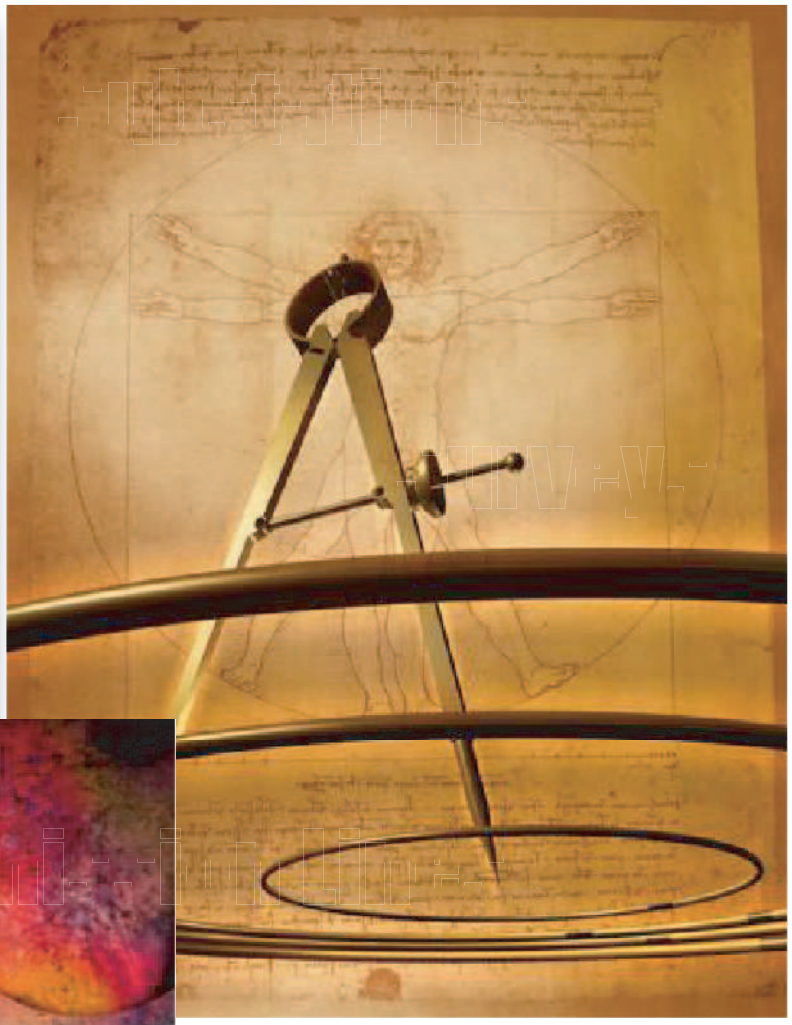
Comlink Land Services

(801) 288-4033 info@comlinkls.com



Spanish Fork Power 2009 Substation Siting & Capital Project Study

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SPANISH FORK CITY

Municipal Power Substation Siting & Capital Project Study

COMLINK L.S., LLC

860 East 4500 South - Suite 312 - Salt Lake City Utah, 84107

October 19, 2009

Spanish Fork City

Municipal Power Substation Siting & Capital Project Study

INTRODUCTION

The Spanish Fork City Power System provided electric service to 8,750 residential customers and 1,130 commercial customers, including 10 large power customers in 2008. Total kilowatt hour sales for the fiscal year ending June 2009 to the residential and commercial customers were 221,992,272 kWh with a maximum demand of 52,300 kilowatts in the first half of the fiscal year. The summer peak for 2009 in Fiscal year 2010 reached 51,500 kilowatts. The number of residential customers has grown at a rate of 8.8% from 2004 to 2007 and the number of commercial customers has grown at a rate of 10.9%.

Electric power is delivered to the system at 46,000 Volts at seven substations. The Whitehead Substation located at 1975 North and 200 East has one 7,500 kilowatt base rated transformer with a fan rating at 55 Deg. C of 8,500 kilowatts. The Woodhouse Substation located at 1650 North and 1100 East has one 10,000 kilowatt base rated transformer with a fan rating at 55 Deg. C of 12,500 kilowatts. The North Substation located at 175 West 3000 North has one base rated 12,000 kilowatt transformer with a fan rating at 55 Deg. C of 20,000 kilowatts. The Industrial Substation at approximately 1000 North and 300 West has one base rated 12,000 kilowatt transformer with a fan rating at 55 Deg. C of 20,000 kilowatts. The Argyle Substation is located at 155 West Center Street and has one 8,400 kilowatt transformer. The Canyon Road Substation located at 2550 East Canyon Road has one 12,000 kilowatt base rated transformer with a fan rating at 55 Deg. C of 20,000 kilowatts. The Bonner Substation located at 1100 East Canyon Road has a 3,800 kilowatt transformer that delivers power at 4 kV to the distribution system. This transformer is scheduled for retirement in 2010 with the completion of the conversion of the 4 kV system to 12.47 kV.

Fourteen circuits distribute power throughout Spanish Fork City.

SERVICE STANDARD

The standard of service for all customers is based on having sufficient installed substation capacity to meet the maximum system demand

with the loss of one 20,000 kilowatt substation transformer. The maximum system demand should not exceed 65% of the fan rating of installed substation capacity at the Woodhouse, Industrial, Canyon, North, and future substations plus 80% of the base transformer rating at the Whitehead and Argyle substations.

SPATIAL LOAD FORECAST

In order to plan the efficient operation and economic capital expansion of an electric power system, the system owner must be able to anticipate the need for power delivery – how much power must be delivered, and where and when it will be needed. Such information is provided by a spatial load forecast, a prediction of future electric demand that includes location (where) as one of its chief elements, in addition to magnitude (how much) and temporal (when) characteristics.[1]

The Spanish Fork City Spatial Load Forecast Projected Impact and Capital Additions map developed for this study on page 41 in Appendix C shows where and what types of future development is anticipated in the City. This map shows the number of acres in each zoning classification. The projected power demand at build-out is approximately 127,248 kW as shown in Table 2. This number will continue to increase as future areas are annexed into the city.

Table 2

Demand at Buildout	
2007 Peak kW	52,673
Future Residential Load	59,875
Future Commercial Load	14,700
Total Demand at Build-out	127,248

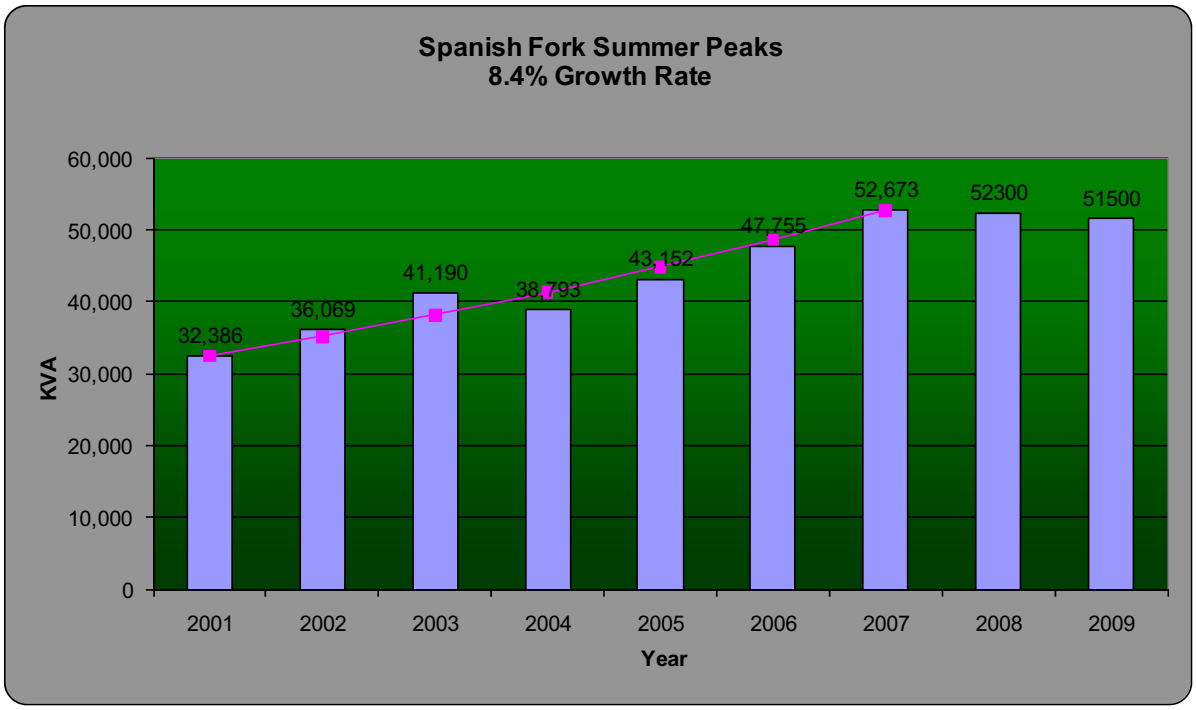
GROWTH

Spanish Fork City has experienced an 8.4% annual rate of growth in its system peak demand from 2002 to 2007 and a 10.5% growth rate from 2004 to 2007. Growth is flat for 2008 and 2009. The growth rate was calculated from Spanish Fork City Power Department historical records, (see Figure 1 on the next page). For the study period the 8.1% growth rate was used for years 2010 through 2019 (ten years).

[1] Spatial Electric Load Forecasting, Second Edition, Revised and Expanded, H. Lee Willis, ABB Inc. Raleigh, North Carolina.

Figure 1

System Demand



FUTURE SUBSTATION REQUIREMENTS

In 2008, system capacity was 79,200 kilowatts of transformer capacity, with the existing fan rating at 55 Deg. C with those transformers so equipped. With the addition of the North Substation, system capacity increases to 88,400 kilowatts.

Capacity available to meet the service standard in the summer of 2007 was 48,500 kilowatts. The peak load was 51,600 kilowatts which left 3,100 kilowatts of load above the Service Standard Capacity. With the addition of the North Substation the Service Standard Capacity increased by 13,000 kilowatts eliminating the 3,100 kilowatt deficit.

The Maple Mountain Substation is under construction with one transformer bay with 20,000 kilowatts of capacity, which increases the Service Standard Capacity by 13,000 kilowatts in 2010. Along with the addition of the Maple Mountain Substation, a single circuit 46 kV tap with a three-way switch will be built.

In 2015 additional transformer capacity will be needed to meet the Capacity Service Standard shortfall of 7,750 kilowatts. The 2015 capacity addition is planned for the Woodhouse Substation, where a new 12/16/20 MVA transformer will replace the existing 10/12.5 transformer. The old transformer that was replaced will then be used for the new Bonner Substation.

A deficit of 8,570 kilowatts is projected for 2017. The Southwest Leland Substation with a 12/16/20 MVA transformer is planned to provide new capacity to maintain the Capacity Service Standard.

A 3,330 kilowatt deficiency in the service standard capacity is expected in 2018, making it necessary to add another transformer. The transformer will be located in a new substation near the Taylor Switch Rack. A 46 kV line will be required from the Taylor Switch Rack to the new substation.

These substation capacity additions provide sufficient capacity to meet the Capacity Service Standard for the projected demand of the 10 year planning period.

Figure 2 on the next page shows the forecasted load for the 10 year study period, the base capacity representing existing transformer capacity prior to 2009 and substation additions for the 10 year study period. Also shown is the total year by year installed capacity after substation additions, the Service Standard Capacity available based on installed capacity year by year, the capacity needed to meet the Capacity Service Standard and the excess capacity available to meet the Service Standard Capacity year by year.

Figure 2

Future Substation Requirements

	2009	1 2010	2 2011	3 2012	4 2013	5 2014	6 2015	7 2016	8 2017	9 2018	10 2019
Yearly Peak Demand (MW)	51.6	55.8	60.3	65.2	70.4	76.1	82.3	88.9	96.1	103.8	112.2
Base Capacity (MW)	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4	88.4
Capacity Addition 2008 (North) (MW)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Planned Capacity Addition 2010 (Maple Mountain)		20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Planned Capacity Addition 2013 Woodhouse/Bonner (MW)							20.0	20.0	20.0	20.0	20.0
Planned Capacity Addition 2015 Canyon/West (MW)									20.0	20.0	20.0
Planned Capacity Addition 2016 Taylor Switchrack (MW)										20.0	20.0
Installed Capacity (MW)	108.4	128.4	128.4	128.4	128.4	128.4	148.4	148.4	168.4	188.4	188.4
Service Standard Capacity (MW)	61.5	74.5	74.5	74.5	74.5	74.5	87.5	87.5	100.5	113.5	113.5
Capacity needed to meet Service Standard (MW)	-	-	-	-	-	1.6	-	1.4	-	-	-
Excess Capacity (MW)	9.9	18.7	14.2	9.3	4.1	-	5.2	-	4.4	9.7	1.3

ACTION PLAN

Figure 3 lists the Spanish Fork capital projects in current dollars, for the study period 2009 through 2019, needed to meet the Capacity Service Standard.

Figure 3

Action Plan - 2009 Update

12 kV - Upgrade Overhead line on 50 S. from 150 W. to 900 W. to Feeder Capacity (600 Amp)	$	60,000	2009
Land - for Bonner Substation 46:12kV 110 E canyon Rd. & Southwest Leland area	$	700,000	2009
46:12kV Substation - 46kV Breaker and Bussing at Woodhouse Substation	$	200,000	2010
12 kV Underground 600 Amp Loop line from 100 S. 900 W. to 400 W. Arrowhead Trail	$	300,000	2010
12 kV Overhead Tie Line 2050 North Chapple Dr. to 2700 N 200 E.	$	250,000	2011
46 kV - Overhead Line from 2700 N 200 E to Dry Creek Sub (Finish Tie)	$	194,000	2011
Take Bonner Substation offline - Remove from System			2009
Construct Maple Mtn. Substation with 20 MVA Transformer	$	2,300,000	2010
3 Distribution Circuits	$	420,000	
Construct Single Circuit tap line to Maple Mtn. Substation with Spacing for a Second Circuit Double Circuit Distribution Underbuild	$	378,750	2010
Install new 20 MVA transformer at Woodhouse - New Bonner 46 kV Substation Addition	$	2,300,000	2015
Construct the Southwest Leland 46 kV substation	$	2,300,000	2017
3 Distribution Circuits	$	420,000	
Taylor Switchrack Substation Addition	$	2,300,000	2018
3 Distribution Circuits	$	420,000	
Transmission Line for Taylor Switchrack Substation	$	168,000	2018
Engineering and Project Management	$	2,575,493	2009-2019
System and Distribution Planning Studies	$	40,000	2009-2019
	Total $	15,326,243	

Figure 4 lists the costs of the SUVPS 5 Year Plan that are the responsibility of Spanish Fork.

Figure 4

SUVPS 5 Year Plan Cost - Dry Creek Substation

Fiscal Year	Description of project	Cost	Spanish Fork Cost
	46 kV steel structures	$ 278,727.50	36% of total
	Concrete	$ 183,920.00	
	Buss	$ 104,480.00	
09-10	Grounding	$ 14,100.00	
	Site work	$ 18,710.00	
	Misc items	$ 53,100.00	
	Total	$ 653,037.50	$ 235,093.50
	Description of project		
	Transformer	$1,700,000.00	
10-11	Transformer installation	$ 100,000.00	
	Total	$1,800,000.00	$ 648,000.00
	Description of project		
	2 - 46 kV breakers	$ 115,000.00	
	10 - 46 GOAB switches	$ 158,400.00	
11-12	Relay panels	$ 87,840.00	
	Control bldg AC - DC	$ 4,740.00	
	Conduit & Cable	$ 93,885.00	
	Total	$ 459,865.00	$ 165,551.40
	Description of project		
	Concrete foundations (Nebo)	$ 101,320.00	
	Transformer	$1,700,000.00	
12-13	Relocate transformer (Nebo)	$ 25,000.00	
	Installation (Nebo)	$ 100,000.00	
	Total	$1,926,320.00	$ 693,475.20
	Description of project (Nebo)		
	138 kV breaker	$ 85,000.00	
	46 kV breaker	$ 57,240.00	
	GOAB switches	$ 23,680.00	
	Relay panels	$ 82,840.00	
	Steel structures	$ 118,080.00	
13-14	Control Bldg	$ 4,900.00	
	Buss	$ 76,930.00	
	Conduit & cable	$ 112,905.00	
	Grounding	$ 12,100.00	
	Site work	$ 15,710.00	
	Misc.	$ 53,100.00	
	Total	$ 642,485.00	$ 231,294.60
	Projects 5 year total	$5,481,707.50	$ 1,973,414.70

Spanish Fork City

Transmission Loading and Substation Siting and Coverage Analysis

Transmission Loading

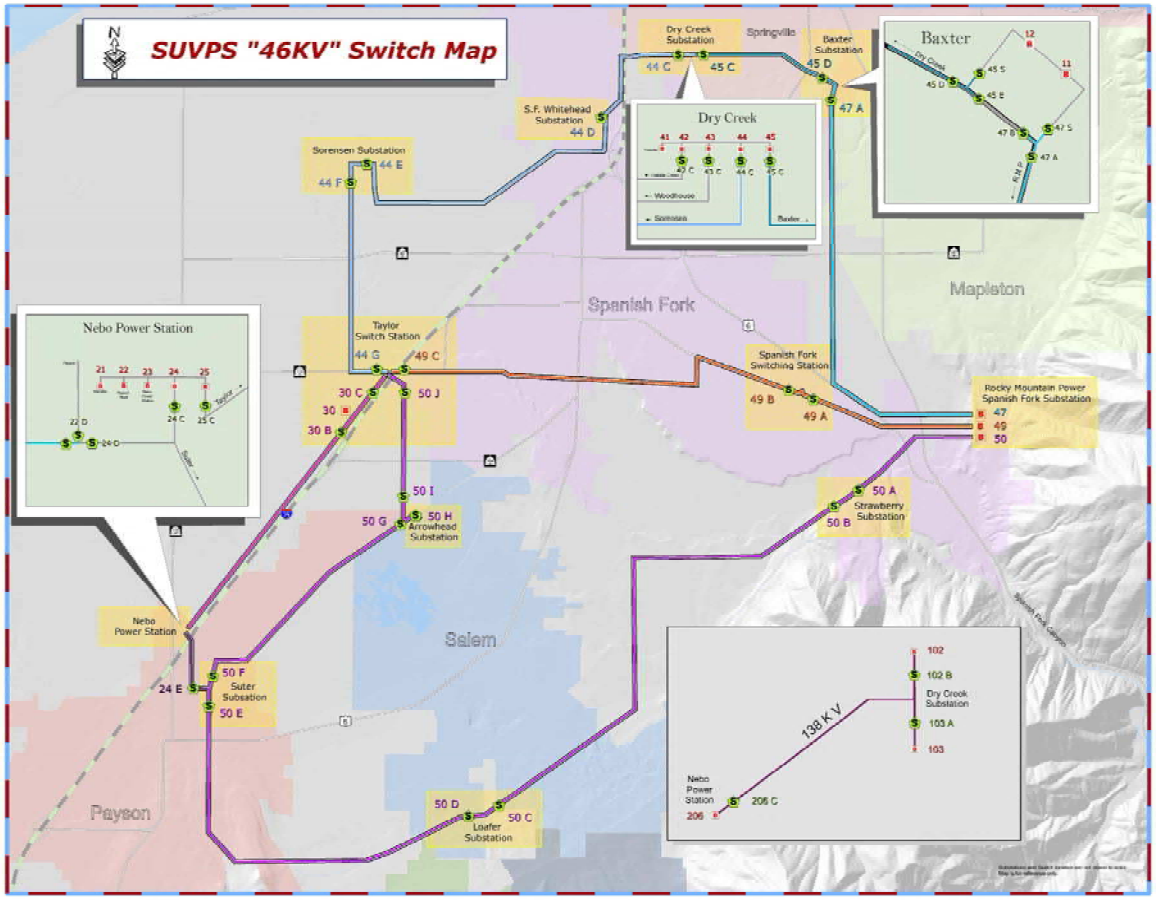
Introduction

Loading of transmission lines depends largely upon the addition of substations. Given a substation's Service Standard Capacity, a substation will cover a given number of square miles for a given load density. In this section of the study we show the area each substation can cover given the average load density in the city at various points of time in the study period, and the effect the substations will have on the transmission line loading. This shows in a graphical way when future substations with additional transformer capacity are needed and helps in locating future substation sites.

The figure on the following page shows when the 46kV lines become overloaded. The normal maximum MVA loading for each conductor type is shown in the green field. The peak MVA loading of the lines are shown for each year of the study with the percent of normal peak loading underneath. When the percent loading reaches 100% or above it is shown in red. The 477 ACSR from Spanish Fork Substation to Canyon Road Substation overloads in 2017.

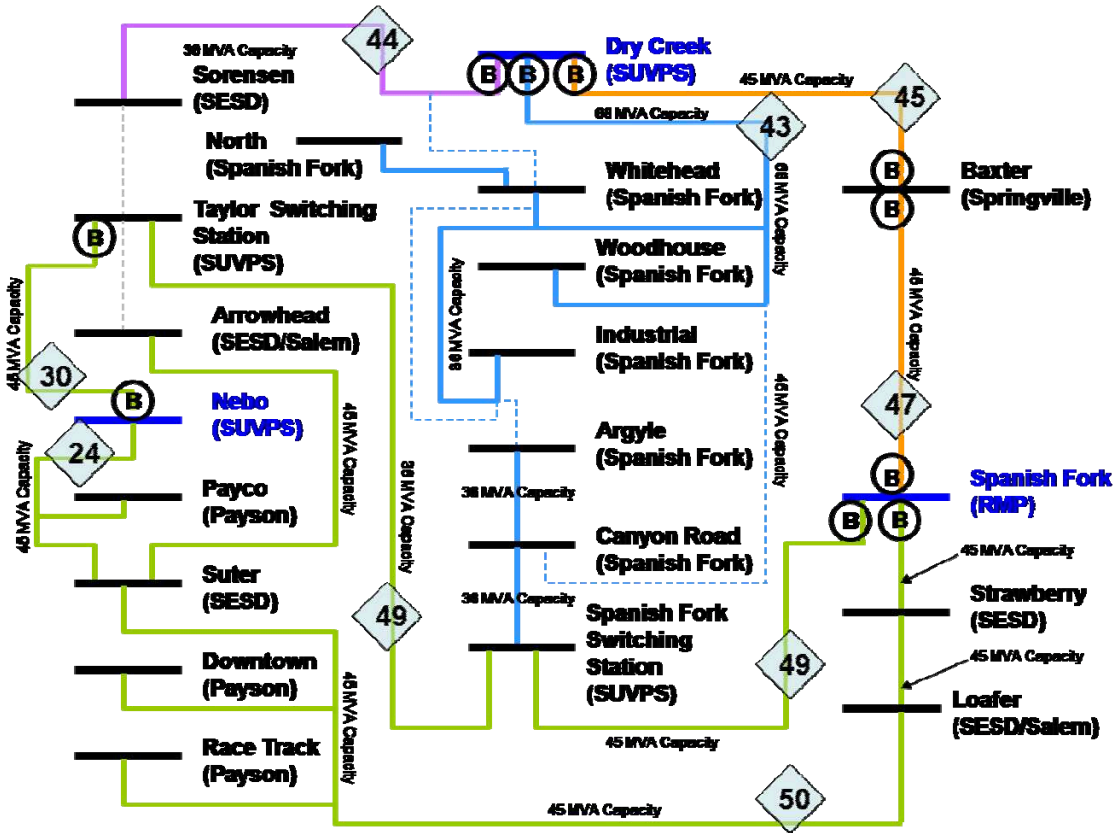
Spanish Fork/SUVPS Transmission Line Loading												
Growth		8.0%	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Dry Creek	795 ACSR		26.6	28.7	31.0	33.5	36.2	39.1	42.2	45.6	49.2	53.2	57.4
		67.9	39.2%	42.3%	45.7%	49.3%	53.3%	57.5%	62.1%	67.1%	72.5%	78.3%	84.5%
	Woodhouse		9.9	10.7	11.6	12.5	13.5	14.6	15.8	17.0	18.4	19.9	21.4
	336 ACSR		16.7	18.0	19.4	21.0	22.7	24.5	26.4	28.6	30.8	33.3	36.0
		36.4	45.8%	49.4%	53.4%	57.7%	62.3%	67.2%	72.6%	78.4%	84.7%	91.5%	98.8%
	Industrial		7.3	7.9	8.5	9.2	9.9	10.7	11.5	12.5	13.5	14.5	15.7
	336 ACSR		9.4	10.1	10.9	11.8	12.8	13.8	14.9	16.1	17.4	18.8	20.3
		36.4	25.8%	27.8%	30.1%	32.5%	35.1%	37.9%	40.9%	44.2%	47.7%	51.5%	55.6%
	Whitehead		2.5	2.7	2.9	3.1	3.4	3.6	3.9	4.3	4.6	5.0	5.4
	North		6.9	7.5	8.0	8.7	9.4	10.1	10.9	11.8	12.8	13.8	14.9
Spanish Fork	477 ACSR		26.1	28.2	30.4	32.9	35.5	38.3	41.4	44.7	48.3	52.1	56.3
		45.3	57.6%	62.2%	67.2%	72.5%	78.3%	84.6%	91.4%	98.7%	106.6%	115.1%	124.3%
	Canyon Road		12.62										
	1/2 Bonner		2.1035										
			14.7	15.9	17.2	18.5	20.0	21.6	23.4	25.2	27.3	29.4	31.8
	336 ACSR		11.4	12.3	13.3	14.3	15.5	16.7	18.0	19.5	21.0	22.7	24.5
		36.4	31.2%	33.7%	36.4%	39.3%	42.5%	45.9%	49.5%	53.5%	57.8%	62.4%	67.4%
	Argyle		9.257										
	1/2 Bonner		2.1035										
			11.4	12.3	13.3	14.3	15.5	16.7	18.0	19.5	21.0	22.7	24.5
	Bonner		4.207										

The next figure shows a map of the SUVPS transmission system, and how Spanish Fork City is tied to that system.

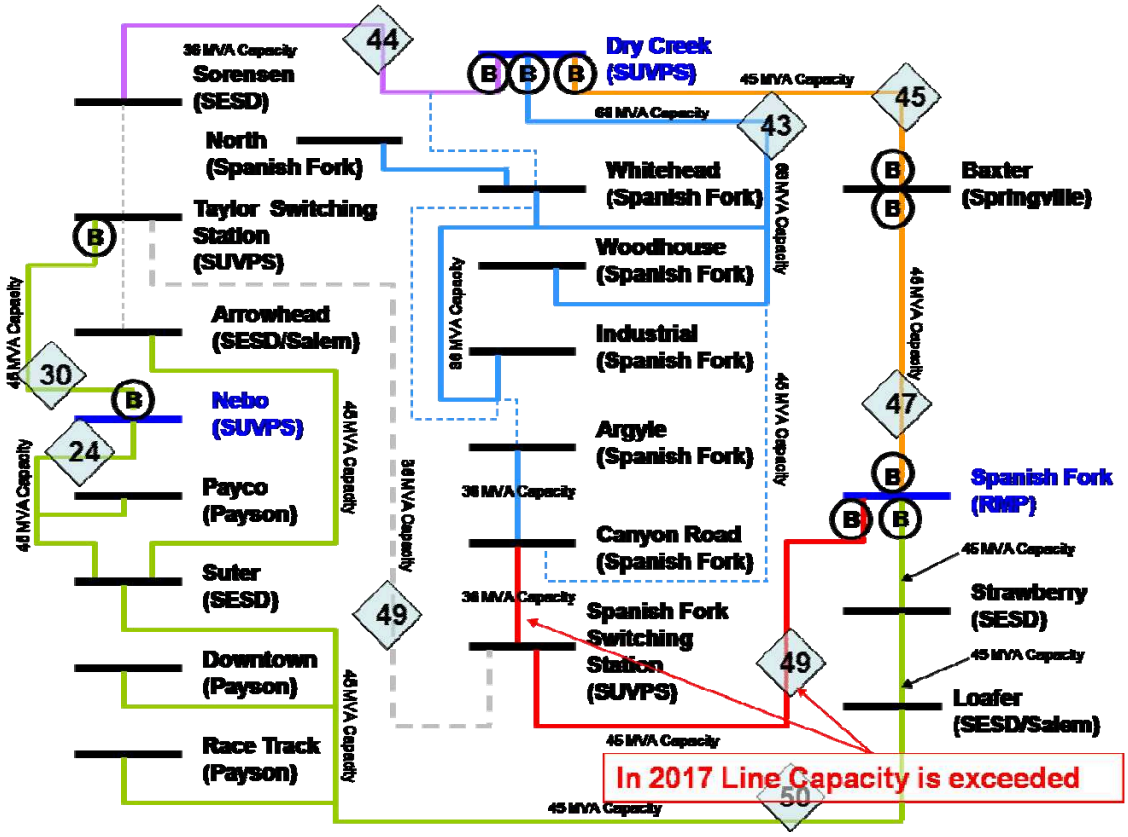


The following two figures show when line upgrades are needed, and in which year, on a system one-line and bus diagram. These figures are a graphical representation of the transmission line loading table shown on page 10.

This first figure represents the system as it is now with all lines operating at the proper capacity.



This second figure shows, in red, the sections of line that need to be upgraded in 2017.



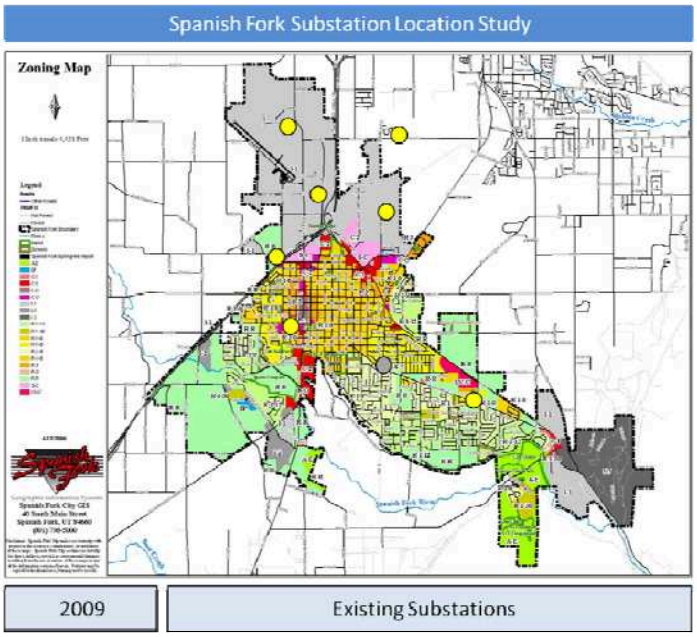
As can be seen, the 45 MVA line capacities between Spanish Fork-Rocky Mountain Substation and Canyon Substation are exceeded. This is in line with the need for a line upgrade shown in the transmission line loading table.

Substation Siting and Coverage

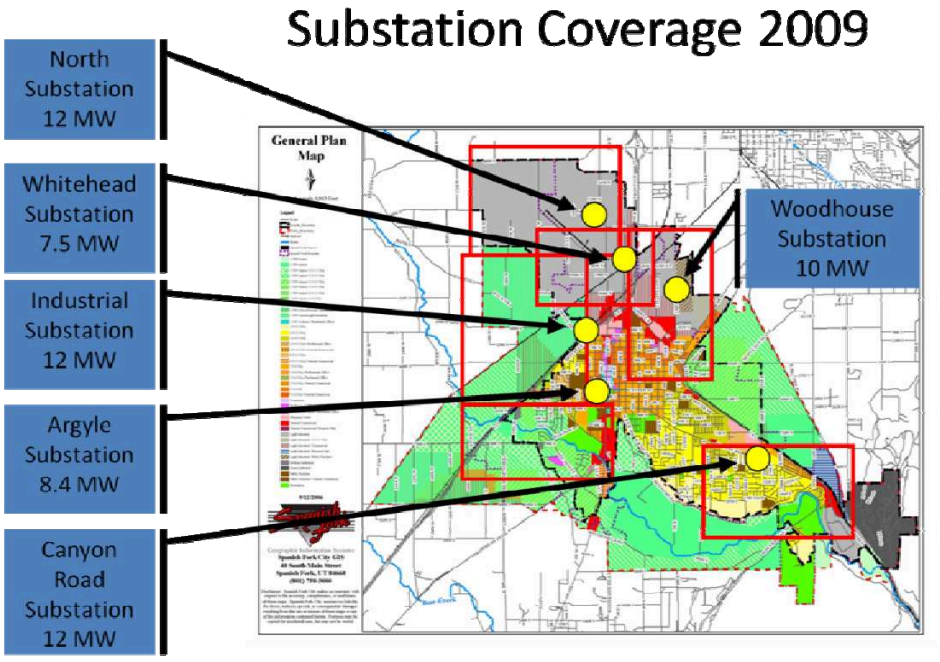
Introduction

Given a substation's Service Standard Capacity, a substation will cover a given number of square miles for a given load density. In this section of the study we show the area each substation can cover given the average load density in the city at various points of time in the study period, and the effect the substations will have on the transmission line loading. This shows in a graphical way when future substations with additional transformer capacity are needed and helps in locating future substation sites. The figures begin with showing the existing substation locations and continue, in chronological order, with location of subsequent substation additions.

This figure shows the location of the existing Spanish Fork substations that are currently in operation.

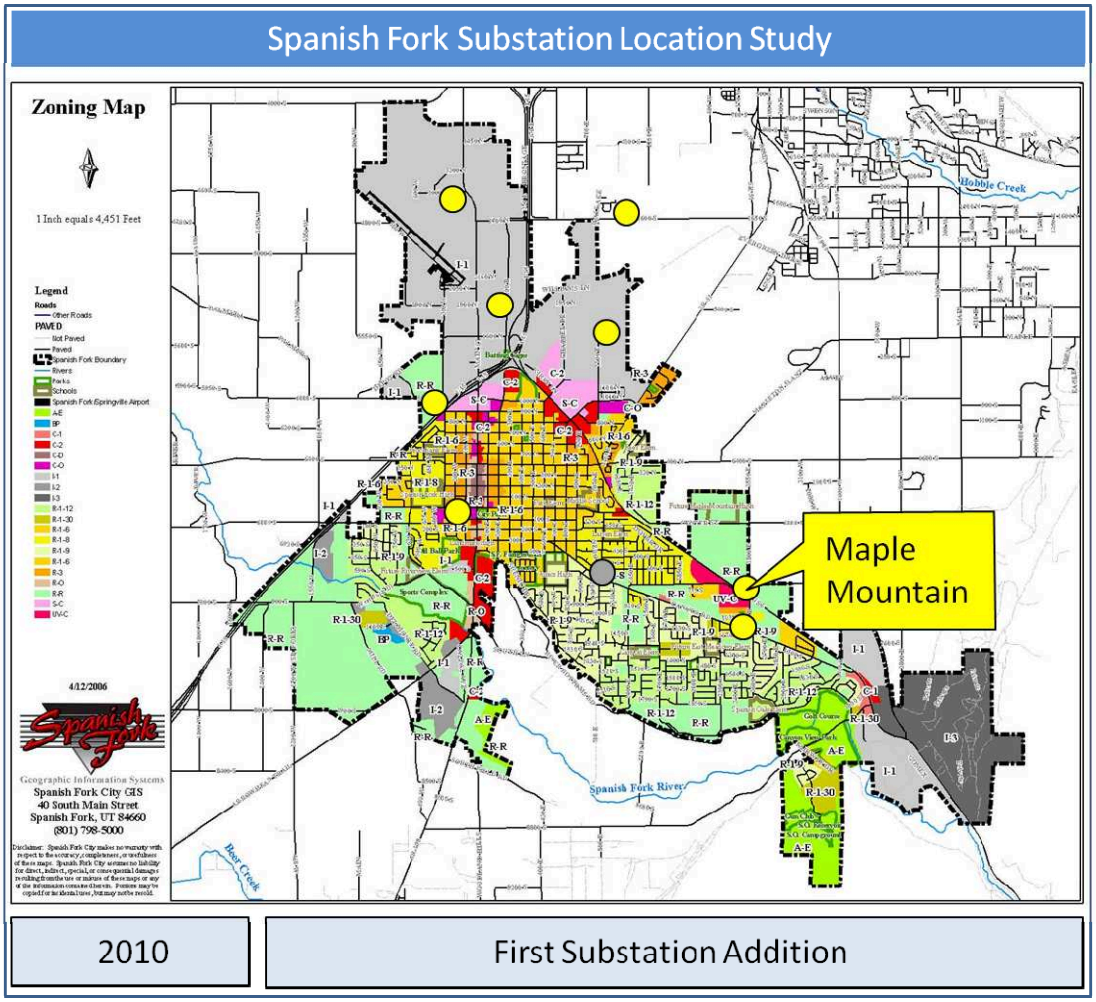


As can be seen, there are a total of eight substations in use in the Spanish Fork power system. However, the gray dot represents the Bonner Substation which will be taken out of service and removed from the system.

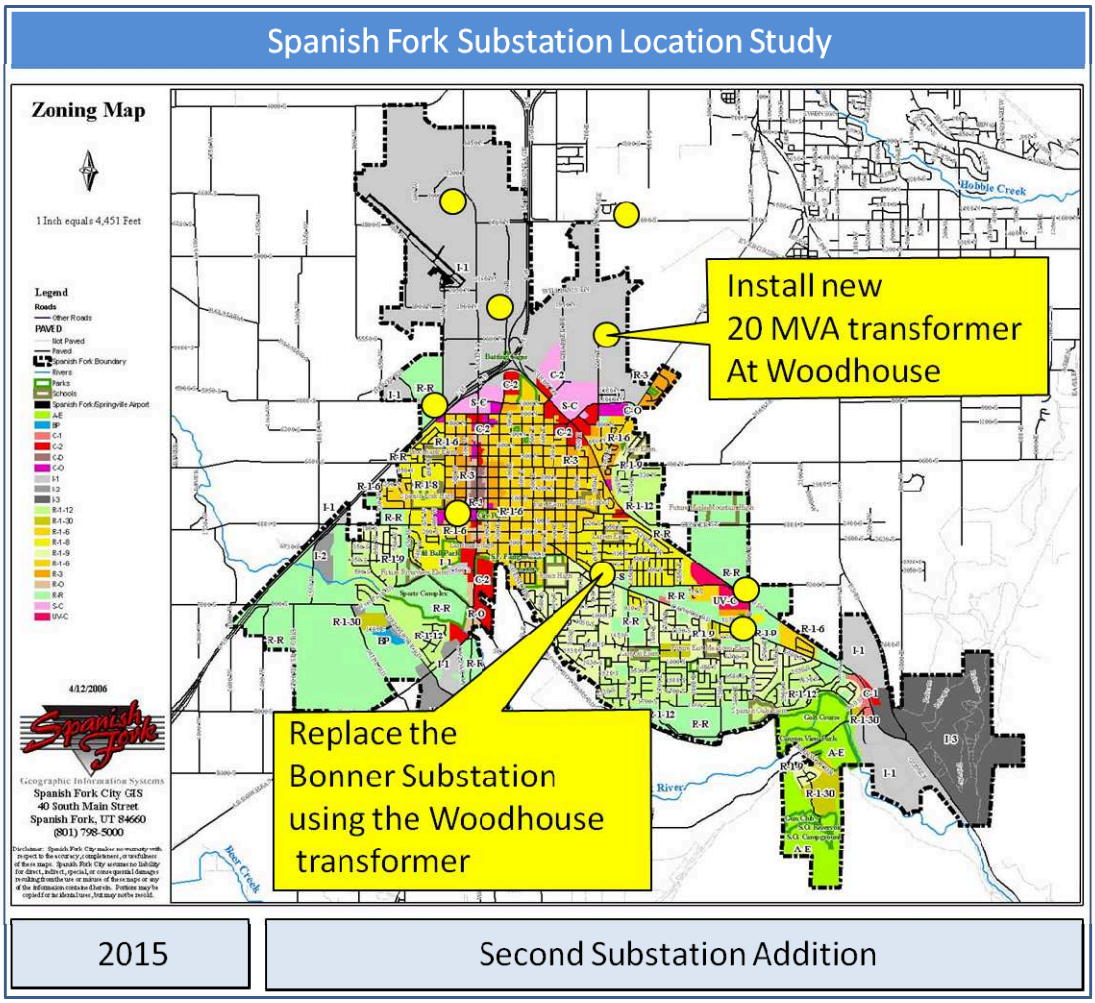


From the figure above, it is evident that there is a deficiency in coverage in 2009. The addition of the Maple Mountain Substation will provide ample coverage for the city's deficiency.

This figure shows the addition of the Maple Mountain Substation, originally known as the East Substation.

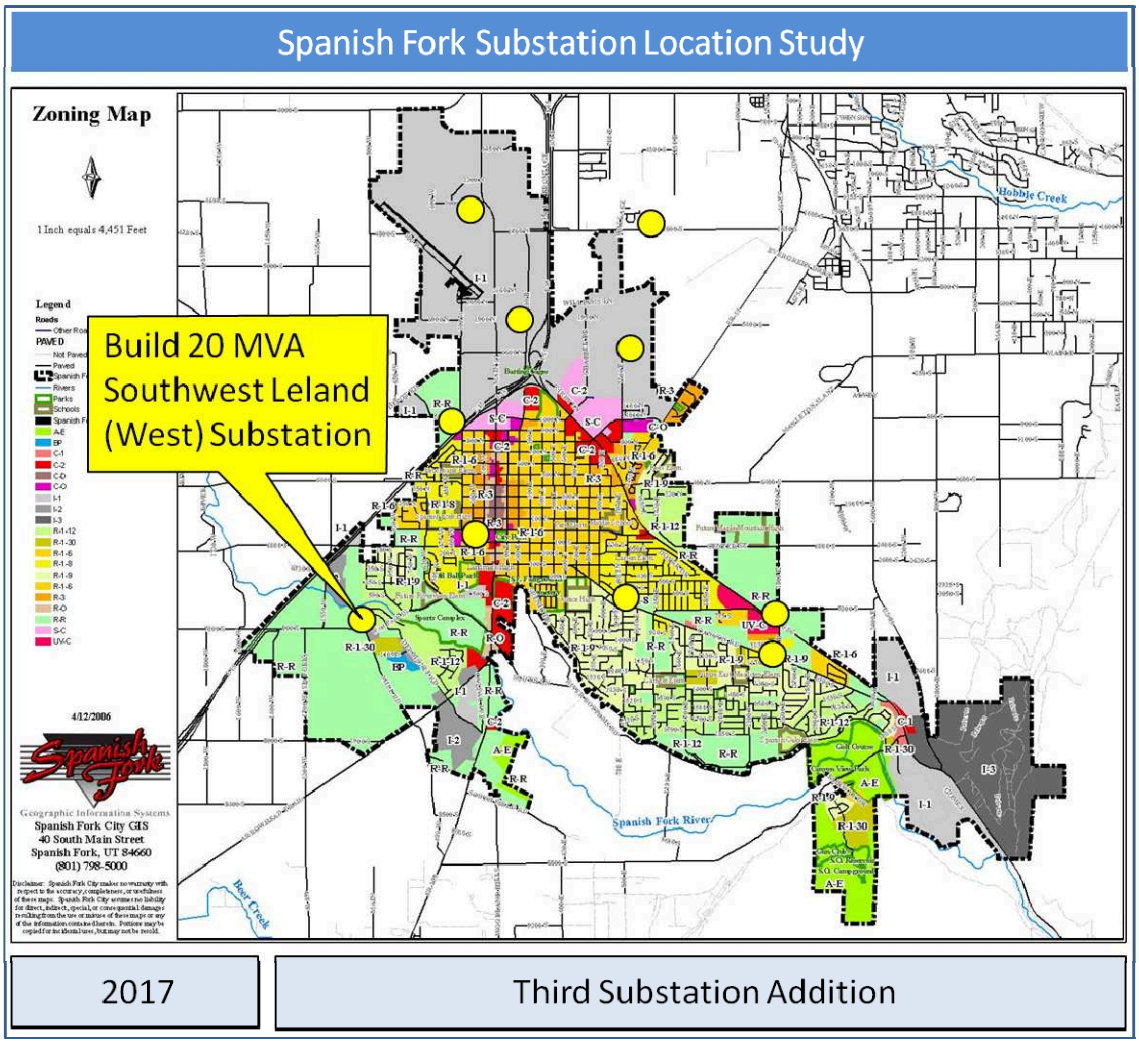


This figure shows the upgrade of Woodhouse and Bonner Substations.

