9.1.6. For the purpose of electrical design, vaults shall be considered “Damp Locations” unless otherwise specified.

9.1.7. The luminaires shall be arranged so that persons changing lamps or making repairs on the lighting system are not endangered by live parts or other equipment. Luminaires shall not be located directly above electrical equipment or conduit penetrations. Luminaires shall not be installed on removable access panels.

9.1.8. It is recommended that the contractor order grounding inserts as early as possible. NES will not supply these inserts, these must be procured prior to vault floor pour. See Appendix E for the required inserts. See section 9.8 for insert details.

9.2. Distributed Generation on the Downtown Network

9.2.1. (Network) For Distributed Generation on the downtown Network refer to the NES “Downtown Underground Network Secondary Services Guidelines”, section 12.0. This document can be found online at www.nespower.com under Builders & Contractors / Guidelines & Manuals.

9.2.2. Provide 2-1 ½” conduits from the inverter to the vault to a NEMA 4X box with SEL-2505 remote I/O monitor. Provide SEL-2505 with multi-mode fiber option. Provide communication cable from the inverter to the vault in one (1) of the 1 ½” conduits, and provide a pull-string in the other 1 ½” conduit.

9.3. Disconnect Switch / Panelboard

9.3.1. (Network) A 120/240V, 100A/2P service entrance rated fused disconnect switch shall be installed as a main disconnect. The Customer shall contact a NES Engineer for fault current available and specify the panel to withstand the available fault. The panel shall not be positioned where it is under the grating.
9.3.2. (Network) The switch shall be heavy-duty type in a NEMA type 4X enclosure equipped with 60A, Class RK-1 current-limiting fuses and clips to reject other fuse types. The switch shall feed the branch circuit panel.

9.3.3. (Network) Provide a two inch (2") knockout in the side closest to the primary conduit entrance toward the top of the disconnect switch for termination of NES supply conduit.

9.3.4. A Square D 120/240V, 60A/2P branch circuit panel with Square D type QOB breakers shall be installed in the vault to be operated by utility personnel. Panelboard schedule should be completed (typed) before vault inspection is requested (Non-Network vault panels shall have a main breaker).

9.3.5. The branch circuit panel shall be in a NEMA type 4X enclosure.

9.3.6. At least two (2) lighting circuits shall be provided.

9.3.7. All receptacle circuits shall be provided and shall have ground fault circuit interrupting breakers for personnel protection.

9.3.8. One dedicated 20A/1P and one dedicated 15A/2P receptacle circuit shall be provided for the sump pump. (Sump circuits not required for Street Level Vaults unless otherwise specified by NES Engineer.)

9.3.9. Two spare 20A/1P breakers shall be installed for future use by NES personnel.

9.3.10. (Network) One dedicated 20A/1P breaker and receptacle for a fiber to analog box. Receptacle shall be installed at a height of sixty inches (60") above finished floor. Location of receptacle to be specified by NES C&M Department. No fire alarm devices shall be installed in the vault.

9.4. Illumination

9.4.1. Illumination shall be provided for all paths of egress and working spaces around electrical equipment. Illumination level shall be 60 foot-candles or greater.

9.4.2. Electrical engineer shall fill out foot-candle calculation sheet attached showing all calculations and determine number of light fixtures required (Appendix C).

9.4.3. A fluorescent light source consisting of 2-48” T8 lamps is required, see Appendix E for required lights. Provide electronic ballast with cold (zero degree) start capabilities. Electrical Engineer shall submit light fixture schedule sheet indicating this item.

9.4.4. Two (2) light switches shall be located adjacent to each personnel access. When a personnel access is provided through the sidewalk grating, two (2) light switches shall be accessible from the top of each ladder.

9.4.5. Luminaires installed below ventilation gratings or removable slabs shall be suitable for installation in “Wet Locations.”

9.4.6. A light switch enclosure installed under a ventilation grating shall be suitable for installation in “Wet Locations.”
9.4.7. Vault lighting/receptacle circuits shall be designed, provided, and installed by the Customer.

