

Lexington Distribution Plan

Proposed 2008 Projects

Distribution Asset Planning team at NPPD has performed considerable analysis of the Lexington Distribution system and took the following actions to improve normal electric distribution system conditions for summer 2007 and beyond. These recommendations have already been implemented:

1. Substation Transformer LTC control settings – Existing settings did not take advantage of Line Drop Compensation (LDC) features of these controls and allowed voltages to fall below minimum voltage criteria in some areas of Lexington. New settings were calculated and programmed into the LTC controls that take advantage of LDC features.
2. Significant phase load imbalance was identified on two 4.16kV feeders that were also contributing to voltages, at peak load conditions, falling below minimum voltage criteria. Phase load transfers were recommended and performed to eliminate these voltage exceptions.

A significant physical inspection of the Lexington substation and distribution system assets has been performed by the NPPD Substations and Operations teams. Several issues were identified and many have already been resolved or are in the process of being resolved such as substation battery banks, PCB contaminated oil in equipment, repair failed relays, repair load tap changers and their controls. This inspection has revealed some issues where minimum reliability standards are not met and it is recommended these be resolved in the near future.

1. 2008 - NE By-Products Reliability – Remove the existing 13.8kV/480V substation class transformer and install 1500kVA or larger pad mount transformer to improve reliability. See map on the last page of this document.
 - a. There is no backup substation class transformer available so a transformer failure would result in an extended outage for NE By-Products. Backup pad transformers are available and would provide more reliable service to NE By-Products.
 - b. SAP notification 10535404
- 1a. 2008 – Distribution Transformer Spares – Review 13.8kV spare xfmr inventory and ensure adequate spare xfmrs exist especially for large pad xfmrs.
 - a. Tyson Foods xfmrs are a special design and spare 2500kVA 13.8/4.16kV and 2500kVA 13.8/.48kV xfmrs exist to cover their needs.
 - b. Cornhusker Ethanol – Lexington City may be under contract to stock a spare 2500kVA 13.8/4.16kV and 2500kVA 13.8/.48kV standard pad xfmr. Spares do not exist today.
 - c. NE By-Products, Depending on what size of pad xfmr is installed in 1 above; a spare xfmr may be needed. It's possible that if a spare is purchased for Cornhusker Ethanol, that spare could also cover NE By-Products pad xfmr.
 - d. Others as needed.

2. 2008 - IBP Substation - replace DPU relays on at least one ACB with Schweitzer 351 relays. DPU relays are obsolete and should be phased out over the next few years, need at least one spare DPU relay on hand to address relay failures. See map on the last page of this document.
 - c. SAP Notification 10535411
3. 2008 – East Walnut breaker relay CT circuits and trip circuits, fix issue with CT circuit lacking neutral on test switch and issue with not having the ability to disable the relay trip circuit so relay testing can be performed.
4. 2008 – All Subs align A, B, C phasing on relays with actual system phasing.
 - d. Presently the actual phasing on the distribution system does not match the phasing identification on the relays. Relays will indicate for instance a phase A trip or fault on phase A when in actuality the fault was on another phase. Having this correctly phased will eliminate confusion and speed restoration.
5. 2008 – Adams, Kugler and East Walnut Subs – Investigate and resolve issues with substation station service to ensure, where possible, substations have two reliable station service sources and an auto transfer switch.
 - e. Reliable station service is necessary to ensure breakers trip when necessary to protect the general public, personnel working on the distribution system and the distribution assets. In subs with two transformers, station service should be provided from both transformers with an auto transfer switch to provide a minimum level of reliability and safety.
6. Adams Substation 34.5kV Circuit Switcher – Replace Circuit Switcher. Existing circuit switcher has an issue with motor operated disconnects not opening when tripped and cannot be repaired.
 - f. Presently the vacuum bottles trip the circuit but the motor operated disconnect is also supposed to open per manufacture design and create a permanent open in the circuit.
 - g. SAP Notification 10536108.
7. IBP, Adams, and Kugler Substation Building Cooling – Add air conditioning to all substation control buildings and aisle-type outdoor switchgear to keep equipment at a reasonable operating temperature and prevent premature equipment failure.
 - h. Walnut sub already has air conditioning. North sub will likely be replaced or retired so no equipment will be installed at this time.
8. Protective relay settings, calibration and maintenance – A protection settings analysis will soon be completed and the new protection settings will need to be programmed into the mechanical and electronic relays. Mechanical relays should be cleaned and calibrated and all relays tested to ensure proper operation. This work is required to maintain adequate protection of public, personnel, and equipment safety.
9. All Subs – Breaker maintenance, perform preventive maintenance on all substation breakers to ensure all are in good condition and will be able to provide adequate protection of the distribution feeders they serve.