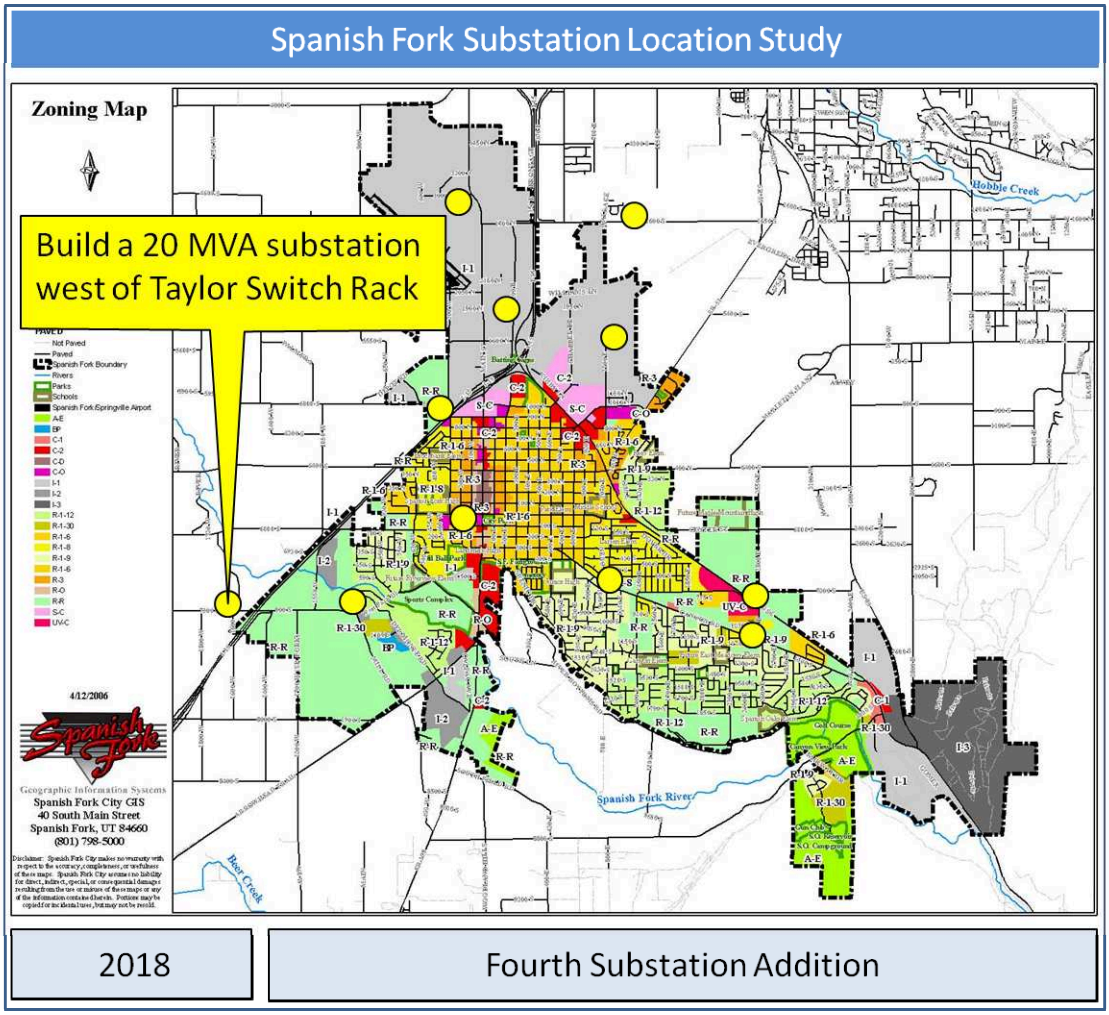


The figure shows that Woodhouse is upgraded to 20 MVA by replacing the transformer. Bonner Substation will be put back into service by using the 10/12.5 transformer from Woodhouse Substation.

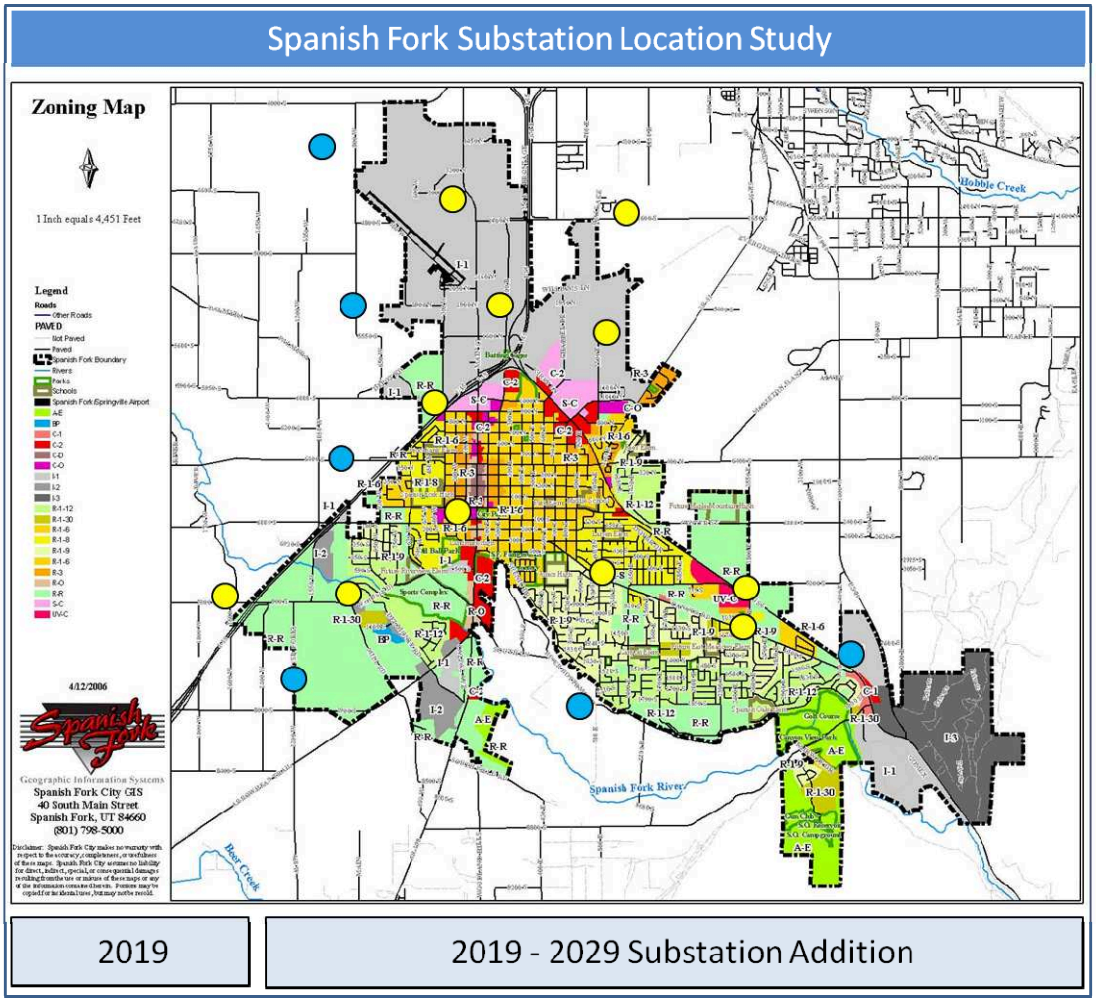
This figure shows the new 20 MVA Southwest Leland (West) Substation planned for 2017.



This figure shows the addition of the Taylor Switch Rack Substation west of the existing Taylor Switch Rack planned for 2018.

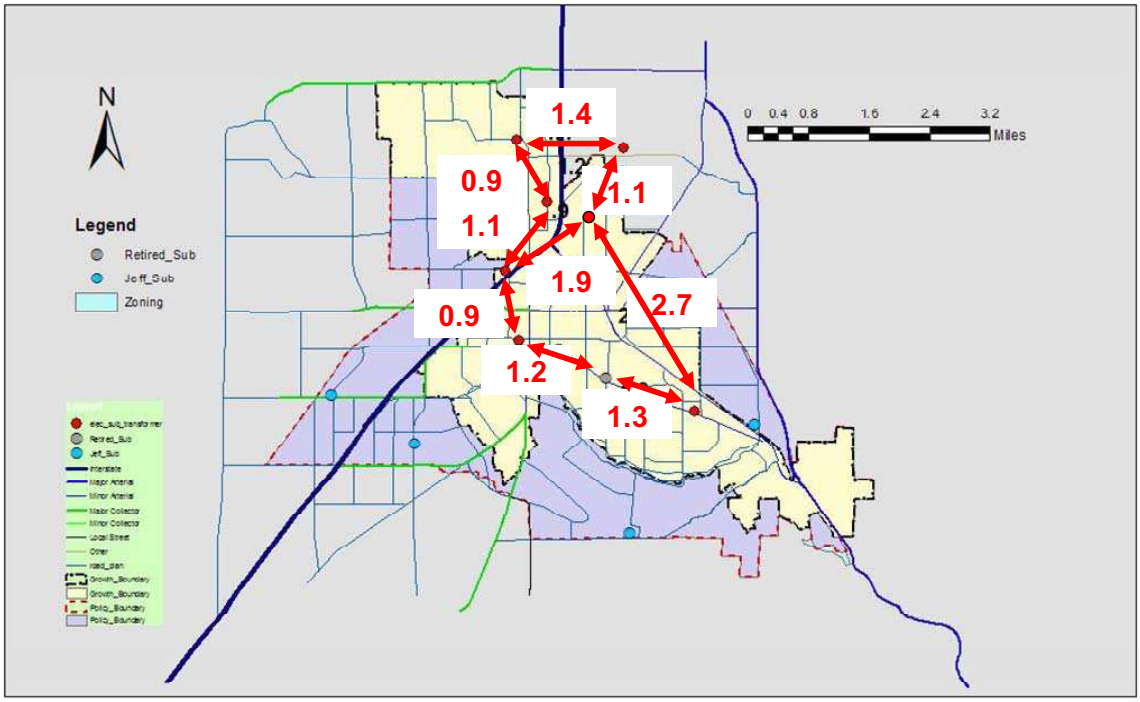


This final Substation Location figure shows potential locations for substations between the years 2017 and 2027.



The substations that are projected to be in service by 2019 are represented by the yellow dots. The rest of the dots, in blue, represent the potential substation locations for the 10 year period between 2019 and 2029. The location and order of addition of the substations in blue will be determined according to need based on growth.

This figure shows the spacing between the substations in service in the year 2009.



The figure below shows what the distance between substations should be given transformer loading. The red circles point out what the spacing should be in the years shown to the left under "Square Miles Served."

	Substation Spacing Guideline						
	Transformer Base Rating 20 MVA				65% of OA/FA/FA Rating 13 MVA		
Load Density MVA/mi^2	Square Miles Served	Distance to Service Boundaries (mi)	Ideal Distance between Substations (mi)		Square Miles Served	Distance to Service Boundaries (mi)	Ideal Distance between Substations (mi)
2	10.0	1.6	3.2		6.5	1.3	2.5
2.4	8.3	1.4	2.9		5.4	1.2	2.3
3	6.7	1.3	2.6		4.3	1.0	2.1
3.5	5.7	1.2	2.4		3.7	1.0	1.9
4	5.0	1.1	2.2		3.3	0.9	1.8
4.5	2007 4.4	1.1	2.1		2.9	0.8	1.7
5	4.0	1.0	2.0		2.6	0.8	1.6
5.7	10 Year 3.5	0.9	1.9		2.3	0.8	1.5
6	3.3	0.9	1.8		2.2	0.7	1.5
7	2.9	0.8	1.7		1.9	0.7	1.4
7.4	15 Year 2.7	0.8	1.6		1.8	0.7	1.3
8	2.5	0.8	1.6		1.6	0.6	1.3
9	2.2	0.7	1.5		1.4	0.6	1.2
9.5	20 Year 2.1	0.7	1.5		1.4	0.6	1.2
10	2.0	0.7	1.4		1.3	0.6	1.1

The next figure sums up the actions to be taken in adding substations and lines in order to keep up with the growing demand over the next 20 years.

Spanish Fork Substation and Line Additions
20 Year Horizon

Year	Project
2009	Build the Maple Mountain 20 MVA Substation.
2011	Build overhead 46 kV line from 2700 N 200E to Dry Creek Substation
2015	Upgrade the Woodhouse Substation to 20 MVA. Construct the new Bonner Substation using the Woodhouse 46 - 12.47 kV transformer.
2017	Construct the West Substation using a 20 MVA transformer and connecting to the Spanish Fork Switch Rack - Taylor Switch Rack SUVPS 46 kV line.
2018	Establish a 46 kV connection to the Taylor Switchrack. Build a 20 MVA Substation near the Taylor Switch Rack and connect to the Taylor Switch Rack.
2019-2029	Plan and Construct Substations and Transmission Facilities on the south and west of Spanish Fork as needed.

APPENDICES

Appendix A
Action Plan Projects

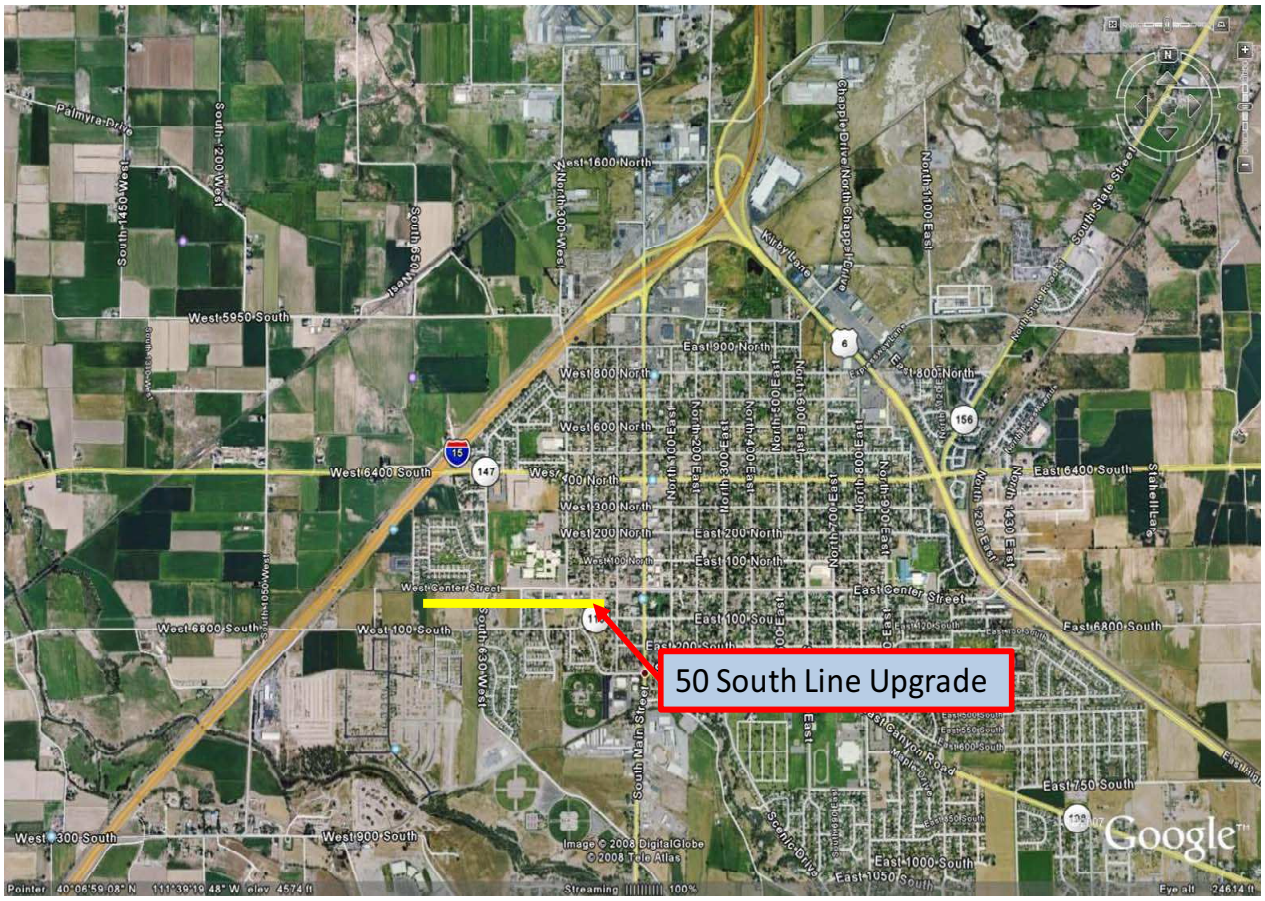
1. 12 kV - Upgrade Overhead line on 50 S. from 150 W. to 900 W. to Feeder Capacity (600 Amp) – 2009
2. Land - for Bonner Substation 46:12kV 1100 E Canyon Rd. & Southwest Leland area – 2009
3. 46:12kV Substation - 46kV Breaker and Bussing at Woodhouse Substation – 2010
4. 12 kV Underground 600 Amp Loop line from 100 S. 900 W. to 400 W, Arrowhead Trail – 2010
5. 12 kV Overhead Tie Line 2050 North Chappel Dr. to 2700 N. 200 E. – 2011
6. 46kV - Overhead Line from 2700 N 200 E to Dry Creek Sub (Finish Tie) – 2011
7. Take Bonner Substation offline - Remove from System – 2010
8. Construct Maple Mtn. Substation with 20 MVA Transformer, 3 Distribution Circuits – 2010
9. Construct single-circuit 46 kV tap line to the Maple Mountain Substation
10. Convert Woodhouse to 20 MVA - New Bonner 46 kV Substation Addition – 2015
11. Construct the Southwest Leland 46 kV Substation, 3 Distribution Circuits – 2017
12. Taylor Switch Rack Substation Addition, 3 Distribution Circuits – 2018
13. 46kV Connection at Taylor Switch Rack – 2018

Project 1

12kV – Upgrade Overhead line on 50 S. from 150 W. to 900 W. to Feeder Capacity (600 Amp)

2009

$ 60,000

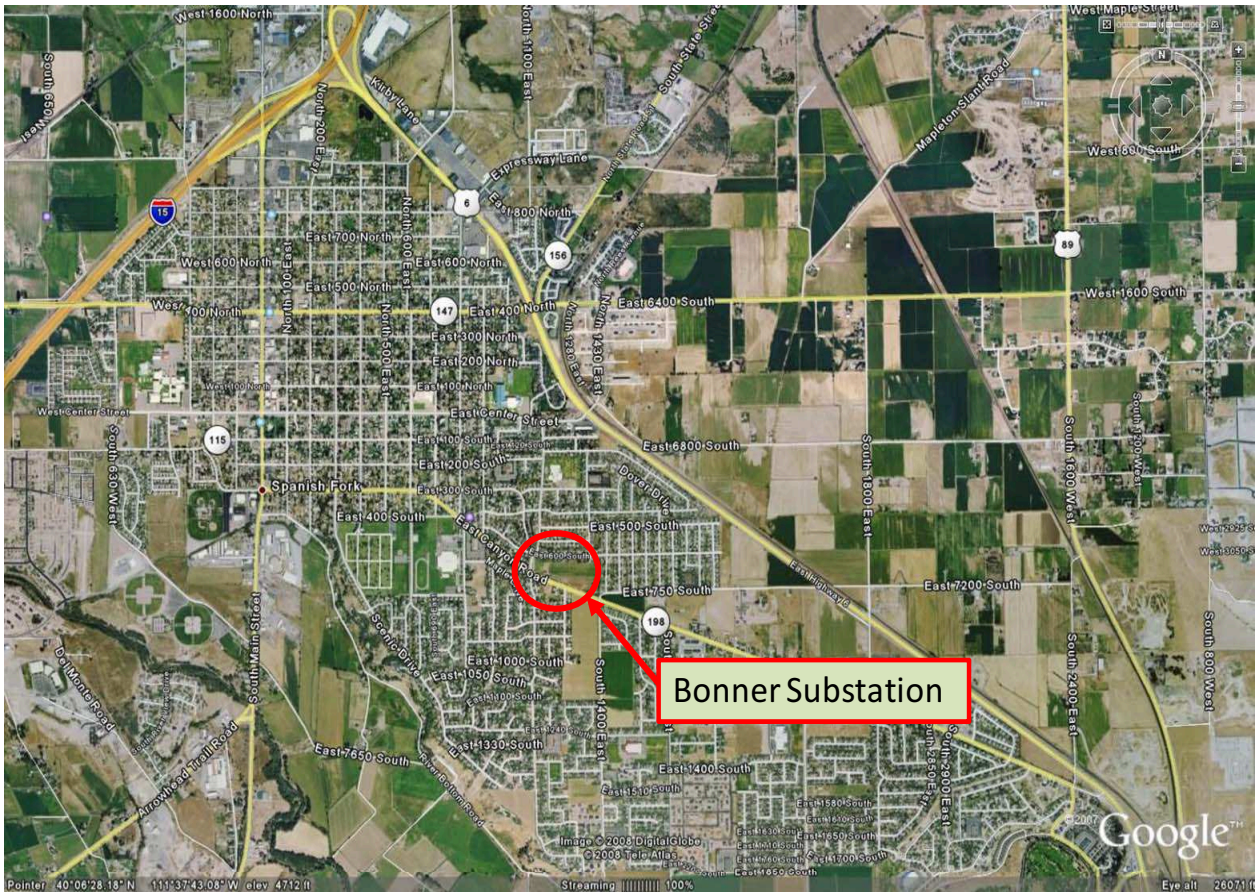


Project 2

Land for Bonner Substation 46:12kV at 1100 E Canyon Rd. & Southwest Leland area

2009

$700,000



Project 3

46:12kV Substation – 46kV Breaker and Bussing at Woodhouse Substation

2010

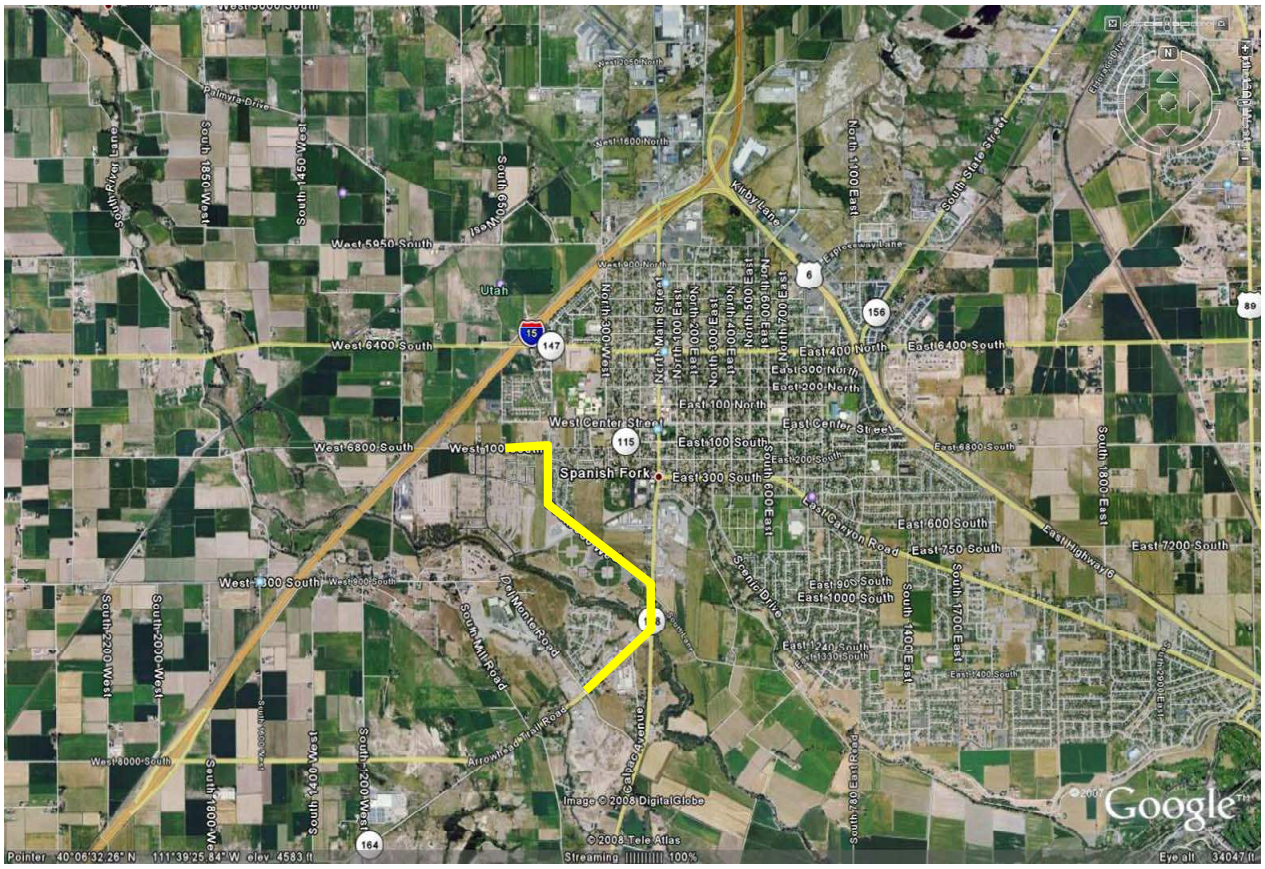
$ 200,000

Project 4

12kV Underground 600 Amp Loop Line from 100 S. 900 W. to 400 W. Arrowhead Trail

2010

$ 300,000



Project 5

12kV Overhead Tie Line 2050 N. Chappel Dr. to 2700 N. 200 E.

2011

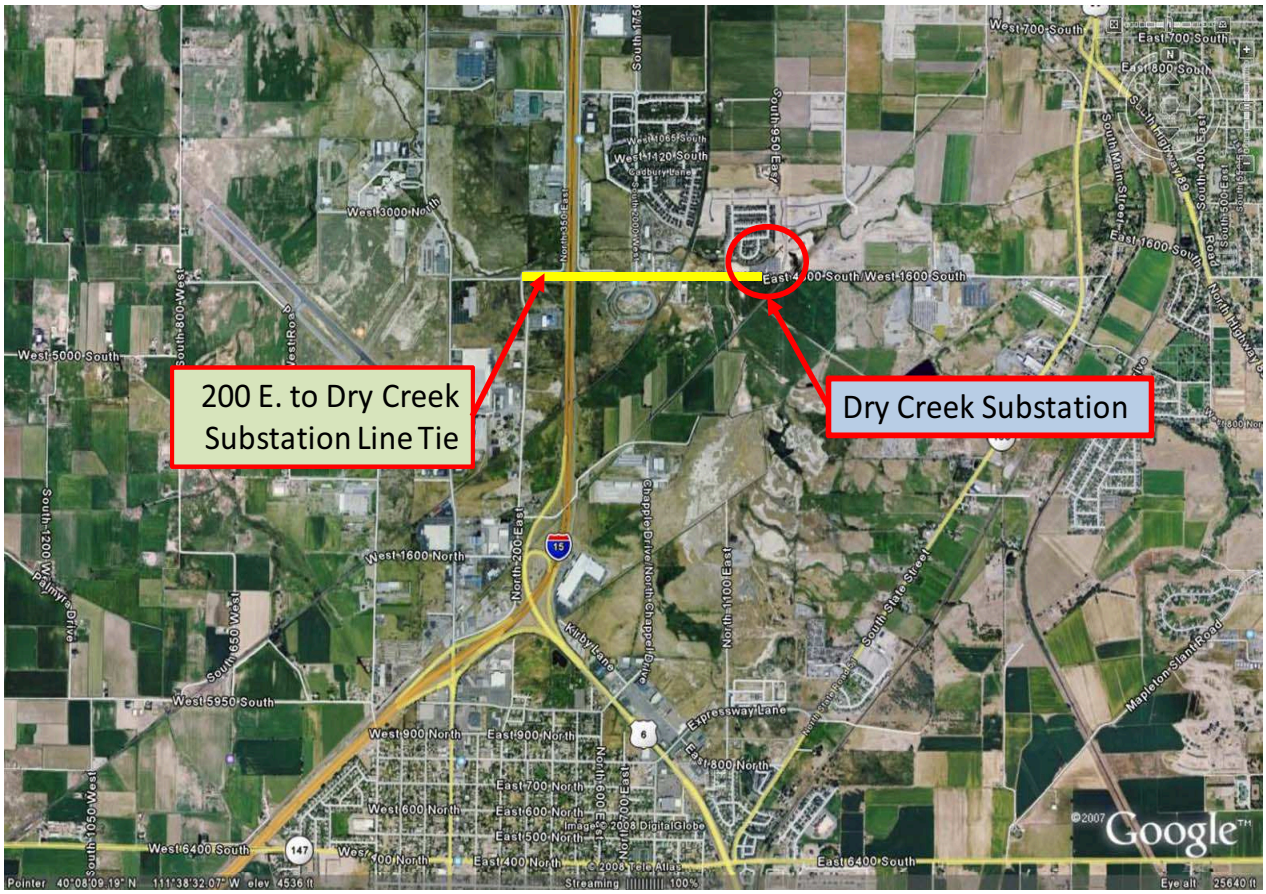
$ 250,000

Project 6

46kV Overhead Line from 2700 N. 200 E. to Dry Creek Substation (Finish Tie)

2011

$ 194,000



Project 7

Take Bonner Substation Offline – Remove from System

2010

Project 8

Construct Maple Mountain Substation with 20 MVA Transformer

$2,300,000

3 Distribution Circuits

$420,000

2010

Project 9

Construct Single Circuit 46kV Tap Line to Maple Mountain Substation

2010

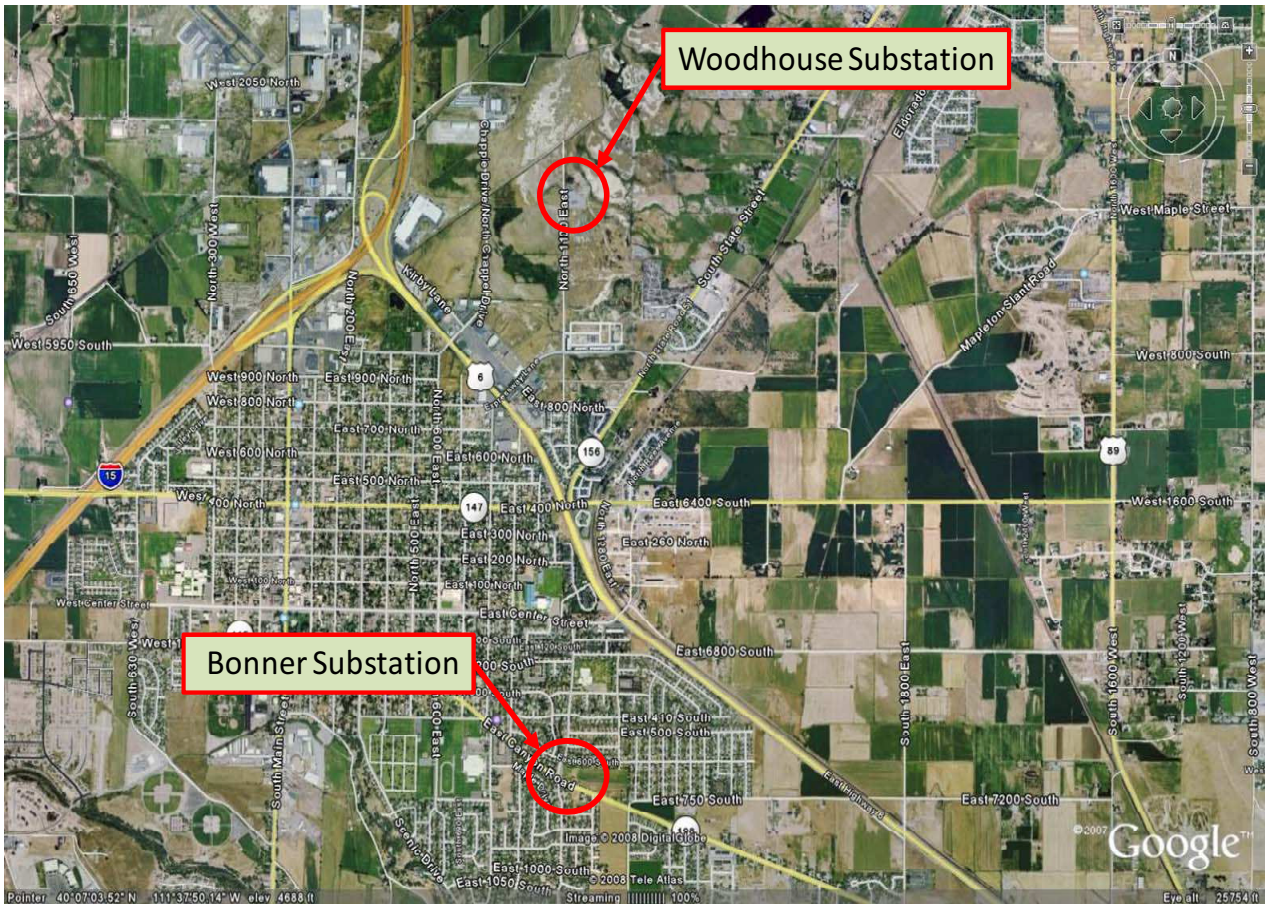
$ 378,750

Project 10

Convert Woodhouse to 20 MVA – New Bonner 46kV Substation Addition

2015

$2,300,000



Project 11

Construct the Southwest Leland 46kV Substation

$2,300,000

3 Distribution Circuits

$420,000

2017

Project 12

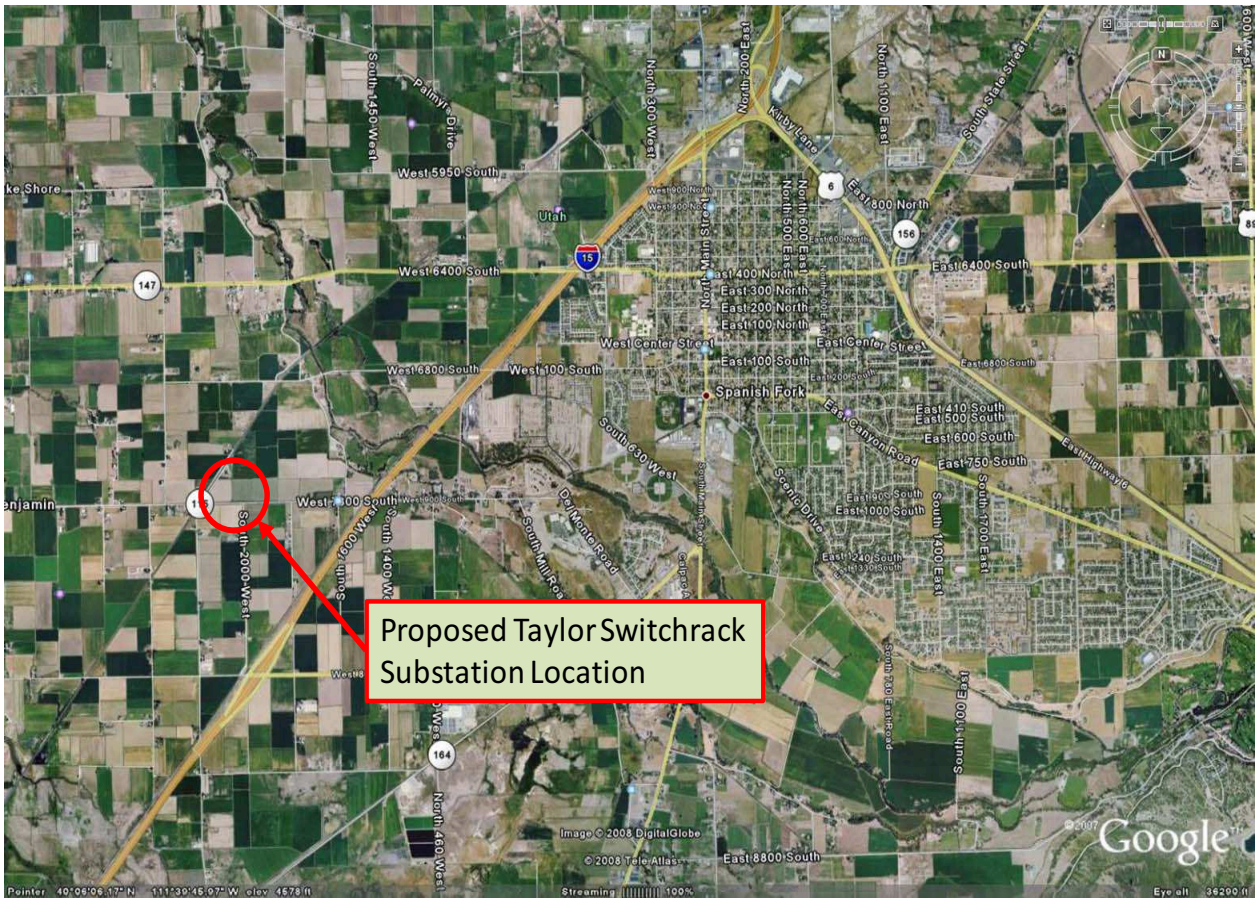
Taylor Switch Rack 46kV Substation Addition

$2,300,000

3 Distribution Circuits

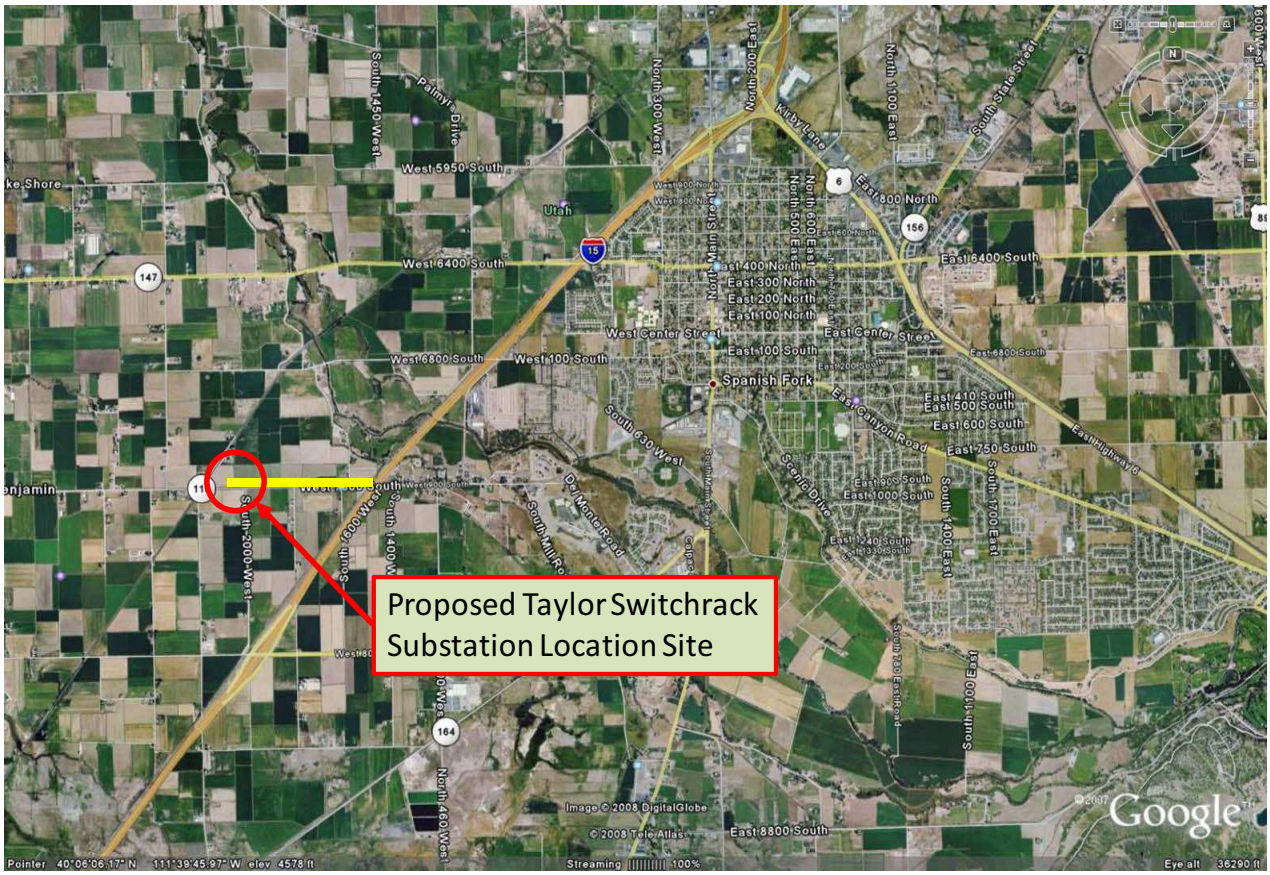
$420,000

2018



Project 13
46kV Connection at Taylor Switch Rack
2018

$168,000



Appendix B
2004 Spatial Load Forecast – 2006 Update

2008 Spatial Load Forecast

Demand Calculation for Future Customers

Future Residential Demand (kW)	Acres	Number of Units	Demand per Customer (kW)	Spatial Forecast Demand (kW)
Residential .2 Units per Acre	158	32	14	442
Residential .2 / 1 Unit per Acre	213	980	7.25	6,986
Residential .2 / 2 Units per Acre	582	3,026	7.25	21,883
Residential .2 / 3 Units per Acre	579	1,737	7.25	24,550
Residential 2 Units per Acre	98	196	8	1,568
Residential 3 Units per Acre	129	387	7	2,709
Residential 4 Units per Acre	62	248	7	1,736
Totals	1,821	6,606		59,875

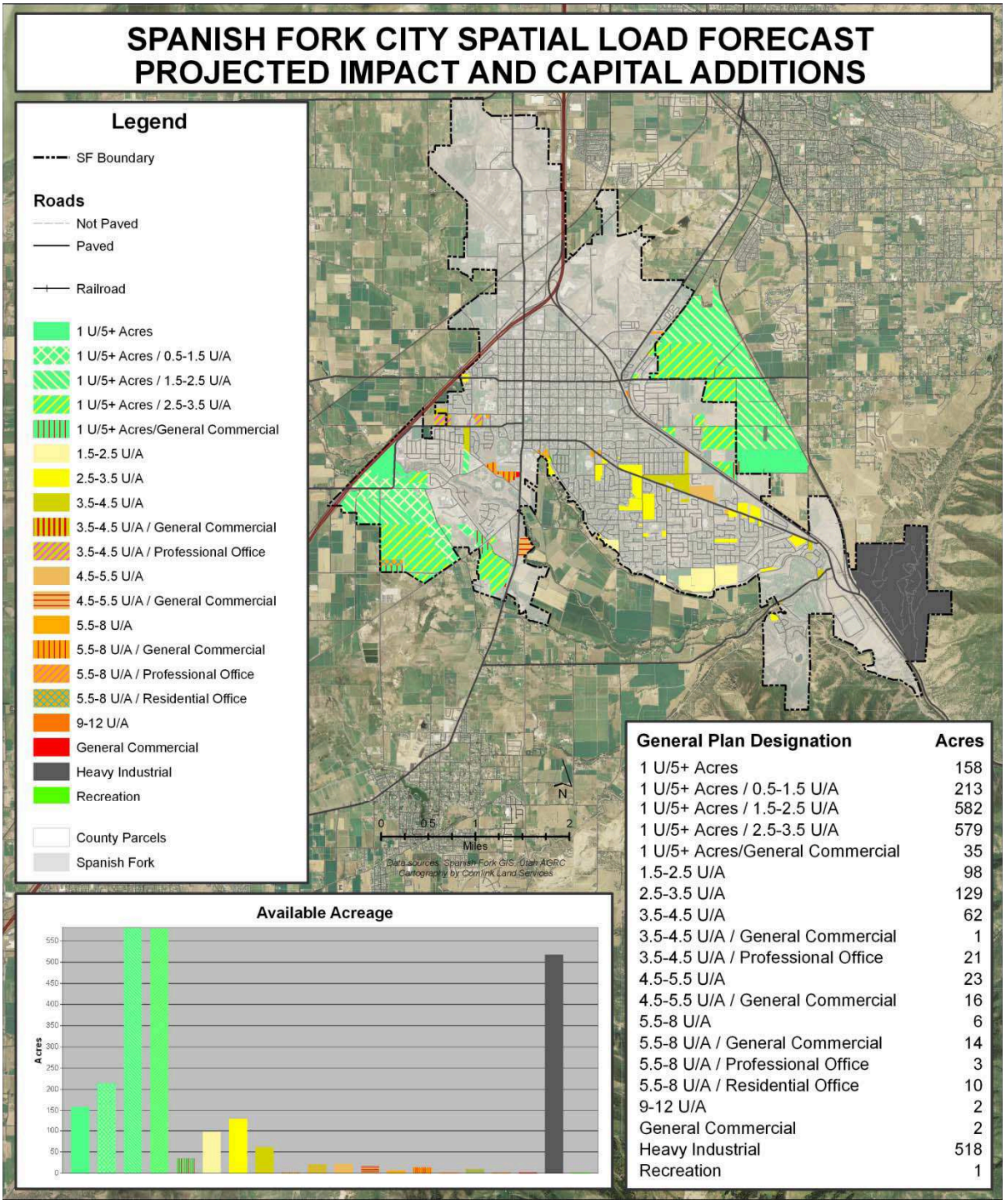
Future Commercial Demand (kW)

	Acres	Number of Units	Demand per Acre (kW)	
Additional Commercial Development	420		35	14,700
Totals				14,700

Demand at Buildout	
2007 Peak kW	52,673
Future Residential Load	59,875
Future Commercial Load	14,700
Total Demand at Build-out	127,248

Appendix C

Spanish Fork City Spatial Load Forecast – Projected Impact and Capital Additions



Appendix D
Expected Demand Based on Service Size

Expected Demand Based on Service Size

Residential Single Phase Service Sizes

AMPS	PEAK DEMAND
100	5
125	6
150	7
200	8
225	10
400	14

Commercial Single Phase Service Sizes

AMPS	PEAK DEMAND
100	5
125	7
150	9
200	14
400	19

Commercial/Residential 3 Phase (120/240V) Service Sizes

AMPS	PEAK DEMAND
125	16
150	24
200	31
400	63
600	94
800	126
1000	157
1200	189
1600	252
2000	315
2500	394

Commercial/Residential 3 Phase (120/208V) Service Sizes

AMPS	PEAK DEMAND
125	16
150	24
200	31
400	63
600	94
800	126
1000	157
1200	189
1600	252
2000	315
2500	394

Commercial/Residential 3 Phase (277/480V) Service Sizes

AMPS	PEAK DEMAND
125	35
150	52
200	73
400	145
600	219
800	290
1000	364
1200	436
1600	583
2000	728
2500	910
3000	1092
3500	1272
3750	1363
4000	1454

Appendix E

Spanish Fork City Power Department

Spanish Fork City Power

2160 North 175 East
Spanish Fork, UT 84660
(801) 798-5030
Power Superintendent: Kelly Peterson

Spanish Fork City Power Department
Capital Plan for System Improvements

Capital Facilities Plan 2009 Update

The Capital Facilities Plan identifies projects needed to meet the demand for electricity resulting from projected growth in the city. Improvements to the City's electrical system are proposed to insure that capacity is in place to supply power to customers when needed.

The Power Department's Capital Facilities Plan was developed from the Spanish Fork Substation Site Study, prepared by Comlink Land Services, LLC.

The Capital Facilities Plan addresses two main concerns related to the year-by-year growth of Spanish Fork City. First, as more customers and residents move in, the required Service Standard Capacity will increase. As this happens, there is a need for additional substations in order to provide for the demand. With the addition of substations, the second concern arises, which deals with the ability of the transmission lines to provide sufficient power to the increased capacity of the substations. This plan is a mitigation of these problems and shows the actions to be taken on a yearly basis.