9.4.8. Installation shall comply with the latest edition of the National Electrical Code in effect.

9.4.9. Locations of all vault electrical equipment shall be subject to NES approval.

9.4.10. (Non-Network) Each doorway (if provided) leading out of the vault shall have a lit emergency exit sign with two (2) LED heads. Exit sign shall be installed next to the door, one (1) foot above the floor.

9.5. Receptacles

9.5.1. At least one receptacle shall be provided on each interior wall. Additional receptacles may be required by the NES Engineer. Receptacles shall be duplex type, 20A/125V, NEMA 5-20R.

9.5.2. If a receptacle is located below a ventilation grating, the enclosure shall be listed for installation in “Wet Locations.”

9.5.3. One duplex type, 20A/125V NEMA 5-20R receptacle and one single 15A/250V NEMA 6-15R 2P/3W receptacle from dedicated circuits shall be provided on the wall adjacent to the sump. This receptacle enclosure shall be listed for installation in “Wet Locations” (Sump receptacles not required for Street Level Vaults unless otherwise specified by NES Engineer).

9.5.4. Receptacles shall be installed at a height of sixty inches (60”) above finished floor in Below Grade Vaults, and thirty six inches (36”) above finished floor in Street Level Vaults.

9.5.5. One receptacle shall be no more than fifteen feet (15’) away from the sump

9.5.6. (Network) Provide a dedicated receptacle for a fiber analysis device. Indicate the word “Fiber” next to receptacle. Receptacle shall be installed at a height of sixty inches (60”) above finished floor. Location of receptacle to be specified by NES C&M Department.

9.6. Conduit Entrance

9.6.1. Customer should be mindful of vault/building structural members when laying out primary or secondary entrance.

9.6.2. Conduit entrance penetrating the floor shall not be located within a path of egress or clear working space. Conduit shall not be directly in front of ventilation louvers.

9.6.3. For conduit entrance penetrating the ceiling or floor, pulling irons shall be installed in the floor or ceiling (respectively) in line with the conduit entrance. Conduit entrance shall not be located such that pulling irons will be necessary in the floor within path of egress or clear working space.

9.6.4. For conduit entrance penetrating a wall, see section 6.3.9 regarding pulling iron location.

9.6.5. Provide bayouts for all conduit penetrations in the wall or ceiling.
9.6.6. See NES drawing #UN-41535 (provided by NES Engineer) for typical conduit bayout details.

9.6.7. Bayout shall not be located under ventilation gratings. Concrete encasement is permissible to extend bayout so no conductor is exposed under a grating. Conduit sleeves shall be permitted under grating if concrete encasement is an obstacle.

9.6.8. Locate bayouts to minimize the amount of cable that passes under ventilation gratings.

9.6.9. Electrical service conduits shall not be located within ten feet (10’) of any above ground or underground storage tank, fill valve, or vent valve.

9.6.10. (Below Grade Vaults) Unused conduits shall be filled with duct seal.

9.6.11. (Above Grade Vaults) Unused conduits shall be filled with fire stop.

9.7. Primary Entrance

9.7.1. When manholes are involved, primary ducts shall extend from the vault to within ten feet (10’) of the manhole (existing or energized) specified by NES Engineer. Customer shall be responsible for excavation from the vault to the manhole. Customer shall complete the duct run to the manhole coordinating with NES (NES may have manhole work to complete to make the manhole ready to accept the duct run).

9.7.2. Primary ducts shall be encased in red dye concrete. See NES drawing #UN-40716 (provide by NES Engineer) for additional duct run requirements.

9.7.3. (Network) One Transformer per Vault - One bank of four (4) - four inch (4”) ducts shall be provided for the transformer primary.

9.7.4. (Network) Multiple Transformers per Vault - One bank of three (3) - four inch (4”) ducts shall be provided for each transformer to be installed in the vault. All primary ducts shall be grouped into one bayout unless otherwise specified in writing by NES Engineer.

9.7.5. (Network & Non-Network) Primary ducts entering a vault through the floor shall be 8” - 10” from vault wall and extend eight feet (8’) above finished floor and shall be galvanized rigid steel conduit.