10. All Subs – Perform general substation maintenance that includes cleaning dust and debris out of switchgear cabinets that can shorten the life of breakers, cleaning up carbon burns from switchgear from previous arc flash events, etc.

Two major load additions are planned in Lexington. Cornhusker Ethanol is planning on tripling their existing load, adding 13MW, 14.4MVA of new load. A Grain handling facility is also planning to add 3MW, 3.3MVA of new load. Both these load additions are to be served out of East Walnut substation. The following projects are necessary to provide reliable service to these new loads.

11. 2008 - Construct new overhead T2 4/0 distribution line from East Walnut 204 east along the south side of East Walnut street and tie into existing East Walnut 204 feeder approximately 3000 feet east. Change jumpers so that the East Walnut 226 feeder serves the distribution lines north of the rail road. Switch S11086 is to be the new normal open point between 204 and 226 feeders. See map on the last page of this document.
 - i. This line is necessary to serve the new Grain Handling Facility load of 3000kVA.
 - j. Rich Tonniges is designing this project and has these costs.
12. 2008 – Construct new 16MVA capacity underground feeder to Cornhusker Ethanol Plant to serve new load using parallel 500Al. See map on the last page of this document.
 - k. This feeder would start at substation breaker 222 or 206 and end at Cornhusker Ethanol 13.8kV switchgear and utilize 600 amp elbows where necessary for pulling and grounding requirements.
 - l. SAP Notification 10535405
13. 2008 – Modify existing two 4/0 ACSR overhead feeders that serve Cornhusker Ethanol, paralleling the conductors to form a single 16MVA capacity feeder and serve from ACB 206 or 222 which ever is not used for the new parallel 500Al feeder above. See map on the last page of this document.
 - m. A single 4/0 ACSR feeder is rated 341 amps or 8.2MVA at 13.8kV and would not provide adequate capacity to serve proposed load increase at Cornhusker Ethanol. By Paralleling the existing two 4/0 ACSR overhead feeders into a single feeder we create a feeder capable of 16.2MVA. This parallel 4/0 ACSR feeder and the new parallel 500Al underground feeder would provide necessary reliability of service to the Cornhusker Ethanol Plant.
 - n. SAP Notification 10535405
14. 2008 – Purchase 2nd 34.5/13.8kV 28MVA xfmr for East Walnut. See map on the last page of this document.
 - o. \$1,200,000 estimate accuracy +25%/-10%. estimate is based on NPPD's present contract bid for current 25MVA xfmr purchase, and includes sales tax, testing, and delivery.
 - p. This capacity is needed to serve the new loads proposed by Cornhusker Ethanol and the new Grain Handling facility.

- q. This transformer capacity addition is also needed to serve future conversions from 4.16kV to 13.8kV.
- 15. 2009 – Install 2nd 34.5/13.8kV 28MVA xfmr at East Walnut. Note this can be budgeted in 2009 as the transformer will not arrive until after October 2008. See map on the last page of this document.
 - r. Purchase and install 2nd 34.5kV circuit switcher.
 - s. Install 2nd substation xfmr.
 - t. SAP notification 10535447
- 16. 2008 - East Walnut to IBP Distribution Tie – **Not Recommended!** Lexington city had proposed constructing a distribution tie, under built on the 34.5kV line, between East Walnut and IBP subs.
 - u. With complete redundancy at both IBP and East Walnut (after installation of the second substation xfmr at East Walnut), this distribution tie cannot be justified today. The tie can be considered again when the total load on either IBP or East Walnut subs that cannot be transferred to other subs exceeds the rating of a single transformer.
 - v. NPPD currently has a 10MVA mobile sub and is expecting the delivery of a new 15MVA mobile sub this fall that can address the rare occasion that a complete East Walnut substation outage is necessary. Cost to install and rent this mobile equipment is more cost effective than the cost to construct the distribution tie between these substations.