Capital Facilities Plan Summary 2009 Update

Action Plan - 2009 Update

12 kV - Upgrade Overhead line on 50 S. from 150 W. to 900 W. to Feeder Capacity (600 Amp)	$	60,000	2009
Land - for Bonner Substation 46:12kV 110 E canyon Rd. & Southwest Leland area	$	700,000	2009
46:12kV Substation - 46kV Breaker and Bussing at Woodhouse Substation	$	200,000	2010
12 kV Underground 600 Amp Loop line from 100 S. 900 W. to 400 W. Arrowhead Trail	$	300,000	2010
12 kV Overhead Tie Line 2050 North Chapple Dr. to 2700 N 200 E.	$	250,000	2011
46 kV - Overhead Line from 2700 N 200 E to Dry Creek Sub (Finish Tie)	$	194,000	2011
Take Bonner Substation offline - Remove from System			2009
Construct Maple Mtn. Substation with 20 MVA Transformer	$	2,300,000	2010
3 Distribution Circuits	$	420,000	
Construct Single Circuit tap line to Maple Mtn. Substation with Spacing for a Second Circuit Double Circuit Distribution Underbuild	$	378,750	2010
Install new 20 MVA transformer at Woodhouse - New Bonner 46 kV Substation Addition	$	2,300,000	2015
Construct the Southwest Leland 46 kV substation	$	2,300,000	2017
3 Distribution Circuits	$	420,000	
Taylor Switchrack Substation Addition	$	2,300,000	2018
3 Distribution Circuits	$	420,000	
Transmission Line for Taylor Switchrack Substation	$	168,000	2018
Engineering and Project Management	$	2,575,493	2009-2019
System and Distribution Planning Studies	$	40,000	2009-2019
	Total $	15,326,243	

COMLINK L.S., LLC "A BRIGHTER TOMORROW THROUGH DESIGN"

ELECTRIC UTILITY CONSULTANTS

860 EAST 4500 SOUTH - SUITE 312 - SALT LAKE CITY UTAH, 84107

Spanish Fork City
Electric System
Capital Facilities Plan

April 24, 2012

Spanish Fork City has determined that the growth of the City is placing demands on various services provided by the City, including the electric system. Growth has created a need for additional and larger substations, and the need to increase capacity on transmission and distribution lines.

The City has studied various ways of providing the funding for these facilities. The sources of revenue for electricity needs are rates, general funds or impact fees. In comparing an equitable allocation to the costs borne in the past and to be borne in the future, in comparison to the benefits already received and yet to be received, the City has determined that impact fees are the most equitable way of financing the growth related electric facilities.

In determining what percent of Cost is appropriate for load growth due to new customers and what percent of cost is appropriate for load growth due to existing customers several approaches have been considered.

Commercial customers actively pursue energy conservation in an effort to lower their energy costs. Residential customers generally realize energy conservation as they replace existing appliances with newer higher efficiency appliances and replacing existing lighting with energy efficient lighting. All these efforts are strongly supported by the city to reduce the pressure on the peak system load growth.

The major area that has an impact on system growth from existing customers comes from residential customers who change from evaporative swamp coolers to air conditioning.

Of Spanish Fork's peak load, approximately 75% is generated by residential customers. With approximately 3,725 residential customers without air-conditioning and estimating 15% will convert to air conditioning each year (with an average 3 kW impact on system peak per conversion) and including the small impact of other native load growth, 20% of additional capacity needs can be attributable to native system load growth. As a result the impact fee is calculated using 80% of the cost of projects for system capacity increases unless otherwise justified.

1. Maple Mountain Substation

    Why needed:

        Included in 2009 IF Study – Load growth related transformer capacity increase.

    Cost Estimate:

        $1,093,259

    Percent of Cost Supported by Impact Fees and Justification:

        80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee Study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

2. New 138/46kV to 12 kV Substation Transformer (2550 East Area)

    Why needed:

        Included in 2009 Study – Load growth related transformer capacity increase as identified by Comlink.

    Cost Estimate:

        $276,019

    Percent of Cost Supported by Impact Fees and Justification:

        80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee Study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

3. 138/46kV Dry Creek Substation Structures and Equipment (SUVPS)

    Why needed:

        Included in 2009 IF Study - SUVPS participation - load growth related transformer capacity increase as identified by SUVPS studies.

Cost Estimate:

$247,500 – SUVPS Estimate

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

4. Wood House/Bonner – Transformer Capacity Upgrade and Substation Rebuild

Why needed:

Included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements.

Cost Estimate:

$1,535,000 – Replace existing Wood House Substation transformer with a new 20 MVA transformer. Uses the old Wood House transformers in the Bonner Substation rebuild.

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

5. 1700 West 1400 South Substation Land – 6 acres for substation 46/12.47kV

Why needed:

Included in 2009 IF Study - Land for Leland area substation, load growth related transformer capacity increase.

Cost Estimate:

$328,548 – actual sale price

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

6. 138/46kV Transformer Dry Creek Substation (SUVPS)

Why needed:

Included in 2009 IF Study - SUVPS participation - load growth related transformer capacity increase as identified by SUVPS studies.

Cost Estimate:

$431,164 – SUVPS Estimate

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

7. Master Plan & Impact Fee Studies

Why needed:

Used as the basis for determining equitable impact fees for new customer load growth.

Cost Estimate:

$250,000

Percent of Cost Supported by Impact Fees and Justification:

100% - As allowed by the Impact Fee Act

8. Upsize 200 Amp to 600 Amp by Developers

Why needed:

Included induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

Varies

Percent of Cost Supported by Impact Fees and Justification:

54.9% - This cost estimate only reflects the increased cost over the capital expenditure for the standard 200 Amp system of a development provided for local service. The increased capacity is to maintain established service levels of reliability, system operability and capacity requirements. The projects enable load transfers between substations as required with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

9. 12kV 600 Amp Circuit US 6 to Oaks Subdivision

   a. Circuit from US 6 to Spanish Oaks
   b. 3400 East to US 6 and Power House Road

   Why needed:

   Not included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

   Cost Estimate:

   $368,000 – Spanish Fork City Electrical Department estimate based on $80 per foot for a 600 amp line

   Percent of Cost Supported by Impact Fees and Justification:

   54.9% - Spanish Fork City Electrical Department has calculated the cost difference from a 600 amp feeder line from a 200 amp feeder line. Construction costs, from department records, for 600 amp feeder line and 200 amp feeder line were compared and it was determined that 54.9% of the 600 amp feeder line construction cost was greater than the construction cost of a 200 amp feeder.

10. 12kV SESD Leland/Cal Pac Area Rebuild (Carry Over)

Why needed:

Load growth induced capital improvement integrating the area into Spanish Fork's power system and to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

Leland Mill Extension: $22,374
Calpac Extension: $95,000

Total: $117,374

Percent of Cost Supported by Impact Fees and Justification:

21% - Work needed to provide load transfer capability between substations to meet the system reliability standard was 21% of the Cost. 79% of the projects cost was system improvements to serve the existing customers.

11. 46kV 2700 North Transmission Line to Dry Creek Substation

Why needed:

Included in 2009 IF Study – SUVPS participation – load growth related transformer capacity increase as identified by SUVPS studies.

Cost Estimate:

$500,000 – SUVPS Estimate

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the line, which provides the required increase in transmission capacity identified in the 2009 Impact Fee Study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

12. 46 kV - Addition to Nebo Substation (46 kV Structure, Buss, Metering) (SUVPS)

Why needed:

Included in 2009 IF Study - SUVPS participation - load growth related transformer capacity increase related and identified by SUVPS studies.

Cost Estimate:

$83,420 – SUVPS Estimate

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the line, which provides the required increase in transmission capacity identified in the 2009 Impact Fee Study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

13. Woodhouse Substation Bussing

Why needed:

Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements.

Cost Estimate:

$30,000

Percent of Cost Supported by Impact Fees and Justification:

80% - The percent of cost supported by impact fees is adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

14. 138/46kV Substation - Add 75 MVA Transformer and Interconnect at Nebo Substation (SUVPS)

Why needed:

Included in 2009 IF Study - SUVPS participation - load growth related transformer capacity increase related and identified by SUVPS studies.

Cost Estimate:

$1,300,000 – SUVPS Estimate

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the substation, which provides the required increase in transformer capacity identified in the 2009 Impact Fee Study with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

15. 12 kV Overhead Tie Line 2700 North Chappel Dr. to North Substation

Why needed:

Included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

$350,000 – Spanish Fork City Electrical Department estimate based on $25 per foot for 12.47kV 600 amp overhead line.

Percent of Cost Supported by Impact Fees and Justification:

21% - Integrates the North Substation as a looped system element. Brings North Substation to established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

16. 12kV - UG 600 Circuit Ties
    a. Loop line from 100 South 900 West to 1400 West Arrowhead Trail

Why needed:

Not included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

$600,000 – Spanish Fork City Electrical Department estimate based on $80 per foot for a 600 amp line.

Percent of Cost Supported by Impact Fees and Justification:

54.9% - Spanish Fork City Electrical Department has calculated the cost difference from a 600 amp feeder line from a 200 amp feeder line. Construction costs, from department records, for 600 amp feeder line and 200 amp feeder line were compared and it was determined that 54.9% of the 600 amp feeder line construction cost was greater than the construction cost of a 200 amp feeder.

17. 46kV Reconductor Upgrades - Citywide

Why needed:

Not included in the 2009 IF Study – New load exceeds the ability to transfer substation loads on the existing conductor. Conductor with additional capacity will allow load transfers. Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

$3,752,350 – Cost estimate based on recent construction estimates for 46kV class lines and replacement of poles due to increased loads for larger conductor.

Percent of Cost Supported by Impact Fees and Justification:

21% - New load exceeds the ability to transfer substation loads on the existing conductor. Conductor with additional capacity will allow load transfers. Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required. Costs incurred for the conductor upgrades provides the required increase in line capacity identified in the 2009 IF Study with the percent attributed to new growth adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

18. Reconductor 200 East URD from 2000 North to 2700 North

Why needed:

Not included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements.

Cost Estimate:

$283,500

Percent of Cost Supported by Impact Fees and Justification:

33.3% - Spanish Fork City Electrical Department has calculated the cost difference from a 600 amp feeder line from a 200 amp feeder line. Construction costs, from department records, for 600 amp feeder line and 200 amp feeder line were compared and it was determined that 54.9% of the 600 amp feeder line construction cost was greater than the construction cost of a 200 amp feeder.

19. 12 kV – UAMPS 1600 A 138/46 kV Transmission Line Easements

Why needed:

Not included in 2009 IF Study - UAMPS participation - load growth related Transmission capacity increase related and identified by UAMPS studies.

Cost Estimate:

$59,055

Percent of Cost Supported by Impact Fees and Justification

100% - Costs incurred constructing the transmission line, which provides the required increase in transmission capacity. The percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

20. West Distribution Overhead

Why needed:

Not included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers between substations as required.

Cost Estimate:

$550,000

Percent of Cost Supported by Impact Fees and Justification

21% - The percent of cost supported by impact fees is adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

21. Reconductor SUVPS 46kV Circuits

Why needed:

Not included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements as justified by SUVPS studies.

Cost Estimate:

$2,150,000 – SUVPS estimate

Percent of Cost Supported by Impact Fees and Justification

21% - Costs incurred constructing the transmission line, which provides the required increase in transmission capacity. The percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

22. Upgrade Argyle Sub Transformer

Why needed:

Not included in 2009 IF Study – Growth related transformer capacity increase identified as needed in the 2009 IF Study which replaces capacity increases associated with substation capacity increases of future substations identified in the 2009 Impact Fee study. Those substations will be pushed further into the future as a result.

Cost Estimate:

$750,000 – Spanish Fork City Electrical Department estimate based recent transformer purchases

Percent of Cost Supported by Impact Fees and Justification:

63% - The Argyle transformer has a capacity of 7.5 MVA. The replacement transformer will have a capacity of 20 MVA. The increased available capacity available for load growth over the replaced transformer is 63%.

23. Woodhouse Expansion

Why needed:

Included in 2009 IF Study – Load growth induced capital improvement to maintain established service levels of reliability, system operability and capacity requirements. Enables load transfers transformers and between substations as required.

Cost Estimate:

$1,175,000

Percent of Cost Supported by Impact Fees and Justification:

80% - Costs incurred constructing the new substation transformer bay, which provides the required increase in transformer capacity identified in the future with the percent adjusted for growth relating to existing customers as explained in the statement at the beginning of this document.

Spanish Fork City
Load Flow & Protection Coordination Study

April 2013

Intermountain Consumer
Professional Engineers, Inc.
1145 East South Union Avenue
Midvale, Utah 84047
(801) 255-1111

TABLE OF CONTENTS

Section – Contents **Page**

SYSTEM STUDY

System Study Overview

This electrical system study report addresses study methods and results of the Load Flow, Protection Device Coordination study, and Fault Analysis of the Spanish Fork City Utility System.

The report is divided into five primary sections which include System Protective Device Coordination, System Load Flow Analysis, System Fault Analysis, System Modeling, and Appendices.

The study scope includes the Spanish Fork City 46kV sub-transmission system, city substations, and the associated 12.47kV distribution system to the primary side of distribution transformers. The primary goals of the load flow portion of the study were to provide system loading distribution that can be used by the city to plan for future growth requirements, future substation locations, and to determine locations for new capacitor banks. The primary goal for the protection coordination portion of the study was to review existing relay/recloser and fuse coordination and to provide guidance for fusing coordination.

System Models and Assumptions

To perform load flow analysis, protective device coordination, and system fault analysis, a system computer model was developed. Model development is discussed in the "System Modeling" section of this report. System model development and analysis were performed on EDSA Paladin Design Base 4.0 Software.

System modeling data was developed from Spanish Fork provided system data. Circuit models are based on the assumption that provided circuit maps and data (conductor sizes, circuit configurations, line lengths, etc.) are reflective of actual field conditions.

Summary

The system load flow study provides insight on substation transformer loading, distribution circuit loading, system voltage drop and power factor. Results and recommendations as developed in the System Load Flow study are discussed in the System Load flow section of this report.

The system coordination study and fault analysis studies determined that some adjustment to distribution circuit fusing is necessary. Results and recommendations as developed in the coordination study are discussed in the coordination section of the report.

SYSTEM PROTECTIVE DEVICE COORDINATION

Protective Device Coordination Overview

System coordination for the 12.47kV Spanish Fork system was preliminarily reviewed. A more detailed system coordination review is to follow. The goal of the coordination review will be to increase pickup levels where possible. This should remove the need to switch between primary and alternate settings during system configuration changes. Fuse recommendations (based on current settings) are summarized in a table below. Coordination plots of maximum recommended fuse sizes to relay/recloser settings are provided in the Appendix of this report. The tables and coordination plots are to be updated based on the outcome of the coordination study.

Sizes of fuses located in some parts of the underground system were not able to be determined for the purposes of this study. Fuse coordination and fuse size recommendations were only based on the fuses sizes that were available. Fuses that are sized at 200A were considered slugs for the purposes of coordination. They are too large to coordinate with substation recloser and relay settings.

Recloser and Relay Settings			
Protective Device Type	**Settings**		**Substation & Circuit**
Cooper Form 6	Phase Min Trip: Phase Fast Curve: Phase Slow Curve: Ground Min Trip: Ground Fast Curve: Ground Slow Curve:	350 A (Pri) 600 A (Alt) 104 132 150 A (Pri) 200 A (Alt) 106 142	North – Main Street North – Airport Argyle – 50 East Argyle – 300 West
ABB PCD	Phase Pickup: 51P Curve: 50P-1 Curve: Ground Pickup: 51N Curve: 50N-1 Curve:	350 A (Pri) 600 A (Alt) B (117) N (104) 150 A (Pri) 200 A (Alt) 2 (135) 4 (106)	Whitehead – Nature's Sunshine Whitehead – Provo Craft Woodhouse – 1100 East Woodhouse – K-Mart
ABB PCD	Phase Pickup: 51P Curve: 50P-1 Curve: Ground Pickup: 51N Curve: 50N-1 Curve:	360 A (Pri) 600 A (Alt) B (117) N (104) 150 A (Pri) 200 A (Alt) 2 (135) 4 (106)	Industrial – Klune
ABB PCD	Phase Pickup: 51P Curve: 50P-1 Curve: Ground Pickup: 51N Curve: 50N-1 Curve:	450 A (Pri) 600 A (Alt) B (117) N (104) 150 A (Pri) 200 A (Alt) 2 (135) 4 (106)	Industrial – Shopko Canyon Road – Fingerhut Canyon Road – IFA Maple Mountain – SR-6 Maple Mountain – High School Woodhouse – SAPA

Recommended Fuse Changes			
Circuit	**Approx. Location and Explanation**	**Existing Fuse**	**Recommended Fuse**
North – Main Street	3450 N 150 W The largest E fuse that will coordinate with Main Street settings is 65E.	100E	**65E**
	3450 N 100 E Change to coordinate with new 65E Fuse at 3450 N 150 W.	50E	**40E**
	3450 N 50 W Change to coordinate with new 65E Fuse at 3450 N 150 W.	50E	**40E**
Industrial – Shopko	900 N 250 W The largest T fuse that will coordinate with Shopko settings is 65T	80T	**65T**
Canyon Road – IFA	Canyon Road 2300 East The largest T fuse that will coordinate with IFA settings is 65T.	100T	**65T**
Maple Mountain – SR-6	400 S 600 E The largest T fuse that will coordinate with SR6 settings is 65T.	140T	**65T**
Woodhouse – K-Mart	650 N 400 E Phase C is a 80T, phase A & B are 65T. The largest T fuse that will coordinate with K-Mart settings is 65T.	Phase C 80T	**Phase C** **65T**
	300 N 400 E Phase A is a 80T, phase B & C are 20T. Phase A current is probably not significantly higher than phase B & C current and 80T won't coordinate with K-Mart Recloser.	Phase A 80T	**Phase A** **20T**
	900 N 100 E The largest T fuse that will coordinate with K-Mart settings is 65T.	100T	**65T**

Recloser Settings

Ideally a fast trip for faults below a branch fuse will occur prior to loss of the fuse. This allows temporary faults on fused branches to clear without melting the fuse so that service can be restored upon reclose. Spanish Fork settings utilize fast trip. Recloser/relay fast trip coordination with downstream fuses is not always possible in the Spanish Fork system. Even for those cases that coordination isn't possible, fast trip does provide a benefit in reduced stress which might have a cumulative affect over time.

Fuse Coordination

The following fusing recommendations should be followed:

1. Same size fuses should not be in line with each other. When a fault occurs that melts a particular fuse, other fuses of the same size that are in line with the melted fuse might not have melted though completely, but will be damaged. Having same size fuses in line with each other will result in damaged fuses in the system.

2. Type "T" fuses are used as branch fuses on overhead lines.

3. Type "E" fuses are used in pad mount sectionalizing cubicles. The size of these fuses is dependent on loads, the number of transformers behind the fuse, the size of cubicle fuses, and the size of source side fuses.

4. Transformer fuses should be the smallest size possible that will carry the inrush currents. Junction fuses, on the other hand, are sized with the largest fuse size that will coordinate with source side protection. The larger the junction size fuse, the greater the flexibility to coordinate with transformer fuses and other load side junction fuses. **In general, a fuse of the same type placed behind another junction fuse should be two sizes smaller for good coordination.**

5. Junction fuses must be sized to coordinate with the next source side fuse or recloser. The Coordination Guide for Junction Fuses and Branch Fuses is included with this report. It lists the largest type "T" fuse and type "E" fuse which will coordinate with each substation recloser or relay.

6. The guides "T" Fuse – "E" Fuse Coordination, and "E" Fuse – "T" Fuse Coordination, are included with this report. The guides can be used to verify that fuses will coordinate.

7. All fuses at a location should be sized the same unless only single phase load are served on the load size of the fuse.

8. Generally the number of fuses in series with each other should be limited to 2 or 3.

"T" Fuse – "E" Fuse Coordination

Application: For sizing "T" fuses on lines to cubicles with down line "E" fuses.

Lists minimum "T" fuses which coordinate with load side "E" fuses.

Lists "E" fuses which coordinate at listed fault currents.

"E" Fuse (Load Side)	"T" Fuse (Source Side)	
	"T" Fuse (Coordinates for Listed Current Range)	Coordination Current Range
80 E	(Note 1)	-
65 E	(Note 1)	-
50 E	65 T	< 2000 Amp
40 E	65 T	< 2500 Amp
30 E	50 T 65 T	< 2000 Amp < 2700 Amp
25 E	50 T 65 T	< 2000 Amp < 3000 Amp
20 E	50 T 65 T	< 2000 Amp < 3000 Amp
15 E	50 T 65 T	< 2000 Amp < 3000 Amp

Note 1: A fuse size which coordinates with this load size fuse will not coordinate with substation recloser or relay.

"E" Fuse – "T" Fuse Coordination

Application: Lists minimum "E" fuses which coordinate with load side "T" fuses.

Lists "T" fuses which coordinate at listed fault currents.

"T" Fuse (Load Side)	"E" Fuse (Source Side)	
	"E" Fuse (Coordinates for Listed Current Range)	Coordination Current Range
65 T	(Note 1)	-
50 T	(Note 1)	-
40 T	80 E	< 2500 Amp
30 T	65 E	< 2000 Amp
	80 E	< 3500 Amp
25 T	50 E	< 1500 Amp
	65 E	< 3000 Amp
	80 E	All
20 T	50 E	< 2500 Amp
	65 E	All
	80 E	All
15 T	40 E	All
	50 E	All
	65 E	All
	80 E	All
12 T	40 E	All
	50 E	All
	65 E	All
	80 E	All
10 T	30 E	All
	40 E	All
	50 E	All
	65 E	All
	80 E	All

Note 1: A fuse size which coordinates with this load side fuse will not coordinate with substation recloser or relay.

Junction Fuses and Branch Fuses

Application: An aid in the selection of junction fuse sizes.

Specifies the maximum fuses for use on lines protected by each recloser.

Location	Recloser	Pickup Phase/ Ground	Max Fuse Size	
			Type T	Type E
North	Main Street	350/150	50T	65E**
	Airport	350/150	50T	65E**
Whitehead	Nature's Sunshine	350/150	65 T*	80E***
	Provo Craft	350/150	65 T*	80E***
Industrial	Shopko	450/150	65 T*	80E****
	Klune	360/150	65 T*	80E***
Argyle	50 East	350/150	50T	65E**
	300 West	350/150	50T	65E**
Canyon Road	Fingerhut	450/150	65 T*	80E****
	IFA	450/150	65 T*	80E****
Maple Mountain	SR-6	450/150	65 T*	80E****
	High School	450/150	65 T*	80E****
Woodhouse	SAPA	450/150	65 T*	80E****
	1100 East	350/150	65 T*	80E***
	K-Mart	350/150	65 T*	80E***

* No coordination for ground fault below 700 Amp
** No coordination for fault above 3000 Amp
*** No coordination for ground fault below 500 Amp or for fault above 6000 Amp Fault
**** No coordination for ground fault below 500 Amp or for fault above 8000 Amp Fault

SYSTEM LOAD FLOW ANALYSIS

System Load flow studies were performed on the Spanish Fork City system for each distribution circuit. Load flow studies were utilized to assess system voltage, line loading conditions, and to evaluate fuse loading as a part of the coordination study. Tables shown below contain projected Spanish Fork City load and projected circuit loads for years that were analyzed. Projected load levels for the Spanish Fork system are consistent with the recently completed SUVPS System Study. The circuit load levels shown below are based on current circuit configuration. In the load flows for future years, load was shifted as required between circuits based on proposed building of new lines and adding transformers and a substation.

Spanish Fork – Projected System Peak Load		
Year	**Load**	
	MW	**MVA @ .98 PF**
2012	59.7	60.9
2015	68.4	69.8
2017	74.9	76.4
2022	93.9	95.8

Spanish Fork City – Projected Circuit Loads									
Substation	**Recloser**	**2012**		**2015**		**2017**		**2022**	
		Amps	**MVA**	**Amps**	**MVA**	**Amps**	**MVA**	**Amps**	**MVA**
North 12/16.05/20 MVA	**Main Street**	88	1.89	108	2.34	120	2.60	156	3.38
	Airport	134	2.90	165	3.56	183	3.96	237	5.13
	Sub Total	**222**	**4.79**	**273**	**5.90**	**304**	**6.56**	**394**	**8.51**
Whitehead 7.5/9.375/10.5 MVA	**Nature's Sunshine**	168	3.63	196	4.24	213	4.61	263	5.67
	Provo Craft	139	3.01	163	3.51	176	3.81	217	4.68
	Sub Total	**308**	**6.64**	**359**	**7.76**	**390**	**8.42**	**480**	**10.36**
Industrial 12/16.05/20 MVA	**Shopko**	110	2.37	136	2.93	151	3.26	196	4.23
	Klune	102	2.20	128	2.76	143	3.09	188	4.06
	Sub Total	**212**	**4.58**	**263**	**5.69**	**294**	**6.35**	**384**	**8.29**
Argyle 8.4/10.5/11.76 MVA	**50 East**	78	1.68	83	1.79	86	1.86	95	2.05
	300 West	327	7.07	348	7.51	360	7.78	396	8.55
	Sub Total	**405**	**8.75**	**431**	**9.30**	**446**	**9.63**	**491**	**10.61**
Canyon Road 12/16.05/20 MVA	**Fingerhut**	260	5.62	270	5.84	277	5.97	295	6.36
	IFA	392	8.46	407	8.79	416	8.99	443	9.57
	Sub Total	**652**	**14.08**	**677**	**14.63**	**693**	**14.96**	**738**	**15.93**
Maple Mountain 12/16.05/20 MVA	**SR-6**	257	5.54	307	6.63	337	7.27	424	9.17
	High School	147	3.17	174	3.75	190	4.10	237	5.12
	Sub Total	**403**	**8.71**	**480**	**10.38**	**526**	**11.37**	**661**	**14.28**
Woodhouse 10/ /14 MVA	**SAPA**	167	3.61	208	4.50	233	5.03	305	6.58
	1100 East	76	1.64	95	2.06	107	2.31	141	3.04
	K-Mart	275	5.95	344	7.42	384	8.30	503	10.87
	Sub Total	**519**	**11.20**	**647**	**13.98**	**724**	**15.64**	**949**	**20.49**
Future1 12/16.05/20 MVA	**Future1**			103	2.23	164	3.55	344	7.43
Total	**Amps**	**2720**		**3235**		**3541**		**4441**	
	MVA		**58.74**		**69.87**		**76.49**		**95.91**

System Load Flow Results

A summary of the results of load flows for each substation are listed below. Proposed system changes, including line, transformer, substation, and capacitor bank additions as well as re-distribution of load between circuits are discussed below.

Proposed System Improvements by 2015	
Proposed Improvement	**Reason/Explanation**
1. Build new 600A 477 ACSR lines between North, Whitehead, and Woodhouse subs	North sub has room to grow while Whitehead and Woodhouse subs are becoming heavily loaded. Building the lines will allow load from Whitehead and Woodhouse to be transferred to North Sub. The new lines will also allow new North circuit to pick up SAPA circuit load during an outage of Woodhouse transformer.
2. Build new 600A 477 ACSR line from Industrial sub to the southwest of town.	Industrial sub has room to grow while Argyle sub is becoming heavily loaded. Building the line will allow load to be transferred from Argyle sub to Industrial sub.
3. 2,100 kVAR of capacitor banks on North sub circuits	System power factor correction to 98%
4. 300 kVAR of capacitor banks on new circuit out of North sub (800 N 1100 E)	Voltage problems on new North circuit (only necessary if new North circuit picks up 1100 East circuit)
5. 2,100 kVAR of capacitor banks on Whitehead sub circuits	System power factor correction to 98%
6. 2,400 kVAR of capacitor banks on Industrial subcircuits	System power factor correction to 98%
7. 300 kVAR of capacitor banks on Argyle's 300 West circuit (Mill Rd. Del Monte Rd.)	Voltage problems on 300 West circuit due to load growth
8. 4,200 kVAR of capacitor banks on Canyon Road circuits	System power factor correction to 98%
9. 3,900 kVAR of capacitor banks on Maple Mountain circuits	System power factor correction to 98%
10. 300 kVAR of capacitor banks on Maple Mountain's SR-6 circuit	Voltage problems on SR-6 circuit due to load growth
11. 2,100 kVAR of capacitor banks on Woodhouse circuits	System power factor correction to 98%

Proposed System Improvements by 2017	
Proposed Improvement	**Reason/Explanation**
1. New transformer added to Woodhouse	Load growth on Woodhouse circuits requires the addition of new transformer.
2. 1,200 kVAR of capacitor banks on new line out of Industrial (1500 W 500 S)	Voltage problems on new line out of Industrial. Wouldn't be necessary for voltage correction if new substation in the southwest of town is built sooner so that load in that area can be transferred to new sub.
3. 300 kVAR of capacitor banks on Argyle's 300 West circuit (Mill Rd. Del Monte Rd.)	Voltage problems on SR-6 circuit due to load growth

Proposed System Improvements by 2022	
Proposed Improvement	**Reason/Explanation**
1. New substation added in the Southwest part of Spanish Fork	Load growth in the southwest part of town will require a new substation to take load off of Argyle and Industrial subs
2. 600 kVAR of capacitor banks on Maple Mountain's SR-6 circuit (750 S 600 E)	Voltage problems on SR-6 circuit due to load growth

North Substation Load Flow: The load at North is currently 4.8 MVA which means it has room to grow. Plans to build new 600A main feeder lines between North, Whitehead, and Woodhouse will result in load being shifted from Whitehead and Woodhouse to North on a new North circuit. Within 3 years this will result in North being loaded around 9 MVA. After 3 years a new transformer will be required to be added to Woodhouse. This could allow some of the load to be switched back to Woodhouse. Under normal load growth North should be sufficient for the next 10 years. If a large industrial load was to be added to North this could result in the need to add a transformer at North.

If the new North circuit picks up the 1100 East circuit (which is an option for switching load from Woodhouse to North) a 150 kVAR capacitor bank will need to be added to that circuit within 3 years for voltage support.

To help correct system power factor to 98%, a total of 2,100 kVAR of capacitor banks need to be added at North substation circuits.

Whitehead Substation Load Flow: The load at Whitehead is currently 6.6 MVA. Normal load growth will result in its transformer being maxed out within 10 years and be above base rating within 5 years. Plans to build new 600A lines between North and Whitehead will allow some load to be shifted from Whitehead to North. This will help, but transformer loading will still remain high. If a large load was to be added to Whitehead a transformer may be required to be added in the next 10 years.

To help correct system power factor to 98%, a total of 2,100 kVAR capacitor banks need to be added at Whitehead substation circuits.

Industrial Substation Load Flow: The load at Industrial is currently 4.6 MVA which means it has room to grow. Plans to build a 600A line from Industrial to the south of town will result in load being shifted from Argyle to Industrial. This will also allow future load that would have been added to Argyle to be added to Industrial instead. This load shifting as well as normal load growth for Industrial will result it being loaded close to the base rating of 12 MVA within 5 years. Argyle sub, which Industrial is picking up load for, will also be near its base rating of 8.4 MVA within 5 years. Load growth beyond 5 years will therefore require a new substation to be built in the southwest part of town. Once this happens, most of the load that Industrial picked up can be shifted off of Industrial to the new sub. Unless there is a large currently unexpected load growth on Industrial circuits, Industrial should be sufficient for the next 10 years if the new substation is installed as outlined.

To help correct system power factor to 98%, a total of 2,400 kVAR capacitor banks need to be added at Industrial substation circuits.

Within 5 years a new 1,200 kVAR capacitor bank will need to be added to the new line out of Industrial that will pick up part of the existing 300 West Circuit and other new load because of voltage problems. Another option that would not require the additional kVAR would be to add the new substation sooner.

Argyle Substation Load Flow: The load at Argyle is currently 8.8 MVA which is above its base rating. Plans to build a 600A line from Industrial to the south of town will result in load being shifted from Argyle to Industrial. Much of the future load over the next 5 years that would normally be added to Argyle can then be put on Industrial. Even with this load shifting Argyle sub will be near its base rating of 8.4 MVA within 5 years. Industrial will also be loaded close to base rating of 12 MVA within 5 years. Load growth beyond 5 years will therefore require a new substation to be built in the southwest part of town. Some load can then be shifted from Argyle to the new substation. There is no room to add a transformer at Argyle. Load will therefore be required to be shifted to other substations to keep Argyle loading at reasonable levels. Following the above load shifting Argyle should be sufficient for the next 10 years.

Within 3 years a new 300 kVAR capacitor bank will need to be added to 300 West Circuit because of voltage problems. Within 5 years an additional 300 kVAR will be required because of voltage problems. Another option that would not require the additional kVAR would be to add the new substation sooner.

The power factor of 50 East circuit is not known due to the circuit being out of service when the circuit power factors were read. For the purposes of this study, it was assumed to be 0.98. That is the power factor of the 300 W circuit, which is the other Argyle circuit. Based on this assumption, no substation capacitor banks are required for system power factor correction. If the power factor of 50 E circuit is found to be less than 0.98 then substation capacitor banks could be required.

Canyon Road Substation: The load at Canyon Road is currently 14.1 MVA which is above base rating of the transformer. Any major growth on the Canyon Road circuits will result in the need to build another substation in the south of town or to add a transformer to Maple Mountain and build lines that could shift load off the Canyon Road circuits to new Maple Mountain circuits. There is no room to add a transformer in Canyon Road sub. High growth for Canyon Road circuits is not expected in the near future, so the sub should be sufficient for now. A method of removing load from Canyon Road circuits may need to be developed within 10 years since normal load growth will result in Canyon Road having 15.9 MVA of load.

To help correct system power factor to 98%, a total of 4,200 kVAR capacitor banks need to be added at Canyon Road substation.

Maple Mountain Substation Load Flow: The load at Maple Mountain is currently 8.8 MVA which means it has some room to grow. Normal load growth will result in 14.3 MVA of load within 10 years which is above its base rating of 12 MVA. Neighboring Canyon Road sub will have 15.9 MVA of load within 10 years. Due to both subs being heavily loaded, it may be necessary to add a transformer to Maple Mountain within 10 years. The new transformer could take loads off the first transformer at Maple Mountain as well as take loads off of Canyon Road. Taking loads off of Canyon Road would require building some lines from Maple Mountain to the Canyon Road circuits.

To help correct system power factor to 98%, a total of 3,900 kVAR capacitor banks need to be added at Maple Mountain substation.

Within 3 years a new 300 kVAR capacitor bank will need to be added to SR-6 Circuit because of voltage problems. Within 10 years an additional 600 kVAR will be required because of voltage problems.

Woodhouse Substation Load Flow: The load at Woodhouse is currently 11.2 MVA which is above its base rating of 10 MVA. Plans to build new 600A lines between North and Woodhouse will result in load being shifted from Woodhouse to North. This will help with loading at Woodhouse, but loading will still remain high due to strong load growth. Within 3 years Woodhouse will still be approaching 12 MVA. After 3 years a new transformer will be required to be added to Woodhouse. Loads will need to be shifted off of the first transformer onto the new transformer as necessary which may require some new lines or switches. With the addition of the new transformer Woodhouse should be sufficient for the next 10 years.

To help correct system power factor to 98%, a total of 2,100 kVAR capacitor banks need to be added at Woodhouse substation.

New Substation Load Flow: In approximately 5 years the Industrial and Argyle subs will both be approaching the base rating of their transformers. They will not be able to continue to feed the entire future load in that part of town. In order to help take loads off of these two substations a new substation will be required to be built in the southwest of town. To help maintain system power factor at 0.98 a total of 3,000 kVAR capacitor banks will be required to be installed.

System Power Factor

It is recommended that Spanish Fork power factor be improved to at least 0.98. This will help support voltage during power system peak loading and during outage conditions. The need for power factor correction becomes more important as transformer and line loading levels increase. Improving power factor also reduces system losses. Improved power factor helps both the Spanish Fork distribution system as well as the SUVPS transmission system. Proposed approximate capacitor bank locations and sizes are discussed below. As a general rule, capacitor banks of 300 kVAR might be switched or fixed, but capacitor banks 600 kVAR or more should be fixed.

Proposed capacitor banks for improving power factor are based on a single power factor reading of each circuit that was made on 01/29/2013. Historical power factor data for the purposes of this study was unavailable. Circuit power factor during summer months could be different. Detail design of capacitor bank size, location, and fixed vs switched type would require more data. Each circuit's minimum load, peak load, and corresponding power factor would be required.

Existing Spanish Fork City Power Factor					
		A	**B**	**C**	**Average**
North Sub	Main Street	0.95	0.98	0.99	0.97
	Airpor	0.98	0.97	0.96	0.97
Whitehead Sub	Nature's Sunshine	0.99	0.94	0.94	0.96
	Provo Craft	0.80	0.82	0.9	0.84
Industrial Sub	Shopko	0.93	0.82	0.98	0.91
	Klune	0.91	0.98	0.99	0.96
Argyle Sub	50 E.	Assumed .98	Assumed .98	Assumed .98	Assumed .98
	300 W.	0.96	0.99	0.99	0.98
Canyon Road Sub	IFA	0.72	0.92	0.92	0.85
	Fingerhut	0.98	0.98	0.98	0.98
Maple Mountain Sub	SR-6	0.84	0.84	0.89	0.86
	Highschool	0.95	0.98	1.0	0.98
Woodhouse Sub	Kmart	0.90	0.98	0.99	0.96
	1100 E.	0.90	1.0	1.0	0.97
	SAPA	0.99	0.95	0.88	0.94

New Capacitor Banks Summary		
Approximate Location	**Total Size**	**Reason and Comments**
North Sub circuits	2,100 kVAR	System power factor correction to 98%
New circuit out of North Sub (800 N 1100 E)	300 kVAR	Voltage problems within 3 years (only necessary if new North circuit picks up part of the 1100 East circuit)
Whitehead Sub circuits	2,100 kVAR	System power factor correction to 98%
Industrial Sub circuits	2,400 kVAR	System power factor correction to 98%
New Line out of Industrial Sub (1500 W 500 S)	1,200 kVAR	Voltage problems within 5 years will require 1200 kVAR to be added to new line out of Industrial Sub unless the new substation in that area is added sooner.
Argyle's 300 West Circuit (Mill Rd. Del Monte Rd.)	300 kVAR	Voltage problems within 3 years will require 300 kVAR to be added to 300 West Circuit.
Argyle's 300 West Circuit (Mill Rd. Del Monte Rd.)	300 kVAR	Voltage problems within 5 years will require an additional 300 kVAR to be added to 300 West Circuit unless the new substation in that area is added sooner.
Canyon Road Sub circuits	4,200 kVAR	System power factor correction to 98%
Maple Mountain Sub circuits	3,900 kVAR	System power factor correction to 98%
Maple Mountain's SR-6 Circuit (750 S 600 E)	300 kVAR	Voltage problems within 3 years will require 300 kVAR to be added to SR6 Circuit.
Maple Mountain's SR-6 Circuit (750 S 600 E)	600 kVAR	Voltage problems within 10 years will require an additional 600 kVAR to be added to SR6 Circuit.
Woodhouse Sub circuits	2,100 kVAR	System power factor correction to 98%
New Sub circuits in the South-West part of Spanish Fork	3,000 kVAR	System power factor correction to 98%

Major Equipment Loss

For the 2012 base case, substation transformers were taken out of service one at a time. Loads were then attempted to be transferred to adjacent substations. This simulates what would happen to the system if a substation transformer was to fail. Some proposed system improvements were required to pick up all loads in every case. This included new lines and new capacitor banks. Results are summarized in the table below. The N-1 results shown below were based on 2012 peak (summer) load levels. As load increases into the future additional system modifications may be required, but a detailed N-1 study was not performed for future load levels.

Lost Transformer	Comments/Results
North Sub	Airport circuit could be picked up by Industrial Sub's Klune circuit. Main Street circuit could be picked up by Whitehead's Provo Craft circuit.
Whitehead Sub	Provo Craft circuit could be picked up by North Sub's Main Street circuit. The east part of Nature's Sunshine circuit could be picked up by Woodhouse Sub's K-Mart circuit. Nature's Sunshine was not able to be entirely picked up without overloading transformers or lines. Proposed additional new line between North Sub and Whitehead Sub will allow Nature's Sunshine circuit to be picked up by new North circuit.
Industrial Sub	Shopko circuit could be picked up by Argyle Sub's 50 East circuit. North Sub's Airport circuit had enough ampacity to pick up Klune circuit, but could not support the voltage with the additional Klune load. Proposed 2,400 kVAR cof apacitor banks to be added at Industrial Sub circuits would allow Klune circuit to be picked up by Airport circuit.
Argyle Sub	50 East circuit could be picked up by Industrial Sub's Shopko circuit. Industrial Sub's Klune and Shopko circuits had enough ampacity to pick up 300 West circuit when the load was split between the two circuits, but could not support the voltage with the additional 300 West load. No circuits were able to pick up the entire 300 West load without creating voltage problems. Putting east part of 300 West circuit on proposed additional line from Industrial Sub and adding 300 kVAR capacitor bank near Mill Rd. Del Monte Rd. (located on the part of 300 West circuit picked up by Shopko circuit) would allow 300 West circuit to be picked up.
Canyon Sub	Woodhouse Sub's K-mart circuit can be moved to Industrial Sub's Shopko circuit to free up Woodhouse transformer. Then Woodhouse Sub's 1100 East circuit would have the ampacity to pick up SR-6 circuit, but would not be able to support the voltage with the additional load. Proposed 3,900 kVAR of capacitor banks to be added to Maple Sub circuits would allow SR-6 circuit to be picked up by 1100 East circuit. Fingerhut circuit and the east two thirds of IFA circuit could be then be picked up by SR-6 circuit except for voltage problems. Proposed 4,200 kVAR of capacitor banks to be added to Canyon Sub circuits would allow the circuits to be picked up. The west side of IFA circuit could be picked up by 50 East circuit.
Maple Sub	High School circuit could be picked up by Canyon Sub's Fingerhut circuit. Woodhouse Sub's K-mart circuit can be moved to Industrial Sub's Shopko circuit to free up Woodhouse transformer. Then Woodhouse Sub's 1100 East circuit would have the ampacity to pick up SR-6 circuit, but would not be able to support the voltage with the additional load. Proposed 4,000 kVAR of capacitor banks to be added to Maple Sub circuits would allow SR-6 circuit to be picked up by 1100 East circuit.
Woodhouse Sub	K-mart circuit could be picked up by Industrial Sub's Shopko circuit. 1100 East circuit could be picked up by Maple Sub's SR-6 circuit. Industrial Sub's Shopko circuit had enough ampacity to pick up SAPA circuit, but could not support the voltage with the additional SAPA load. No circuit was able to pick up SAPA circuit without creating voltage problems. Proposed 2,100 kVAR of capacitor banks to be added at Woodhouse Sub circuits would allow SAPA circuit to be picked up by Shopko circuit. This will load Shopko circuit to about 550A which is close to its max. Another alternative, which would become necessary as load increases, would be to feed SAPA circuit from new proposed North circuit that comes over to Woodhouse.

SYSTEM FAULT ANALYSIS

System Fault studies were performed on the Spanish Fork City system for each distribution circuit. The system fault study model was developed in conjunction with the load flow model and was utilized in the protection coordination study.

The table shown below contains fault current levels that are available at each substation bus as of 2012. In performing the coordination study the fault currents listed below were utilized. It is noted that fault current levels can change over time and that alternative system configurations are possible. New system fault studies and protection coordination should be made after major system changes occur. Detailed fault current levels throughout the Spanish Fork system are shown in the Appendix.

Spanish Fork City - Substation Available Fault Currents				
	46 kV 3LG	**46kV 1LG**	**12.47 kV 3LG**	**12.47 kV 1LG**
North	8973	6320	6465	6912
Whitehead	12435	10294	4611	4769
Industrial	7514	4985	6131	6612
Argyle	7039	4172	4643	4930
Canyon Road	15683	11544	7092	7389
Maple Mountain	13518	9378	6773	7089
Woodhouse	12708	10667	5110	5301

SYSTEM MODELING

To perform a comprehensive load flow analysis and protective coordination analysis, system computer modeling is necessary. To develop a system model substantial system data is required.

As a part of model development, ICPE was provided with a GIS system model and system maps that provided information on circuit conductor sizes, circuit distances, transformer sizes, and circuit configurations. Additionally, ICPE was provided information on distribution circuit fusing, substation protective device settings, substation equipment, and substation and distribution circuit loading.

Overhead circuit impedances were developed for each conductor size using EDSA-Paladin Transmission Line Constant software.

For underground circuits, existing conductor size, type, and typical circuit installation methods were provided by Spanish Fork City. Underground circuit data was submitted to cable manufacturers for calculation of positive and zero sequence values.

Overhead and underground distribution circuit impedance values as developed for this study are presented in tables shown below. Transformer data is also shown below. Detailed model input data is shown in the appendix.