9.7.6. Additional ducts may be required. Verify final arrangement and quantity of ducts with NES Engineer.

9.7.7. (Non-Network) The primary conductors are to be supported by a four inch (4”) “Angle Iron or Aluminum Angle” bracket supported from the walls of the room and ceiling if required. “Angle Iron or Aluminum Angle” bracket shall be positioned so it is one foot (1’) in front of the transformer and nine feet (9’) above finished floor. The “Angle Iron or Aluminum Angle” bracket shall be installed after the transformer is installed if the transformer is placed with the front facing the door.

9.7.8. Elbows (90°) and turn ups shall be galvanized rigid steel conduit.
9.7.9. Engineer shall submit an existing site plan and a final site plan to help coordinate lighting, recognizing existing underground lighting pull boxes, and underground electrical lines indicated on civil plans.

9.8. Secondary Entrance

9.8.1. One bank of conduits shall be provided for secondary service entrance cables unless otherwise approved by NES Engineer in writing.

9.8.2. (Non-Network) Secondary ducts entering a vault through the floor shall extend eight inches (8”) above finished floor in Street Level Vaults. Secondary ducts should not enter through the vault floor in Below Grade Vaults.

9.8.3. (Non-Network) The number of secondary ducts, the location of the entrance, and the arrangement of the ducts shall be subject to NES approval. The maximum number of conduits, including fire pump shall be eighteen (18). “Compacted” (aka Compact Strand) secondary cable will not be accepted. Consulting engineer shall consider providing all eighteen (18) conduits and terminate spare conduits in terminating cabinets so they may be used in the future if needed. Refer to the Metering section of the NES “Electric Service Guidelines”. This can be found online at www.nespower.com under Builders & Contractors / Guidelines & Manuals.

9.8.4. (Non-Network) The electrical construction drawings shall indicate cable racking from the secondary conduits to the transformer. Layout shall be approved by the NES Engineer.

9.8.5. (Non-Network) See Appendix E for required cable racks. Conductors shall be shaped, strapped and cut at the floor per NES direction.

9.8.6. (Network) Primary and secondary cable racking shall be procured and installed by NES. Electrical contractor shall pull a minimum of fifteen feet (15’) of secondary cable into the vault from each service entrance.

9.8.7. The consulting engineer shall specify the service cable be provided with color insulation per Table 6 and Table 12 (see Appendix A & B).

9.8.8. (Network) Conductors shall be 500 MCM copper or 4/0 MCM copper. Only these two sizes shall be accepted.


9.9.1. NEMA Std 4-hole ground inserts shall be provided and cast into the concrete structure by the Customer, see Appendix E for required inserts.

9.9.2. (Non-Network) At a minimum, ground inserts shall be installed to the left of where electrical conduits enter the vault and in the floor on each end of the transformer.

9.9.3. (Network) At a minimum, ground inserts shall be installed to the left of where electrical conduits bayout, and in the vault wall (building side) 24” above finished floor across from the front side (Network Protector / Secondary side) of each transformer.

9.9.4. Additional ground inserts may be required by NES Engineer.
9.9.5. All ground inserts shall be inter-connected with 4/0 AWG -7 STR bare hard drawn copper conductor conforming to latest revision of ASTM B8.

9.9.6. Grounding conductor shall be compression bonded to structural steel in the vault floor and wall, forming a ring bus between grounding inserts.

9.9.7. Customer shall coordinate grounding inspection per Section 4.1.

9.9.8. For (Non-Network) services, the trench ground shall be bonded to the building steel in a building column with largest size rebar.

9.9.9. For (Network) services, there should be two grounds in the primary conduit trench. One network trench ground shall be bonded to the building steel column, to the largest size rebar. The second ground shall continue through the first bayout ground insert and on the transformers.

9.9.10. Compression bonds shall be made to the rebar between each ground insert and to the building steel column, to the largest size rebar after the last transformer.

9.10. Cable Limiters (Network)

9.10.1. Cable limiters shall be indicated by the engineer at both the switchboard and in the vault.

9.10.2. See Appendix E for required cable limiters.

9.10.3. Cable limiters shall be flat bar/bus bar type in customer gear.

9.10.4. Electrical Engineer to specify cable to cable type for NES. Vault quantity shall equal 1.5 times number of cables being sent to the vault. Do not include neutral in count, (NES will use more sets than contractor).