The Lexington Distribution Plan analysis is studying four possible options to maintain adequate reliability of service to customers in Lexington. Analysis shows the 13.8kV system to be fairly reliable and can survive most single contingency conditions such as loss of a substation transformer or feeder breaker. The 4.16kV load has grown to the point that for several single contingency conditions, equipment overloads or minimum voltage criteria violations would occur at high load levels. The following 4 options are being studied to increase the reliability of the 4.16kV system and maintain reliability of the 13.8kV system.

1. Convert Kugler ACB 106 and 108 feeders to 13.8kV, increase conductor sizes where necessary on the remaining 4.16kV system to eliminate conductor overloads and voltage issues during contingency conditions. Construct a new North 4.16kV sub and retire the existing substation. Existing North sub has physical issues.
2. Convert Kugler ACB 106 and 108 feeders all North sub feeders and a portion of the Adams 4.16kV feeders to 13.8kV and serve this load from existing East Walnut and Adams 13.8kV subs establishing a 13.8kV distribution outer ring around a 4.16kV core area. Retire the North sub. Adams T1 and Kugler T1 and T2 would remain to serve the 4.16kV core area.
3. Convert all but the downtown core area of Lexington to 13.8kV and leave 4 feeders on Kugler at 4.16kV. Add 13.8kV substation capacity in the existing 4.16kV bay at Adams sub, retire the North sub. Kugler T1 and T2 would serve the downtown 4.16kV core area.

4. Convert the entire Lexington Distribution system to 13.8kV system, retire the North sub, and add 13.8kV substation capacity at Adams and Kugler.

While the Distribution Plan is not far enough along to make a final decision on which long range option provides the most benefits for a reasonable cost, some projects make sense that are common to all four plans and can be budgeted for completion in 2008. These projects along with the projects listed above to address physical issues and service to new load. As the distribution plan progresses later this year we can decide which long range plan provides the most benefits, and then schedule additional projects for 2009 and beyond.

17. 2008 – Install gang operated distribution switch in the distribution primary along Plum Creek Parkway between Ash and Sagebrush. See map on the last page of this document.
 - a. SAP Notification 10535176 created for Distribution Engineering to estimate the cost of this project.
 - b. Open this new switch and close switch S11069 at IBP sub placing load on IBP T2 ACB 202. This switch strengthens backup support for Adams 13.8kV feeder, reduces kW losses, and sets up East Walnut ACB 224 feeder to serve load converted from 4.16kV to 13.8kV in the next two projects below.
 - c. This switch installation and load transfer results in a kW loss savings at peak loads of 16kW and reduces Lexington's wholesale power costs by an estimated \$2,816 per year.
18. 2008 – Kugler T2 ACB 108 feeder – Convert to 13.8kV and serve from East Walnut 224, 4395kVA of connected Distribution Xfmrs. See map on the last page of this document.
 - a. Loss Savings 15kW at peak or \$2640 annually.
 - b. SAP Notification 10535002
19. 2008 – Kugler T1 ACB 106 feeder – Convert to 13.8kV and serve from East Walnut 224, 1465kVA of connected Distribution Xfmrs. See map on the last page of this document.
 - a. Loss Savings 34kW at peak or \$5984 annually.
 - b. SAP Notification 10535003
20. 2008 - Install a gang operated distribution switch along Monroe just south of 10th to improve contingency conditions between North and Kugler substations. See map on the last page of this document.
 - a. SAP Notification 10535177