Spanish Fork City - 46 kV Overhead						
Conductor Size	Ampacity (Amps)	Z(+) Ohms/1000'		Z(0) Ohms/1000'		1/2 Bpu mmho/1000'
		R	X	R	X	
336	530	**0.05799**	**0.13089**	**0.13830**	**0.49451**	**0.00000**
477	670	**0.04089**	**0.12384**	**0.12119**	**0.48750**	**0.00000**
795	900	**0.02439**	**0.12195**	**0.10398**	**0.47386**	**0.00000**
1272	1200	**0.01415**	**0.11403**	**0.10080**	**0.51040**	**0.00000**

Spanish Fork City - 12.47 kV Overhead						
Conductor Size	Ampacity (Amps)	Z(+) Ohms/1000'		Z(0) Ohms/1000'		1/2 Bpu mmho/1000'
		R	X	R	X	
#6	100	**0.67428**	**0.14788**	**0.79699**	**0.54896**	**0.00000**
#4	140	**0.42430**	**0.14280**	**0.56133**	**0.50536**	**0.00000**
#2	180	**0.26712**	**0.13784**	**0.40331**	**0.45241**	**0.00000**
1/0	230	**0.16773**	**0.13269**	**0.28527**	**0.40348**	**0.00000**
3/0	300	**0.10545**	**0.12729**	**0.19648**	**0.36841**	**0.00000**
4/0	340	**0.08369**	**0.12443**	**0.16195**	**0.35568**	**0.00000**
336	530	**0.05271**	**0.11564**	**0.11011**	**0.33116**	**0.00000**
477	670	**0.03718**	**0.11085**	**0.08206**	**0.31913**	**0.00000**

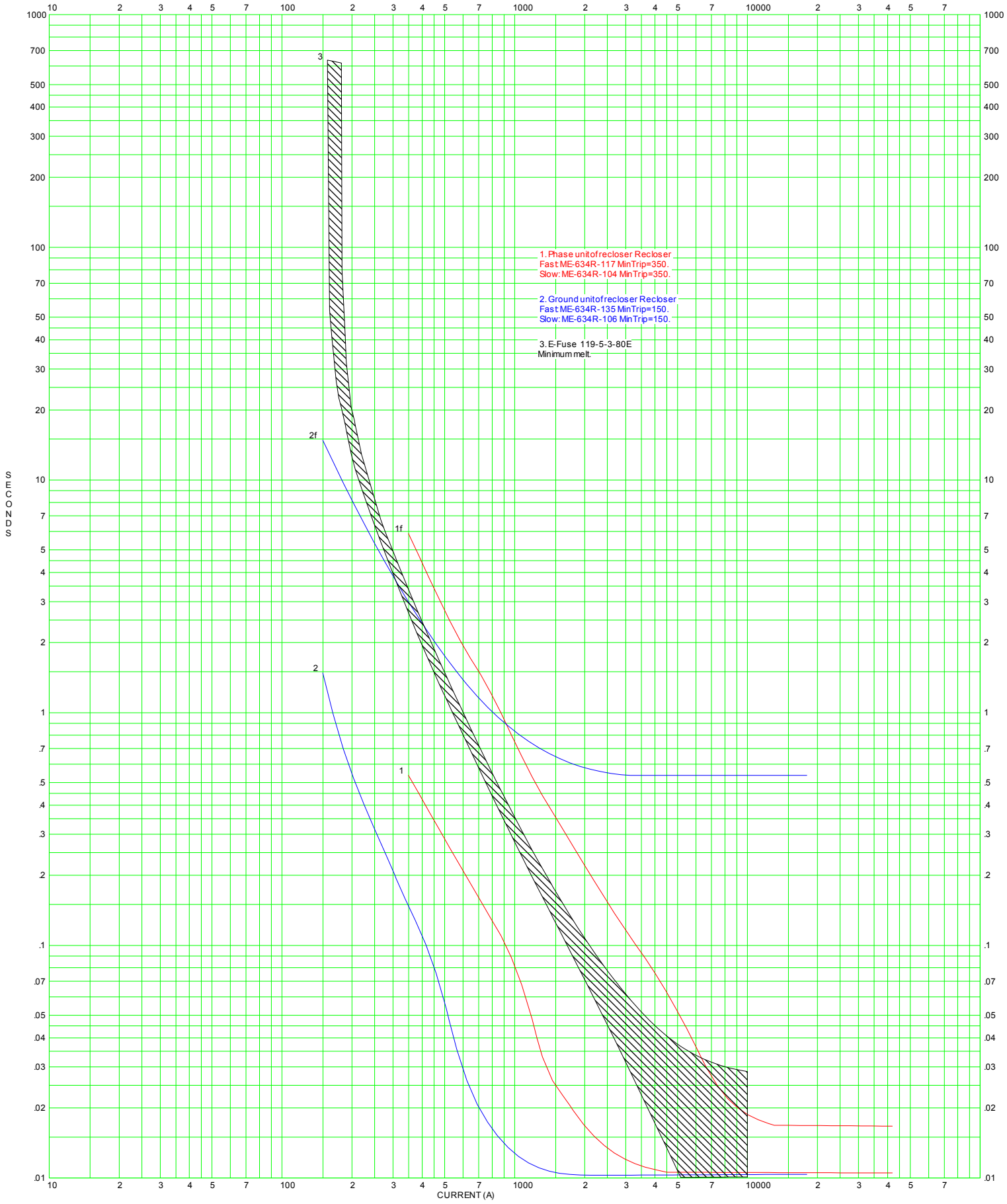
Spanish Fork City - 12.47 kV Underground						
Conductor Size	Ampacity (Amps)	Z(+) Ohms/1000'		Z(0) Ohms/1000'		1/2 Bpu mmho/1000'
		R	X	R	X	
1/0	175	**0.21100**	**0.05150**	**0.36800**	**0.06500**	**0.01204**
4/0	255	**0.10800**	**0.04630**	**0.32200**	**0.09500**	**0.01517**
750	510	**0.03010**	**0.04090**	**0.19400**	**0.06000**	**0.02541**
1100	620	**0.02280**	**0.03880**	**0.11400**	**0.03000**	**0.02782**

Spanish Fork City – Transformer Data			
Transformer	**MVA Rating**	**Voltage Rating**	**%IZ @ Nominal**
North	12/16.05/20	46-12.47 kV Delta-Gnd-Y	Z1 = 6.93%
Whitehead	7.5/9.375.10.5 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 6.78%
Industrial	12/16.05/20 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 7.09%
Argyle	8.4/10.5/11.76 MVA	46-12.47 kV Delta-Gnd-Y	Z =6.92%
Canyon Road	12/16.05/20 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 6.89%
Maple	12/16.05/20 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 7.11%
Woodhouse	10/14 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 8.08%

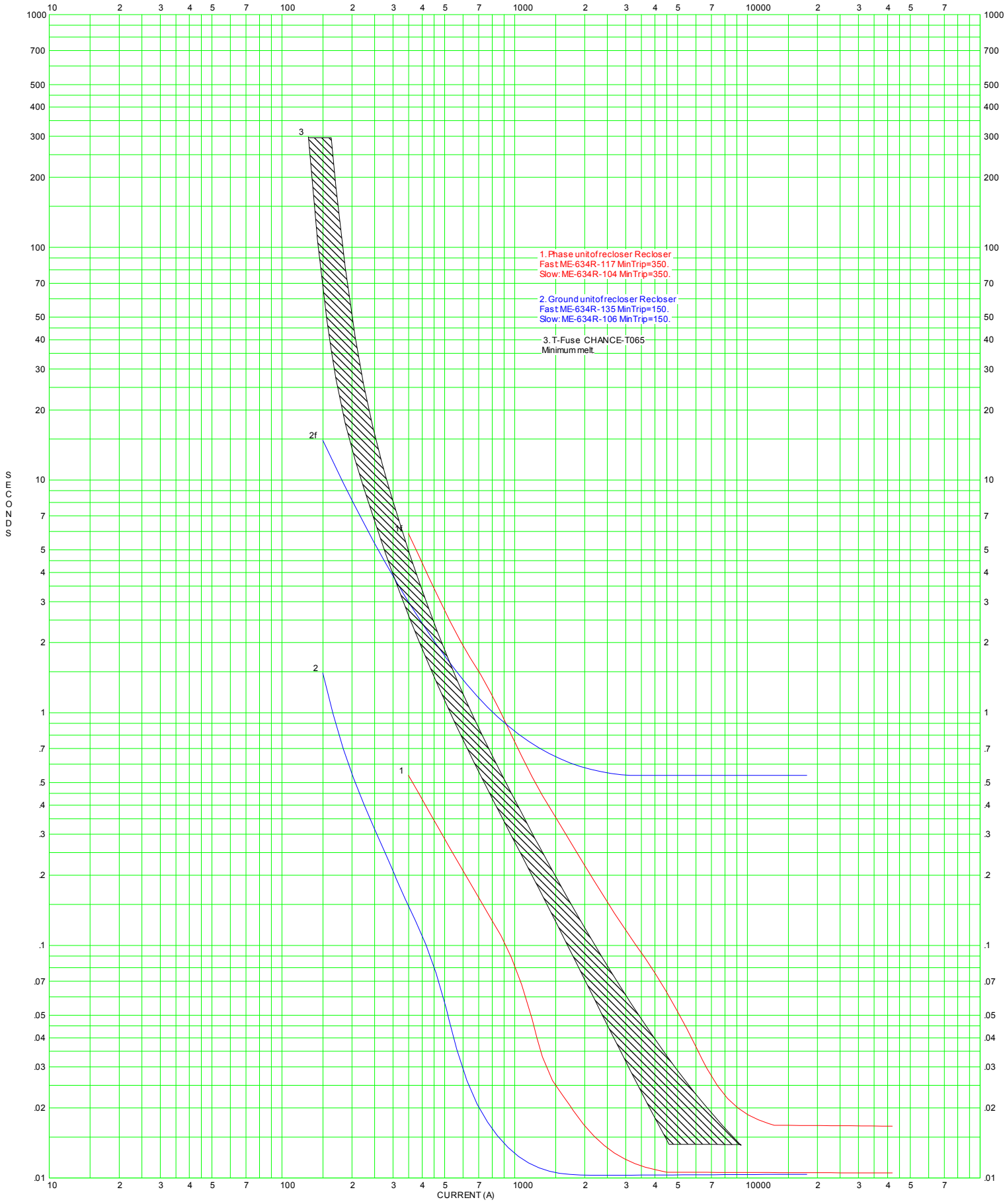
APPENDICES

1. Coordination Plots
2. Load Flow Studies
3. Fault Studies
4. Model Input Data

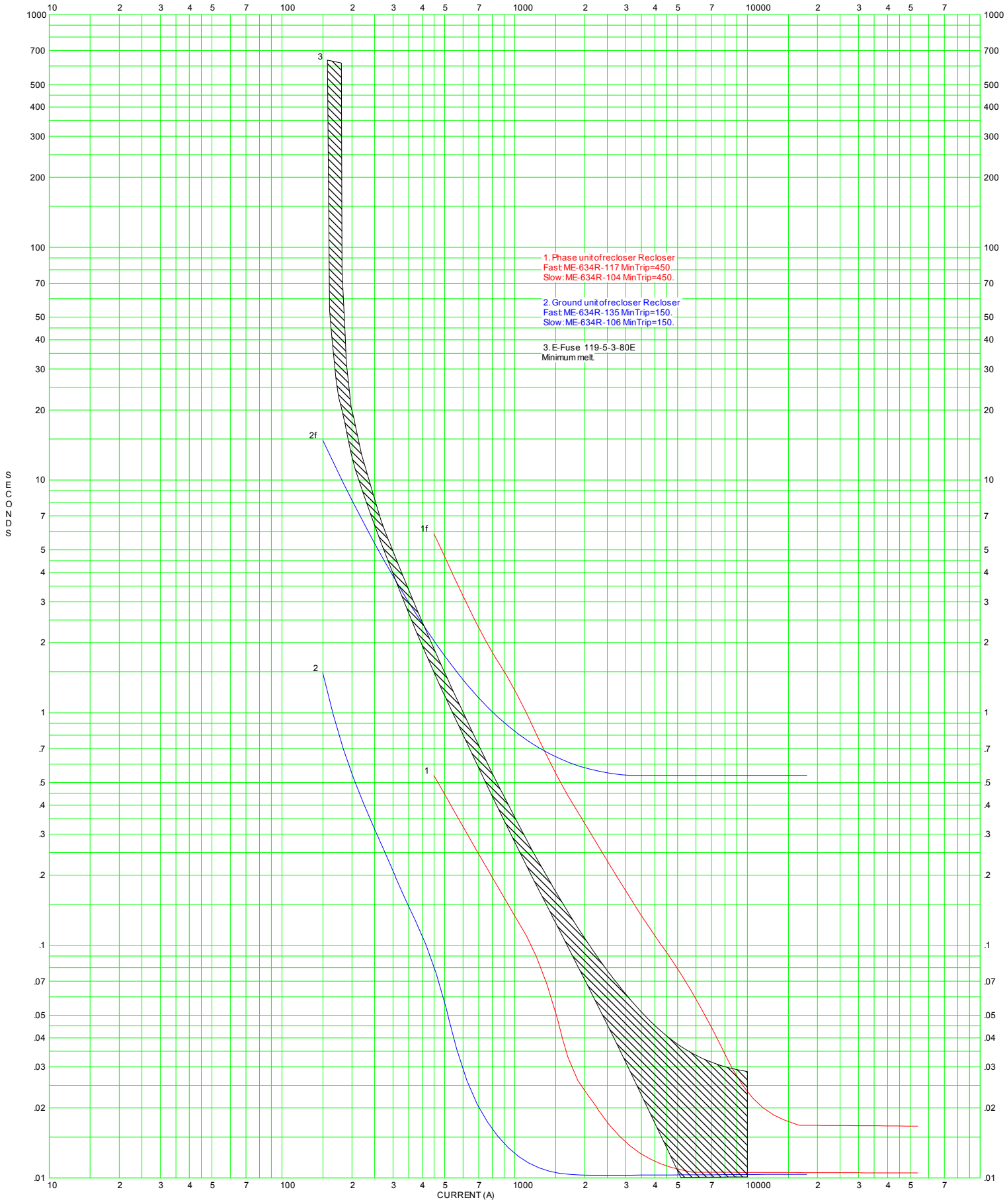
APPENDIX 1 – COORDINATION PLOTS



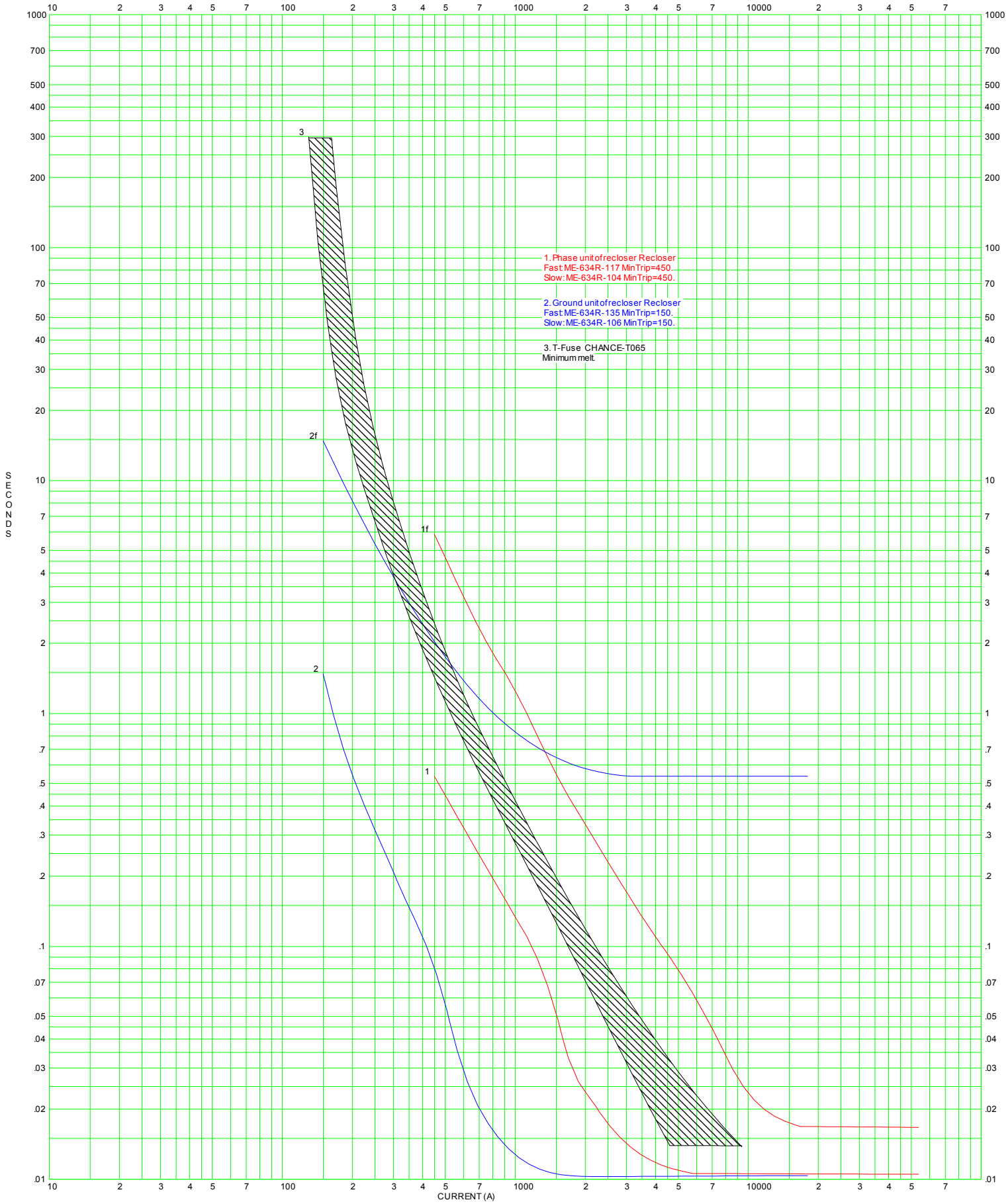
TIME-CURRENT CURVES @ Voltage 12.47 kV		By ICPE
For Spanish Fork		No.
Comment ABB DPU, 350A Phase, 150A Ground, Coordination with E-Fuse		Date



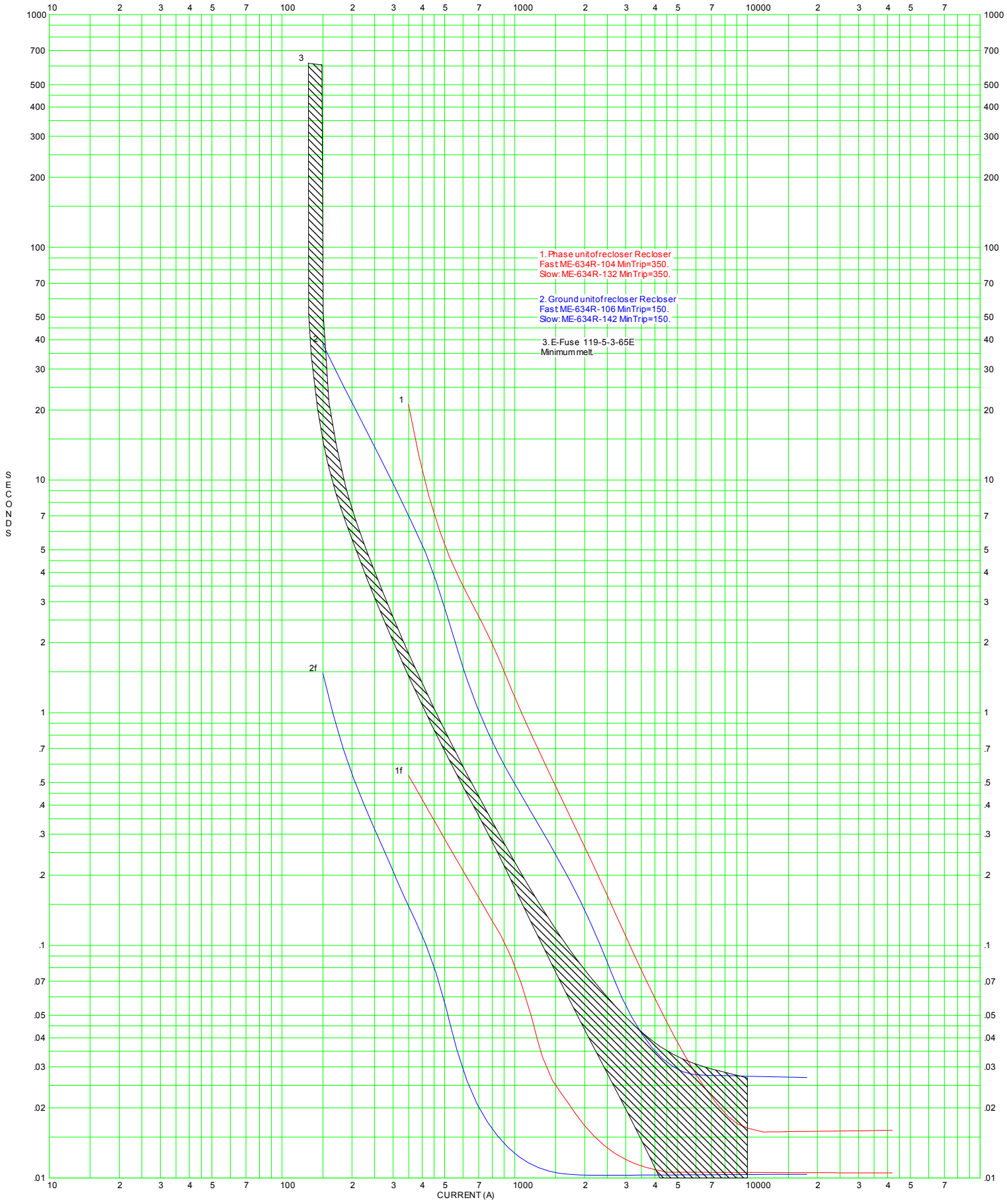
TIME-CURRENT CURVES @ Voltage 12.47 kV		By ICPE
For Spanish Fork		No.
Comment ABB DPU, 350A Phase, 150A Ground, Coordination with T-Fuse		Date



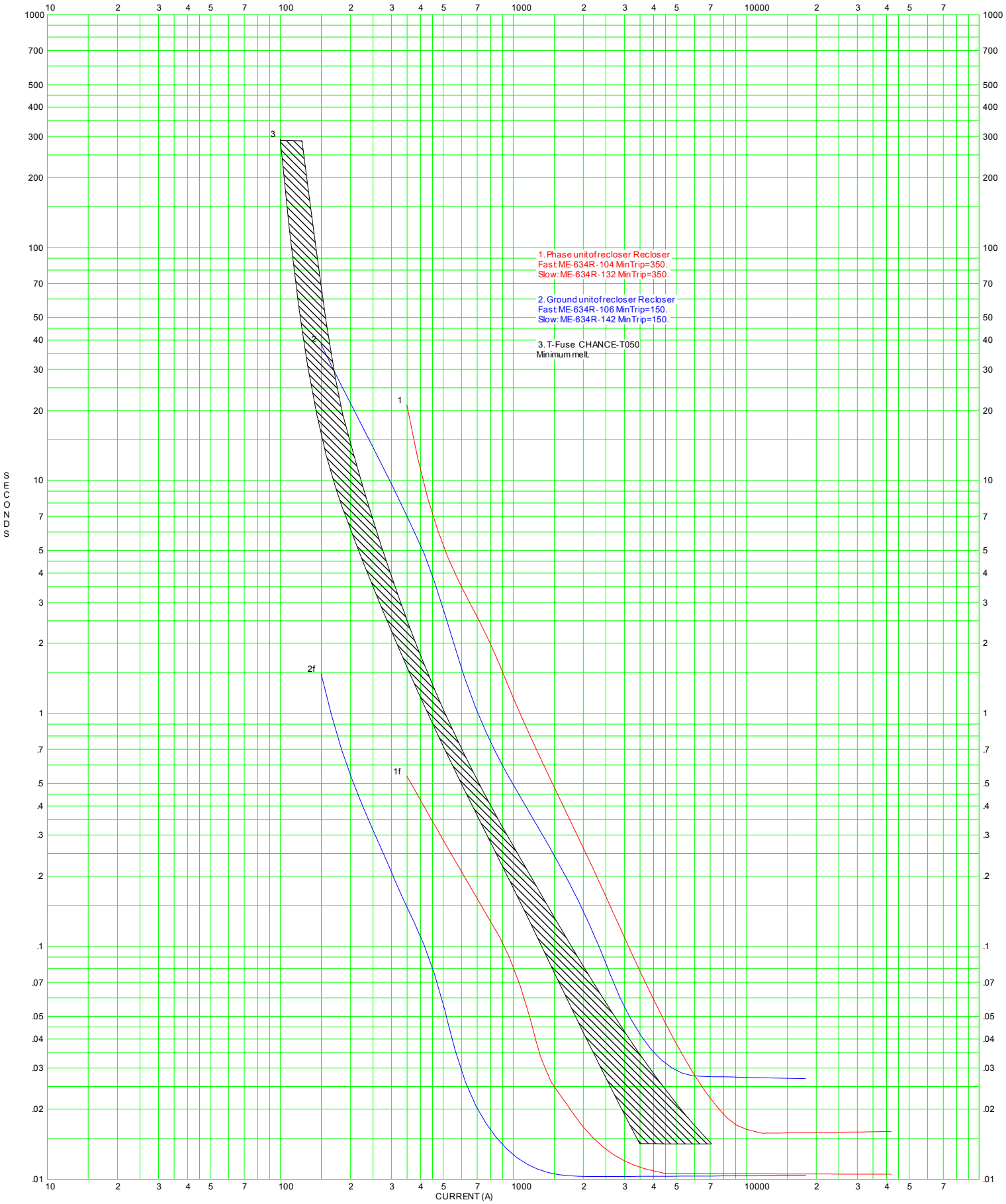
TIME-CURRENT CURVES @ Voltage 12.47 kV	By ICPE
For Spanish Fork	No.
Comment ABB DPU, 450A Phase, 150A Ground, Coordination with E-Fuse	Date



TIME-CURRENT CURVES @ Voltage 12.47 kV		By ICPE
For Spanish Fork		No.
Comment ABB DPU, 450A Phase, 150A Ground, Coordination with T-Fuse		Date



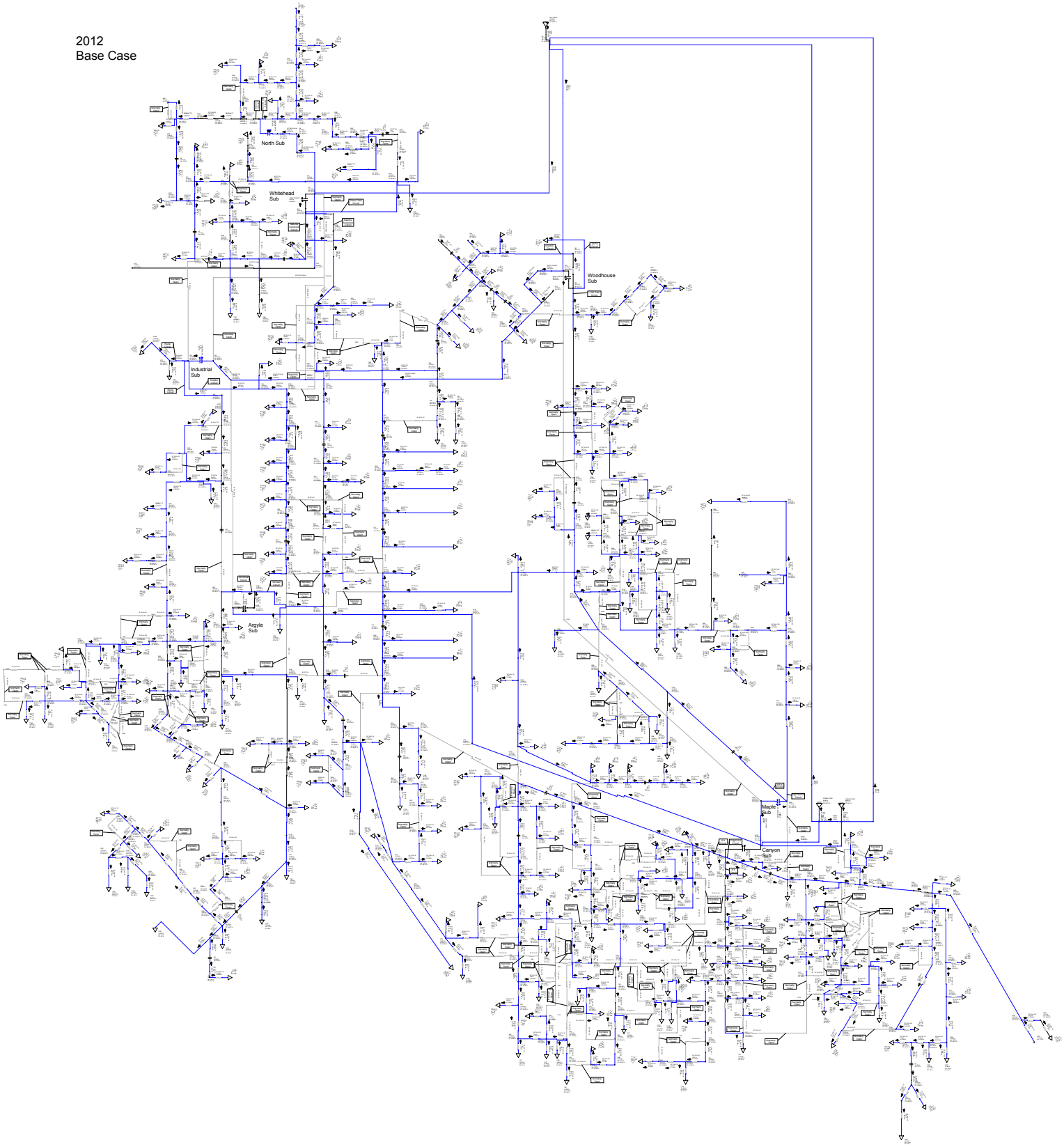
TIME-CURRENT CURVES @ Voltage 12.47 kV	By ICPE
For Spanish Fork	No.
Comment Cooper Form 6, 350A Phase , 150A Ground, Coordination with E-fuse	Date



TIME-CURRENT CURVES @ Voltage 12.47 kV	By ICPE
For Spanish Fork	No.
Comment Cooper Form 6, 350A Phase , 150A Ground, Coordination with T-fuse	Date

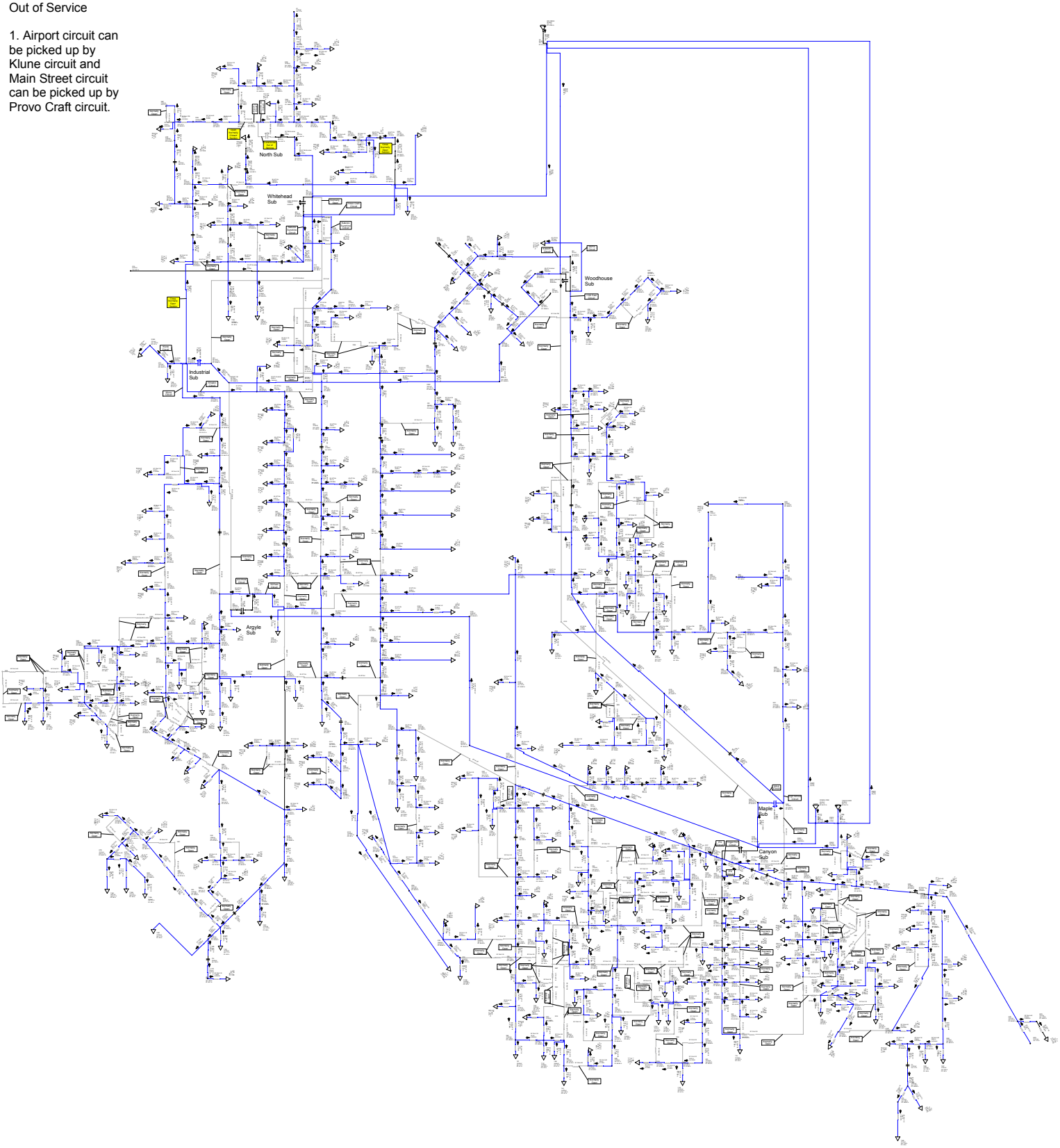
APPENDIX 2 – LOAD FLOW STUDIES

2012
Base Case



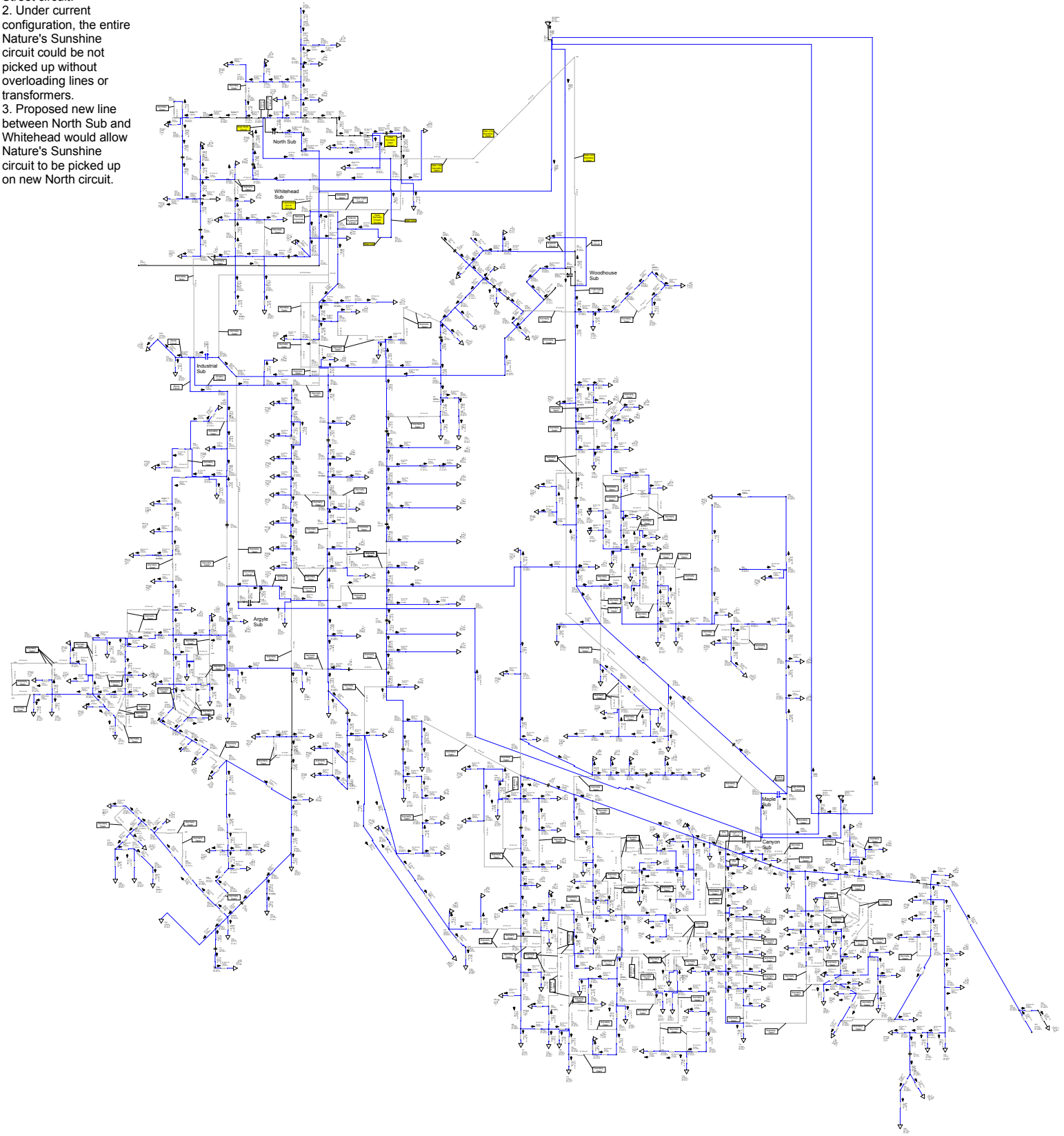
2012
North Transformer
Out of Service

1. Airport circuit can be picked up by Klune circuit and Main Street circuit can be picked up by Provo Craft circuit.



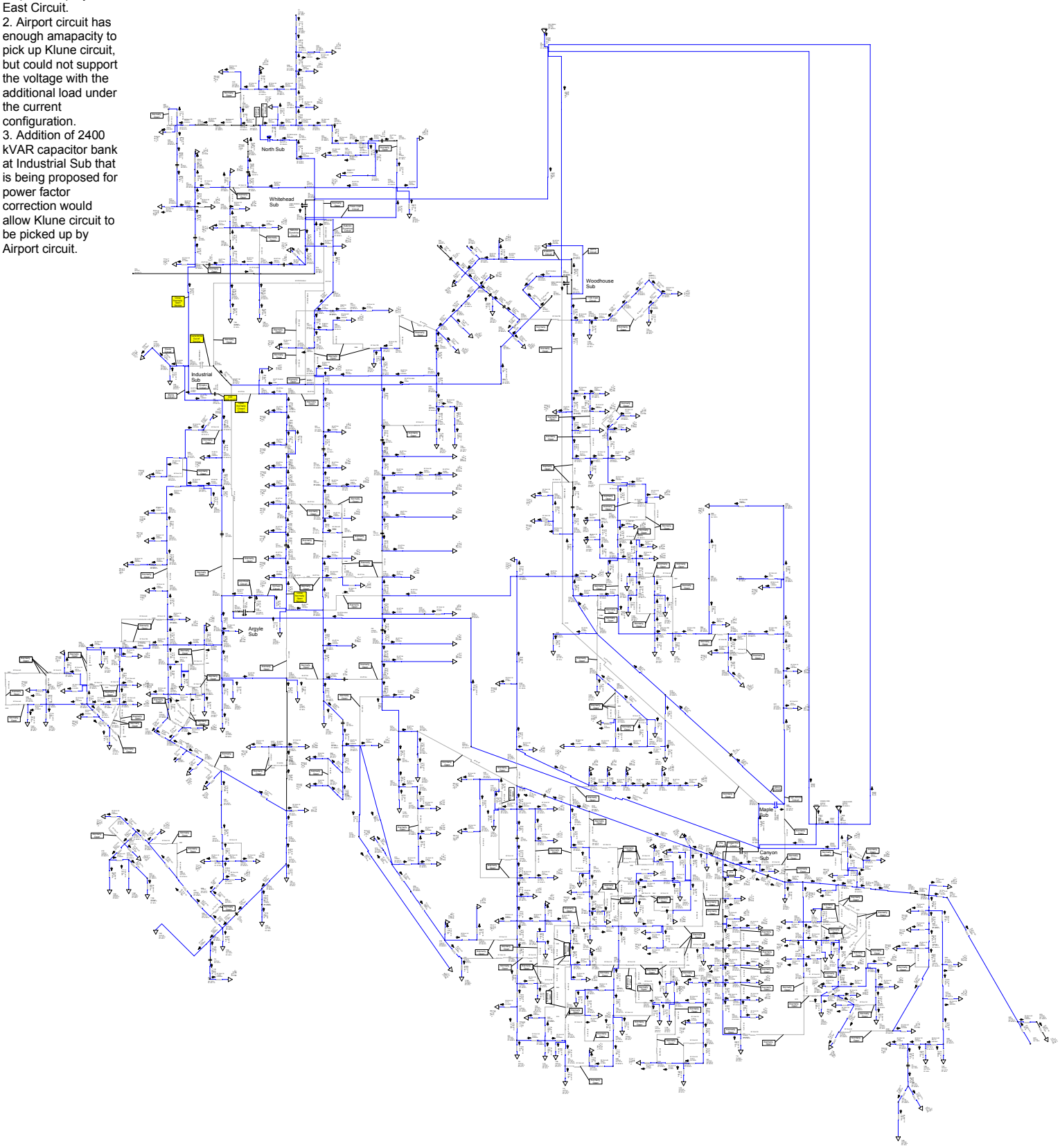
2012
Whitehead Transformer
Out of Service

1.Provo Craft circuit can be picked up by Main Street circuit.
2. Under current configuration, the entire Nature's Sunshine circuit could be not picked up without overloading lines or transformers.
3. Proposed new line between North Sub and Whitehead would allow Nature's Sunshine circuit to be picked up on new North circuit.



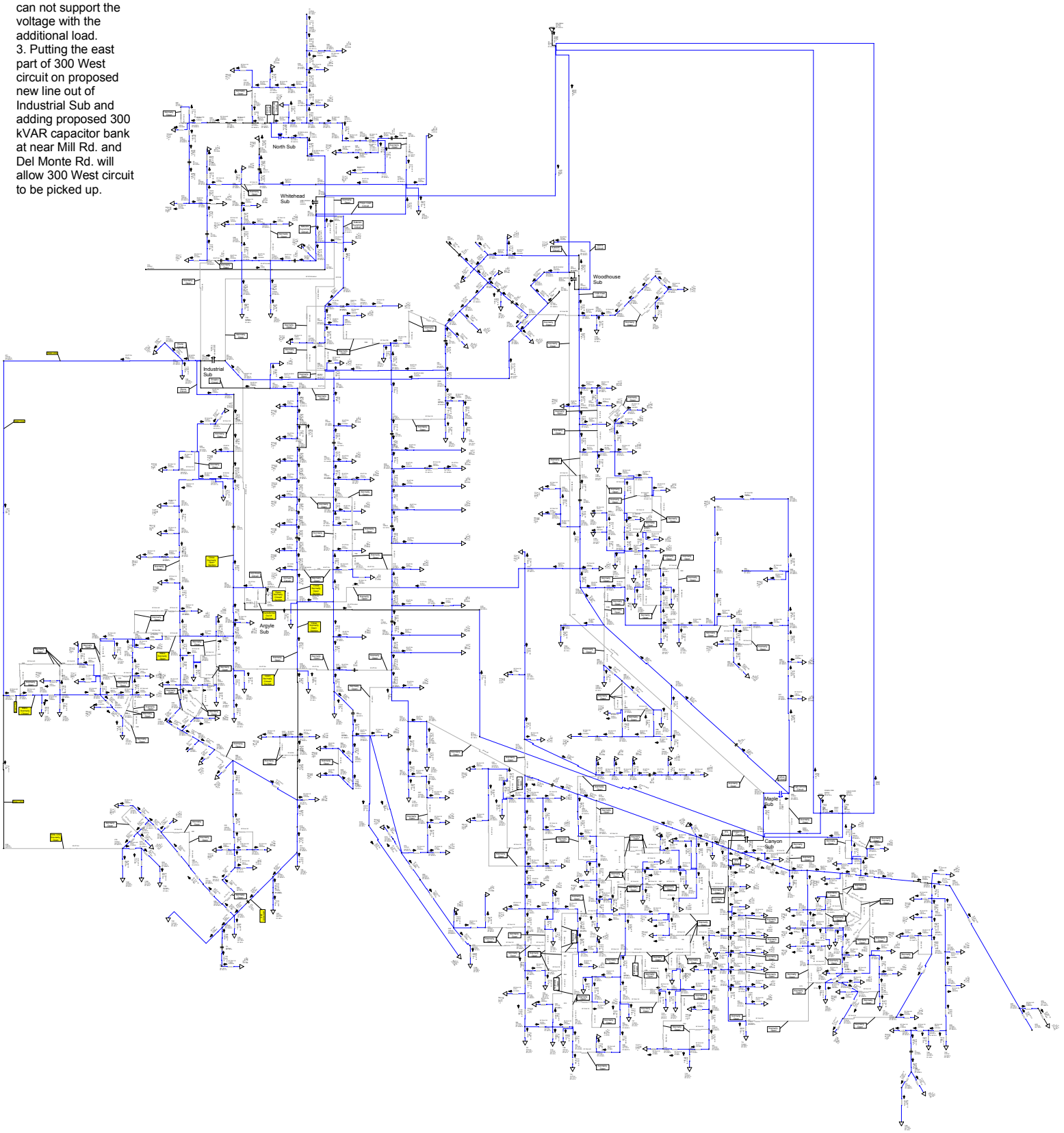
2012
Industrial Transformer
Out of Service

1. Shopko circuit can be picked up by 50 East Circuit.
2. Airport circuit has enough amapacity to pick up Klune circuit, but could not support the voltage with the additional load under the current configuration.
3. Addition of 2400 kVAR capacitor bank at Industrial Sub that is being proposed for power factor correction would allow Klune circuit to be picked up by Airport circuit.