9.10.5. Electrical Engineer shall specify cold shrink for each cable limiter. See Appendix E for required cold shrink connector insulators.

9.11. NES Meter Information

9.11.1. Meter locations, room/space requirements, bases, and general information shall be coordinated with NES Meter Department at 615-415-6770.

9.11.2. Meter information is available on our website at www.nespower.com under the Builders & Contractors pulldown menu. Download the “Electrical Service Guidelines” under the Guidelines & Manuals pull down. Refer to the meter section of this manual. For more detailed meter information contact NES engineer.

9.11.3. NES recommends with businesses who have unknown retail spaces with separate meter type loads, to install an adequately sized fused disconnect and a NES approved terminating cabinet with adequate space for meter installations around this equipment. Coordinating space requirements with NES Meter Department.

9.11.4. Coordinate with NES Metering Department for meter base types (Network meter requires an extra terminal on all single-phase services).
9.11.5. Architect will need to specify a “Knox-Box” type key holder for interior meter rooms for NES personnel to gain access.
## APPENDIX A

### NON-NETWORK TRANSFORMER SPECIFICATIONS

**TABLE 1: Non-Network Transformer Requirements for Standard Service Ratings**

<table>
<thead>
<tr>
<th>Secondary Voltage</th>
<th>Total From 4.2.2</th>
<th>Rated Power</th>
<th>Maximum Available Fault Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Size (min)</td>
<td>Size (max)</td>
<td>(kVA)</td>
</tr>
<tr>
<td>(V)</td>
<td>(kVA)</td>
<td>(kVA)</td>
<td>(A)</td>
</tr>
<tr>
<td>208Y/120</td>
<td>min</td>
<td>1000</td>
<td>1000</td>
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<tr>
<td>208Y/120</td>
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<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>480Y/277</td>
<td>min</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1001</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1501</td>
<td>2500</td>
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<tr>
<td>480Y/277</td>
<td>2501</td>
<td>3000</td>
<td>3000</td>
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**TABLE 2: Maximum Non-Network Transformer Dimensions**

<table>
<thead>
<tr>
<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Width (In)</th>
<th>Length (including connections) (In)</th>
<th>Height (floor to cover) (Ft-In)</th>
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<tbody>
<tr>
<td>1000</td>
<td>208Y/120</td>
<td>2776</td>
<td>72</td>
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<td>97</td>
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<td>72</td>
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<td>93</td>
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<td>480Y/277</td>
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<td>72</td>
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<td>97</td>
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<tr>
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<td>480Y/277</td>
<td>3007</td>
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**TABLE 3: Minimum Working Clearance Required for a Non-Network Transformer**

<table>
<thead>
<tr>
<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Width (In)</th>
<th>Length (including connections) (In)</th>
<th>Height (floor to cover) (Ft-In)</th>
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<tbody>
<tr>
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### TABLE 4: Minimum Clearance Required for Moving a Non-Network Transformer

<table>
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<tr>
<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Secondary Voltage (A)</th>
<th>Rated Current (A)</th>
<th>Width (In.)</th>
<th>Length (Ft-In)</th>
<th>Height (In.)</th>
<th>(Floor to cover) (In.)</th>
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<td>4164</td>
<td>96</td>
<td>8-0</td>
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<td>96</td>
<td>8-0</td>
<td>132</td>
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### TABLE 5: Miscellaneous Non-Network Transformer Information

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<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Secondary Voltage (A)</th>
<th>Rated Current (A)</th>
<th>Approx. Max Unit Weight (lbs.)</th>
<th>Approx. Max Liquid Capacity of One Unit (gal)</th>
<th>Full Load Heat Loss (kW)</th>
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<td>14500</td>
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### TABLE 6: Secondary Cable Color Code

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<th>PHASE</th>
<th>VOLTAGE</th>
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<td>Red</td>
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<tr>
<td>C</td>
<td>Blue</td>
<td>Yellow</td>
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### APPENDIX B

