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Algona Municipal Utilities Power System Designs

DESIGN DOCUMENT

Contents

1 Introduction

1.1 PROJECT STATEMENT

This project is based on the distribution system of Algona Municipal Utilities. The distribution system starts with the substation that is fed one or more subs transmission lines. (1) That means distribution system carries electricity from the substation to consumers. In our project, Algona municipal Utilities hope to improve the old and weak overhead line. We will focus on the distribution system of second largest customers, a industrial company, of Algona Municipal Utilities.

1.2 PURPOSE

The most important part of power engineering is the experience of customers. So the satisfaction of target customer drives our project. On the same time, we need to meet the financial and technology problem of Algona Municipal Utilities. The distribution system ensures the life of people and development of world. Our project can help Utilities Company to save resources and support a higher reliability and security for customer.

1.3 GOALS

Our goal is to build a high reliable, high flexible, and low cost distribution system for industrial company based on the real situation.

2 Deliverables

1. We will find all possible routes with company require and choose two or three high reliable routes.

2. Build the simulation of distribution system for every route.

3. Test the reliability of every route.

4. Analysis the cost for every route.

3 Design

3.1 SYSTEM SPECIFICATIONS

Software:

OpenDSS and Milsoft

3.1.1 Non-functional

Our design must meet the following non-functional requirements.

1. Reliable. Our design must have low error probability.
2. Flexible. Our design must have space for future grown of customer.
3. Economic. Our design must match the financial of Algona Municipal Utilities.

3.1.2 Functional

Our design must meet the following functional requirements.

1. Calculate the impedance matrix of two-type feeder.
2. Calculate the power flow of tow-type feeder.
3. Modeling the distribution system lines.
4. Build the simulation of distribution system.
5. Calculate whatever our design is reliable or no.
6. Calculate the current cost and potential cost.

3.2 PROPOSED DESIGN/METHOD

Our design goal finds the best route of improve the distribution system of industrial company. So we will design all possible routes and simulate these routes. And for every route, we will do the cost analysis about the current cost and potential cost. In the whole design, we need to meet some specific requirement of company and think about the satisfaction of target customer.

3.3 DESIGN ANALYSIS

We calculated and draw the monthly peak demand figure to analysis the demand of industrial company. And we still ask for more detail data to prove our result. Monthly peak demand figure 1 and figure 2 show in the Appendices.

And we find all possible routes with currently requires. Now, we have 5 possible plans. We need to check these routes with Dr. Kimber and Dr. Wang. Because there are a lot of real issues to limited the design, like railway, field, forest, etc.

We have begun to write some small part in OpenDss. On the same time, we try to understand the Milsoft.

The reliability of design should be important for us. We need to calculate the frequency of interruptions and average duration of interruptions for every load. Based on the data of every load, we can get the reliability data of whole system. Because we don't have relative data, the similar radial figure 3 shows in Appendix. (Chowdhury, Ali., and Don. Koval, 2011)

We have begun to learn the reliable principle and designing reliability into industrial and commercial power system.

4 Testing/Development

4.1 INTERFACE SPECIFICATIONS

Software: OpenDss and Milsoft

The OpenDss is a useful tool to deal with electric power distribution. OpenDss can convert data sources easily to OpenDSS script and it has ability to model n-phase, m-winding transformers.

The Milsoft provides more than a thousand utilities. As a professional and widely used software, the Milsoft easy to accepted by Algona Municipal Utilities.

4.2 HARDWARE/SOFTWARE

For the first step, we will calculate the basic data for our different plans. Like, load factor, line impedance, voltage drop, Shunt Admittance of Underground Lines. So we will build every segment distribution modeling line.