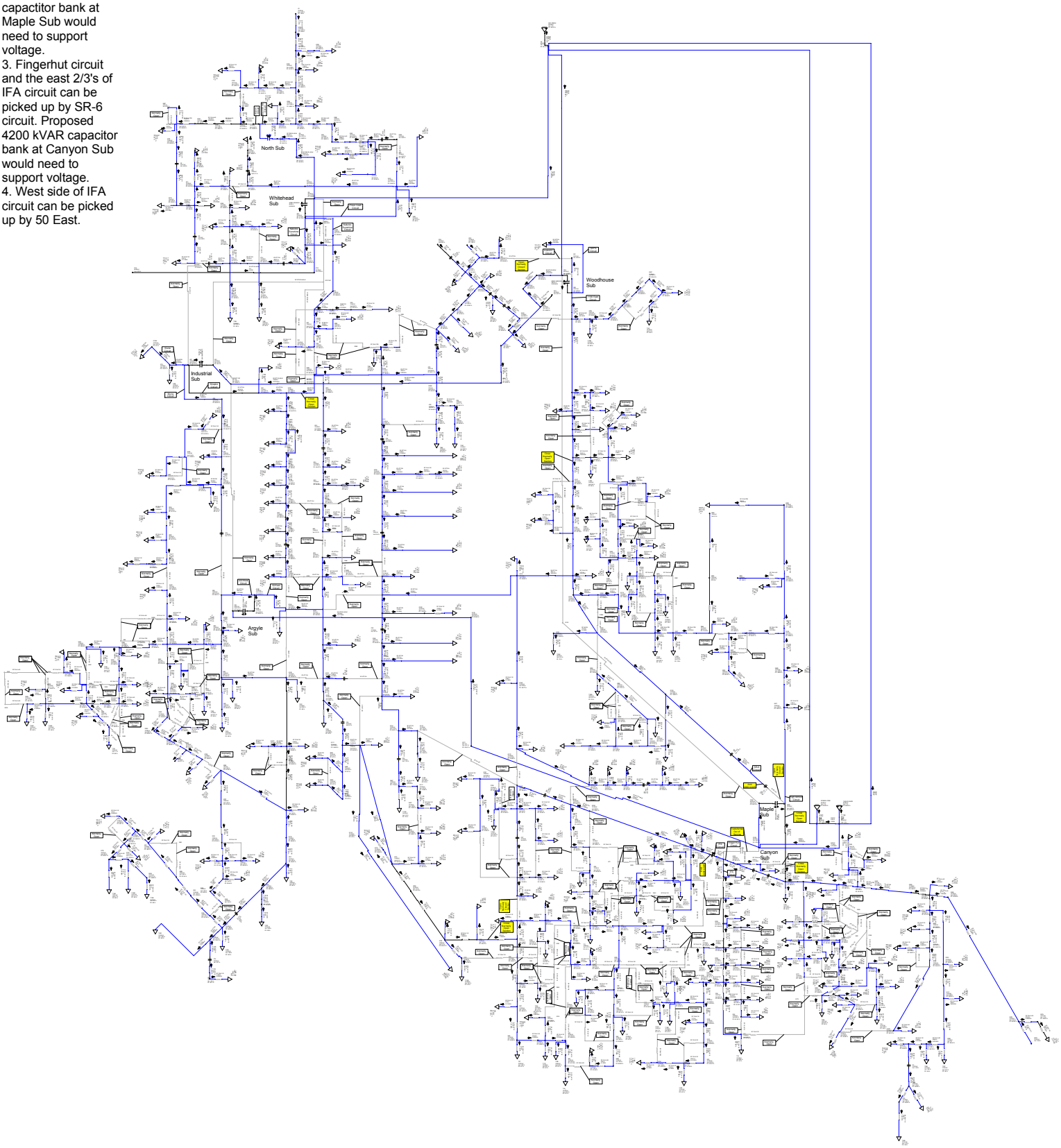
2012
Argyle Transformer
Out of Service

1. 50 East circuit can be picked up by Shopko circuit.
2. Klune and Shopko circuits have enough ampacity to pick up 300 West circuit when the load is shared between them, but can not support the voltage with the additional load.
3. Putting the east part of 300 West circuit on proposed new line out of Industrial Sub and adding proposed 300 kVAR capacitor bank at near Mill Rd. and Del Monte Rd. will allow 300 West circuit to be picked up.



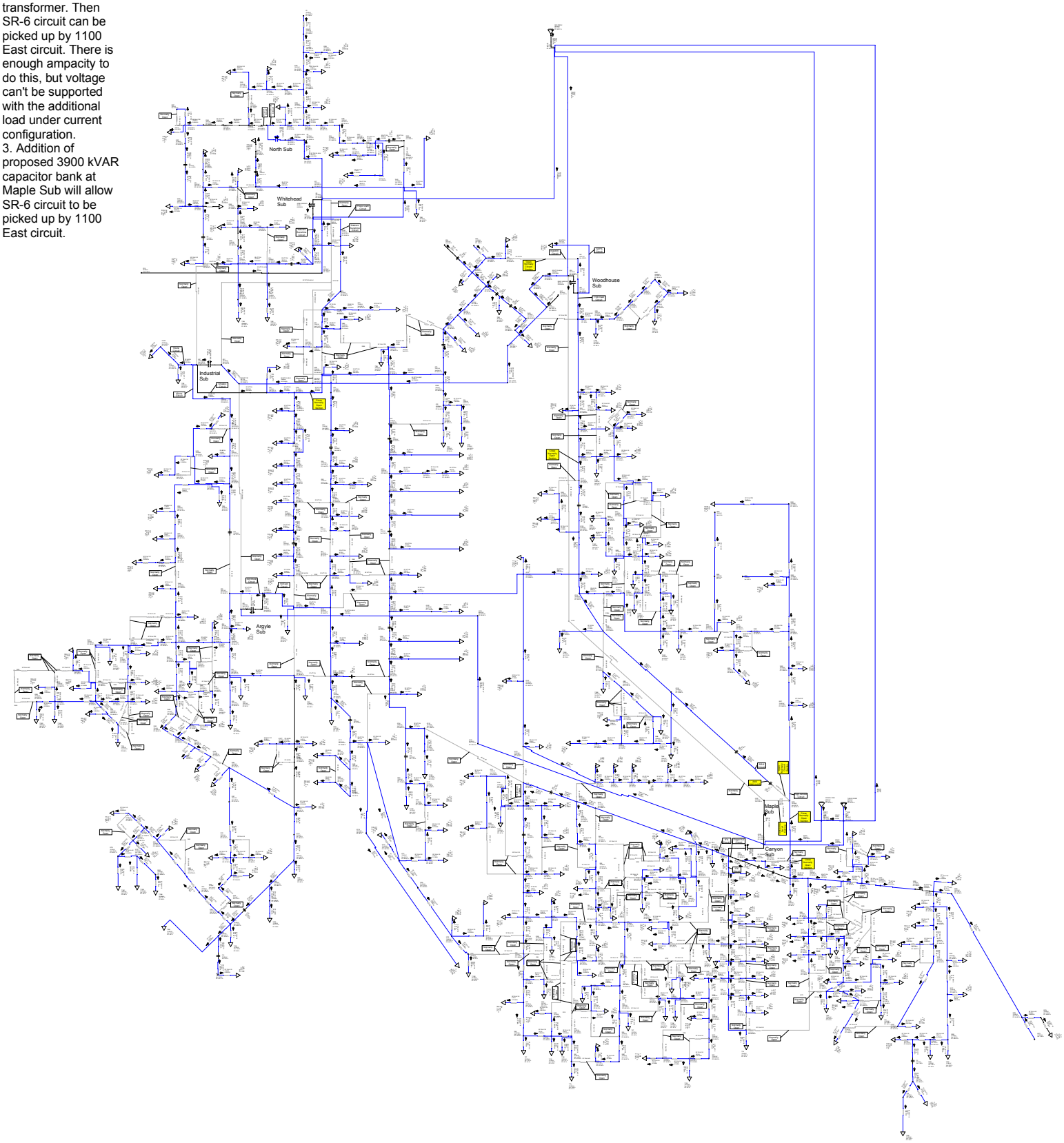
2012
Canyon Transformer
Out of Service

1. Shopko circuit can pick up K-Mart circuit circuit to free up Woodhouse transformer.
2. 1100 East circuit can pick up SR-6 circuit to free up Maple transformer. Proposed 3900 kVAR capactitor bank at Maple Sub would need to support voltage.
3. Fingerhut circuit and the east 2/3's of IFA circuit can be picked up by SR-6 circuit. Proposed 4200 kVAR capacitor bank at Canyon Sub would need to support voltage.
4. West side of IFA circuit can be picked up by 50 East.



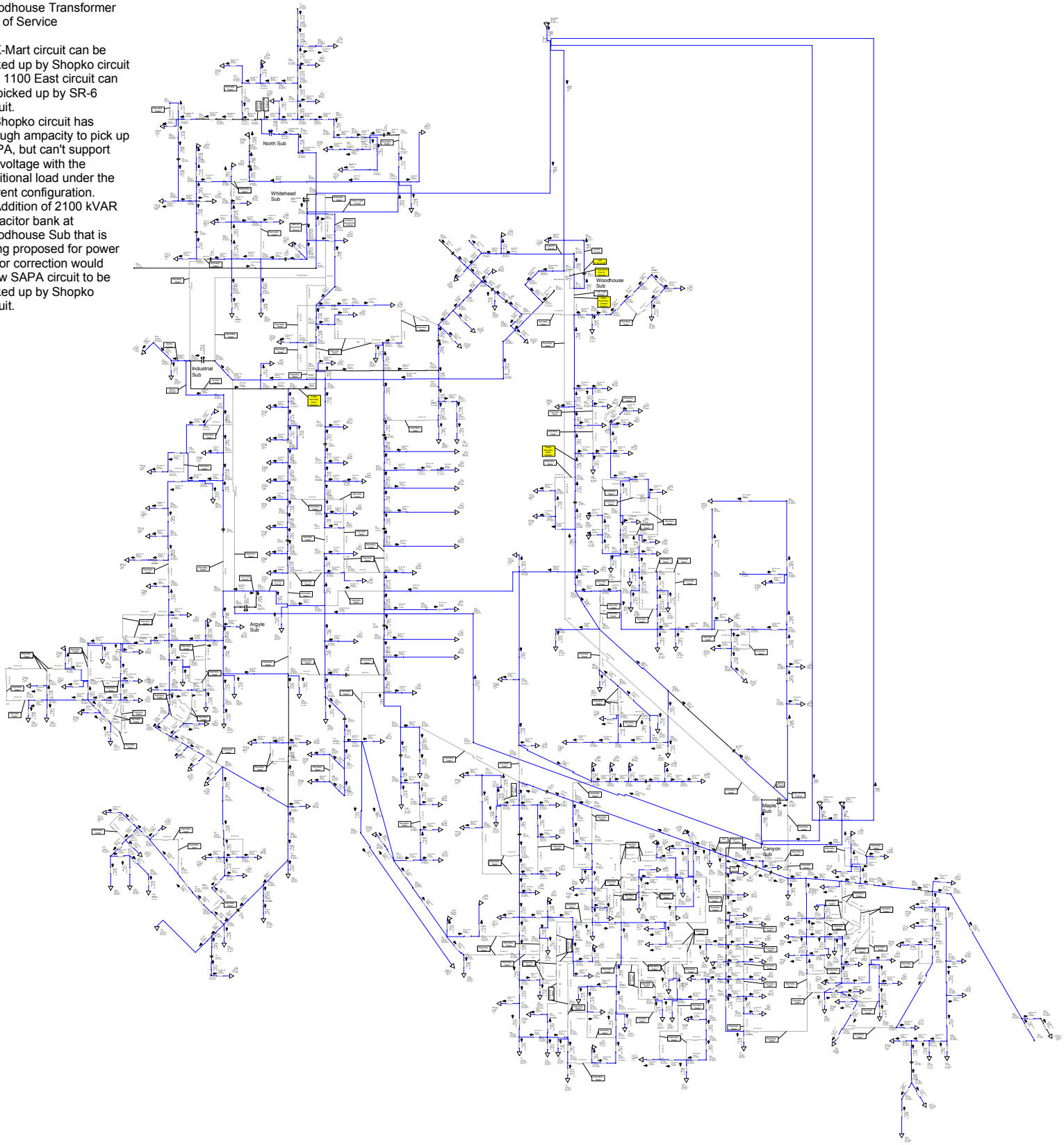
2012
Maple Transformer
Out of Service

1. High School circuit can be picked up by Fingerhut circuit.
2. Can move K-Mart load to Shopko to free up Woodhouse transformer. Then SR-6 circuit can be picked up by 1100 East circuit. There is enough ampacity to do this, but voltage can't be supported with the additional load under current configuration.
3. Addition of proposed 3900 kVAR capacitor bank at Maple Sub will allow SR-6 circuit to be picked up by 1100 East circuit.

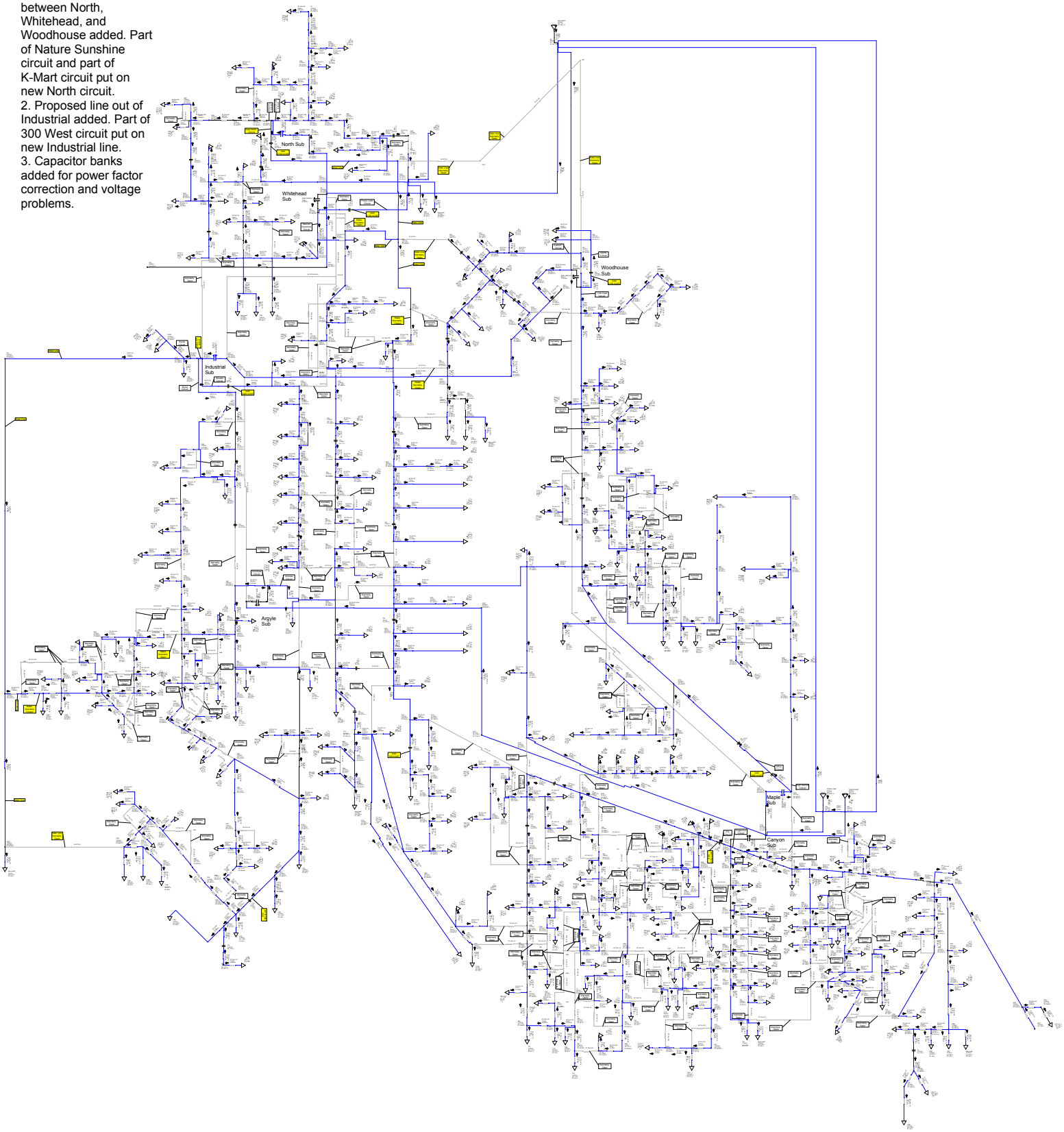


2012
Woodhouse Transformer
Out of Service

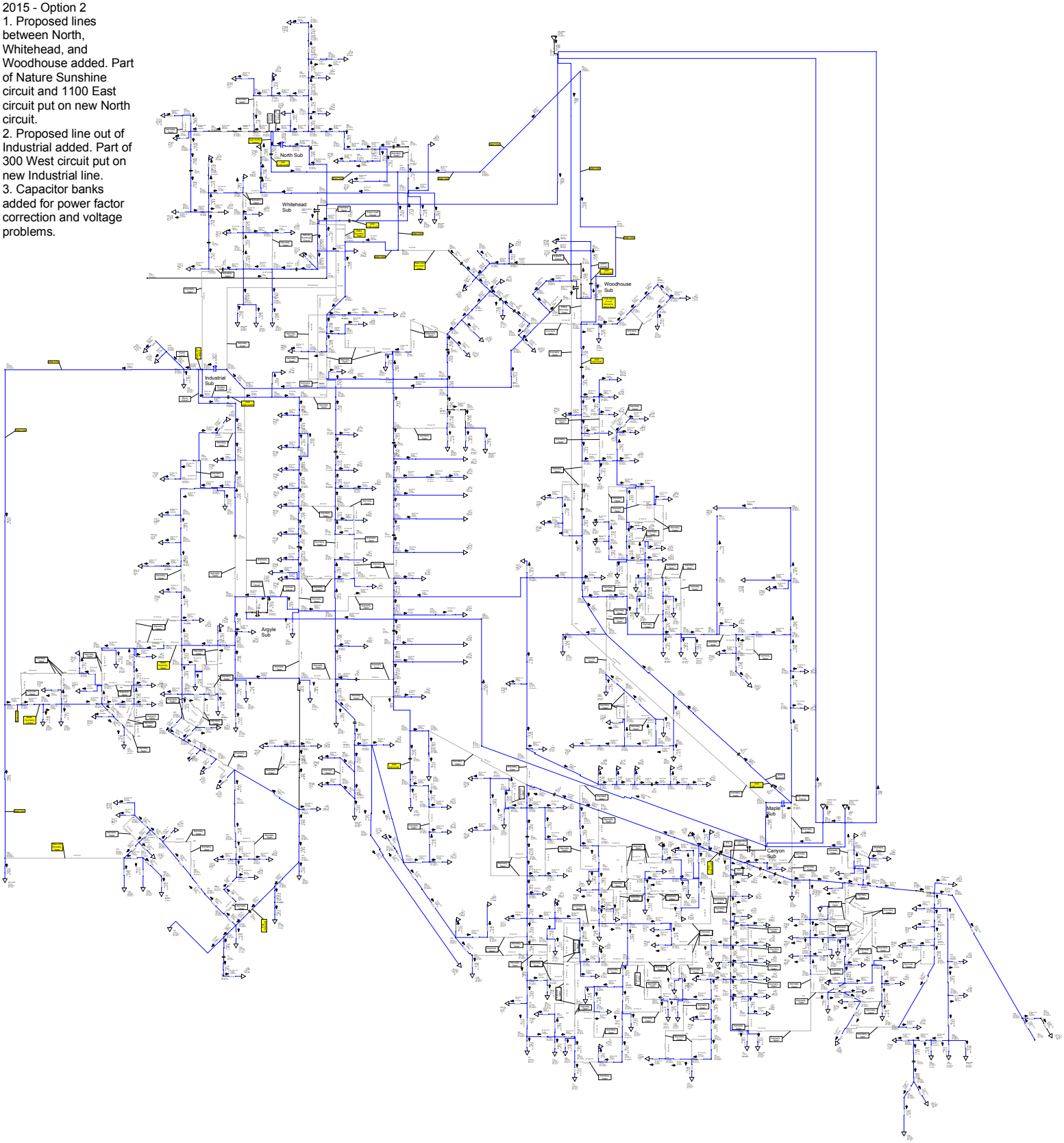
1. K-Mart circuit can be picked up by Shopko circuit and 1100 East circuit can be picked up by SR-6 circuit.
2. Shopko circuit has enough ampacity to pick up SAPA, but can't support the voltage with the additional load under the current configuration.
3. Addition of 2100 kVAR capacitor bank at Woodhouse Sub that is being proposed for power factor correction would allow SAPA circuit to be picked up by Shopko circuit.



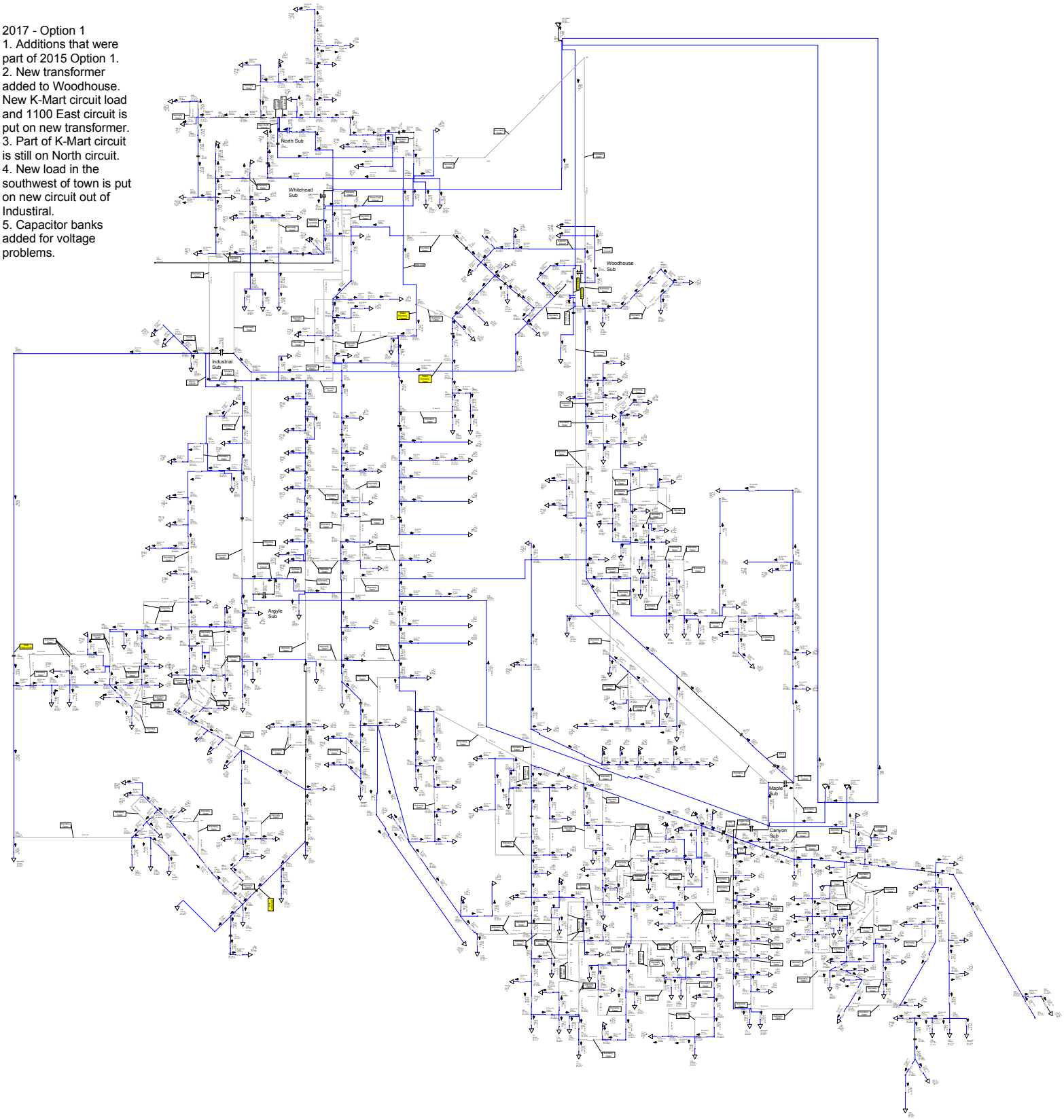
2015 - Option 1
1. Proposed lines between North, Whitehead, and Woodhouse added. Part of Nature Sunshine circuit and part of K-Mart circuit put on new North circuit.
2. Proposed line out of Industrial added. Part of 300 West circuit put on new Industrial line.
3. Capacitor banks added for power factor correction and voltage problems.



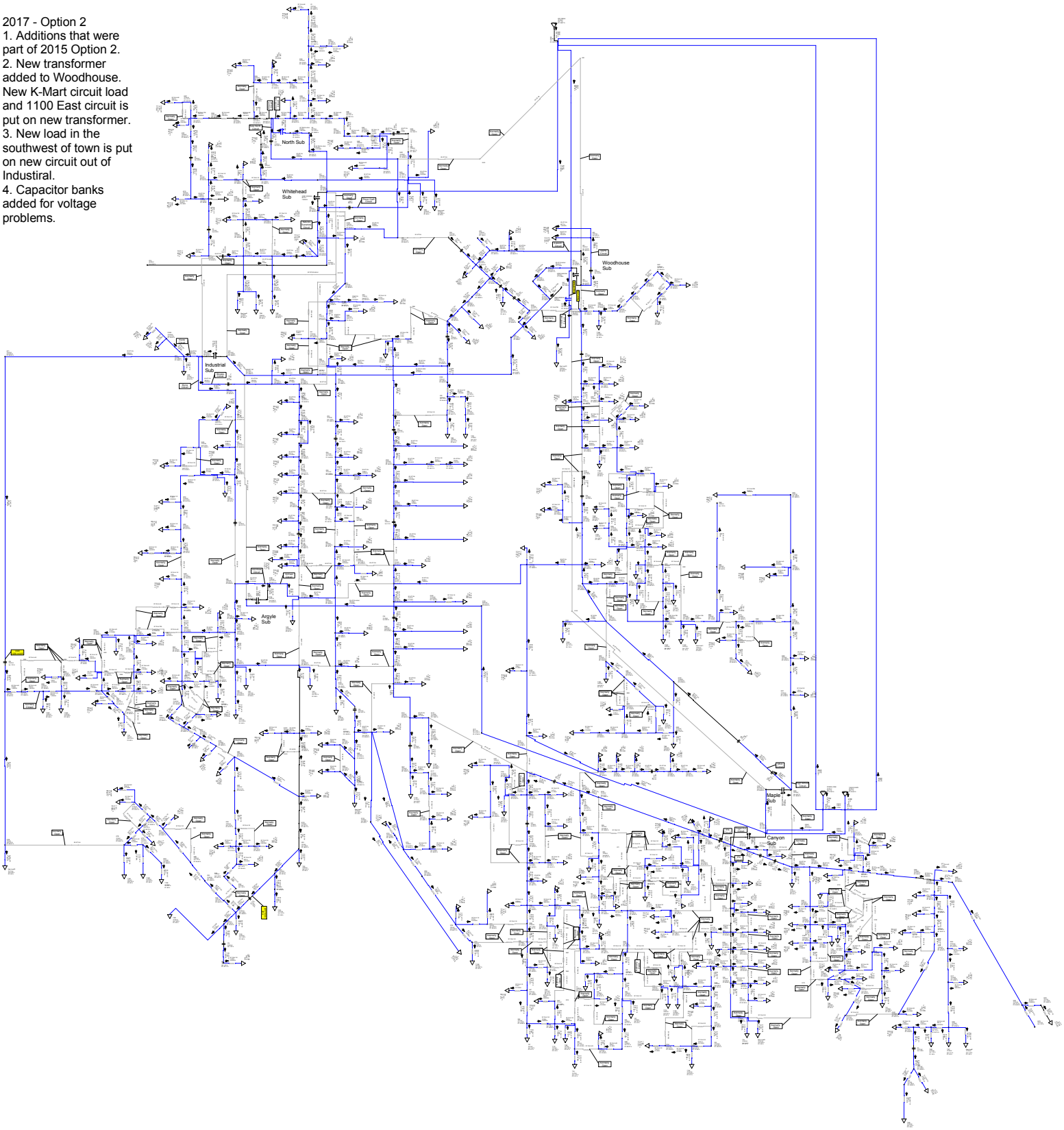
2015 - Option 2
1. Proposed lines between North, Whitehead, and Woodhouse added. Part of Nature Sunshine circuit and 1100 East circuit put on new North circuit.
2. Proposed line out of Industrial added. Part of 300 West circuit put on new Industrial line.
3. Capacitor banks added for power factor correction and voltage problems.



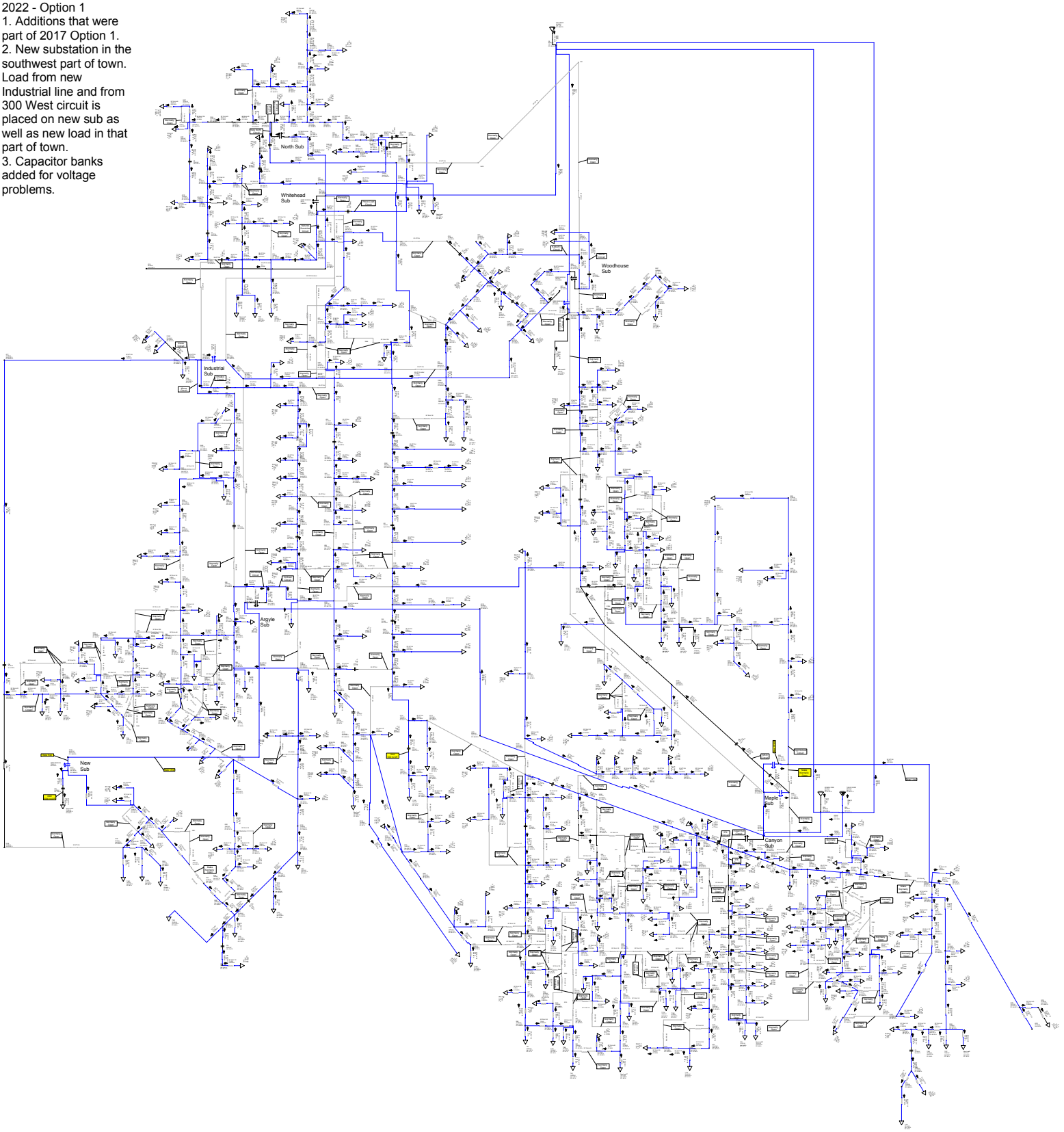
2017 - Option 1
1. Additions that were part of 2015 Option 1.
2. New transformer added to Woodhouse. New K-Mart circuit load and 1100 East circuit is put on new transformer.
3. Part of K-Mart circuit is still on North circuit.
4. New load in the southwest of town is put on new circuit out of Industiral.
5. Capacitor banks added for voltage problems.



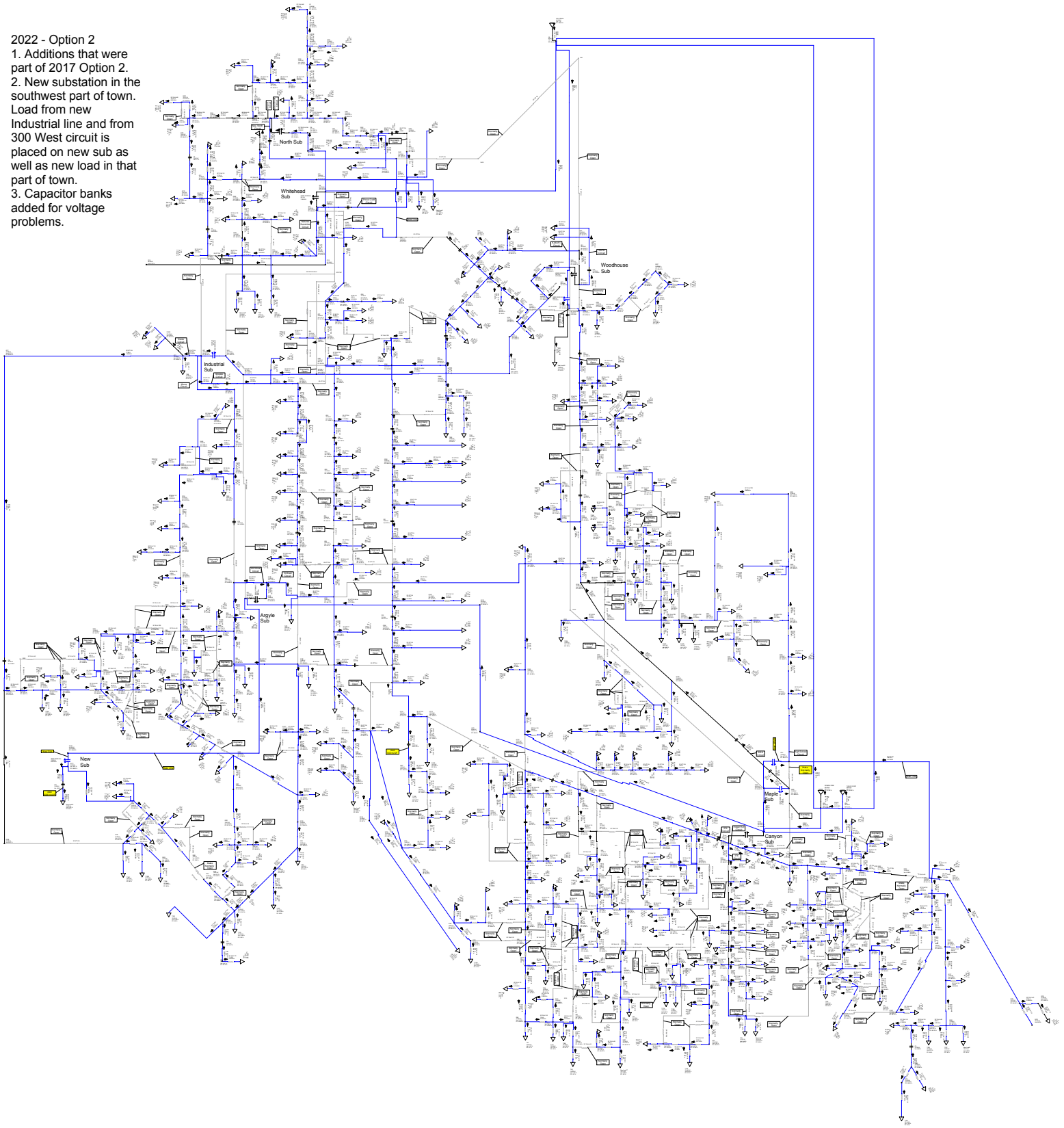
2017 - Option 2
1. Additions that were part of 2015 Option 2.
2. New transformer added to Woodhouse. New K-Mart circuit load and 1100 East circuit is put on new transformer.
3. New load in the southwest of town is put on new circuit out of Industiral.
4. Capacitor banks added for voltage problems.



2022 - Option 1
1. Additions that were part of 2017 Option 1.
2. New substation in the southwest part of town. Load from new Industrial line and from 300 West circuit is placed on new sub as well as new load in that part of town.
3. Capacitor banks added for voltage problems.

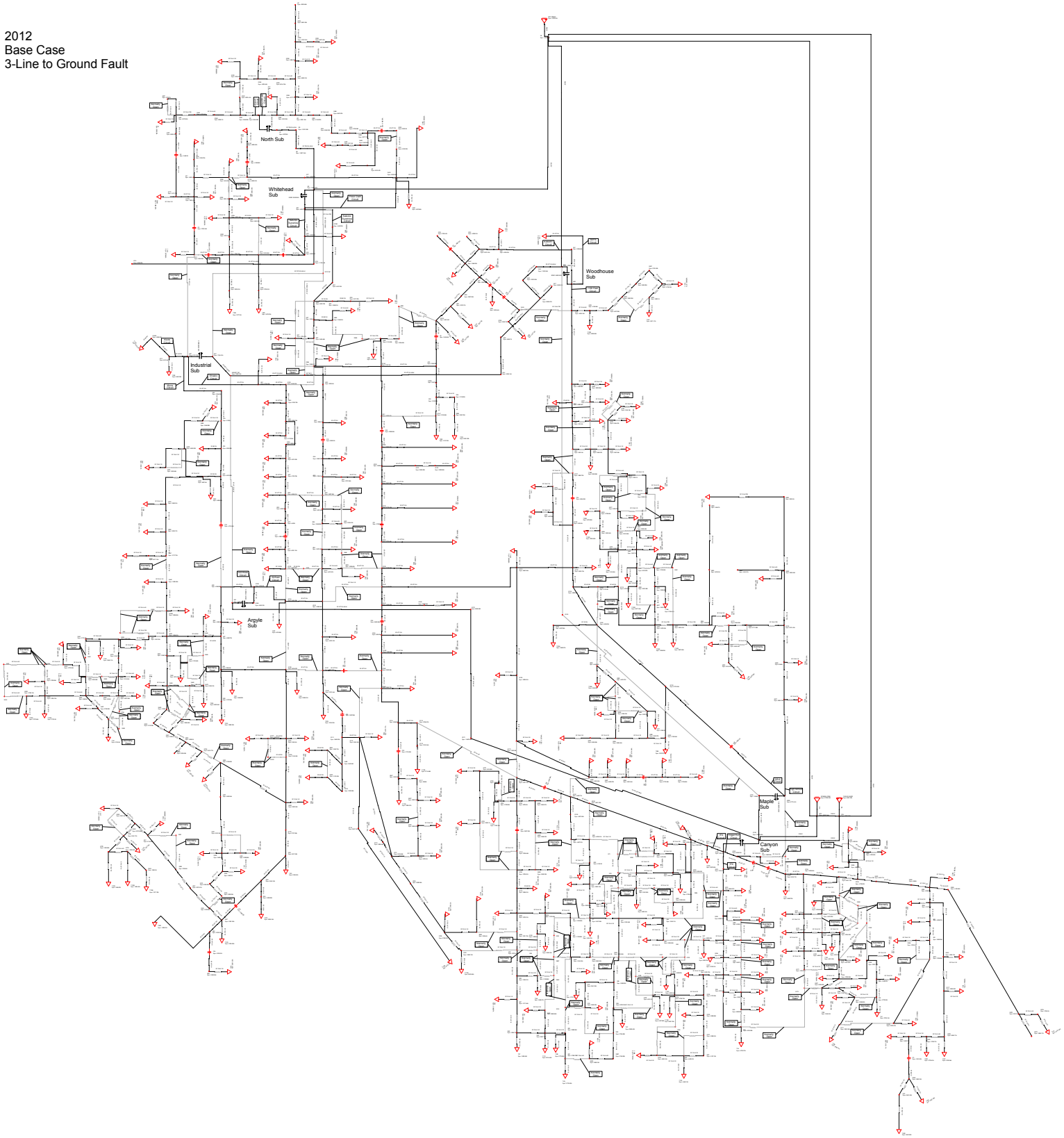


2022 - Option 2
1. Additions that were part of 2017 Option 2.
2. New substation in the southwest part of town. Load from new Industrial line and from 300 West circuit is placed on new sub as well as new load in that part of town.
3. Capacitor banks added for voltage problems.