#### NETWORK TRANSFORMER SPECIFICATIONS

**TABLE 7: Network Transformer Requirements for Standard Service Ratings**

<table>
<thead>
<tr>
<th>Secondary Voltage</th>
<th>Total From 4.2.2 Quantity and Rating of Transformers</th>
<th>Maximum Available Fault Current</th>
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<tbody>
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<td></td>
<td>Size (min) (V)</td>
<td>Size (max) (kVA)</td>
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<td>(2) 750</td>
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<td>751</td>
<td>1125</td>
</tr>
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<td>277/480</td>
<td>min. 750</td>
<td>(2) 750</td>
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<td>1500</td>
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<td>1501</td>
<td>2000</td>
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<tr>
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<td>3000</td>
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<tr>
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<td>7500</td>
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**TABLE 8: Maximum Standard Network Transformer Dimensions**

<table>
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<tr>
<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Width (In.)</th>
<th>Length (door closed) (In.)</th>
<th>Length (door open) (In.)</th>
<th>Height (In.)</th>
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<tbody>
<tr>
<td>750</td>
<td>125/216</td>
<td>2005</td>
<td>60</td>
<td>5</td>
<td>137</td>
<td>11 7</td>
</tr>
<tr>
<td>750</td>
<td>277/480</td>
<td>902</td>
<td>60</td>
<td>5</td>
<td>130</td>
<td>10 8</td>
</tr>
<tr>
<td>1000</td>
<td>277/480</td>
<td>1203</td>
<td>66</td>
<td>5</td>
<td>136</td>
<td>11 4</td>
</tr>
<tr>
<td>1500</td>
<td>277/480</td>
<td>1804</td>
<td>66</td>
<td>5</td>
<td>143</td>
<td>11 11</td>
</tr>
<tr>
<td>2000</td>
<td>277/480</td>
<td>2406</td>
<td>66</td>
<td>5</td>
<td>143</td>
<td>11 11</td>
</tr>
<tr>
<td>2500</td>
<td>277/480</td>
<td>3007</td>
<td>66</td>
<td>5</td>
<td>143</td>
<td>11 11</td>
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**TABLE 9: Minimum Working Clearance Required for a Network Transformer**

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<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Width (In.)</th>
<th>Length (door closed) (In.)</th>
<th>Length (door open) (In.)</th>
<th>Height (In.)</th>
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<td>2005</td>
<td>132</td>
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<td>247</td>
<td>20 7</td>
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<td>750</td>
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<td>902</td>
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<td>19 8</td>
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<td>1000</td>
<td>277/480</td>
<td>1203</td>
<td>138</td>
<td>11</td>
<td>242</td>
<td>20 2</td>
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<tr>
<td>1500</td>
<td>277/480</td>
<td>1804</td>
<td>138</td>
<td>11</td>
<td>253</td>
<td>21 1</td>
</tr>
<tr>
<td>2000</td>
<td>277/480</td>
<td>2406</td>
<td>138</td>
<td>11</td>
<td>253</td>
<td>21 1</td>
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<td>2500</td>
<td>277/480</td>
<td>3007</td>
<td>138</td>
<td>11</td>
<td>275</td>
<td>22 11</td>
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### TABLE 10: Minimum Clearance Required for Moving a Network Transformer

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<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Width (In.)</th>
<th>Length (Ft. In.)</th>
<th>Height (In.)</th>
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<td>84</td>
<td>161</td>
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<td>13</td>
<td>10</td>
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<tr>
<td>750</td>
<td>277/480</td>
<td>902</td>
<td>84</td>
<td>154</td>
<td>110</td>
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<td>7</td>
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<td>2</td>
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<td>277/480</td>
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<td>277/480</td>
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### TABLE 11: Miscellaneous Network Transformer Information

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<th>Rated Power (kVA)</th>
<th>Secondary Voltage (V)</th>
<th>Rated Current (A)</th>
<th>Liquid Capacity of One Unit (lbs.)</th>
<th>Full Load Heat Loss (kW)</th>
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<td>12050</td>
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<td>277/480</td>
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<td>22.00</td>
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### TABLE 12: Secondary Cable Color Code