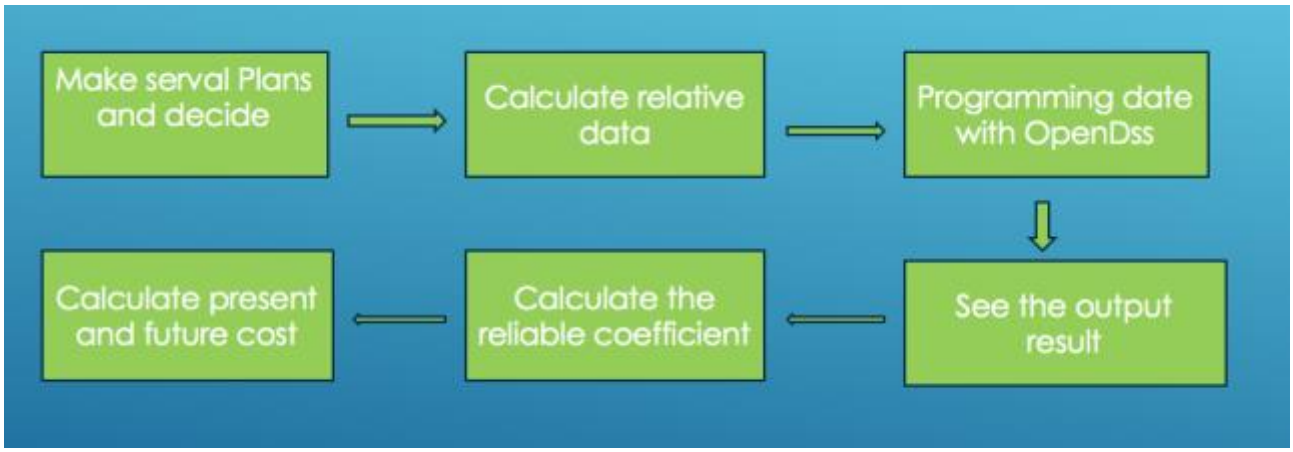
Then we need use OpenDss to simulation our design. And if possible, we try to use Milsoft to build our routes.

After the success of simulation, we need to test the reliability of our design. The way of power distribution system reliability method should be used, like Zone Branch method. The average duration of interruption per feeder and every year need how many hours to repair will be provided with our plan.

And we need more calculation about the cost analysis. Just like I said, the financial problem is one of the most important problems in our project. The currently cost and potential cost will be considered in our cost analysis.

4.2 PROCESS

Please see the diagram below for our project process:



5 Results

Firstly, we will find the results of the basic calculation. We will find load factor, line impedance, voltage drop and shunt admittance for each of us. Then we will compare our results and find difference. Finally, we will use Matlab to double-check our results to decrease the error.

Secondly, to simulate our design.,we will use the software OpenDSS to get our design results. However, because OpenDSS is very hard to use and is very strange for AMU, we will try to use Milsoft, which is more popular in companies and easier to learn and use.

In the third part, we will find the result of average duration of interruption per feeder and the hours to repair and preserve in each year. The results are based on reliability data of every element and node from the book 'Power Distribution System Reliability Practical Methods and Applications". Then we will use Matlab to prove our results to decrease the percentage of the error.

Finally, by reading the book "Contemporary Engineering Economics", we will calculate the cost of the devices, the cost of preserve, the cost of repair and so on. Also we will think about currency inflation to find the lowest cost for our company.

6 Conclusion

In this project, we need to find a best way to support our company with the highest reliable, highest flexible and lowest cost distribution system. We will design a better route for our company's customer—an industrial company. We will need Matlab to help us check our results, need OpenDSS or Milsoft to simulate our distribution systems and also need some relative books to help us analysis the cost of repair, the cost of preserve, the cost of interest, and so on. We will design some new lines, feeders or switch to solve problems and get the goal.

7 References

1. Kersting, William H. *Distribution System Modeling and Analysis / William H. Kersting.* 3rd ed. Boca Raton: CRC/Taylor & Francis, 2012. P2.

2. Chowdhury, Ali., and Don. Koval. *Power Distribution System Reliability Practical Methods and Applications*. Hoboken: Wiley, 2011. IEEE Press Ser. on Power Engineering. Web.

3. Park, Chan S. *Contemporary Engineering Economics Case Studies / Chan S. Park.* Reading, Mass.: Addison-Wesley, 1993. Print.