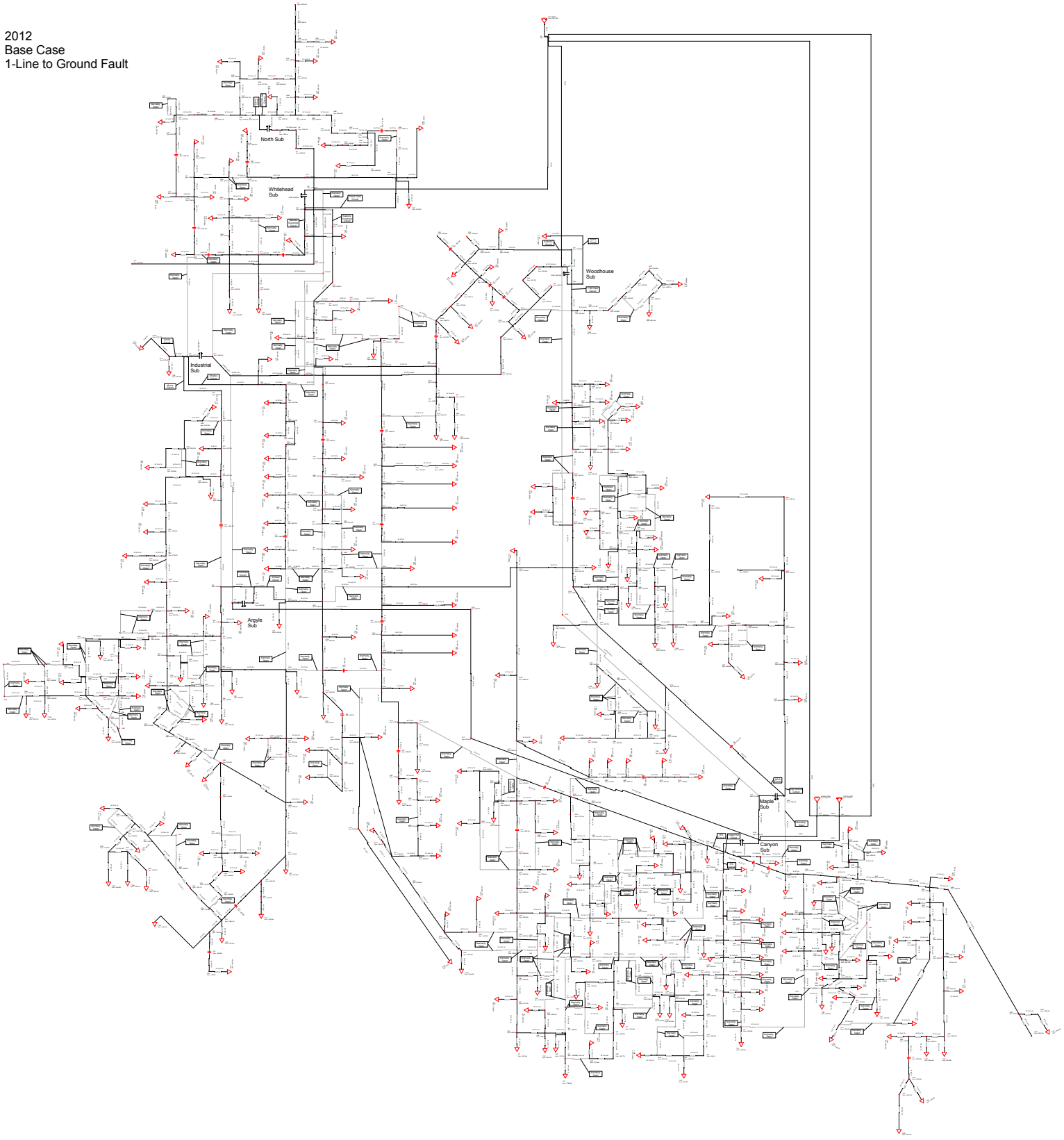


APPENDIX 3 – FAULT STUDIES

2012
Base Case
3-Line to Ground Fault



2012
Base Case
1-Line to Ground Fault



EDSA

3-Phase Short Circuit v6.70.00

Project No.		**Page**	1
Project Name	Spansih Fork City	**Date**	4/25/2013 12:00:00A
Title		**Time**	09:41:30 am
Drawing No.		**Company**	ICPE
Revision No.		**Engineer**	MTF
Jobfile Name	SPANISH_FORK_2012	**Check by**	
Scenario	1 :	**Check Date**	

System Summary

Base MVA	100.00
Frequency	60
# of Total Buses	813
# of Active Buses	762
# of Total Branche	764
# of Active Sources	3
# of Active Motors	0
# of Active Shunts	297
# of Transformers	7
Reference Temperature(°C)	20.00
Impedance Displaying Temperature(°C)	25.00

Calculation Options

Calculating Faults at All Buses or Mult-Buses with Fault Z = 0.00000 + j 0.00000 Ohms

Classical Calculation : Complex Z for X/R and Fault Current

Base Voltages: Adjusted by Tap/Turn Ratio
Prefault Voltages: Use System Voltages

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
C1	12470	6064	5252	5743	5954	0.7635	0.8917	14.8050
C10	12470	3960	3429	3737	3890	1.1692	1.3791	17.4900
C11	12470	3630	3144	3144	3475	1.2754	1.8683	9.5532
C12	12470	3414	2957	2887	3245	1.3562	2.1001	8.4944
C13	12470	2440	2113	1949	2273	1.8972	3.3322	2.7192
C14	12470	2313	2003	1820	2150	2.0020	3.6270	2.7345
C15	12470	2858	2475	2287	2692	1.6199	2.8370	6.3888
C16	12470	4175	3615	3654	4007	1.1091	1.5837	3.9585
C17	12470	4327	3747	3847	4214	1.0700	1.4735	7.4108
C18	12470	3567	3089	3248	3450	1.2980	1.6811	8.3447
C19	12470	3726	3227	3465	3629	1.2427	1.5230	9.0279
C2	12470	6021	5215	5681	5904	0.7690	0.9074	14.4170
C20	12470	3063	2653	2322	2819	1.5116	2.9580	5.2447
C21	12470	2756	2387	2176	2569	1.6798	3.0251	6.3506
C22	12470	2993	2592	2420	2808	1.5470	2.6461	6.9857
C23	12470	2714	2350	2007	2483	1.7059	3.5095	4.8535
C24	12470	4085	3537	3348	3836	1.1335	1.8815	6.8524
C25	12470	2810	2433	2003	2573	1.6479	3.6401	3.5622
C26	12470	4249	3680	3468	3989	1.0896	1.8261	6.9324
C27	12470	3868	3349	3068	3603	1.1971	2.1329	6.2336
C28	12470	6593	5710	6775	6719	0.7022	0.6458	27.3750
C29	12470	4166	3608	4044	4132	1.1113	1.2122	23.1350
C3	12470	3182	2756	2209	2902	1.4551	3.3786	1.7546
C4	12470	3435	2975	2911	3267	1.3479	2.0762	8.5871
C5	12470	3703	3207	3046	3610	1.2502	2.0758	4.5556
C6	12470	5446	4717	5306	5921	0.8501	0.9630	5.8973
C7	12470	3670	3178	3332	3560	1.2617	1.6454	13.0290
C8	12470	5464	4732	5141	5734	0.8473	1.0348	3.9012
C9	12470	3883	3363	3461	3751	1.1923	1.6295	11.1850
DRY CREEK	46000	18753	16246	22817	21885	0.0669	0.0312	10.2490
G08	12470	5847	5063	5958	6401	0.7919	0.7732	5.8499
G1	12470	5624	4871	5570	6162	0.8233	0.8897	4.3708
G10	12470	4106	3556	3351	3827	1.1277	1.8895	3.6620
G100	12470	4078	3532	3535	3934	1.1353	1.6605	6.8582
G101	12470	4072	3526	3974	4035	1.1371	1.2208	10.5830
G103	12470	4266	3695	4280	4286	1.0852	1.0750	14.5480
G104	12470	4424	3832	4544	4516	1.0465	0.9642	16.8740
G105	12470	4079	3533	3984	4038	1.1350	1.2162	11.7820
G106	12470	3616	3132	3312	3500	1.2804	1.6335	9.2921
G107	12470	3882	3362	3689	3809	1.1928	1.3802	9.8172
G108	12470	3747	3245	3496	3654	1.2355	1.5024	9.1301

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
G11	12470	3653	3164	2985	3540	1.2674	2.1317	3.4595
G110	12470	3303	2860	2905	3159	1.4019	1.9783	7.4094
G111	12470	3481	3014	3133	3353	1.3302	1.7733	8.0142
G112	12470	3382	2929	3005	3245	1.3690	1.8843	7.6673
G114	12470	2859	2476	2136	2622	1.6197	3.2648	5.0084
G115	12470	2796	2421	2080	2562	1.6559	3.3676	4.9402
G116	12470	2743	2376	2033	2511	1.6877	3.4579	4.8841
G117	12470	2646	2292	1918	2418	1.7498	3.7431	4.2391
G118	12470	2847	2466	2373	2675	1.6262	2.6014	3.5923
G119	12470	4126	3573	3395	3879	1.1222	1.8469	6.4249
G12	12470	3585	3105	2918	3476	1.2915	2.1917	4.4858
G120	12470	6101	5284	6144	6695	0.7588	0.7748	10.5460
G122	46000	13518	11709	9378	12287	0.0928	0.2159	4.6394
G124	12470	4290	3715	3575	4048	1.0793	1.7267	7.2999
G125	12470	4539	3931	3862	4308	1.0200	1.5572	7.9286
G126	12470	7092	6142	7389	7301	0.6529	0.5742	41.8580
G127	12470	3890	3369	3140	3638	1.1903	2.0436	6.4748
G128	12470	4153	3597	3423	3907	1.1148	1.8281	6.9956
G129	12470	4224	3658	3501	3979	1.0962	1.7750	7.1494
G13	12470	3786	3279	3491	3691	1.2230	1.5339	14.5100
G130	12470	5780	5006	5487	5675	0.8010	0.9294	13.8700
G131	12470	3868	3350	3117	3616	1.1970	2.0628	6.4350
G132	12470	4057	3514	3321	3801	1.1411	1.8998	4.4053
G133	12470	5817	5038	5390	5670	0.7960	0.9850	12.8190
G134	12470	5660	4901	5174	5493	0.8181	1.0486	11.8130
G135	12470	4842	4193	4138	4604	0.9563	1.4449	8.3891
G136	12470	4728	4095	4027	4550	0.9792	1.4932	7.5564
G137	12470	6743	5840	6795	6774	0.6866	0.6709	25.8090
G138	12470	6384	5529	6222	6329	0.7253	0.7818	18.5210
G139	12470	4528	3921	3775	4275	1.0225	1.6346	7.5490
G14	12470	3916	3391	3674	3840	1.1823	1.4167	16.6310
G140	12470	4566	3954	3818	4315	1.0141	1.6103	7.6414
G141	12470	2777	2405	1976	2543	1.6675	3.6955	3.5551
G142	12470	2725	2360	1934	2495	1.6991	3.7848	3.5441
G143	12470	3599	3116	2800	3335	1.2866	2.3878	5.8192
G144	12470	3786	3279	2986	3522	1.2228	2.2060	6.1027
G145	12470	4107	3557	3317	3844	1.1273	1.9338	6.6548
G146	12470	4068	3523	3896	4017	1.1380	1.2891	20.0670
G147	12470	3136	2716	2448	2905	1.4764	2.7208	4.7514
G148	12470	3161	2738	2602	2981	1.4646	2.4105	7.5200
G149	12470	2963	2566	2389	2778	1.5625	2.6904	6.8990

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
G15	12470	4055	3512	3877	4001	1.1417	1.2997	19.7150
G150	12470	2899	2510	2322	2713	1.5972	2.7894	6.7187
G151	12470	2690	2330	2109	2503	1.7211	3.1430	6.1929
G152	12470	2631	2278	1991	2420	1.7600	3.4545	4.7143
G153	12470	2838	2458	2259	2651	1.6314	2.8872	6.5565
G154	12470	2779	2407	2199	2592	1.6659	2.9856	6.4071
G155	12470	2723	2359	2143	2536	1.7000	3.0828	6.2715
G156	12470	3108	2692	2365	2863	1.4894	2.8950	5.3004
G157	12470	3149	2727	2403	2903	1.4703	2.8405	5.3510
G158	12470	4534	3927	4735	4687	1.0211	0.8919	18.9870
G159	12470	4643	4021	4930	4866	0.9971	0.8238	21.6790
G16	12470	4229	3663	4142	4207	1.0947	1.1644	25.6780
G160	12470	3621	3136	2862	3368	1.2788	2.2958	6.0166
G161	12470	3099	2684	2356	2854	1.4940	2.9079	5.2888
G162	12470	2729	2363	2020	2497	1.6968	3.4837	4.8687
G163	12470	6539	5663	6466	6516	0.7080	0.7323	21.0970
G164	12470	3029	2623	2291	2787	1.5284	3.0056	5.2044
G165	12470	2963	2566	2230	2722	1.5628	3.1033	5.1262
G166	12470	2923	2531	2194	2684	1.5841	3.1637	5.0805
G167	12470	3946	3417	3543	3821	1.1733	1.5748	11.6800
G168	12470	2894	2506	2167	2656	1.6000	3.2090	5.0476
G169	46000	15683	13584	11544	14425	0.0800	0.1662	5.0341
G17	12470	4450	3854	4497	4477	1.0404	1.0080	41.7610
G170	46000	8990	7786	5571	8066	0.1396	0.3967	3.9811
G171	46000	10408	9014	6672	9352	0.1206	0.3232	4.1671
G172	12470	3244	2809	2492	2996	1.4273	2.7183	5.4730
G173	12470	5550	4806	5316	6175	0.8343	1.0380	6.7633
G175	12470	4372	3786	3823	4409	1.0590	1.5405	4.9930
G176	12470	2737	2371	2258	2559	1.6914	2.7682	2.9436
G18	46000	11129	9640	8640	10403	0.1128	0.2105	6.6491
G19	46000	8397	7273	5773	7645	0.1495	0.3533	5.2075
G2	12470	6281	5440	6711	6625	0.7371	0.5963	22.7260
G20	46000	27528	23848	32600	31100	0.0456	0.0243	9.4665
G21	46000	7514	6508	4985	6795	0.1670	0.4214	4.8273
G22	12470	3460	2997	3032	3347	1.3381	1.9081	5.6104
G23	12470	4611	3993	4769	4713	1.0042	0.9040	76.8270
G24	46000	9861	8541	7288	9036	0.1273	0.2622	4.9533
G25	12470	4348	3765	4396	4635	1.0649	1.0467	12.3900
G26	12470	3804	3294	3549	3882	1.2172	1.4968	6.0383
G27	12470	3524	3052	3167	3528	1.3138	1.7735	4.7966
G28	12470	3597	3115	3258	3615	1.2873	1.7047	4.6537

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
G29	12470	3517	3046	3151	3514	1.3163	1.7904	4.1289
G3	12470	6465	5599	6912	6772	0.7162	0.5775	34.7940
G31	12470	3029	2623	2459	2845	1.5285	2.5933	7.0940
G32	12470	3193	2766	2568	2987	1.4499	2.5093	5.8949
G34	12470	3117	2699	2411	2878	1.4855	2.7892	4.4759
G35	12470	3570	3092	3071	3411	1.2968	1.9298	9.2340
G36	12470	3598	3116	3104	3440	1.2869	1.9014	9.3776
G37	12470	3683	3190	3209	3532	1.2571	1.8157	9.8538
G38	12470	3780	3274	3330	3638	1.2247	1.7226	10.4590
G39	12470	4230	3663	3679	4048	1.0947	1.5867	6.5607
G4	46000	18753	16246	22816	21884	0.0669	0.0312	10.2450
G40	12470	4530	3923	4364	4492	1.0221	1.1389	19.8840
G41	12470	5096	4414	5284	5200	0.9085	0.8116	63.1910
G44	46000	9186	7957	6531	8417	0.1366	0.3034	5.4973
G45	46000	9427	8165	6773	8656	0.1331	0.2898	5.6089
G46	46000	9680	8384	7032	8910	0.1297	0.2763	5.7314
G47	46000	9498	8227	6846	8728	0.1321	0.2859	5.6431
G48	46000	10232	8862	7619	9468	0.1227	0.2490	6.0171
G49	46000	11091	9607	8594	10360	0.1132	0.2120	6.5228
G5	46000	10817	9370	8277	10098	0.1160	0.2231	7.1921
G50	46000	12708	11008	10667	12128	0.0988	0.1557	7.7445
G51	46000	7039	6097	4172	6307	0.1783	0.5461	3.7495
G52	12470	2936	2542	2368	2772	1.5772	2.7149	6.5799
G53	12470	2908	2519	2339	2743	1.5920	2.7572	6.5112
G54	12470	2845	2464	2273	2678	1.6273	2.8581	6.3578
G55	12470	2785	2412	2212	2617	1.6623	2.9582	6.2185
G56	12470	2698	2337	2123	2528	1.7161	3.1115	6.0263
G562	12470	2074	1796	1556	1901	2.2324	4.4610	1.8658
G57	12470	6131	5310	6612	6489	0.7551	0.5908	22.2650
G58	12470	2648	2293	2074	2477	1.7484	3.2038	5.9216
G59	12470	3875	3356	3682	3810	1.1947	1.3827	8.3159
G6	46000	12435	10772	10294	11823	0.1009	0.1641	7.6577
G60	12470	2728	2362	2153	2558	1.6974	3.0582	6.0904
G61	12470	5765	4992	5951	5888	0.8032	0.7277	16.2210
G62	12470	5765	4992	5951	5888	0.8032	0.7277	16.2210
G63	12470	5331	4617	5238	5297	0.8685	0.9148	12.2840
G64	12470	5226	4526	5076	5170	0.8860	0.9647	11.6040
G65	12470	5115	4430	4908	5039	0.9051	1.0196	10.9640
G66	12470	4913	4255	4648	4913	0.9423	1.1066	9.1454
G67	12470	4737	4102	4396	4696	0.9774	1.2077	8.5436
G68	12470	4567	3955	4162	4493	1.0139	1.3123	8.0339

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
G69	12470	4501	3898	4073	4415	1.0287	1.3551	7.8520
G7	46000	8973	7772	6320	8247	0.1399	0.3163	6.7250
G70	12470	4422	3830	3970	4324	1.0470	1.4075	7.6461
G71	12470	4281	3708	3788	4162	1.0815	1.5063	7.3026
G72	12470	3094	2680	2533	2924	1.4962	2.4925	7.1653
G73	12470	5513	4775	5539	5559	0.8397	0.8283	9.5818
G74	12470	5105	4421	4900	5060	0.9069	1.0215	7.0373
G75	12470	4834	4187	4511	4746	0.9578	1.1644	5.7315
G76	12470	4611	3993	4207	4492	1.0041	1.2938	4.9755
G78	12470	3364	2914	2830	3193	1.3762	2.1574	8.2837
G79	12470	4230	3664	3925	4133	1.0945	1.3504	14.7930
G8	46000	10152	8793	7533	9418	0.1236	0.2528	7.0165
G80	12470	5110	4426	5301	5233	0.9060	0.8080	71.6290
G81	12470	3949	3420	3544	3817	1.1725	1.5748	11.8130
G82	12470	3827	3314	3386	3683	1.2099	1.6826	10.8620
G83	12470	3742	3241	3280	3591	1.2373	1.7612	10.2890
G84	12470	3592	3111	3096	3430	1.2890	1.9095	9.4102
G85	12470	3351	2902	2975	3227	1.3815	1.9067	5.5312
G87	12470	2381	2062	1889	2216	1.9442	3.4644	2.7262
G88	12470	2325	2014	1833	2162	1.9912	3.5966	2.7330
G89	12470	2285	1979	1793	2124	2.0259	3.6941	2.7378
G9	12470	5012	4341	4525	5109	0.9237	1.2428	3.8135
G90	12470	2273	1969	1750	2106	2.0367	3.8637	2.3160
G91	12470	2117	1833	1593	1946	2.1871	4.3457	1.9415
G92	12470	2543	2202	2055	2372	1.8205	3.1169	2.7069
G93	12470	2618	2267	2134	2444	1.7688	2.9716	2.6981
G930	12470	4831	4184	4125	4593	0.9583	1.4508	8.3582
G94	12470	2430	2104	1941	2263	1.9056	3.3442	2.6228
G95	12470	4308	3731	4348	4345	1.0747	1.0449	15.0980
G96	12470	4251	3681	4254	4264	1.0892	1.0864	14.3520
G97	12470	4089	3541	3998	4045	1.1324	1.2098	12.6000
G98	12470	3895	3373	3705	3817	1.1888	1.3714	10.9920
G99	12470	3758	3254	3508	3660	1.2321	1.4954	10.0850
INDUST TAP	46000	7666	6640	5116	6940	0.1637	0.4086	4.8813
S10	12470	3131	2711	2189	2874	1.4789	3.3893	3.0228
S100	12470	3097	2682	2144	2845	1.4952	3.4915	2.8584
S1000	12470	3248	2813	2698	3071	1.4255	2.2987	7.8280
S1003	12470	3299	2857	2832	3132	1.4034	2.0984	4.6002
S1012	12470	3481	3015	2966	3316	1.3299	2.0246	8.7991
S1014	12470	3145	2724	2713	2990	1.4721	2.1764	4.2701
S1031	12470	3632	3145	2758	3459	1.2747	2.5012	2.5464

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S1055	12470	4209	3645	3775	4047	1.1000	1.4798	1.9432
S106	12470	3214	2783	2308	2946	1.4406	3.1383	3.5324
S1075	12470	3892	3370	3255	3827	1.1897	1.9062	4.6711
S1077	12470	3107	2691	2669	2951	1.4902	2.2246	4.5852
S1095	12470	4174	3615	3448	3929	1.1092	1.8104	6.6608
S1109	12470	4259	3688	4188	4243	1.0871	1.1424	27.0800
S111	12470	2991	2591	1804	2859	1.5478	4.7391	0.9657
S117	12470	3920	3395	3026	3711	1.1810	2.2347	3.3263
S1188	12470	4442	3847	4550	4675	1.0423	0.9745	26.0040
S120	12470	5438	4710	5408	5428	0.8514	0.8657	13.0680
S121	12470	5269	4563	3667	4937	0.8787	2.0406	1.7563
S125	12470	5509	4771	3947	5148	0.8405	1.8444	1.9755
S128	12470	5712	4947	4209	5330	0.8105	1.6825	2.2113
S129	12470	5875	5088	4438	5477	0.7881	1.5555	2.4478
S141	12470	4038	3497	3679	4030	1.1466	1.4905	6.6778
S148	12470	2295	1988	1666	2123	2.0171	4.3072	1.6532
S149	12470	2322	2011	1793	2161	1.9937	3.7600	2.4518
S151	12470	2352	2037	1736	2170	1.9685	4.0649	1.7501
S152	12470	2408	2086	1810	2216	1.9225	3.8298	1.8580
S154	12470	3535	3061	2764	3353	1.3098	2.4131	2.8741
S155	12470	3304	2862	2485	3047	1.4012	2.7866	3.4356
S157	12470	3388	2934	2631	3126	1.3666	2.5453	4.1224
S159	12470	3180	2754	2297	2936	1.4559	3.1370	2.7866
S160	12470	5470	4738	4637	5176	0.8463	1.3030	5.7742
S163	12470	5213	4515	4095	4835	0.8881	1.6158	3.6446
S169	12470	5755	4984	5363	5858	0.8045	0.9910	4.4031
S170	12470	5104	4421	3906	4730	0.9071	1.7425	3.1901
S171	12470	4743	4108	3382	4405	0.9762	2.1587	2.2967
S18	12470	2690	2329	1618	2553	1.7215	5.2625	1.0923
S180	12470	4582	3968	3186	4264	1.0104	2.3464	2.0512
S184	12470	4652	4029	3269	4325	0.9952	2.2645	2.1506
S186	12470	4922	4262	3624	4563	0.9407	1.9529	2.6576
S19	12470	2841	2461	1728	2688	1.6295	4.8752	1.1790
S190	12470	4108	3557	2691	3852	1.1271	2.9321	1.5621
S194	12470	3783	3276	2403	3567	1.2240	3.3778	1.3380
S195	12470	3275	2836	2006	3116	1.4136	4.1920	1.0797
S20	12470	2881	2495	1893	2662	1.6073	4.1389	2.1490
S202	12470	4235	3667	2814	3962	1.0934	2.7693	1.6690
S203	12470	3025	2620	1867	2851	1.5305	4.4457	1.2989
S206	12470	2884	2497	1896	2665	1.6056	4.1300	2.1561
S207	12470	3014	2610	2042	2775	1.5360	3.7370	2.5340

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S217	12470	3088	2674	1872	2947	1.4993	4.5433	1.0027
S22	12470	4433	3839	2860	4199	1.0445	2.8101	1.2566
S226	12470	3853	3337	3270	3656	1.2017	1.8451	6.6345
S227	12470	3774	3269	3084	3535	1.2267	2.0505	5.0324
S23	12470	5157	4466	3546	4838	0.8978	2.1349	1.6698
S231	12470	7014	6075	7254	7180	0.6601	0.5947	36.7860
S235	12470	6659	5767	5984	6418	0.6953	0.9307	5.7489
S236	12470	5858	5073	4413	5462	0.7904	1.5686	2.4206
S238	12470	6150	5326	4879	5737	0.7528	1.3413	3.0111
S240	12470	3348	2900	2954	3212	1.3828	1.9368	5.4109
S243	12470	4004	3468	3105	3782	1.1563	2.1655	3.6635
S244	12470	4142	3587	3384	4001	1.1179	1.8782	4.8983
S249	12470	3083	2670	2141	2820	1.5016	3.4871	1.6772
S252	12470	4355	3772	3262	3995	1.0630	2.1317	3.2614
S255	12470	4266	3695	3517	4099	1.0853	1.7844	6.3040
S256	12470	4209	3645	3456	4055	1.1000	1.8263	5.5613
S258	12470	6094	5277	4782	5683	0.7598	1.3852	2.8728
S260	12470	6037	5228	4688	5628	0.7670	1.4297	2.7465
S265	12470	3857	3340	2966	3657	1.2005	2.2900	3.1121
S266	12470	3162	2739	1924	3014	1.4640	4.3996	1.0324
S267	12470	3260	2823	1995	3102	1.4204	4.2201	1.0730
S268	12470	3784	3277	2847	3551	1.2236	2.4375	2.8224
S272	12470	3790	3282	2904	3598	1.2216	2.3505	2.9171
S273	12470	3699	3204	2916	3604	1.2516	2.2877	2.8282
S274	12470	3761	3257	2980	3662	1.2312	2.2238	2.9978
S275	12470	3814	3303	3036	3712	1.2140	2.1703	3.1636
S280	12470	4153	3597	3397	4011	1.1148	1.8691	4.9997
S292	12470	3403	2947	2364	3083	1.3607	3.1544	1.9538
S298	12470	2962	2565	2153	2725	1.5632	3.3267	3.1105
S3	12470	6460	5595	6357	6503	0.7167	0.7524	14.0300
S30	12470	4806	4162	3195	4529	0.9633	2.4461	1.4438
S302	12470	3943	3415	3418	3848	1.1742	1.7218	4.8843
S305	12470	3692	3197	3033	3561	1.2540	2.0812	3.2327
S307	12470	3850	3334	3203	3690	1.2025	1.9363	3.9350
S308	12470	2981	2582	2408	2796	1.5532	2.6638	6.9505
S31	12470	4819	4173	3207	4541	0.9608	2.4342	1.4511
S318	12470	3983	3450	3188	3711	1.1623	2.0328	2.7201
S320	12470	3833	3320	2945	3572	1.2079	2.3014	2.3278
S325	12470	3523	3051	3130	3392	1.3143	1.8092	5.7322
S330	12470	2464	2133	1887	2272	1.8794	3.6033	1.9776
S331	12470	2512	2176	1959	2337	1.8430	3.4064	2.0970

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S332	12470	2387	2067	1781	2198	1.9397	3.9187	1.8154
S336	12470	5999	5196	6227	6529	0.7717	0.7016	7.7537
S337	12470	6055	5244	6326	6565	0.7646	0.6775	8.8504
S338	12470	5870	5084	5718	6129	0.7887	0.8641	5.4373
S339	12470	6015	5209	6255	6540	0.7698	0.6948	8.0259
S34	12470	3156	2733	1920	3008	1.4670	4.4119	1.0298
S342	12470	6291	5449	6474	6533	0.7359	0.6751	10.7930
S343	12470	6348	5498	6726	6684	0.7293	0.6074	15.2230
S346	12470	6391	5535	6832	6650	0.7244	0.5842	28.6780
S348	12470	6299	5455	6645	6679	0.7351	0.6227	12.4100
S349	12470	6170	5344	6427	6632	0.7504	0.6684	8.4972
S35	12470	2771	2399	1655	2659	1.6711	5.2280	0.8874
S351	12470	6073	5259	6280	6588	0.7624	0.7010	7.8984
S354	12470	5691	4929	5687	6239	0.8135	0.8531	4.7254
S355	12470	5567	4822	5474	6096	0.8316	0.9212	4.1158
S356	12470	5748	4978	5785	6300	0.8056	0.8234	5.0740
S358	12470	6178	5350	6537	6618	0.7495	0.6299	13.0520
S359	12470	6144	5321	6480	6608	0.7535	0.6422	11.5230
S360	12470	6008	5203	6242	6535	0.7707	0.6979	7.8978
S361	12470	5706	4942	5713	6255	0.8114	0.8452	4.8120
S362	12470	5578	4831	5304	5900	0.8301	0.9884	3.9238
S363	12470	5356	4638	4988	5578	0.8645	1.0815	3.8797
S366	12470	3257	2821	2864	3165	1.4214	2.0103	4.4833
S373	12470	3196	2768	2720	3061	1.4488	2.2123	3.8215
S374	12470	3117	2699	2556	2939	1.4854	2.4645	3.2401
S38	12470	5674	4914	4157	5295	0.8160	1.7127	2.1626
S381_	12470	4373	3787	4132	4307	1.0587	1.2447	16.7230
S392	12470	3727	3228	3418	3665	1.2421	1.5816	10.2180
S394	12470	3707	3211	3353	3626	1.2489	1.6472	8.8473
S396	12470	3591	3110	3037	3425	1.2892	1.9964	5.2378
S398	12470	3419	2961	2576	3187	1.3543	2.6860	2.4798
S400	12470	5443	4714	4939	5587	0.8507	1.1340	3.3167
S402	12470	5312	4600	4759	5455	0.8717	1.2036	3.0107
S415	12470	4546	3937	4658	4613	1.0185	0.9451	57.3490
S418	12470	3386	2933	2855	3216	1.3672	2.1317	8.3762
S42	12470	2789	2416	1800	2585	1.6598	4.4187	1.9501
S428	12470	4043	3501	3294	3769	1.1452	1.9264	2.9203
S429	12470	3947	3418	3126	3677	1.1731	2.0979	2.6119
S433	12470	3829	3316	2940	3568	1.2090	2.3080	2.3197
S446	12470	3263	2826	2751	3077	1.4187	2.2124	4.1683
S447	12470	3718	3220	2779	3468	1.2454	2.5101	2.1001

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S449	12470	4268	3696	3768	4109	1.0848	1.5171	4.1393
S45	12470	6022	5215	4664	5614	0.7688	1.4409	2.7164
S450	12470	4620	4001	3919	4492	1.0022	1.5468	6.9014
S452	12470	2852	2470	2381	2679	1.6234	2.5871	3.2246
S454	12470	3303	2861	2904	3160	1.4016	1.9801	5.1929
S456	12470	3360	2910	2985	3232	1.3780	1.8980	5.6540
S458	12470	3979	3446	3832	3921	1.1635	1.2975	10.6170
S459	12470	3198	2769	2614	2982	1.4479	2.4187	3.5737
S460	12470	3130	2711	2487	2914	1.4792	2.6275	3.1332
S463	12470	3058	2648	2420	2832	1.5140	2.7119	2.8753
S465	12470	3085	2672	2409	2870	1.5008	2.7650	2.9025
S467	12470	3135	2715	2496	2919	1.4766	2.6107	3.1643
S470	12470	2938	2545	2184	2735	1.5757	3.2124	2.3561
S481	12470	2890	2503	1902	2670	1.6021	4.1108	2.1716
S482	12470	3440	2980	3080	3309	1.3457	1.8177	7.8692
S49	12470	2961	2564	1980	2730	1.5636	3.8959	2.3643
S491	12470	3172	2747	2763	3102	1.4594	2.1156	3.8484
S492	12470	3038	2631	2410	2824	1.5242	2.7142	2.8261
S495	12470	2758	2389	2079	2535	1.6786	3.3225	2.0784
S497	12470	2797	2422	2112	2566	1.6556	3.2640	2.1439
S499	12470	2882	2496	2186	2659	1.6064	3.1412	2.3062
S500	12470	2836	2456	2146	2608	1.6327	3.2065	2.2151
S504	12470	2783	2410	2101	2555	1.6638	3.2849	2.1198
S505	12470	2763	2393	2083	2542	1.6757	3.3178	2.1125
S507	12470	5704	4940	5711	6318	0.8117	0.8558	6.2461
S51	12470	3859	3342	2972	3661	1.1996	2.2830	3.1258
S516	12470	2771	2399	2055	2554	1.6711	3.4180	2.0563
S52	12470	4008	3471	3113	3788	1.1551	2.1574	3.6890
S520	12470	2916	2525	2215	2695	1.5878	3.0956	2.3773
S525	12470	2751	2382	2276	2603	1.6830	2.7390	2.8198
S528	12470	4627	4007	3777	4383	1.0006	1.6775	5.4125
S53	12470	4467	3869	3629	4183	1.0364	1.7543	6.0312
S532	12470	4399	3810	3335	4053	1.0524	2.0606	3.4704
S539	12470	3617	3133	2646	3379	1.2800	2.6949	1.9366
S54	12470	6379	5524	5316	5977	0.7258	1.1611	3.7763
S547	12470	2682	2323	1979	2452	1.7263	3.5674	4.8203
S555	12470	2001	1733	1494	1841	2.3133	4.6710	1.7496
S560	12470	2235	1935	1694	2073	2.0716	4.0601	2.1840
S57	12470	6070	5257	4742	5659	0.7628	1.4039	2.8181
S576	12470	4028	3488	3150	3724	1.1495	2.1100	4.6795
S586	12470	2952	2556	2220	2711	1.5686	3.1200	5.1133

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S587	12470	2893	2505	2116	2647	1.6006	3.3615	4.1933
S588	12470	2832	2452	2021	2594	1.6351	3.6041	3.5669
S590	12470	5743	4974	5356	5606	0.8062	0.9812	10.9540
S592	12470	4821	4175	3495	4486	0.9604	2.0578	2.2922
S594	12470	5288	4579	4224	4922	0.8756	1.5368	3.5778
S595	12470	4441	3846	3042	4152	1.0426	2.4944	1.7960
S598	12470	5204	4507	4074	4839	0.8896	1.6306	3.2372
S603	12470	5060	4382	3836	4702	0.9151	1.7920	2.7916
S604	12470	5292	4583	4234	4927	0.8748	1.5312	3.6005
S606	12470	5463	4731	4586	5142	0.8475	1.3338	4.6774
S61	12470	5513	4775	3952	5152	0.8398	1.8406	1.9803
S615	12470	3334	2887	2584	3084	1.3887	2.5986	3.7805
S617	12470	3269	2831	2526	3033	1.4163	2.6674	3.4413
S618	12470	2721	2356	1848	2511	1.7016	4.1215	1.7748
S619	12470	3213	2782	2475	2988	1.4412	2.7310	3.1956
S620	12470	3160	2736	2427	2946	1.4653	2.7938	2.9976
S624	12470	3033	2627	2232	2776	1.5265	3.1709	2.4872
S626	12470	2895	2507	2314	2696	1.5992	2.8043	3.2022
S627	12470	2603	2255	1851	2381	1.7785	3.9472	3.7278
S63	12470	5052	4375	3437	4746	0.9164	2.2254	1.5956
S637	12470	5413	4688	4108	4987	0.8553	1.6704	2.7091
S638	12470	5280	4572	3910	4871	0.8769	1.7993	2.4404
S64	12470	2878	2493	1755	2721	1.6086	4.7855	1.2017
S642	12470	5042	4366	3593	4666	0.9183	2.0316	2.0807
S644	12470	5782	5007	4773	5476	0.8008	1.3092	4.0068
S65	12470	2966	2569	1822	2799	1.5609	4.5790	1.2585
S657	12470	3086	2673	2202	2845	1.5002	3.3095	2.4993
S66	12470	2785	2412	1686	2638	1.6625	5.0154	1.1456
S661	12470	2999	2598	2282	2811	1.5436	3.0045	2.5287
S662	12470	3052	2643	2329	2856	1.5172	2.9324	2.6638
S663	12470	2952	2556	2198	2735	1.5686	3.1854	2.3576
S665	12470	3569	3091	3033	3392	1.2972	1.9857	8.1059
S68	12470	4227	3660	3167	3895	1.0954	2.1950	3.5456
S681	12470	5508	4771	4262	5083	0.8405	1.5781	2.9465
S69	12470	4150	3594	3046	3826	1.1157	2.3294	3.1671
S692	12470	3686	3192	2719	3386	1.2560	2.5973	3.7145
S693	12470	3626	3141	2736	3329	1.2767	2.5224	4.4673
S695	12470	3806	3296	2929	3510	1.2165	2.3089	4.9058
S696	12470	3376	2924	2586	3117	1.3713	2.6287	5.5158
S698	12470	3352	2903	2539	3083	1.3813	2.7085	5.0582
S699	12470	2654	2299	1942	2473	1.7442	3.6709	2.1983

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S7	12470	3437	2977	2217	3209	1.3470	3.5987	1.6580
S701	12470	2640	2286	1923	2460	1.7537	3.7228	2.1595
S703	12470	2768	2397	2104	2575	1.6725	3.2600	2.5717
S709	12470	2896	2508	2315	2696	1.5990	2.8024	3.2055
S711	12470	3019	2614	2565	2856	1.5336	2.3486	4.3152
S713	12470	2909	2520	2340	2710	1.5913	2.7521	3.2975
S718	12470	2970	2572	2460	2783	1.5587	2.5296	3.7842
S73	12470	3825	3313	2618	3543	1.2104	2.8932	2.2235
S732	12470	4522	3916	2937	4278	1.0240	2.7197	1.2974
S736	12470	4627	4007	3046	4349	1.0007	2.5830	1.3895
S738	12470	4707	4076	3102	4442	0.9837	2.5391	1.3896
S74	12470	3371	2919	2156	3152	1.3736	3.7267	1.5886
S743	12470	4006	3469	2514	3817	1.1557	3.2837	1.0863
S747	12470	3511	3040	2462	3232	1.3189	3.0058	2.7992
S750	12470	3880	3360	3081	3615	1.1934	2.1223	6.2535
S752	12470	3721	3222	2921	3457	1.2443	2.2674	6.0006
S753	12470	3285	2845	2193	3039	1.4094	3.5276	2.1599
S754	12470	3793	3284	2904	3492	1.2208	2.3418	4.7292
S756	12470	3647	3158	2657	3351	1.2695	2.6897	3.4534
S761	12470	6841	5924	6547	6747	0.6768	0.7682	9.4611
S767	12470	5669	4910	5658	6286	0.8167	0.8727	6.1262
S77	12470	3322	2877	2114	3110	1.3935	3.8213	1.5416
S776	12470	1994	1727	1488	1835	2.3220	4.6937	1.7384
S779	12470	1926	1668	1429	1776	2.4045	4.9123	1.6416
S784	12470	2042	1768	1528	1875	2.2677	4.5520	1.8124
S79	12470	2851	2469	1901	2633	1.6240	4.0712	1.4280
S790	12470	3353	2904	2820	3194	1.3809	2.1659	7.3359
S792	12470	4109	3558	3771	4075	1.1268	1.4339	8.2936
S797	12470	2625	2274	2145	2501	1.7635	2.9554	2.4445
S798	12470	3014	2610	2378	2798	1.5363	2.7674	2.7377
S8	12470	3510	3040	2286	3272	1.3191	3.4613	1.7410
S816	12470	1885	1633	1395	1741	2.4559	5.0503	1.5889
S819	12470	3766	3261	2884	3579	1.2294	2.3688	2.8568
S829	12470	6773	5866	7089	7001	0.6835	0.5925	34.9260
S83	12470	3243	2809	2045	3041	1.4276	3.9808	1.4694
S831	12470	2635	2282	2061	2467	1.7574	3.2267	5.6532
S833	12470	2673	2315	2099	2503	1.7319	3.1568	5.9740
S839	12470	3989	3455	3861	4007	1.1605	1.2782	7.6791
S84	12470	3099	2684	1926	2916	1.4940	4.2830	1.3528
S844	12470	6065	5253	5480	5959	0.7633	1.0103	6.9804
S849	12470	3244	2809	2832	3097	1.4273	2.0508	5.4962

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
S850	12470	3122	2703	2684	2965	1.4832	2.2096	5.3498
S857	12470	5439	4711	5122	6021	0.8512	1.1130	5.5647
S86	12470	3055	2645	2091	2809	1.5157	3.6163	2.6827
S863	12470	3972	3440	3253	3796	1.1656	1.9437	5.7141
S866	12470	5712	4947	5559	6348	0.8106	0.9509	7.5557
S869	12470	6348	5498	6506	6838	0.7293	0.6889	14.1280
S87	12470	3117	2700	2172	2863	1.4851	3.4288	2.9569
S871	12470	6583	5701	6836	6899	0.7033	0.6272	20.9890
S874	12470	3020	2615	2301	2829	1.5331	2.9759	2.5798
S875	12470	3743	3241	2930	3545	1.2370	2.2728	3.6369
S876	12470	3831	3318	3105	3684	1.2086	2.0651	4.3707
S877	12470	3901	3379	3179	3741	1.1867	2.0025	4.9444
S88	12470	3181	2754	2259	2917	1.4557	3.2396	3.3055
S884	12470	5391	4669	4984	5890	0.8588	1.1650	4.1414
S892	12470	5830	5049	5738	6466	0.7941	0.8923	8.2665
S895	12470	5564	4818	5336	6190	0.8322	1.0303	6.8242
S9	12470	3162	2738	2232	2901	1.4642	3.2951	3.1940
S903	12470	3676	3183	2951	3572	1.2597	2.2083	3.9174
S906	12470	3465	3001	2729	3377	1.3363	2.4478	3.0138
S907	12470	3874	3355	3160	3737	1.1950	2.0163	5.3396
S91	12470	3374	2922	2882	3323	1.3720	2.0934	3.7457
S920	12470	2756	2387	2078	2533	1.6799	3.3259	2.0749
S929	12470	6229	5395	6038	6300	0.7433	0.8162	14.3740
S93	12470	3458	2995	3088	3486	1.3387	1.8432	4.6052
S933	12470	5315	4603	4910	5846	0.8711	1.1995	4.6644
S933_	12470	3899	3376	2919	3593	1.1875	2.3838	3.5816
S936	12470	3718	3220	3061	3583	1.2452	2.0559	3.3300
S937	12470	3782	3275	3129	3635	1.2243	1.9966	3.5940
S96	12470	3137	2717	2198	2880	1.4760	3.3707	3.0549
S966	12470	2650	2295	1618	2507	1.7470	5.1879	1.0944
S967	12470	2748	2380	1668	2602	1.6848	5.0602	1.1313
S979	12470	2940	2546	2309	2740	1.5748	2.8660	2.5365
S981	12470	3070	2658	2431	2843	1.5083	2.6979	2.9136
S982	12470	3028	2623	2392	2809	1.5289	2.7490	2.7809
S983	12470	3118	2701	2476	2900	1.4848	2.6408	3.0879
S984	12470	3843	3329	3130	3717	1.2046	2.0413	5.2308
S989	12470	3349	2900	2939	3308	1.3825	1.9742	3.7033
S99	12470	3272	2834	2400	2998	1.4148	2.9590	4.0311
S997	12470	3117	2699	2553	2935	1.4854	2.4700	7.3718
SF TAP 1	46000	8299	7188	5684	7549	0.1512	0.3601	5.1209
SPANISH FORK	46000	27528	23849	32601	31101	0.0456	0.0243	9.4683

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T1000	12470	2679	2320	1804	2476	1.7282	4.2548	1.7096
T1003	12470	3025	2620	2220	2765	1.5305	3.1946	2.4613
T1005	12470	3152	2730	2414	2935	1.4690	2.8175	2.9587
T1006	12470	3253	2817	2498	3011	1.4232	2.7143	3.3373
T1008	12470	2816	2439	2179	2620	1.6440	3.0878	2.7751
T1009	12470	2711	2348	2020	2523	1.7077	3.4655	2.3684
T1024	12470	3869	3351	2970	3581	1.1966	2.2840	3.1434
T1028	12470	4346	3764	2942	4069	1.0653	2.6078	1.7044
T1039	12470	5389	4667	4071	4965	0.8592	1.6940	2.6551
T104	12470	3090	2676	2136	2840	1.4982	3.5101	2.8306
T1043	12470	5199	4503	3798	4801	0.8905	1.8773	2.3047
T1047	12470	3544	3069	3033	3367	1.3064	1.9675	5.0094
T1057	12470	3622	3137	2968	3399	1.2783	2.1229	5.5578
T1060	12470	3139	2719	2241	2900	1.4748	3.2515	2.6289
T1063	12470	4869	4217	3388	4519	0.9509	2.2036	1.8824
T1069	12470	3501	3032	2864	3286	1.3225	2.2050	5.8364
T107	12470	3065	2655	2104	2819	1.5104	3.5846	2.7250
T1077	12470	6120	5300	4827	5708	0.7565	1.3646	2.9358
T1079	12470	6598	5714	6233	6476	0.7017	0.8253	9.4726
T1087	12470	5759	4987	4725	5440	0.8040	1.3326	3.8822
T109	12470	5039	4364	4027	4719	0.9188	1.6118	2.8174
T1090	12470	5484	4750	4222	5050	0.8442	1.6016	2.8817
T11	12470	3425	2966	2206	3199	1.3519	3.6223	1.6446
T1102	12470	5998	5195	5289	5834	0.7719	1.0846	5.8686
T1105	12470	2741	2374	1753	2544	1.6892	4.5701	1.8591
T1110	12470	3578	3099	2653	3284	1.2939	2.6478	3.9813
T1114	12470	3612	3128	2605	3321	1.2817	2.7703	3.2563
T1116	12470	3791	3283	2900	3490	1.2214	2.3464	4.7058
T1119	12470	3446	2984	2653	3174	1.3437	2.5482	4.3959
T112	12470	2914	2524	1929	2691	1.5886	4.0363	2.2343
T1120	12470	3369	2918	2572	3107	1.3741	2.6515	5.3764
T1126	12470	2634	2281	1915	2454	1.7580	3.7464	2.1425
T1132	12470	2709	2346	2017	2522	1.7090	3.4726	2.3621
T1144	12470	2412	2089	1655	2260	1.9194	4.5806	1.6883
T1159	12470	2625	2273	1884	2400	1.7637	3.8437	3.9694
T116	12470	3029	2623	2059	2788	1.5286	3.6932	2.5858
T1162	12470	2563	2219	1792	2346	1.8067	4.1388	3.3556
T1167	12470	2823	2445	2190	2626	1.6399	3.0630	2.8075
T1174	12470	4498	3895	2916	4257	1.0294	2.7435	1.2863
T1180	12470	4682	4055	3079	4420	0.9889	2.5629	1.3765
T1181	12470	4603	3986	3024	4328	1.0059	2.6068	1.3767

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T1192	12470	2715	2351	1984	2482	1.7054	3.5918	4.4056
T1198	12470	3500	3031	2449	3223	1.3227	3.0291	2.7615
T1209	12470	3265	2828	2171	3022	1.4180	3.5745	2.1179
T1210	12470	3783	3276	2886	3479	1.2238	2.3647	4.6143
T122	12470	3573	3094	2703	3404	1.2959	2.5637	2.4299
T1222	12470	6366	5513	6152	6294	0.7273	0.8035	15.8650
T1231	12470	3478	3012	3007	3361	1.3312	1.9604	1.3688
T1232	12470	3358	2908	2845	3294	1.3787	2.1410	3.6190
T1236	12470	3252	2817	2820	3225	1.4236	2.0973	3.2451
T1239	12470	4100	3551	3743	4057	1.1293	1.4569	7.9156
T124	12470	2603	2254	1557	2475	1.7790	5.5003	1.0466
T1241	12470	1990	1723	1482	1829	2.3267	4.7176	1.7299
T125	12470	3785	3278	2805	3518	1.2232	2.5083	2.7612
T1252	12470	2745	2377	2264	2593	1.6868	2.7627	2.7897
T1268	12470	2519	2182	2031	2348	1.8377	3.1636	2.7266
T1271	12470	2941	2547	2261	2715	1.5740	2.9947	2.4688
T1274	12470	2722	2357	2048	2505	1.7008	3.3798	2.0202
T1282	12470	2984	2584	2258	2790	1.5516	3.0523	2.4765
T1284	12470	3078	2666	2191	2838	1.5042	3.3330	2.4728
T1286	12470	2612	2262	1851	2380	1.7724	3.9574	2.9787
T1294	12470	1872	1621	1383	1730	2.4735	5.0977	1.5720
T1296	12470	3797	3288	2356	3628	1.2193	3.5457	1.0147
T1298	12470	3818	3307	2923	3558	1.2125	2.3279	2.2958
T1301	12470	3322	2877	2514	3063	1.3939	2.7371	3.5558
T1306	12470	1905	1650	1404	1750	2.4299	5.0358	1.6042
T1312	12470	2018	1747	1497	1848	2.2948	4.6901	1.7594
T1317	12470	1993	1726	1483	1830	2.3228	4.7188	1.7324
T132	12470	4242	3674	2701	4029	1.0914	3.0128	1.1759
T1323	12470	2099	1818	1569	1932	2.2053	4.4412	1.8977
T1332	12470	6518	5645	5816	6332	0.7103	0.9687	4.8470
T1336	12470	6817	5904	6464	6701	0.6792	0.7905	8.6736
T1337	12470	5421	4695	5062	5967	0.8540	1.1363	5.3398
T1346	12470	3296	2855	2887	3149	1.4045	2.0030	5.0719
T1348	12470	2715	2351	2008	2496	1.7052	3.5087	1.9687
T1353	12470	2727	2362	2038	2500	1.6975	3.4214	2.0107
T136	12470	5449	4719	3874	5095	0.8497	1.8926	1.9159
T1363	12470	5027	4353	4452	5446	0.9211	1.4077	3.4382
T1372	12470	3655	3166	2939	3483	1.2666	2.1987	3.0211
T1383	12470	2982	2582	2222	2760	1.5528	3.1460	2.4211
T1386	12470	3015	2611	2296	2824	1.5358	2.9831	2.5668
T1389	12470	2642	2288	1612	2499	1.7527	5.2117	1.0897