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<th>PHASE</th>
<th>VOLTAGE</th>
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<tbody>
<tr>
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<td>216Y/125V</td>
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<tr>
<td></td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
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<tr>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C

STANDARD LIGHTING CALCULATION

ROOM NAME: TRANSFORMER VAULT

DATA REQUIRED:

ROOM LENGTH (RL): _______
ROOM WIDTH (RW): _______
ROOM AREA (RL X RW): _______
CEILING HEIGHT: _______
FIXTURE HEIGHT ABOVE WORK PLACE (HAWP): 7'
MAINTENANCE FACTOR (MF): .85
LAMP LUMENS (LL) (OBTAINED FROM CATALOG): _______

ROOM CAVITY RATIO (RCR) = \( \frac{(5)(7)(RL+RW)}{(RL)(RW)} \)

COEFFICIENT OF UTILIZATION (CU) (OBTAINED FROM CATALOG): _______

#FIXTURES = \( \frac{60(RL)(RW)}{(2)(LL)(CU)(.85)} \)
APPENDIX D

STANDARD DRAWINGS (Provided by NES Engineer)

NES Drawing #UN-10386 - Detail of Pull-In Iron
NES Drawing #UGS-00033 - Vault Grating
NES Drawing #UN-22304 - Concrete Support Beams for vault transformer
NES Drawing #UN-40716 - Trench Requirements
NES Drawing #UN-41178 - Standard Vault Top Design - Lift-Off Slabs with Large ADA Gratings
NES Drawing #UGS-00034 - Standard Non-Network Vault Layout
NES Drawing #UN-41535 - Standard Vault Bayout Detail
APPENDIX E

REQUIRED HARDWARE (not an exhaustive list)
CUSTOMER PROCURED AND INSTALLED

Grounding Provisions - Ground Inserts
Manufacturer: Dossert®
Product: PGU 30-4 NEMA Std. 4-hole or equal approved by NES
   Cable Range: Min. 1/0 STR. - 373 D, MAX. 300 MCM - 630 D
   Material: Copper Alloy 113-DI, U-Bolts, Nuts and L.Washers-Everdur

Vault Lift Off Slab - Ductile Embed Insert
Manufacturer: Dayton Superior®
Product: 1"-8NC Bolt dia., 1-1/8" Shaft dia., threaded F-54 hot-dipped galvanized (with brass plugs)
   4 per slab

Grating
Manufacturer: Ohio Gratings Inc.®
Product: Wheels n’ Heels® InVent 64-7-WH-63 3/16” Galvanized

Vault Door - Panic Hardware
Manufacturer: Yale®
Product: 7100 Series flat bar exit device with door closer
   Outside Trim: Augusta trim lever Type 626(F) Series wide escutcheon trim
   Lock Set: Setup to operate as “Storeroom” (ANSI 09) function
   Lock Core: Shall be provided and installed by NES

Personnel Access - Ladder
Corrosion resistant, per OSHA Standard 1926.1053, for “Fixed Ladders”

Personnel Access - Ladder Safety Post
Manufacturer: Bilco®
Product: LadderUp® Safety Post model LU-2

Cable Limiters (Network)
Manufacturer: Cooper Bussmann® OR Ferraz Shawmut®
Product: 4/0 KCF, 500 KCM Amp-Trap® CP4/0C1, CP500C1
Cable Limiters - Cold Shrink Connector Insulators (Network)
Manufacturer: 3M®
Product: 8426-11 for 4/0 MCM, 8428-18 for 500 MCM

Secondary Cable Racking - Cable Tray (Non-Network)
Manufacturer: Thomas & Betts®
Product: Aluminum, H Beam, Series #1, 6” Side Rail, 36” Wide, 12” Rung Spacing

Lighting
Manufacturer: Lithonia Lighting®
Product: DMW-2-32-120-GEB-10IS or approved equal, 48” T8 Lamps
APPENDIX F

NETWORK MAP

FIGURE 1: NES Network Area
<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Revision History</th>
<th>Approvals</th>
</tr>
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<tbody>
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</tr>
<tr>
<td></td>
<td></td>
<td>Supervisor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manager</td>
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<td></td>
<td>Supervisor</td>
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