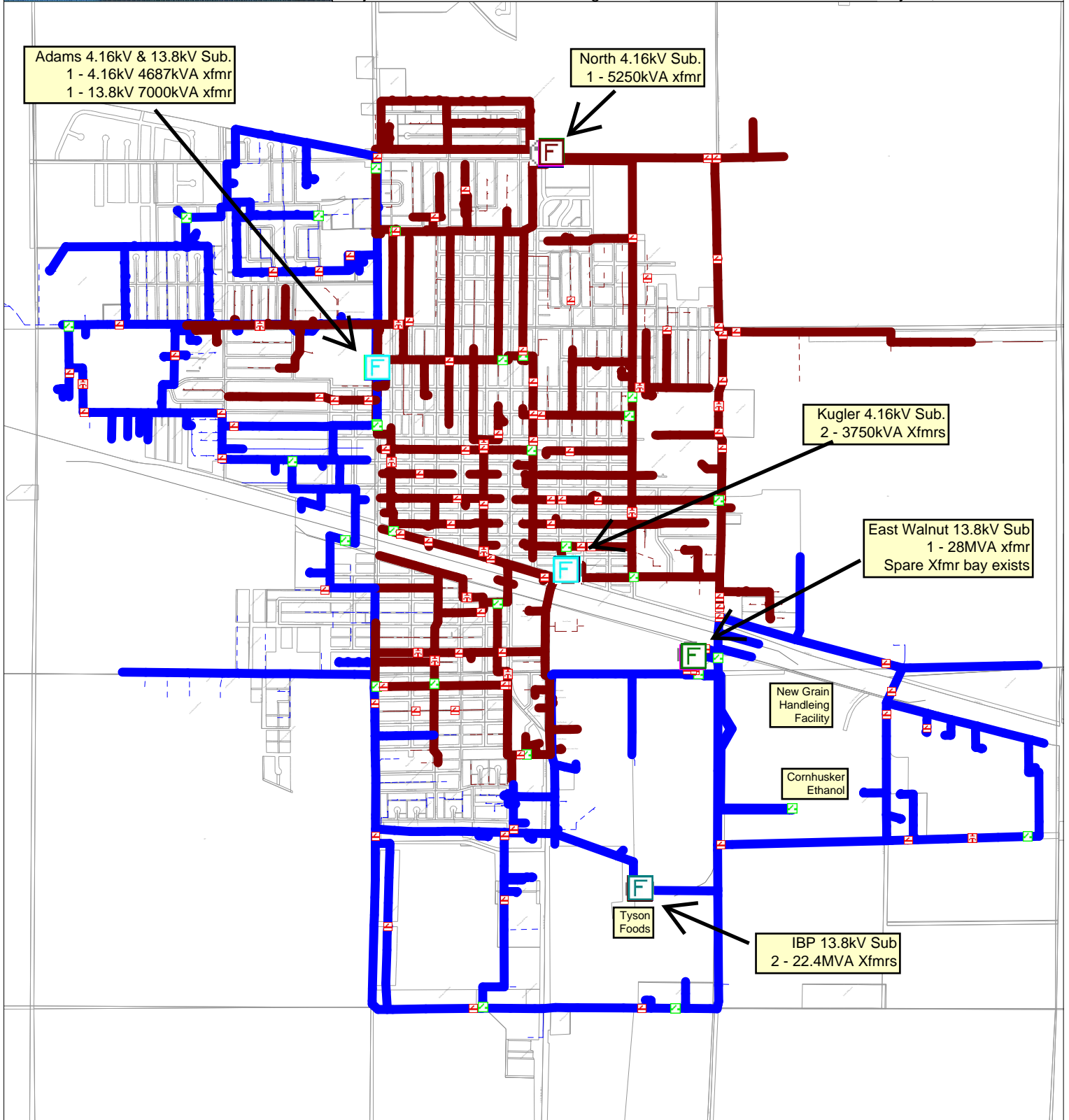


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Lexington City Distribution System 4.16kV (Brown) and 13.8kV (Blue) areas

Project Name: Dist. Asset Planning - SDA

July 17, 2007 10:07 AM





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Lexington City Distribution System

Color by Feeder

Capitol Project Items shown

Project Name: Dist. Asset Planning - SDA

July 17, 2007 10:09 AM