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T1393	12470	2877	2492	2094	2638	1.6091	3.4151	2.1582
T1395	12470	3792	3284	3025	3621	1.2210	2.1573	4.0089
T1399	12470	3043	2635	2394	2816	1.5215	2.7590	2.8069
T1402	12470	3834	3321	3109	3701	1.2075	2.0648	5.0886
T1404	12470	5600	4850	5333	6171	0.8267	1.0314	5.3756
T1405	12470	5137	4449	4708	5692	0.9012	1.2958	5.3455
T1408_	12470	6329	5481	6423	6778	0.7315	0.7123	12.5400
T1409	12470	6564	5685	6749	6847	0.7053	0.6496	17.5510
T142	12470	5626	4872	4094	5252	0.8230	1.7509	2.1042
T1422	12470	3412	2955	2891	3272	1.3568	2.0932	6.7804
T1425	12470	3605	3122	2632	3318	1.2843	2.7089	3.3120
T1439	12470	3868	3350	3152	3731	1.1971	2.0224	5.2649
T1452	12470	3958	3428	3238	3785	1.1698	1.9550	5.5411
T153	12470	2334	2022	1812	2172	1.9835	3.7001	2.5024
T159	12470	3429	2969	2592	3201	1.3503	2.6622	2.5095
T161	12470	2384	2064	1901	2225	1.9424	3.4205	2.3177
T163	12470	3259	2823	2414	3006	1.4205	2.9143	3.1634
T165	12470	5452	4722	4593	5148	0.8491	1.3258	5.5310
T172	12470	4829	4182	4104	4584	0.9587	1.4673	7.9373
T175	12470	5193	4498	4059	4816	0.8915	1.6389	3.5511
T176	12470	5801	5024	5336	5641	0.7982	1.0071	11.5990
T182	12470	5084	4403	3873	4712	0.9106	1.7658	3.1198
T185	12470	4820	4174	3483	4472	0.9606	2.0700	2.4379
T190	12470	4632	4011	3245	4307	0.9996	2.2880	2.1210
T203	12470	3965	3434	2561	3727	1.1676	3.1217	1.4564
T210	12470	3766	3262	2389	3552	1.2293	3.4016	1.3282
T211	12470	3262	2825	1996	3104	1.4194	4.2158	1.0740
T214	12470	3917	3392	3624	3806	1.1821	1.4686	7.3054
T219	12470	4216	3651	2795	3946	1.0982	2.7930	1.6524
T221	12470	3006	2604	2033	2769	1.5400	3.7604	2.5074
T230	12470	3246	2811	1985	3090	1.4262	4.2439	1.0674
T232	12470	3138	2717	1907	2992	1.4757	4.4472	1.0223
T236	12470	2851	2469	1708	2732	1.6241	5.0431	0.9149
T237	12470	3040	2633	1838	2904	1.5228	4.6386	0.9842
T245	12470	3732	3232	2996	3474	1.2405	2.1560	4.4898
T249	12470	3795	3287	3130	3566	1.2200	1.9974	5.3623
T252	12470	4341	3759	3239	3976	1.0666	2.1551	3.1985
T256	12470	5613	4861	4078	5241	0.8248	1.7608	2.0896
T267	12470	3910	3386	2943	3646	1.1840	2.3549	3.1556
T270	12470	4131	3577	3360	3983	1.1209	1.9018	4.7640
T273	12470	2827	2449	1878	2614	1.6375	4.1338	1.4063

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T288	12470	4201	3638	3448	4049	1.1021	1.8322	5.4732
T292	12470	5973	5173	4587	5568	0.7751	1.4789	2.6203
T294	12470	6006	5202	4639	5599	0.7708	1.4531	2.6847
T30	12470	4796	4154	3186	4521	0.9653	2.4551	1.4383
T300	12470	6325	5477	5205	5916	0.7320	1.2043	3.5561
T307	12470	3769	3264	2823	3530	1.2283	2.4688	2.7697
T308	12470	2777	2405	1788	2574	1.6673	4.4577	1.9257
T310	12470	3772	3267	2828	3535	1.2274	2.4613	2.7812
T311	12470	4001	3465	3616	3882	1.1571	1.5282	12.1540
T312	12470	4409	3818	4180	4338	1.0502	1.2228	17.6150
T317	12470	3631	3145	2760	3461	1.2750	2.4972	2.5487
T325	12470	3122	2703	2063	2863	1.4831	3.7718	1.5838
T332	12470	2892	2504	2054	2664	1.6012	3.5643	2.7551
T34	12470	4793	4151	3183	4518	0.9659	2.4579	1.4366
T341	12470	3671	3179	2992	3527	1.2612	2.1289	3.1293
T352	12470	5482	4748	5422	5493	0.8445	0.8728	8.3462
T364	12470	2971	2573	2384	2781	1.5584	2.7091	6.5704
T365	12470	3072	2661	2450	2868	1.5070	2.6554	5.8467
T368_	12470	3655	3166	3130	3486	1.2666	1.9053	8.1895
T37	12470	3067	2656	1857	2928	1.5098	4.5857	0.9944
T373	12470	3576	3097	2900	3462	1.2946	2.2154	4.3879
T381	12470	3882	3362	3232	3809	1.1928	1.9299	4.5560
T387	12470	3731	3231	2798	3480	1.2408	2.4855	2.1243
T388	12470	3378	2925	2790	3163	1.3708	2.2373	3.7932
T4	12470	6405	5547	6147	6385	0.7228	0.8149	10.3420
T401	12470	2331	2019	1710	2153	1.9860	4.1529	1.7134
T402	12470	2400	2079	1799	2209	1.9290	3.8637	1.8415
T407	12470	2349	2035	1733	2168	1.9707	4.0759	1.7455
T41	12470	2738	2371	1633	2629	1.6909	5.3057	0.8766
T410	12470	5849	5066	5648	6076	0.7915	0.8878	5.2062
T412	12470	5563	4818	4872	5477	0.8323	1.1928	3.4044
T414	12470	6321	5475	6504	6478	0.7324	0.6710	14.0910
T415	12470	5346	4630	5104	5821	0.8661	1.0514	3.3630
T417	12470	5980	5179	6148	6467	0.7743	0.7253	7.2800
T418	12470	6160	5335	6455	6563	0.7516	0.6528	11.7200
T419	12470	5196	4500	4604	5335	0.8910	1.2681	2.7871
T42	12470	4667	4042	3066	4407	0.9920	2.5767	1.3691
T42_	12470	2774	2403	1785	2572	1.6689	4.4657	1.9208
T431	12470	3463	2999	3017	3410	1.3371	1.9417	3.6629
T435	12470	3086	2673	2525	2915	1.5001	2.5026	3.1152
T442	12470	3250	2815	2847	3153	1.4245	2.0337	4.3942

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T447	12470	3939	3411	3519	3807	1.1755	1.5970	10.9680
T449	12470	4003	3466	3426	3801	1.1567	1.7413	5.3005
T458	12470	3730	3230	3404	3626	1.2413	1.5982	7.4137
T463	12470	3648	3159	3182	3520	1.2691	1.8295	6.4828
T465	12470	3680	3187	3261	3539	1.2582	1.7438	5.9474
T466	12470	3583	3103	3018	3412	1.2920	2.0195	5.1043
T469	12470	3408	2952	2561	3173	1.3583	2.7099	2.4509
T471	12470	4813	4168	4258	4915	0.9619	1.3689	3.1735
T473	12470	4016	3478	3828	4001	1.1528	1.3250	13.3270
T482	12470	4538	3930	4620	4582	1.0203	0.9662	41.7900
T487	12470	3351	2902	2773	3168	1.3818	2.2460	4.0449
T494	12470	4048	3506	3849	3987	1.1437	1.3215	17.7080
T496	12470	3850	3335	3581	3764	1.2025	1.4748	15.4880
T498	12470	2443	2116	1544	2292	1.8951	5.2630	1.1185
T5	12470	5906	5115	5677	6126	0.7839	0.8908	5.1664
T500	12470	3623	3138	3125	3464	1.2778	1.8907	9.1094
T504	12470	3427	2968	2728	3190	1.3509	2.3891	4.8237
T508	12470	3227	2795	2538	3003	1.4347	2.6042	4.4630
T51	12470	2882	2496	1894	2663	1.6064	4.1342	2.1527
T519	12470	3640	3153	2676	3399	1.2719	2.6522	1.9717
T527	12470	3803	3294	2901	3544	1.2174	2.3553	2.2637
T53	12470	3996	3461	3091	3771	1.1585	2.1811	3.6149
T532	12470	2977	2578	2240	2770	1.5552	3.0938	2.4775
T554	12470	2840	2459	2356	2660	1.6305	2.6340	3.1445
T557	12470	3067	2656	2620	2908	1.5097	2.2831	5.1395
T559	12470	3234	2801	2820	3086	1.4318	2.0630	5.4555
T560	12470	3779	3272	2884	3581	1.2253	2.3744	2.8731
T566	12470	3101	2685	2654	2941	1.4932	2.2477	4.4963
T572	12470	2229	1931	1750	2078	2.0770	3.7856	2.2901
T578	12470	2261	1958	1754	2102	2.0475	3.8254	2.6117
T582	12470	1963	1700	1501	1829	2.3586	4.5369	2.1133
T587	12470	3292	2851	2815	3121	1.4065	2.1215	4.5053
T591	12470	3167	2742	2583	2958	1.4621	2.4533	3.4177
T599	12470	2923	2531	2163	2721	1.5840	3.2594	2.3116
T602	12470	3074	2662	2391	2860	1.5060	2.7977	2.8529
T610	12470	3698	3203	3323	3556	1.2519	1.6758	7.0649
T611	12470	3849	3333	3552	3734	1.2029	1.5041	8.0880
T622	12470	4138	3584	3856	4027	1.1189	1.3643	6.9431
T63	12470	5427	4700	3849	5076	0.8531	1.9101	1.8953
T631	12470	3589	3108	3228	3453	1.2901	1.7226	7.8217
T633	12470	3740	3239	3472	3640	1.2379	1.5246	8.7117

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T6380	12470	4360	3776	3791	4384	1.0620	1.5644	4.8460
T65	12470	5025	4352	3409	4722	0.9214	2.2491	1.5775
T654	12470	5092	4410	4913	5139	0.9092	1.0113	9.8478
T660	12470	4573	3961	4154	4442	1.0124	1.3194	4.0908
T67	12470	2868	2484	1748	2712	1.6141	4.8092	1.1956
T672	12470	4370	3785	4323	4347	1.0595	1.0940	10.3580
T698	12470	4093	3545	3554	3951	1.1312	1.6486	6.8890
T699	12470	4208	3645	3696	4080	1.1001	1.5598	7.1371
T7	12470	2751	2383	1662	2608	1.6829	5.1014	1.1263
T700	12470	4339	3758	3862	4228	1.0670	1.4648	7.4403
T701	12470	4514	3910	4092	4431	1.0256	1.3460	7.8896
T703	12470	4651	4028	4276	4592	0.9955	1.2597	8.2779
T704	12470	4832	4185	4499	4710	0.9581	1.1715	9.6088
T705	12470	5022	4350	4771	4930	0.9219	1.0676	10.4790
T707	12470	3829	3316	3238	3659	1.2091	1.8732	4.9346
T71_	12470	4137	3582	3026	3814	1.1193	2.3527	3.1104
T710	12470	3254	2818	2233	3060	1.4227	3.4007	1.5116
T741	12470	2744	2376	2059	2516	1.6873	3.3703	2.0456
T746	12470	3033	2626	2406	2820	1.5267	2.7206	2.8102
T749	12470	3046	2638	2496	2894	1.5199	2.5279	2.9864
T753	12470	2697	2336	1959	2492	1.7167	3.6605	1.9030
T758	12470	2785	2412	2075	2566	1.6623	3.3699	2.0901
T76	12470	3812	3301	2602	3531	1.2146	2.9166	2.1974
T761	12470	2749	2380	2062	2523	1.6845	3.3655	2.0786
T781	12470	2760	2391	2186	2591	1.6772	3.0007	6.1628
T784	12470	3721	3222	3461	3630	1.2443	1.5246	7.7900
T785	12470	3981	3448	3832	3989	1.1631	1.3010	7.3633
T788	12470	3895	3373	3707	3821	1.1886	1.3696	10.4550
T79	12470	3359	2909	2146	3141	1.3786	3.7504	1.5765
T791	12470	4614	3996	3748	4363	1.0035	1.7006	5.2303
T792	12470	4385	3798	3311	4034	1.0559	2.0839	3.3985
T799	12470	2821	2443	2249	2654	1.6411	2.8974	6.3016
T801	12470	2644	2290	2070	2473	1.7509	3.2109	5.9137
T802	12470	2599	2251	2026	2428	1.7811	3.2971	5.8228
T836	12470	2989	2588	2254	2747	1.5491	3.0646	5.1565
T850	12470	4029	3489	3268	3756	1.1492	1.9514	2.8705
T854	12470	3376	2923	2987	3235	1.3715	1.9067	7.3987
T874	12470	2655	2299	1955	2427	1.7438	3.6171	4.7928
T889	12470	2445	2117	1872	2261	1.8936	3.6343	5.6707
T893	12470	2675	2317	2094	2488	1.7308	3.1707	6.1580
T902	12470	3121	2703	2420	2884	1.4833	2.7731	4.5376

Bus Results: 0.5 Cycle--Symmetrical

Bus Name	Pre-Flt	3P Flt.	LL Flt.	LG Flt.	LLG Flt.	Thevenin Imped. Z+(pu)	Thevenin Imped. Zo(pu)	Complex 3P X/R
	V	A	A	A	A			
T908	12470	2529	2190	1898	2321	1.8309	3.6555	4.6182
T910	12470	2479	2147	1904	2294	1.8675	3.5599	5.7383
T911	12470	2478	2146	1903	2293	1.8682	3.5620	5.7364
T913	12470	3646	3158	2555	3369	1.2697	2.9010	2.5267
T918	12470	4214	3649	3477	3964	1.0987	1.7975	6.8599
T919	12470	2661	2305	1960	2433	1.7398	3.6057	4.7991
T92	12470	3174	2749	1987	2981	1.4585	4.1229	1.4117
T923	12470	2675	2317	1930	2446	1.7305	3.7342	4.0571
T928	12470	3571	3093	2760	3298	1.2965	2.4390	5.0560
T929	12470	2547	2206	1861	2325	1.8178	3.8269	4.6855
T93	12470	3077	2665	1909	2896	1.5046	4.3304	1.3365
T938	12470	4007	3470	3109	3696	1.1556	2.1558	4.4471
T947	12470	3237	2804	2480	2987	1.4301	2.7411	5.3410
T954	12470	2840	2460	2033	2601	1.6303	3.5709	3.6405
T956	12470	2778	2406	1944	2547	1.6667	3.8136	3.1684
T958	12470	2715	2351	1861	2494	1.7054	4.0573	2.8117
T960	12470	2614	2264	1761	2404	1.7714	4.3507	2.5839
T968	12470	5398	4675	4443	5045	0.8578	1.4106	4.1841
T97	12470	3005	2603	2031	2768	1.5405	3.7632	2.5042
T971	12470	5247	4544	4149	4881	0.8825	1.5832	3.4000
T98	12470	3086	2673	2131	2836	1.5001	3.5217	2.8135
T980	12470	5184	4489	4038	4819	0.8932	1.6539	3.1634
T998	12470	4590	3975	3208	4282	1.0088	2.3206	1.9613
TAYLOR SUVPS	46000	9861	8541	7288	9036	0.1273	0.2622	4.9531

APPENDIX 4 – MODEL INPUT DATA

Paladin DesignBase

3-Phase Short Circuit v6.70.00

Project No. :	Page : 1
Project Name: Spansih Fork City	Date : 04/25/2013
Title :	Time : 09:39:04 am
Drawing No. :	Company : ICPE
Revision No.:	Engineer: MTF
Jobfile Name: SPANISH_FORK_2012	Check by:
Scenario : 1 :	Date :

System Summary

Base MVA	:	100.000
System Frequence(Hz)	:	60
# of Total Buses	:	813
# of Active Buses	:	762
# of Total Branches	:	764
# of Active Sources	:	3
# of Active Motors	:	0
# of Active Shunts	:	297
# of Transformers	:	7
Reference Temperature(°C)	:	20.0
Impedance Displaying Temperature(°C)	:	25.0

Calculation Options

Calculating All or Mult-Buses Fault with Fault Z = 0.00000 + j 0.00000 Ohms

Fault Phases:
    Phase A for Line-Ground Fault
    Phase B,C for Line-Line or Line-Line-Ground Fault

Classical Calculation:
    Complex Z for X/R and Fault Current

Transformer Phase Shift is not considered.
Generator and Motor X/R is constant.
Base Voltages : Adjusted by Tap/Turn Ratio
Prefault Voltages : Use System Voltages

Input Data Report

Utility/Power Company Data

Bus Name	System V	Cd	SCkVA	X"/R	Ground
DRY CREEK	46000	PC	889825.3-3P	19.901(+)	Solid
Actual V.->	46000		770965.6-LL	19.433(-)	
			1154882-LG	8.7569(0)	
SPANISH FORK	46000	PC	1590907-3P	10.810(+)	Solid
Actual V.->	46000		1378350-LL	10.671(-)	
			1967440-LG	9.6667(0)	
TAYLOR SUVPS	46000	PC	223082.2-3P	16.873(+)	Solid
Actual V.->	46000		193252.6-LL	16.630(-)	
			192771.3-LG	3.5824(0)	

Transformers Data

Branch Name	Cd	Device Type	kVA	%R	%X		Nameplt V	Ground Ohms
ARGYLE	TR	XFMR 11760 KVA	11760	0	9.688	(+)	46000	Delta
				0	9.688	(0)	12470	Y-Solid
		%Z = 9.688	X/R =	-		(+)		
CANYON	TR	XFMR 20000 KVA	20000	0	11.48	(+)	46000	Delta
				0	11.48	(0)	12470	Y-Solid
		%Z = 11.48	X/R =	-		(+)		
INDUSTRIAL	TR	XFMR 20000 KVA	20000	0	11.82	(+)	46000	Delta
				0	11.82	(0)	12470	Y-Solid
		%Z = 11.82	X/R =	-		(+)		
MAPLE	TR	XFMR 20000 KVA	20000	0	11.85	(+)	46000	Delta
				0	11.85	(0)	12470	Y-Solid
		%Z = 11.85	X/R =	-		(+)		
NORTH	TR	XFMR 20000 KVA	20000	0	11.55	(+)	46000	Delta
				0	11.55	(0)	12470	Y-Solid
		%Z = 11.55	X/R =	-		(+)		
WHITEHEAD	TR	XFMR 10500 KVA	10500	0	9.492	(+)	46000	Delta
				0	9.492	(0)	12470	Y-Solid
		%Z = 9.492	X/R =	-		(+)		
WOODHOUSE	TR	XFMR 14000 KVA	14000	0	11.31	(+)	46000	Delta
				0	11.31	(0)	12470	Y-Solid
		%Z = 11.31	X/R =	-		(+)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L1028		SF 15 kV 1/0	456	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1061		SF 3/0 OH	1042	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L1091		SF 15 kV-750	840	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L1120		SF 477 OH	1753	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1121		SF 477 OH	649	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1126		SF 477 OH	2810	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1128		SF 15 kV 1/0	929	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1129		SF #2 OH	842	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L1156		SF 15 kV 1/0	267	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1166		SF 15 kV 1/0	424	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1169		SF 15 kV 1/0	151	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1170		SF 15 kV 1/0	590	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1171		SF 15 kV-4/0	165	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1173		SF 15 kV-4/0	400	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1178		SF 15 kV-4/0	421	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1183		SF 15 kV-750	1887	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L1184		SF 15 kV-750	425	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L1187		SF 15 kV-4/0	596	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1188		SF 15 kV-4/0	742	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1194		SF 15 kV-4/0	838	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1194_		SF 477 OH	427	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1196		SF 15 kV-4/0	189	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1197		SF 15 kV-4/0	420	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L1199		SF 15 kV-4/0	365	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1200		SF 15 kV-4/0	481	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1201		SF 15 kV-4/0	465	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1202		SF 15 kV-4/0	538	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1203		SF 15 kV-4/0	465	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1205		SF 15 kV 1/0	300	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1206		SF 477 OH	230	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1211		SF #4 OH	1054	0.4159	0.1428	(+)		20.0
				0.5502	0.5054	(0)		
L1228		SF 3/0 OH	1703	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L1229		SF 477 OH	450	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1231		SF 1/0 OH	677	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L1233		SF #2 OH	234	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L1234		SF 15 kV 1/0	318	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1254		SF 477 OH	1574	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1276		SF #2 OH	564	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L1278		SF 15 kV 1/0	145	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1282		SF 1/0 OH	894	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L1284		SF 15 kV 1/0	763	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1298		SF 15 kV 1/0	1162	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1300		SF 477 OH	1250	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1306		SF 15 kV-4/0	435	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1323		SF 15 kV 1/0	2100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1349		SF 15 kV 1/0	728	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L1362		SF 477 OH	2548	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1367		SF 15 kV 1/0	1292	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1371		SF 477 OH	250	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1382		SF 15 kV 1/0	1012	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1403		SF 15 kV 1/0	494	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1425		SF 15 kV 1/0	389	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L143		SF 15 kV 1/0	1195	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1432		SF 15 kV 1/0	625	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1454		SF 15 kV 1/0	441	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1455		SF 15 kV 1/0	569	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1456		SF 15 kV 1/0	630	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1457		SF 15 kV 1/0	1100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L146		SF 15 kV 1/0	321	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1460		SF 15 kV 1/0	390	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1492		SF 15 kV-4/0	2163	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1498		SF 15 kV-4/0	400	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1504		SF 15 kV-4/0	754	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L1553		SF 15 kV 1/0	279	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1556		SF 1/0 OH	3070	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L1561		SF 4/0 OH	2481	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L1568		SF 15 kV 1/0	437	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1580		SF 15 kV 1/0	448	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1608		SF 15 kV 1/0	1044	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L1609		SF 15 kV 1/0	742	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L168		SF 15 kV 1/0	199	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L169		SF 15 kV 1/0	1422	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L170		SF 15 kV 1/0	995	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1702		SF 15 kV 1/0	385	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L1715		SF 477 OH	592	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1744		SF 477 OH	1250	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1755		SF 477 OH	733	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1773		SF 477 OH	674	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1803		SF 3/0 OH	856	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L1831		SF 1/0 OH	722	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L1841		SF 477 OH	673	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1849		SF 477 OH	720	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1854		SF 477 OH	721	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1856		SF 477 OH	654	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1858		SF 477 OH	724	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1859		SF 477 OH	724	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L1862		SF 477 OH	730	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L194		SF 15 kV 1/0	343	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L195		SF 15 kV 1/0	415	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L196		SF 15 kV 1/0	1809	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2078		SF 15 kV-4/0	800	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2079		SF 15 kV 1/0	414	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L2088		SF 15 kV 1/0	492	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2092		SF 15 kV 1/0	676	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2107		SF 15 kV 1/0	474	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2115		SF 15 kV 1/0	545	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2119		SF 15 kV 1/0	412	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2137		SF 15 kV 1/0	944	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2139		SF 15 kV 1/0	660	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2174		SF 15 kV 1/0	809	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2180		SF 15 kV 1/0	874	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2197		SF 15 kV 1/0	364	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2200		SF 15 kV 1/0	1172	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2225		SF 15 kV 1/0	1888	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2270		SF 477 OH	527	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L2272		SF 1/0 OH	812	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L2280		SF 477 OH	582	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L2298		SF 15 kV 1/0	1486	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2357		SF 477 OH	627	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L2364		SF 15 kV-4/0	846	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2366		SF 15 kV 1/0	536	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2367		SF 15 kV 1/0	529	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2372		SF 15 kV-4/0	410	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2374		SF 15 kV-4/0	893	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2378		SF 15 kV-4/0	803	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L2387		SF 15 kV 1/0	431	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2408		SF 15 kV-750	1716	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L2487		SF 15 kV 1/0	806	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L249		SF 477 OH 46 kV	540	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L250		SF #4 OH	1556	0.4159	0.1428	(+)		20.0
				0.5502	0.5054	(0)		
L251		SF 4/0 OH	1010	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L2514		SF 15 kV 1/0	869	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2515		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2554		SF 15 kV 1/0	444	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L2605		SF 15 kV-4/0	1040	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2654		SF 15 kV-4/0	1200	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L2660		SF 15 kV-750	832	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L2661		SF 15 kV-750	832	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L2833		SF 477 OH	722	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L2928		SF 477 OH	282	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L2929		SF 477 OH	1200	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L316		SF 15 kV 1/0	439	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L3166		SF 477 OH	1157	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L318		SF 15 kV 1/0	838	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L319		SF 15 kV 1/0	451	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L3399		SF 15 kV 1/0	1162	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L3453		SF 15 kV 1/0	510	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L3510		SF 1/0 OH	1182	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L3537		SF 15 kV 1/0	620	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L357		SF 15 kV 1/0	462	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3577		SF 15 kV 1/0	983	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3629		SF 15 kV 1/0	978	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3637		SF 15 kV 1/0	948	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3657		SF 15 kV 1/0	980	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3671		SF 15 kV 1/0	528	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3672		SF 15 kV 1/0	527	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3684		SF 15 kV 1/0	926	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3692		SF 15 kV 1/0	1115	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3711		SF 15 kV 1/0	1112	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3818		SF 15 kV 1/0	781	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3820		SF 15 kV 1/0	428	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3821		SF 15 kV 1/0	560	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3822		SF 15 kV 1/0	214	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3860		SF 15 kV 1/0	1125	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L388		SF 15 kV 1/0	1713	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3900		SF 15 kV 1/0	1412	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3904		SF 15 kV 1/0	606	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L3992		SF 15 kV 1/0	828	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4026		SF 477 OH	1364	0.0364	0.1108 (+)		20.0
				0.0804	0.3191 (0)		
L4027		SF 15 kV 1/0	465	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4028		SF 15 kV 1/0	463	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L4037		SF 15 kV 1/0	956	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4045		SF #2 OH	860	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L4070		SF 15 kV 1/0	802	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4081		SF 15 kV 1/0	603	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4091		SF 15 kV 1/0	451	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4094		SF 15 kV 1/0	1228	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4102		SF 15 kV 1/0	753	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L411		SF 15 kV 1/0	1070	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L413		SF 15 kV 1/0	344	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4149		SF 15 kV-4/0	484	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L4151		SF 15 kV 1/0	1520	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4158		SF 15 kV 1/0	795	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4189		SF 15 kV-4/0	517	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L4259		SF 15 kV-4/0	256	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L4278		SF 15 kV 1/0	400	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4279		SF 15 kV 1/0	491	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4280		SF 15 kV 1/0	1355	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4313		SF 15 kV 1/0	1077	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4343		SF 15 kV 1/0	481	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4344		SF 15 kV 1/0	501	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4346		SF 15 kV 1/0	387	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4351		SF 15 kV 1/0	485	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L4365		SF 15 kV 1/0	408	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L4375		SF 15 kV 1/0	849	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4407		SF 15 kV 1/0	1084	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4443		SF 15 kV 1/0	465	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4470		SF 15 kV 1/0	1524	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4482		SF 15 kV 1/0	521	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4534		SF 15 kV 1/0	244	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4549		SF 15 kV 1/0	715	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4590		SF 15 kV 1/0	1289	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4614		SF 15 kV 1/0	354	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4666		SF 15 kV 1/0	1042	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4730		SF 15 kV 1/0	1070	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4741		SF 15 kV 1/0	337	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4775		SF 15 kV 1/0	471	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4830		SF 15 kV 1/0	937	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4835		SF 15 kV 1/0	1318	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4864		SF 15 kV 1/0	815	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4865		SF 15 kV 1/0	476	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4876		SF 15 kV 1/0	624	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4886		SF 15 kV 1/0	281	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4887		SF 15 kV 1/0	435	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4894		SF 15 kV 1/0	484	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4921		SF 15 kV 1/0	596	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4944		SF 15 kV 1/0	519	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L4950		SF 15 kV 1/0	459	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4964		SF 15 kV 1/0	599	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L497		SF 15 kV 1/0	954	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4978		SF 15 kV 1/0	315	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4984		SF 15 kV 1/0	408	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4985		SF 15 kV 1/0	403	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L4999		SF 15 kV 1/0	283	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5022		SF 15 kV 1/0	762	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5024		SF 15 kV 1/0	339	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5040		SF 15 kV 1/0	1111	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5056		SF 15 kV 1/0	410	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5070		SF 15 kV 1/0	374	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5085		SF 15 kV 1/0	559	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5123		SF 15 kV 1/0	175	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5129		SF 15 kV 1/0	608	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5136		SF 15 kV 1/0	873	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5156		SF 15 kV 1/0	983	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5202		SF 15 kV 1/0	452	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5209		SF 15 kV 1/0	1924	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L524		SF 15 kV 1/0	567	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5257		SF 795 OH 46 kV	2770	0.0239	0.1220 (+)		20.0
				0.1019	0.4739 (0)		
L5259		SF 15 kV 1/0	977	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L5260		SF 15 kV 1/0	977	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L5262		SF 15 kV 1/0	869	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5280		SF 15 kV 1/0	384	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5306		SF 15 kV 1/0	1522	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5322		SF 15 kV 1/0	679	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5326		SF 15 kV 1/0	603	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5327		SF 15 kV 1/0	444	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5349		SF 15 kV 1/0	415	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5360		SF 15 kV 1/0	391	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5364		SF 15 kV 1/0	1143	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L539		SF 15 kV 1/0	638	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5391		SF 15 kV 1/0	293	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L540		SF 15 kV 1/0	411	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5448		SF 15 kV 1/0	1116	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5468		SF 15 kV 1/0	756	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5485		SF 15 kV 1/0	681	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5488		SF 15 kV 1/0	1999	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5525		SF 15 kV 1/0	361	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5541		SF #2 OH	611	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L5542		SF 477 OH	810	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L5557		SF 15 kV-4/0	223	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5565		SF 15 kV-4/0	186	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5572		SF 15 kV-4/0	805	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5580		SF 15 kV-4/0	542	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L5590		SF 15 kV-4/0	429	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5591		SF 15 kV 1/0	305	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5642		SF 15 kV-4/0	359	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5651		SF 15 kV-4/0	897	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5652		SF 15 kV-4/0	513	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5751		SF 1/0 OH	1860	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L5758		SF 15 kV-4/0	1545	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L581		SF 15 kV 1/0	1772	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5868		SF 15 kV-4/0	1508	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5886		SF 15 kV 1/0	415	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5890		SF 15 kV-4/0	286	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5891		SF 15 kV 1/0	927	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L5924		SF 15 kV-4/0	915	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5933		SF 15 kV-4/0	1368	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L5992		SF 15 kV 1/0	953	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L60		SF 15 kV 1/0	562	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6015		SF 15 kV 1/0	259	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6065		SF 15 kV 1/0	289	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6066		SF 15 kV-4/0	841	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6085		SF 15 kV-4/0	1371	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6112		SF 15 kV-750	658	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6123		SF 15 kV-4/0	307	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6166		SF 15 kV-4/0	358	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L617		SF 15 kV 1/0	1713	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6191		SF 15 kV-4/0	419	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6194		SF 15 kV-750	1494	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6209		SF 15 kV-4/0	1021	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6214		SF 15 kV 1/0	439	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6222		SF 15 kV-750	1003	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6232		SF 15 kV-750	733	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6248		SF 15 kV-4/0	1254	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6249		SF 15 kV-4/0	1605	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6296		SF 15 kV-4/0	286	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6324		SF 15 kV 1/0	1643	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6356		SF 15 kV-4/0	183	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6358		SF 15 kV-4/0	470	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6392		SF 15 kV 1/0	448	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6433		SF 15 kV 1/0	195	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6449		SF 15 kV 1/0	481	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6462		SF 15 kV-4/0	473	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6465		SF 15 kV-4/0	407	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6466		SF 15 kV-4/0	885	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6494		SF 15 kV-750	950	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6501		SF 15 kV-750	1333	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6507		SF 15 kV-4/0	1560	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6512		SF 15 kV-750	1251	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L6531		SF 15 kV-750	376	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6549		SF 15 kV-4/0	864	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6564		SF 795 OH 46 kV	2575	0.0239	0.1220	(+)		20.0
				0.1019	0.4739	(0)		
L6574		SF 15 kV 1/0	522	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6601		SF 15 kV-750	1830	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6608		SF 15 kV-4/0	702	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6626		SF 15 kV-750	1061	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6634		SF 15 kV-750	2375	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L6672		SF 477 OH	262	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L6692		SF 15 kV-4/0	331	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6729		SF 15 kV-4/0	471	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6735		SF 15 kV-4/0	878	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6770		SF 15 kV-4/0	2042	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6784		EQUIV	1000	0.1390	0.7082	(+)		20.0
				0.5922	2.7521	(0)		
L6785		EQUIV	1000	0.1301	0.6632	(+)		20.0
				0.5542	2.5771	(0)		
L6846		SF 15 kV-1100	498	0.0223	0.0388	(+)	0.02782	20.0
				0.1117	0.0300	(0)		
L6847		SF 15 kV-1100	325	0.0223	0.0388	(+)	0.02782	20.0
				0.1117	0.0300	(0)		
L6848		SF 15 kV-4/0	137	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L6849		SF 15 kV 1/0	357	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L6872		SF 795 OH 46 kV	1297	0.0239	0.1220	(+)		20.0
				0.1019	0.4739	(0)		
L708		SF 15 kV 1/0	1353	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L732		SF 15 kV-4/0	930	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L77		SF 15 kV 1/0	1207	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L777		SF 15 kV 1/0	976	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L79		SF 15 kV 1/0	1207	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L792		SF 15 kV-750	804	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L793		SF 15 kV-750	805	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L799		SF 15 kV-4/0	362	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L80		SF 15 kV 1/0	638	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L800		SF 15 kV 1/0	608	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8000		SF 477 OH 46 kV	1955	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8001		SF 477 OH 46 kV	6027	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8004		SF 477 OH	1260	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8005		SF 15 kV-750	1422	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8006		SF 15 kV-4/0	670	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8007		SF #2 OH	548	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L8008		SF 477 OH	200	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8009		SF 15 kV 1/0	612	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8010		SF 477 OH	245	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8011		SF 477 OH	135	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8012		SF 477 OH	407	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8013		SF 477 OH	1145	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8014		SF 477 OH	443	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8015		SF 15 kV 1/0	765	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8016		SF 477 OH	506	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8017		SF 477 OH	1577	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8018		SF 477 OH 46 kV	2046	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8019		SF 477 OH 46 kV	2392	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8020		SF 477 OH 46 kV	572	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8021		SF 477 OH 46 kV	572	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8022		SF 477 OH 46 kV	407	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8023		SF 477 OH 46 kV	1148	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8024		SF 477 OH 46 kV	1564	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8025		SF 477 OH 46 kV	2376	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8027		SF 15 kV 1/0	525	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8030		SF 477 OH	200	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8031		SF 477 OH	377	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8032		SF 477 OH	473	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8033		SF 477 OH	725	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8034		SF 477 OH	214	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8035		SF 477 OH	222	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8037		SF 477 OH	663	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8038		SF 477 OH	674	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8039		SF 477 OH	473	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8041		SF 477 OH	663	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8042		SF 15 kV-4/0	220	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8045		SF 477 OH	663	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8046		SF 477 OH	663	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8047		SF 477 OH	663	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8048		SF 477 OH	235	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8049		SF 477 OH	239	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8050		SF 477 OH	451	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8051		SF 477 OH	478	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8052		SF 477 OH	495	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8053		SF 477 OH	202	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8054		SF 477 OH	248	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8056		SF 477 OH	312	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8057		SF 3/0 OH	1176	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L8058		SF 3/0 OH	557	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L8059		SF 3/0 OH	500	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L8060		SF #2 OH	450	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L8061		SF 15 kV-750	91	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8062		SF 477 OH	2610	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8063		SF 15 kV-4/0	440	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8064		SF 477 OH	1070	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8065		SF 477 OH	513	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8066		SF 477 OH	374	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8067		SF 477 OH	705	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8068		SF 15 kV 1/0	170	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8069		SF 15 kV 1/0	522	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L807		SF 15 kV 1/0	591	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8070		SF 15 kV-4/0	589	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8072		SF 15 kV 1/0	247	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8073		SF 15 kV 1/0	85	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8074		SF 15 kV-4/0	85	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8075		SF 15 kV 1/0	509	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8076		SF 15 kV-4/0	935	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8078		SF 15 kV-4/0	481	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8081		SF 15 kV 1/0	343	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8082		SF 15 kV 1/0	469	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8084		SF 15 kV-4/0	344	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8086		SF 15 kV-4/0	113	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8087		SF 15 kV-4/0	143	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8088		SF 15 kV 1/0	480	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8089		SF 15 kV 1/0	329	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8090		SF 15 kV 1/0	507	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8091		SF 15 kV 1/0	627	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8092		SF 477 OH	144	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8093		SF 477 OH	318	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8094		SF 15 kV-4/0	780	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8095		SF 15 kV-4/0	601	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8096		SF 477 OH	627	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8097		SF 477 OH	1022	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8098		SF 477 OH	690	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8099		SF 4/0 OH	910	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8100		SF 1/0 OH	1440	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8101		SF 1/0 OH	1464	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8102		SF 3/0 OH	1110	0.1034	0.1273	(+)		20.0
				0.1926	0.3684	(0)		
L8104		SF 477 OH	200	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8105		SF 477 OH	773	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8106		SF 15 kV 1/0	405	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8107		SF 477 OH	592	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8108		SF 4/0 OH	370	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8111		SF 15 kV 1/0	1456	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8114		SF 477 OH	729	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8115		SF 4/0 OH	676	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8118		SF 4/0 OH	617	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8119		SF 477 OH	2000	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8120		SF 15 kV-4/0	630	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8122		SF 477 OH	534	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8124		SF 336 OH	649	0.0517	0.1156	(+)		20.0
				0.1079	0.3312	(0)		
L8125		SF 336 OH	749	0.0517	0.1156	(+)		20.0
				0.1079	0.3312	(0)		
L8127		SF 1/0 OH	1211	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8128		SF 1/0 OH	668	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8129		SF 4/0 OH	995	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8130		SF 1/0 OH	1373	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8131		SF 1/0 OH	598	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8132		SF 1/0 OH	668	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8133		SF 477 OH	850	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8134		SF 477 OH	211	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8135		SF 477 OH	762	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8137		SF 1/0 OH	804	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8138		SF 477 OH	438	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8141		SF 477 OH	350	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8142		SF 477 OH	486	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8143		SF 15 kV 1/0	590	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8144		SF 477 OH	274	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8145		SF 477 OH	155	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8146		SF 1/0 OH	2450	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8147		SF 1/0 OH	1600	0.1644	0.1327	(+)		20.0
				0.2796	0.4035	(0)		
L8148		SF 15 kV-4/0	489	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8149		SF 15 kV-4/0	506	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8152		SF 15 kV 1/0	439	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8154		SF 15 kV-4/0	504	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8155		SF 15 kV-4/0	504	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8156		SF 15 kV-750	328	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8157		SF 15 kV-750	826	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8158		SF 15 kV-4/0	1096	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8160		SF 477 OH 46 kV	6300	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8163		SF 477 OH	253	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8164		SF 4/0 OH	345	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8165		SF 477 OH	804	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8166		SF 4/0 OH	150	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8167		SF 477 OH	100	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8168		SF 477 OH	2988	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8169		SF 477 OH	259	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8170		SF 477 OH	768	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8171		SF 477 OH	252	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8172		SF 477 OH	229	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8173		SF 477 OH	1364	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8174		SF 15 kV 1/0	595	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8175		SF 15 kV 1/0	1409	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8177		SF 15 kV 1/0	240	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8178		SF 15 kV 1/0	440	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8179		SF 15 kV 1/0	118	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8180		SF 477 OH	303	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8181		SF 15 kV 1/0	681	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8183		SF 15 kV 1/0	1115	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8185		SF 15 kV 1/0	824	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8188		SF 15 kV 1/0	940	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8189		SF 15 kV 1/0	377	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8190		SF 15 kV 1/0	302	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8191		SF 15 kV 1/0	365	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8192		SF 15 kV 1/0	163	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8193		SF 15 kV-4/0	597	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8194		SF 15 kV 1/0	324	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8195		SF 15 kV-4/0	522	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8196		SF #2 OH	597	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L8197		SF #2 OH	288	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L8198		SF 477 OH	305	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8199		SF 477 OH	371	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8200		SF 477 OH	75	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8201		SF 477 OH	765	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8202		SF 477 OH	100	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8203		SF 15 kV 1/0	213	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8204		SF 15 kV 1/0	578	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8205		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8206		SF 15 kV 1/0	147	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8207		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8208		SF 15 kV 1/0	275	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8209		SF 477 OH	469	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8210		SF 477 OH	534	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8211		SF 15 kV 1/0	426	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8212		SF 15 kV 1/0	161	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8216		SF 15 kV 1/0	769	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8217		SF 15 kV 1/0	291	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8218		SF 477 OH	3189	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8220		SF 477 OH	757	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8221		SF 477 OH	115	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8222		SF 15 kV 1/0	265	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8224		SF 477 OH	262	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8225		SF 477 OH	422	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8227		SF 15 kV 1/0	270	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8231		SF 15 kV 1/0	380	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8233		SF 15 kV 1/0	840	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8234		SF 15 kV 1/0	203	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8235		SF 15 kV 1/0	747	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8237		SF 15 kV-4/0	920	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8239		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8242		SF 15 kV 1/0	547	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8244		SF 477 OH	1140	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8245		SF #2 OH	476	0.2618	0.1378	(+)		20.0
				0.3953	0.4524	(0)		
L8246		SF 477 OH	570	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8247		SF 477 OH	291	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8248		SF 477 OH	346	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8249		SF 477 OH	50	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8250		SF 477 OH	893	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8251		SF 477 OH	510	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8252		SF 15 kV 1/0	628	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8253		SF 15 kV 1/0	273	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8254		SF 15 kV 1/0	82	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8255		SF 15 kV 1/0	482	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8256		SF 477 OH	1023	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8257		SF 477 OH	170	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8259		SF 477 OH	230	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8260		SF 477 OH	336	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8261		SF 477 OH	369	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8262		SF 477 OH	553	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8263		SF 477 OH	450	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8264		SF 477 OH	532	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8265		SF 477 OH	560	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8266		SF 477 OH	180	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8267		SF 477 OH	380	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8268		SF 477 OH	1100	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8269		SF 477 OH	150	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8270		SF 477 OH	260	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8271		SF 15 kV 1/0	114	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8272		SF 477 OH	385	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8273		SF 477 OH	680	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8274		SF 15 kV 1/0	409	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8275		SF 477 OH	866	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8276		SF 477 OH	1900	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8277		SF 477 OH	250	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8278		SF 477 OH	210	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8279		SF 477 OH	2274	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8280		SF 477 OH	469	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8281		SF 477 OH	1674	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8282		SF 15 kV 1/0	683	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8283		SF 477 OH	950	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8284		SF 477 OH	463	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8285		SF 477 OH	3184	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8286		SF 477 OH	466	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8287		SF 477 OH	2728	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8288		SF 477 OH	273	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8289		SF 477 OH	2610	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8290		SF 477 OH	187	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8293		SF 477 OH	258	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8294		SF 477 OH	802	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8295		SF 477 OH	739	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8296		SF 477 OH	331	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8298		SF 477 OH	3681	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8299		SF 477 OH	319	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8300		SF 477 OH	2723	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8301		SF 15 kV 1/0	547	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8302		SF 477 OH	225	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8303		SF 477 OH	2838	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8304		SF 477 OH	237	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8305		SF 477 OH	462	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8306		SF 477 OH	3422	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8307		SF 477 OH	286	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8308		SF 477 OH	214	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8309		SF 477 OH	264	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8310		SF 477 OH	1930	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8311		SF 477 OH	2000	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8312		SF 477 OH	1103	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8313		SF 15 kV 1/0	315	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8314		SF 477 OH	650	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8315		SF 477 OH 46 kV	2096	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8316		SF 477 OH 46 kV	3100	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8317		SF 477 OH 46 kV	6624	0.0401	0.1238	(+)		20.0
				0.1188	0.4875	(0)		
L8321		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8322		EQUIV	1000	0.0002	0.0002	(+)		20.0
				0.0002	0.0002	(0)		
L8323		NA	100	0.0005	0.0005	(+)		20.0
				0.0005	0.0005	(0)		
L8324		NA	100	0.0005	0.0005	(+)		20.0
				0.0005	0.0005	(0)		
L8326		SF 15 kV 1/0	400	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8327		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8328		SF 15 kV 1/0	200	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8329		SF 15 kV-4/0	384	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8330		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L8331		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8332		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8333		SF 15 kV 1/0	400	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8334		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8335		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8336		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8339		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8340		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8341		SF 15 kV 1/0	300	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8342		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8344		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8345		SF 15 kV 1/0	200	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8346		SF 477 OH	670	0.0364	0.1108 (+)		20.0
				0.0804	0.3191 (0)		
L8347		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8349		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8350		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8351		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8352		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8353		SF 15 kV 1/0	200	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8354		SF 15 kV 1/0	300	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8355		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8356		SF 15 kV 1/0	300	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8357		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L8358		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8359		SF 15 kV 1/0	500	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8360		SF 15 kV 1/0	200	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8361		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8362		SF 15 kV 1/0	961	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8364		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8365		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8367		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8368		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8369		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8370		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8371		SF 15 kV 1/0	165	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8372		SF 15 kV 1/0	363	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8373		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8374		SF 15 kV 1/0	738	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8375		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8376		SF 15 kV 1/0	426	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8377		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8378		SF 15 kV 1/0	550	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8379		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8380		SF 15 kV 1/0	300	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8381		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8383		SF 15 kV 1/0	200	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8384		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8385		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8386		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8387		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8389		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8390		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8391		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8392		SF 15 kV 1/0	250	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8393		SF 15 kV 1/0	200	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8394		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8395		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8396		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8398		SF 15 kV 1/0	400	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8399		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8400		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8401		SF 15 kV-4/0	352	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8402		SF 15 kV-4/0	50	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8403		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8404		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8405		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8406		SF 15 kV-4/0	400	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8407		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8408		SF 15 kV 1/0	375	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8409		SF 15 kV 1/0	575	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8410		SF 15 kV 1/0	400	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8411		SF 4/0 OH	50	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8412		SF 4/0 OH	300	0.0820	0.1244	(+)		20.0
				0.1588	0.3557	(0)		
L8413		SF 15 kV 1/0	1939	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8414		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8415		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8416		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8417		SF 15 kV 1/0	300	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8418		SF 15 kV 1/0	200	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8419		SF 15 kV 1/0	300	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8420		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8421		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8422		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8423		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8424		SF 15 kV-750	375	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8426		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8427		SF 15 kV 1/0	200	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8428		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8429		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8430		SF 15 kV-4/0	300	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8431		SF 15 kV-4/0	50	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8432		SF 15 kV-4/0	113	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K	1/2 Cap mMhos/K	Temp °C
L8433		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8434		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8435		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8436		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8437		SF 15 kV 1/0	400	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8438		SF 15 kV-4/0	300	0.1059	0.0463 (+)	0.01517	20.0
				0.3156	0.0950 (0)		
L8439		SF 15 kV 1/0	500	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8440		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8441		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8442		SF 15 kV 1/0	200	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8443		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8444		SF 15 kV 1/0	335	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8445		SF 15 kV 1/0	230	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8446		SF 15 kV 1/0	275	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8447		SF 15 kV 1/0	245	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8448		SF 15 kV 1/0	485	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8449		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8450		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8451		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8452		SF 15 kV 1/0	280	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8453		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8454		SF 15 kV 1/0	100	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		
L8455		SF 15 kV 1/0	50	0.2068	0.0515 (+)	0.01204	20.0
				0.3607	0.6500 (0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L8456		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8457		SF 15 kV 1/0	100	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8458		SF 15 kV-750	525	0.0295	0.0409	(+)	0.02541	20.0
				0.1902	0.0600	(0)		
L8459		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8460		SF 15 kV-4/0	100	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8461		SF 15 kV-4/0	50	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8462		SF 15 kV-4/0	820	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8463		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8464		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8466		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8467		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8468		SF 477 OH	765	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8469		SF 15 kV 1/0	140	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8478		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8479		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8481		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8482		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8483		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8484		SF 15 kV-4/0	50	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L8485		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8487		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8488		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8489		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Feeders/Cables Data

Resistance Displayed in Editor is at 25.0 °C.