8 Appendices

Figure 1

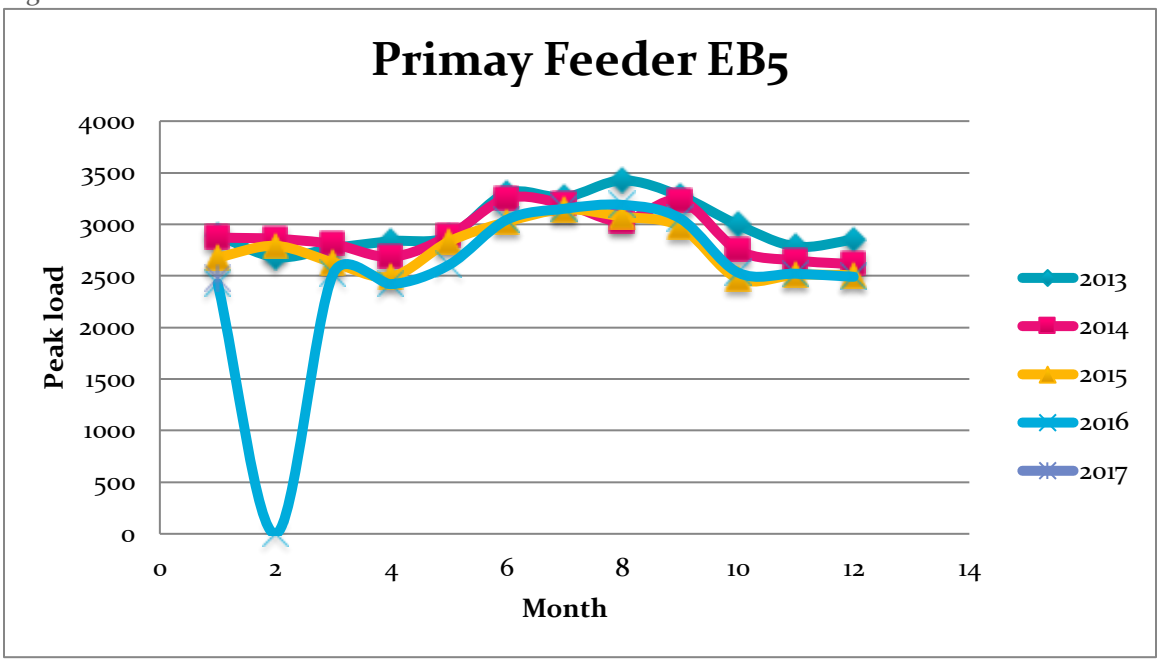


Figure 2

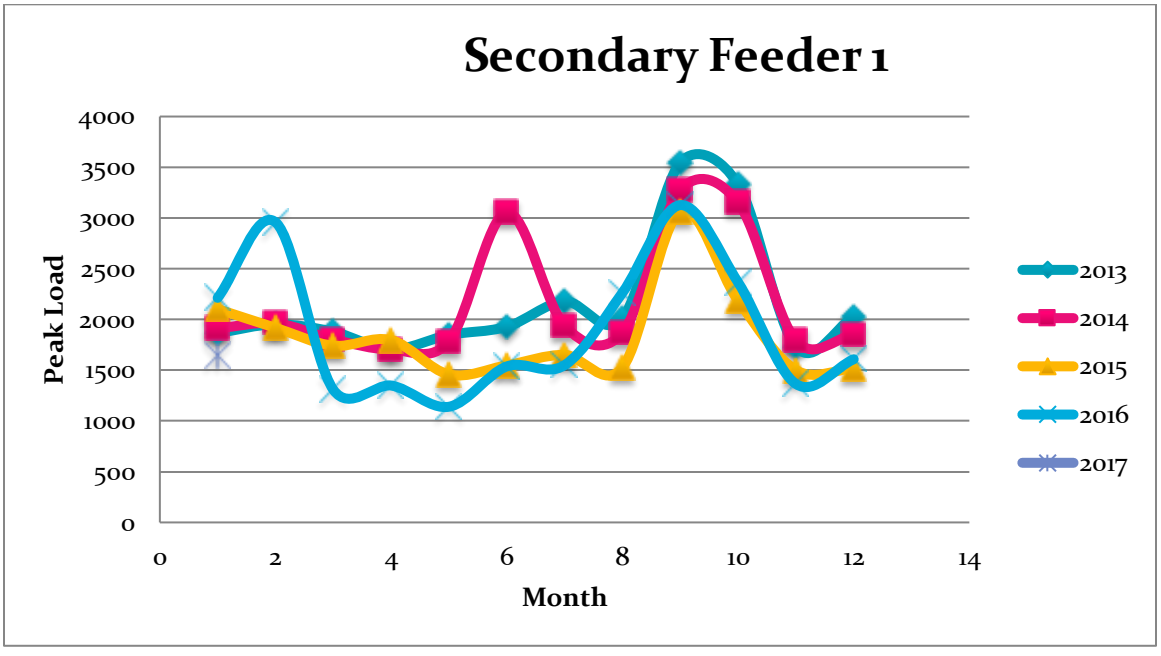
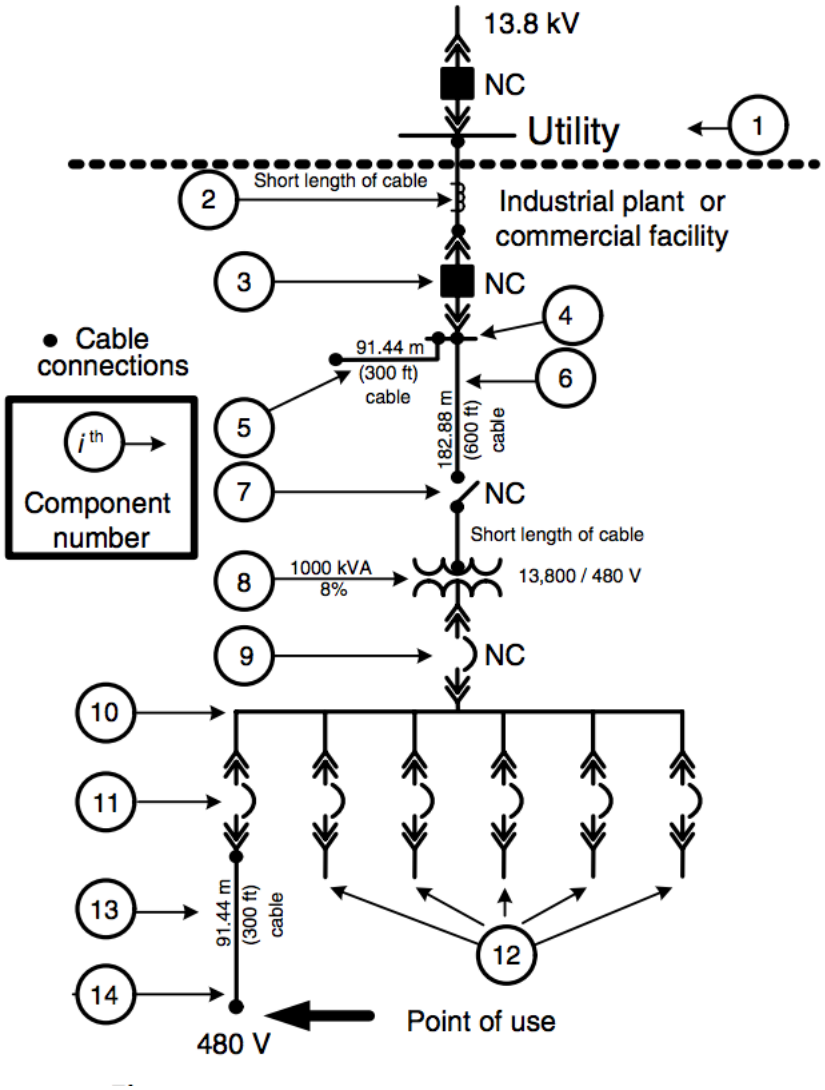


Figure 3


13.8 kV
NC
Utility
1
Short length of cable
2
Industrial plant or
commercial facility
3
NC
4
Cable
connections
91.44 m
(300 ft)
cable
6
5
182.88 m
(600 ft)
cable
i th
Component
number
7
NC
Short length of cable
8
1000 kVA
8%
13,800 / 480 V
9
NC
10
11
13
91.44 m
(300 ft)
cable
12
14
480 V
Point of use