Branch Name	#C	Device Type	Length Feet	R Ohms/K	X Ohms/K		1/2 Cap mMhos/K	Temp °C
L849		SF 477 OH	1123	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L8490		SF 15 kV 1/0	50	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L8491		SF 477 OH	1200	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L857		SF 15 kV 1/0	401	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L860		SF 477 OH	1885	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L877		EQUIV	1000	0.2962	0.9154	(+)		20.0
				0.8782	3.6035	(0)		
L878		EQUIV	1000	1.3117	3.0202	(+)		20.0
				3.1281	11.410	(0)		
L879		EQUIV	1000	3.2990	12.297	(+)		20.0
				13.793	87.652	(0)		
L880		EQUIV	1000	0.5779	2.5108	(+)		20.0
				0.7200	6.4517	(0)		
L881		EQUIV	1000	0.5237	23.341	(+)		20.0
				0.6932	25.662	(0)		
L886		SF 15 kV 1/0	1222	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L920		SF 477 OH	1858	0.0364	0.1108	(+)		20.0
				0.0804	0.3191	(0)		
L922		SF 15 kV-4/0	425	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L926		SF 15 kV-4/0	424	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L928		SF 15 kV-4/0	348	0.1059	0.0463	(+)	0.01517	20.0
				0.3156	0.0950	(0)		
L929		SF 15 kV 1/0	572	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L945		SF 15 kV 1/0	1683	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L948		SF 15 kV 1/0	1292	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L986		SF 15 kV 1/0	2493	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		
L99		SF 15 kV 1/0	290	0.2068	0.0515	(+)	0.01204	20.0
				0.3607	0.6500	(0)		

Spanish Fork City
Capital Facilities Plan - Electrical

August 2014

Intermountain Consumer
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INTRODUCTION

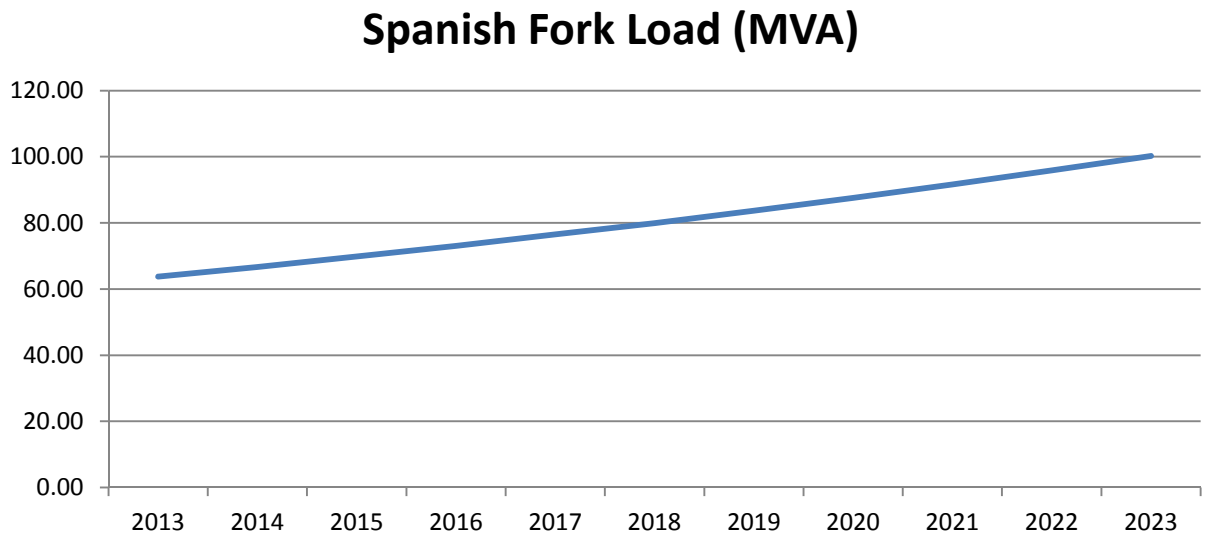
Intermountain Consumer Professional Engineers ("ICPE") has prepared this Capital Facilities Plan ("CFP") update at the request of Spanish Fork City. Improvements to the system are proposed to insure that capacity is in place to supply power to customers when needed. This report has been prepared to provide Spanish Fork City information for budgeting and planning purposes. Detailed design work is not included as part of this study.

The general findings and recommendations of the CFP update are presented in the system improvement summary section of this report. The system improvement summary section lists major projects that are proposed in the plan, the general estimated timeframe when these projects should be completed, and the estimated cost of the projects in 2013 dollars.

This plan should be considered an extension to the previously prepared Load Flow and Protection Coordination Study. Refer to that study for system modeling information and details of load flow analysis.

SPANISH FORK CITY LOAD PROJECTION

The following graph shows projected Spanish Fork City load for the next 10 years and the table shown on the next page contains projected Spanish Fork City circuit loads. Projected load levels for the Spanish Fork system are consistent with the recently completed Load Flow and Protection Coordination Study and with the recently completed SUVPS System Study. The circuit load levels are based on the proposed system improvements being implemented. See the Peak Loads and System Improvements section of the appendix for more information regarding system loads and how they are affected by the proposed system improvements.



Spanish Fork City – Projected Circuit Loads							
Substation	**Recloser**	**2013**		**2018**		**2023**	
		Amps	**MVA**	**Amps**	**MVA**	**Amps**	**MVA**
North 12/16.05/20 MVA	**Main Street**	97	2.09	127	2.74	164	3.55
	Airport	148	3.20	193	4.17	249	5.39
	North3	-	-	71	1.54	104	2.25
	Sub Total	**245**	**5.29**	**391**	**8.45**	**518**	**11.19**
Whitehead 7.5/9.375/10.5 MVA	**Nature's Sunshine**	181	3.91	151	3.25	169	3.66
	Provo Craft	150	3.24	184	3.97	226	4.88
	Sub Total	**331**	**7.14**	**334**	**7.22**	**395**	**8.54**
Industrial 12/16.05/20 MVA	**Shopko**	122	2.62	159	3.44	206	4.45
	Klune	113	2.45	226	4.89	292	6.31
	Sub Total	**235**	**5.08**	**385**	**8.32**	**498**	**10.76**
Argyle 8.4/10.5/11.76 MVA	**50 East**	80	1.73	88	1.89	97	2.09
	300 West	383	8.27	264	5.69	282	6.10
	Sub Total	**463**	**10.00**	**351**	**7.58**	**379**	**8.19**
Canyon Road 12/16.05/20 MVA	**Fingerhut**	265	5.72	280	6.04	299	6.45
	IFA	399	8.61	421	9.09	229	4.94
	Sub Total	**663**	**14.33**	**701**	**15.14**	**527**	**11.39**
Maple Mountain 12/16.05/20 MVA	**SR-6**	279	6.03	352	7.61	195	4.22
	High School	159	3.43	198	4.28	247	5.35
	Sub Total	**438**	**9.46**	**551**	**11.89**	**443**	**9.56**
Woodhouse 10/ /14 MVA 12/16/20 MVA	**SAPA**	186	4.01	246	5.31	321	6.93
	1100 East	85	1.83	113	2.44	148	3.20
	K-Mart	306	6.61	202	4.35	263	5.67
	Woodhouse4	-	-	204	4.41	267	5.77
	Sub Total	**576**	**12.45**	**764**	**16.50**	**999**	**21.57**
Future Leland 12/16/20 MVA	**Future Leland1**	-	-	112	2.42	206	4.45
	Future Leland2	-	-	112	2.42	206	4.45
	Sub Total	**-**	**-**	**224**	**4.84**	**412**	**8.90**
Future Bonner 12/16/20 MVA	**Future Bonner1**	-	-	-	-	249	5.37
	Future Bonner2	-	-	-	-	221	4.76
	Sub Total	**-**	**-**	**-**	**-**	**469**	**10.13**
Total	**Amps**	**2951**		**3702**		**4641**	
	MVA		**63.74**		**79.96**		**100.24**

SYSTEM IMPROVEMENT SUMMARY

The following System Improvement Summary details the anticipated projects and expenditures necessary to sustain the projected growth rate for Spanish Fork City's electrical system for the next 10 years. There is greater confidence in projecting requirements for 2 to 3 years than there is for a 5-year or longer outlook. However it is necessary to forecast future projects due to the magnitude (and cost) of the modifications necessary. Also substation and transmission line projects can take significant time from start to finish due to material lead times and permitting requirements. Substation, distribution, and transmission line requirements need to be addressed to meet future needs of the City in a timely fashion.

The proposed projects will provide a method for Spanish Fork City to plan and budget for the facilities necessary to serve the anticipated electrical load growth. The following table provides a summary of the recommended project timing and costs. Explanations of each project are listed below the table.

The following table provides a summary of the recommended project timing and costs. Costs shown are based on present 2013 project material and labor pricing. The Cost Estimates section of the appendix provides more details related to the cost of each project. The Capital Facilities Plan Map on the next page shows the locations for each recommended project except for the capacitor bank additions. Capacitor banks will be located throughout the city as needed. Detail design of capacitor bank size and location has not been completed.

Capital Facilities Plan Projects

Map ID	Recommended Project	Approximate Timeframe	Approximate Cost
	Legacy Farms Development Agreement	**2012**	$406,939***
1(A-C)	Lines between North, Whitehead, & Woodhouse	**2013-2016**	$1,284,405***
2	Capacitor Bank Additions	**2013-2016**	$115,000*
3(A-E)	Line from Industrial to 900 S	**2013-2014**	$391,390***
4	New Woodhouse Transformer	**2013-2015**	$1,213,590**
5	Future Leland Substation	**2017-2018**	$2,177,334
6	Reconductor River Ridge Ln and Del Monte Rd	**2017-2018**	$358,837
7	Reconductor Main Street (SR-198)	**2017-2018**	$159,162
8	Future Bonner Substation	**2021-2022**	$2,177,334
9	Reconductor 1100 E	**2023-2024**	$196,631
10	Reconductor 2300 E	**2023-2024**	$249,682
11	Reconductor US-6	**2023-2024**	$215,687
	Total	**2013-2024**	**$8,945,991**

Costs do not include right of way or land

* Cost that is shown for capacitor bank additions came from an existing 10 year CFP budget spreadsheet that was given to ICPE from Spanish Fork. ICPE was not able to develop costs for this project since capacitor bank sizes, types, and locations are not known.

** Woodhouse Transformer addition based on actual costs obtained from Spanish Fork, No cost estimate provided

*** Actual Project Cost

Insert system map here.

Project #1 Lines between North, Whitehead, & Woodhouse

The load at North is currently 5.3 MVA on a 12/16/20 MVA transformer which means it has room to grow. The load at Whitehead is currently 7.1 MVA on a 7.5/9.375/10.5 MVA transformer. Normal load growth will result in Whitehead's transformer being maxed out within 10 years and be above base rating within 2 years. The load at Woodhouse is currently 12.4 MVA on a 10/14 MVA transformer which is above its base rating. Normal load growth will result in Woodhouse being maxed out within 2 years.

Proposed 600A 12.47 kV 477 ACSR overhead and 750 kcmil underground lines between North, Whitehead, and Woodhouse will allow load to be shifted from Whitehead and Woodhouse to North on a new North circuit which is necessary to improve loading at Whitehead and Woodhouse. North has a spare recloser which can be utilized for the new circuit.

New lines consist of three sections. The first section is a new 46 kV 795 ACSR line with 12.47 kV 477 ACSR under build. The second section is a 12.47 kV 477 ACSR under build on an existing 46 kV line. The third section is an underground 12.47 kV 750 kcmil line in 6" conduit. The cost estimates assume that existing structures on the second section can be reused.

Proposed lines are also necessary to help with N-1 reliability. The new lines will allow new North circuit to pick up SAPA circuit during an outage of Woodhouse transformer and will allow new North circuit to pick up Nature's Sunshine circuit during an outage of Whitehead transformer. Without the new lines, those two circuits would not be able to be entirely picked up if those transformers had an outage.

Project #2 Capacitor Bank Additions

It is recommended that Spanish Fork power factor be improved to at least 0.98. This will help support voltage during power system peak loading and during outage conditions. The need for power factor correction becomes more important as transformer and line loading levels increase. Improving power factor also reduces system losses. Improved power factor helps both the Spanish Fork distribution system as well as the SUVPS transmission system.

A detailed capacitor bank study will be performed when the necessary circuit power factor information is provided to ICPE. Until this study is performed, ICPE is unable to provide specific details concerning required capacitor bank sizes, types, and locations.

Cost that is shown for capacitor bank additions came from an existing 10 year CFP budget spreadsheet that was given to ICPE from Spanish Fork. ICPE was not able to develop costs for this project since capacitor bank sizes, types, and locations are not known.

Project #3 Line from Industrial to 900 S

The load at Industrial is currently 5.1 MVA on a 12/16/20 MVA transformer which means it has room to grow. The load at Argyle is currently 10 MVA on a 8.4/10/5/11.76 MVA transformer which is above its base rating. Normal load growth will result in Argyle being maxed out within 3 years.

Proposed 600A 12.47 kV 477 ACSR overhead line from Industrial to the 900 S will allow load to be shifted from Argyle to Industrial on Klune circuit which is necessary to improve loading at Argyle.

The new line consists of five sections. The first section is reconductoring an existing 12.47 kV 4/0 ACSR line to 477 ACSR. The second section is a new 12.47 kV 477 ACSR line. The third section is a 12.47 kV 477 ACSR under build on an existing 46 kV line. The fourth section is a new 12.47 kV 477 ACSR line. The fifth section is reconductoring an existing 12.47 kV 4/0 & 1/0 ACSR line to 477 ACSR. The cost estimates assume that existing structures on reconductored and under build line sections can be reused.

Proposed line is also necessary to help with N-1 reliability. The new line will allow Klune circuit to pick up the east part of 300 West circuit during an outage of Argyle transformer. Without the new line, 300 West circuit would not be able to be entirely picked up if Argyle transformer had an outage.

Project #4 New Woodhouse Transformer

The load at Woodhouse is currently 12.4 MVA on a 10/14 MVA transformer which is above its base rating. Proposed project #1 lines between North and Woodhouse will result in load being shifted from Woodhouse to North. This will help with loading at Woodhouse, but loading will still remain high due to strong load growth. A new 12/16/20 MVA transformer and associated substation equipment will be required to be added to Woodhouse. New load in the K-Mart circuit area as well as existing load on Woodhouse Transformer #1 should be transferred to the new transformer.

Woodhouse Transformer addition cost shown is based on actual costs obtained from Spanish Fork. No detailed cost estimate is provided.

Project #5 Future Leland Substation

The load at Argyle is currently 10 MVA on a 8.4/10/5/11.76 MVA transformer which is above its base rating. Proposed project #3 line between Industrial and 900 S will result in new load that would have had to go on Argyle to be shifted to Industrial. Load growth by 2018 will result in load levels equal to the combined base ratings of Industrial and Argyle transformers. By 2018 Leland substation containing a new 12/16/20 MVA transformer will be required to be built in the southwest part of town at approximately 900 S 1400 W. The substation will be fed from the existing 46 kV line feeding Taylor Substation. Leland Substation will pick up load from Industrial and Argyle as well as new load in the southwest of Spanish Fork.

Project #6 Reconductor River Ridge Ln and Del Monte Rd

In order to be able to tie Project #5 substation to the rest of the system, the underground line along River Ridge Ln and Del Monte Rd from 900 S to Arrowhead Trail should be reconductored. Conductor is currently 4/0 AWG AL. New conductor should be 500 kcmil CU reduced diameter cable. Cost estimates assume that existing 4" conduit can be reused. New 500 kcmil CU cable will have approximately 500 A capacity.

Project #7 Reconductor Main Street (SR-198)

In order to be able to tie Project #5 substation to the rest of the system, the overhead line along along Main Street (SR-198) from 300 S to Arrowhead Trail should be reconductored. Conductor is currently 1/0 ACSR. New conductor should be 477 ACSR. Cost estimates assume that existing poles can be reused.

Project #8 Future Bonner Substation

Normal load growth will result in 14.9 MVA of load on Maple Mountain's 12/16/20 MVA transformer within 10 years which is above its base rating. Normal load growth will result in 16.1 MVA of load on Canyon Road's 12/16/20 MVA transformer within 10 years which is above its base rating. Due to both substations being heavily loaded, it will be necessary to build Bonner substation and add a new 12/16/20 MVA transformer. IFA circuits and SR-6 circuits will both be very heavily loaded and it is recommended that about half of each circuit be transferred to Bonner circuits. Bonner Substation is centrally located between these two circuits which will allow their load to be easily transferred to Bonner circuits.

Project #9 Reconductor 1100 E

A new substation in the river bottoms will be required in the future as growth continues on Canyon Road circuits in the south part of town. New circuits from this substation will be required to tie into the existing system through the areas fed by IFA and Fingerhut circuits. Existing IFA and Fingerhut circuit conductors are mainly 1/0 and 4/0 AL. These are not large enough conductors to tie the new circuits into the existing system. In preparation for the new substation, the underground line along 1100 E from 1240 S to 1750 S should be reconductored. Conductor is currently 1/0 AWG AL. New conductor should be 500 kcmil CU reduced diameter cable. Cost estimates assume that existing 4" conduit can be reused. New 500 kcmil CU cable will have approximately 500 A capacity.

Project #10 Reconductor 2300 E

A new substation in the river bottoms will be required in the future as growth continues on Canyon Road circuits in the south part of town. New circuits from this substation will be required to tie into the existing system through the areas fed by IFA and Fingerhut circuits. Existing IFA and Fingerhut circuit conductors are mainly 1/0 and 4/0 AL. These are not large enough conductors to tie the new circuits into the existing system. In preparation for the new substation, the underground line along 2300 E from Canyon Road to 1850 S should be reconductored. Conductor is currently 1/0 AWG AL. New conductor should be 500 kcmil CU reduced diameter cable. Cost estimates assume that existing 4" conduit can be reused. New 500 kcmil CU cable will have approximately 500 A capacity.

Project #11 Reconductor US-6

A new substation in the river bottoms will be required in the future as growth continues on Canyon Road circuits in the south part of town. New circuits from this substation will be required to tie into the existing system through the areas fed by IFA and Fingerhut circuits. Existing IFA and Fingerhut circuit conductors are mainly 1/0 and 4/0 AL. These are not large enough conductors to tie the new circuits into the existing system. In preparation for the new substation, the underground line along US-6 from Canyon Road to Power House Rd should be reconductored. Conductor is currently 4/0 AWG AL. New conductor should be 500 kcmil CU reduced diameter cable. Cost estimates assume that existing 4" conduit can be reused. New 500 kcmil CU cable will have approximately 500 A capacity.

APPENDIX 1 – PEAK LOADS AND SYSTEM IMPROVEMENTS

Spanish Fork City

Peak Loads - No Improvements

(No Improvements)			2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Substation		Recloser	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA
North	XFMR Base: 12	Main Street	97	2.09	102	2.21	108	2.34	114	2.46	120	2.60	127	2.74	134	2.89	141	3.04	148	3.21	156	3.38	164	3.55
	XFMR 80%: 16	Airport	148	3.20	156	3.37	165	3.56	174	3.75	183	3.96	193	4.17	203	4.39	214	4.62	225	4.87	237	5.13	249	5.39
	XFMR Total: 20	Sub Total	245	5.29	259	5.58	273	5.90	288	6.22	304	6.56	320	6.91	337	7.28	355	7.67	374	8.07	394	8.51	414	8.94
Whitehead	XFMR Base: 7.5	Nature's Sunshine	181	3.91	188	4.07	196	4.24	204	4.42	213	4.61	222	4.80	232	5.00	241	5.21	252	5.44	263	5.67	274	5.91
	XFMR 80%: 8.4	Provo Craft	150	3.24	156	3.37	163	3.51	169	3.65	176	3.81	184	3.97	191	4.13	199	4.31	208	4.49	217	4.68	226	4.88
	XFMR Total: 10.5	Sub Total	331	7.14	344	7.44	359	7.76	374	8.07	390	8.42	406	8.76	423	9.13	441	9.52	460	9.93	480	10.36	500	10.79
Industrial	XFMR Base: 12	Shopko	122	2.62	128	2.77	136	2.93	143	3.09	151	3.26	159	3.44	168	3.62	177	3.81	186	4.02	196	4.23	206	4.45
	XFMR 80%: 16	Klune	113	2.45	120	2.60	128	2.76	135	2.92	143	3.09	151	3.26	160	3.45	169	3.64	178	3.84	188	4.06	198	4.28
	XFMR Total: 20	Sub Total	235	5.08	249	5.37	263	5.69	278	6.00	294	6.35	310	6.70	327	7.07	345	7.46	364	7.86	384	8.29	404	8.73
Argyle	XFMR Base: 8.4	50 East	80	1.73	81	1.76	83	1.79	84	1.82	86	1.86	88	1.89	89	1.93	91	1.97	93	2.01	95	2.05	97	2.09
	XFMR 80%: 9.4	300 West	383	8.27	416	8.98	451	9.74	486	10.49	524	11.33	563	12.16	604	13.05	647	13.98	692	14.95	740	15.99	788	17.03
	XFMR Total: 11.76	Sub Total	463	10.00	497	10.74	534	11.53	570	12.32	610	13.18	651	14.05	693	14.98	738	15.95	785	16.96	835	18.04	885	19.12
Canyon Road	XFMR Base: 12	Fingerhut	265	5.72	268	5.78	270	5.84	273	5.90	277	5.97	280	6.04	283	6.12	287	6.19	291	6.28	295	6.36	299	6.45
	XFMR 80%: 16	IFA	399	8.61	403	8.70	407	8.79	411	8.89	416	8.99	421	9.09	426	9.20	432	9.32	437	9.44	443	9.57	449	9.70
	XFMR Total: 20	Sub Total	663	14.33	670	14.47	677	14.63	685	14.79	693	14.96	701	15.14	709	15.32	718	15.52	728	15.72	738	15.93	748	16.15
Maple Mountain	XFMR Base: 12	SR-6	279	6.03	293	6.32	307	6.63	321	6.93	337	7.27	352	7.61	369	7.97	387	8.35	405	8.74	424	9.17	444	9.59
	XFMR 80%: 16	High School	159	3.43	166	3.58	174	3.75	181	3.92	190	4.10	198	4.28	207	4.47	217	4.68	226	4.89	237	5.12	247	5.35
	XFMR Total: 20	Sub Total	438	9.46	458	9.90	480	10.38	502	10.85	526	11.37	551	11.89	576	12.45	603	13.03	631	13.64	661	14.28	691	14.93
Woodhouse	XFMR Base: 10	SAPA	186	4.01	197	4.25	208	4.50	220	4.75	233	5.03	246	5.31	259	5.60	274	5.91	289	6.24	305	6.58	321	6.93
	XFMR 80%: 11.2	1100 East	85	1.83	90	1.94	95	2.06	101	2.18	107	2.31	113	2.44	119	2.58	126	2.72	133	2.87	141	3.04	148	3.20
	XFMR Total: 14	K-Mart	306	6.61	324	7.00	344	7.42	363	7.84	384	8.30	406	8.76	428	9.25	452	9.76	477	10.30	503	10.87	530	11.45
		Sub Total	576	12.45	611	13.19	647	13.98	684	14.77	724	15.64	764	16.50	807	17.43	852	18.40	899	19.41	949	20.49	999	21.57
Total		Amps	2951		3088		3235		3381		3541		3702		3873		4053		4241		4441		4641	
		MVA		63.74		66.70		69.87		73.02		76.49		79.96		83.66		87.54		91.59		95.91		100.24

Combined Substations (No Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA
North, Whitehead, Woodhouse Base: 29.5 MVA, 80%: 35.6 MVA, Total: 44.5 MVA	1152	24.88	1214	26.21	1280	27.64	1345	29.06	1418	30.62	1490	32.18	1567	33.84	1648	35.59	1732	37.41	1822	39.36	1912	41.30
Industrial, Argyle Base: 20.4 MVA, 80%: 25.4 MVA, Total: 31.76 MVA	698	15.07	746	16.11	797	17.22	848	18.32	905	19.54	961	20.75	1021	22.04	1084	23.40	1149	24.82	1219	26.33	1289	27.85
Canyon Road, Maple Mountain Base: 24 MVA, 80%: 32 MVA, Total: 40 MVA	1101	23.78	1129	24.38	1158	25.01	1187	25.64	1219	26.33	1251	27.03	1286	27.77	1322	28.54	1359	29.35	1399	30.22	1439	31.08
Total - Base: 73.9 MVA, Total: 116.26 MVA	2951	63.74	3088	66.70	3235	69.87	3381	73.02	3541	76.49	3702	79.96	3873	83.66	4053	87.54	4241	91.59	4441	95.91	4641	100.24

Substation MVA (No Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA
North - Base: 12 MVA, Total: 20 MVA	44%	26%	47%	28%	49%	30%	52%	31%	55%	33%	58%	35%	61%	36%	64%	38%	67%	40%	71%	43%	74%	45%
Whitehead - Base: 7.5 MVA, Total: 10.5 MVA	95%	68%	99%	71%	103%	74%	108%	77%	112%	80%	117%	83%	122%	87%	127%	91%	132%	95%	138%	99%	144%	103%
Industrial - Base: 12 MVA, Total: 20 MVA	42%	25%	45%	27%	47%	28%	50%	30%	53%	32%	56%	33%	59%	35%	62%	37%	66%	39%	69%	41%	73%	44%
Argyle - Base: 8.4 MVA, Total: 11.76 MVA	119%	85%	128%	91%	137%	98%	147%	105%	157%	112%	167%	119%	178%	127%	190%	136%	202%	144%	215%	153%	228%	163%
Canyon Road - Base: 12 MVA, Total: 20 MVA	119%	72%	121%	72%	122%	73%	123%	74%	125%	75%	126%	76%	128%	77%	129%	78%	131%	79%	133%	80%	135%	81%
Maple Mountain - Base: 12 MVA, Total: 20 MVA	79%	47%	83%	50%	86%	52%	90%	54%	95%	57%	99%	59%	104%	62%	109%	65%	114%	68%	119%	71%	124%	75%
Woodhouse - Base: 10 MVA, Total: 14 MVA	124%	89%	132%	94%	140%	100%	148%	105%	156%	112%	165%	118%	174%	124%	184%	131%	194%	139%	205%	146%	216%	154%
Total - Base: 73.9 MVA, Total: 116.26 MVA	86%	55%	90%	57%	95%	60%	99%	63%	104%	66%	108%	69%	113%	72%	118%	75%	124%	79%	130%	82%	136%	86%

Combined Substation MVA (No Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA
North, Whitehead, Woodhouse Base: 29.5 MVA, Total: 44.5 MVA	84%	56%	89%	59%	94%	62%	98%	65%	104%	69%	109%	72%	115%	76%	121%	80%	127%	84%	133%	88%	140%	93%
Industrial, Argyle Base: 20.4 MVA, Total: 31.76 MVA	74%	47%	79%	51%	84%	54%	90%	58%	96%	62%	102%	65%	108%	69%	115%	74%	122%	78%	129%	83%	137%	88%
Canyon Road, Maple Mountain Base: 24 MVA, Total: 40 MVA	99%	59%	102%	61%	104%	63%	107%	64%	110%	66%	113%	68%	116%	69%	119%	71%	122%	73%	126%	76%	130%	78%
Total - Base: 73.9 MVA, Total: 116.26 MVA	86%	55%	90%	57%	95%	60%	99%	63%	104%	66%	108%	69%	113%	72%	118%	75%	124%	79%	130%	82%	136%	86%

Color Code:
Above Base
Above 80% Total
Above Total

Spanish Fork City

Peak Loads - After Improvements

(After Improvements)			2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Substation		Recloser	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA
North	XFMR Base: 12	Main Street	97	2.09	102	2.21	108	2.34	114	2.46	120	2.60	127	2.74	134	2.89	141	3.04	148	3.21	156	3.38	164	3.55
	XFMR 80%: 16	Airport	148	3.20	156	3.37	165	3.56	174	3.75	183	3.96	193	4.17	203	4.39	214	4.62	225	4.87	237	5.13	249	5.39
	XFMR Total: 20	North3	-		50	1.08	55	1.19	60	1.30	66	1.42	71	1.54	77	1.67	84	1.81	90	1.95	97	2.10	104	2.25
		Sub Total	245	5.29	309	6.66	328	7.09	348	7.52	370	7.98	391	8.45	415	8.95	439	9.48	464	10.02	491	10.61	518	11.19
Whitehead	XFMR Base: 7.5	Nature's Sunshine	181	3.91	138	2.99	141	3.05	144	3.12	147	3.19	151	3.25	154	3.33	158	3.41	161	3.49	165	3.57	169	3.66
	XFMR 80%: 8.4	Provo Craft	150	3.24	156	3.37	163	3.51	169	3.65	176	3.81	184	3.97	191	4.13	199	4.31	208	4.49	217	4.68	226	4.88
	XFMR Total: 10.5	Sub Total	331	7.14	294	6.36	304	6.57	313	6.77	324	7.00	334	7.22	345	7.46	357	7.71	369	7.98	382	8.26	395	8.54
Industrial	XFMR Base: 12	Shopko	122	2.62	128	2.77	136	2.93	143	3.09	151	3.26	159	3.44	168	3.62	177	3.81	186	4.02	196	4.23	206	4.45
	XFMR 80%: 16	Klune	113	2.45	235	5.07	266	5.74	296	6.40	330	7.13	226	4.89	238	5.15	251	5.42	264	5.70	278	6.00	292	6.31
	XFMR Total: 20	Sub Total	235	5.08	363	7.85	401	8.67	439	9.49	481	10.39	385	8.32	406	8.77	427	9.23	450	9.72	474	10.24	498	10.76
Argyle	XFMR Base: 8.4	50 East	80	1.73	81	1.76	83	1.79	84	1.82	86	1.86	88	1.89	89	1.93	91	1.97	93	2.01	95	2.05	97	2.09
	XFMR 80%: 9.4	300 West	383	8.27	301	6.50	313	6.76	325	7.01	337	7.29	264	5.69	267	5.77	271	5.84	274	5.92	278	6.01	282	6.10
	XFMR Total: 11.76	Sub Total	463	10.00	383	8.26	396	8.55	409	8.83	423	9.14	351	7.58	356	7.69	362	7.81	367	7.93	373	8.06	379	8.19
Canyon Road	XFMR Base: 12	Fingerhut	265	5.72	268	5.78	270	5.84	273	5.90	277	5.97	280	6.04	283	6.12	287	6.19	291	6.28	295	6.36	299	6.45
	XFMR 80%: 16	IFA	399	8.61	403	8.70	407	8.79	411	8.89	416	8.99	421	9.09	426	9.20	432	9.32	437	9.44	226	4.87	229	4.94
	XFMR Total: 20	Sub Total	663	14.33	670	14.47	677	14.63	685	14.79	693	14.96	701	15.14	709	15.32	718	15.52	728	15.72	520	11.24	527	11.39
Maple Mountain	XFMR Base: 12	SR-6	279	6.03	293	6.32	307	6.63	321	6.93	337	7.27	352	7.61	369	7.97	387	8.35	405	8.74	185	4.00	195	4.22
	XFMR 80%: 16	High School	159	3.43	166	3.58	174	3.75	181	3.92	190	4.10	198	4.28	207	4.47	217	4.68	226	4.89	237	5.12	247	5.35
	XFMR Total: 20	Sub Total	438	9.46	458	9.90	480	10.38	502	10.85	526	11.37	551	11.89	576	12.45	603	13.03	631	13.64	422	9.12	443	9.56
Woodhouse	XFMR Base: 22	SAPA	186	4.01	197	4.25	208	4.50	220	4.75	233	5.03	246	5.31	259	5.60	274	5.91	289	6.24	305	6.58	321	6.93
	XFMR 80%: 27.2	1100 East	85	1.83	90	1.94	95	2.06	101	2.18	107	2.31	113	2.44	119	2.58	126	2.72	133	2.87	141	3.04	148	3.20
	XFMR Total: 34	K-Mart	306	6.61	162	3.49	171	3.70	181	3.90	191	4.13	202	4.35	213	4.59	224	4.85	237	5.11	250	5.39	263	5.67
		Woodhouse4	-	-	163	3.51	172	3.72	182	3.94	193	4.17	204	4.41	216	4.66	228	4.92	240	5.19	254	5.48	267	5.77
		Sub Total	576	12.45	611	13.19	647	13.98	684	14.77	724	15.64	764	16.50	807	17.43	852	18.40	899	19.41	949	20.49	999	21.57
Future Leland	XFMR Base: 12	Future Leland1	-	-	-	-	-	-	-	-	-	-	112	2.42	129	2.79	147	3.18	166	3.59	186	4.02	206	4.45
	XFMR Max: 20	Future Leland2	-	-	-	-	-	-	-	-	-	-	112	2.42	129	2.79	147	3.18	166	3.59	186	4.02	206	4.45
	80% Base: 9.6	Sub Total	-	-	-	-	-	-	-	-	-	-	224	4.84	259	5.58	294	6.36	332	7.17	372	8.03	412	8.90
Future Bonner	XFMR Base: 12	Future Bonner1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	239	5.16	249	5.37
	XFMR Max: 20	Future Bonner2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	217	4.70	221	4.76
	80% Base: 9.6	Sub Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	457	9.86	469	10.13
Total		Amps	2951		3088		3235		3381		3541		3702		3873		4053		4241		4441		4641	
		MVA		63.74		66.70		69.87		73.02		76.49		79.96		83.66		87.54		91.59		95.91		100.24

Combined Substations (After Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA	Amps	MVA
North, Whitehead, Woodhouse, New Transformer (2014) Base: 41.5 MVA, Total: 64.5 MVA	1152	24.88	1214	26.21	1280	27.64	1345	29.06	1418	30.62	1490	32.18	1567	33.84	1648	35.59	1732	37.41	1822	39.36	1912	41.30
Industrial, Argyle, Future Leland (2018) Base: 32.4 MVA, Total: 51.76 MVA	698	15.07	746	16.11	797	17.22	848	18.32	905	19.54	961	20.75	1021	22.04	1084	23.40	1149	24.82	1219	26.33	1289	27.85
Canyon Road, Maple Mountain, Future Bonner (2022) Base: 36 MVA, Total: 60 MVA	1101	23.78	1129	24.38	1158	25.01	1187	25.64	1219	26.33	1251	27.03	1286	27.77	1322	28.54	1359	29.35	1399	30.22	1439	31.08
Total - Base: 103.9 MVA, Total: 176.26 MVA	2951	63.74	3088	66.70	3235	69.87	3381	73.02	3541	76.49	3702	79.96	3873	83.66	4053	87.54	4241	91.59	4441	95.91	4641	100.24

Substation MVA (After Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA
North - Base: 12 MVA, Total: 20 MVA	44%	26%	56%	33%	59%	35%	63%	38%	67%	40%	70%	42%	75%	45%	79%	47%	84%	50%	88%	53%	93%	56%
Whitehead - Base: 7.5 MVA, Total: 10.5 MVA	95%	68%	85%	61%	88%	63%	90%	64%	93%	67%	96%	69%	99%	71%	103%	73%	106%	76%	110%	79%	114%	81%
Industrial - Base: 12 MVA, Total: 20 MVA	42%	25%	65%	39%	72%	43%	79%	47%	87%	52%	69%	42%	73%	44%	77%	46%	81%	49%	85%	51%	90%	54%
Argyle - Base: 8.4 MVA, Total: 11.76 MVA	119%	85%	98%	70%	102%	73%	105%	75%	109%	78%	90%	64%	92%	65%	93%	66%	94%	67%	96%	69%	98%	70%
Canyon Road - Base: 12 MVA, Total: 20 MVA	119%	72%	121%	72%	122%	73%	123%	74%	125%	75%	126%	76%	128%	77%	129%	78%	131%	79%	94%	56%	95%	57%
Maple Mountain - Base: 12 MVA, Total: 20 MVA	79%	47%	83%	50%	86%	52%	90%	54%	95%	57%	99%	59%	104%	62%	109%	65%	114%	68%	76%	46%	80%	48%
Woodhouse - Base: 22 MVA, Total: 34 MVA	124%	89%	60%	39%	64%	41%	67%	43%	71%	46%	75%	49%	79%	51%	84%	54%	88%	57%	93%	60%	98%	63%
Fure Leland - Base: 12 MVA, Total: 20 MVA	-	-	-	-	-	-	-	-	-	-	40%	24%	47%	28%	53%	32%	60%	36%	67%	40%	74%	45%
Future Bonner - Base: 12 MVA, Total: 20 MVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82%	49%	84%	51%
Total - Base: 103.9 MVA, Total: 176.26 MVA	86%	55%	90%	57%	95%	60%	99%	63%	89%	56%	93%	59%	85%	54%	89%	56%	94%	59%	92%	54%	96%	57%

Combined Substation MVA (After Improvements)	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA	% Base MVA	% Total MVA
North, Whitehead, Woodhouse, New Transformer (2014) Base: 41.5 MVA, Total: 64.5 MVA	84%	56%	63%	41%	67%	43%	70%	45%	74%	47%	78%	50%	82%	52%	86%	55%	90%	58%	95%	61%	100%	64%
Industrial, Argyle, Future Leland (2018) Base: 32.4 MVA, Total: 51.76 MVA	74%	47%	79%	51%	84%	54%	90%	58%	96%	62%	64%	40%	68%	43%	72%	45%	77%	48%	81%	51%	86%	54%
Canyon Road, Maple Mountain, Future Bonner (2022) Base: 36 MVA, Total: 60 MVA	99%	59%	102%	61%	104%	63%	107%	64%	110%	66%	113%	68%	116%	69%	119%	71%	122%	73%	84%	50%	86%	52%
Total - Base: 103.9 MVA, Total: 176.26 MVA	86%	55%	90%	57%	95%	60%	99%	63%	89%	56%	93%	59%	85%	54%	89%	56%	94%	59%	92%	54%	96%	57%

System Upgrades	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lines between North, Whitehead, & Woodhouse											
Capacitor Bank Additions											
Line from Industrial to 900 S											
New Woodhouse Transformer											
Future Leland Substation											
Reconductor River Ridge Ln and Del Monte Rd											
Reconductor SR-98											
Future Bonner Substation											
Recondcutor 1100 E											
Reconductor 2300 E											
Reconductor US-6											

Color Code:

Above Base

Above 80% Total

Above Total

APPENDIX 2 – COST ESTIMATES

Capital Facilities Plan - Project Cost Estimates					
Map ID	**Project Description**	**Size/Length**	**Approx. Total Cost**	**IFFP**	**Percent to New Development**
	Legacy Farms Development Agreement 600 Amp Distribution Line 400 N and 2550 E	Project competed in 2012.	$406,939 ***	$71,214	17.5%
1	Lines between North, Whitehead, & Woodhouse	**Project 1A:** 5600 feet, 46 kV 795 ACSR with 12 kV 477 ACSR under build	$1,042,166	$458,553	44%
		Project 1B: 5550 feet, 477 ACSR, 12 kV under build on existing 46 kV structures (assumes structures can be reused)	$124,792	$54,908	44%
		Project 1C: 2000 feet, 12 kV 750 kcmil, 6" conduit	$117,447 ***	$31,711	27%
		Project #1 Subtotal	**$1,284,405**	**$545,172**	
2	Capacitor Bank Additions	**Project 2:** Capacitor Study required to determine sizes and locations (Accurate cost not possible at this time)	$115,000*	$93,150	81%
3	Line from Industrial to 900 S	**Project 3A:** 1200 feet, 12 kV 477 ACSR, reconductor from 4/0 ASCR, (assumes existing poles can be reused)			
		Project 3B: 2400 feet, 12 kV 477 ACSR			
		Project 3C: 1800 feet, 12 kV 477 ACSR, under build on existing 46 kV structures (assumes structures can be reused)			
		Project 3D: 6100 feet, 12 kV 477 ACSR			
		Project 3E: 5300 feet, 12 kV 477 ACSR, reconductor from #2 ACSR & 1/0 ACSR, (assumes existing poles can be reused)			
		Project #3 Subtotal	**$391,390 *** **	**$317,026**	**81%**
4	New Woodhouse Transformer	**Project 4:** 12/16/20 MVA transformer	$1,213,590 **	$983,008	81%
5	Future Leland Substation	**Project 5:** Substation with 12/16/20 MVA transformer	$2,177,334	$1,763,641	81%
6	Reconductor River Ridge Ln and Del Monte Rd	**Project 6:** 5050 feet, 12 kV 500 kcmil CU, reconductor from 4/0 AWG AL, (assumes existing 4" conduit can be reused)	$358,837	$190,184	53%
7	Reconductor Main Street (SR-198)	**Project 7:** 3100 feet, 12 kV 477 ACSR, reconductor from 1/0 ACSR, (assumes existing poles can be reused)	$159,162	$108,230	68%

Capital Facilities Plan - Project Cost Estimates					
Map ID	**Project Description**	**Size/Length**	**Approx. Total Cost**	**IFFP**	**Percent to New Development**
8	Future Bonner Substation	**Project 8:** Substation with 12/16/20 MVA transformer	$2,177,334	$1,763,641	81%
9	Reconductor 1100 E	**Project 9:** 2600 feet, 12 kV 500 kcmil CU, reconductor from 1/0 AWG AL, (assumes existing 4" conduit can be reused)	$196,631	$133,709	68%
10	Reconductor 2300 E	**Project 10:** 3450 feet, 12 kV 500 kcmil CU, reconductor from 1/0 AWG AL, (assumes existing 4" conduit can be reused)	$249,682	$169,784	68%
11	Reconductor US-6	**Project 11:** 2700 feet, 12 kV 500 kcmil CU, reconductor from 4/0 AWG AL, (assumes existing 4" conduit can be reused)	$215,687	$114,314	53%
	Total		**$8,945,991**	**$6,253,072**	

Costs do not include right of way or land

* Cost that is shown for capacitor bank additions came from an existing 10 year CFP budget spreadsheet that was given to ICPE from Spanish Fork. ICPE was not able to develop costs for this project since capacitor bank sizes, types, and locations are not known.

** Woodhouse Transformer addition based on actual costs obtained from Spanish Fork, No cost estimate provided

*** Actual Project Cost

MAP ID 1A COST ESTIMATE

SPANISH FORK POWER DEPARTMENT

46 KV TRANSMISSION LINE - ALTERNATE ROUTE ALONG RAILROAD TRACK MAP ID 1A

Construction Cost Estimate Summary

Rev. 3 (10-2013)

PROJECT: Spanish Fork 46 kV Double Circuit Line - Map ID 1	**BASIS OF ESTIMATE:**
Along Railroad Tracks - New ROW Along 2700 North	CODE A - (Schematic Design)
DESCRIPTION: Cost Estimate Summary	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:** Craig Michaelis

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	COST ($)
Wood Poles:								
1. 80 Cl H2	1	EA	20.0	20.0	$800.00	$3,015.00	$3,015.00	$3,815.00
LD and Custom Steel Poles	1	LS	625.0	625.0	$25,000.00	$325,032.00	$325,032.00	$350,032.00
46 kV Switch	1	LS	40.0	40.0	$1,600.00	$14,000.00	$14,000.00	$15,600.00
46 kV Double Circuit Tangent	1	LS	195.0	195.0	$7,800.00	$31,965.00	$31,965.00	$39,765.00
46 kV Double Circuit DDE	1	LS	140.0	140.0	$5,600.00	$11,880.00	$11,880.00	$17,480.00
Dist PTAs	1	LS	128.0	128.0	$5,120.00	$4,260.93	$4,260.93	$9,380.93
795 kcmil ACSR[1]	32,700	Ft.	0.020	654.0	$26,160.00	$1.85	$60,495.00	$86,655.00
477 kcmil ACSR[1]	20,600	Ft.	0.020	412.0	$16,480.00	$1.65	$33,990.00	$50,470.00
3/8" EHS Shield Wire[2]	5,150	Ft.	0.015	77.3	$3,090.00	$0.35	$1,802.50	$4,892.50
Concrete Foundations	1	LS			$90,800.00		$76,545.00	$167,345.00
Wood Pole Ground	6	EA	1.0	6.0	$240.00	$55.00	$330.00	$570.00
Single Down Guy	2	EA	1.0	2.0	$80.00	$65.00	$130.00	$210.00
Cross Plate Anchor	2	EA	2.0	4.0	$160.00	$45.00	$90.00	$250.00
Cutoff Exist Pole	16	EA	20.0	320.0	$12,800.00			$12,800.00
Remove Exist Pole	8	EA	10.0	80.0	$3,200.00			$3,200.00
Remove Existing Cond	13,900	Ft.	0.01	139.0	$5,560.00			$5,560.00
Transfer Existing Cond.	6,000	Ft.	0.15	900.0	$36,000.00			$36,000.00
Labor Rate			$40.00					
Subtotal Labor Hours/$				3,742.25	$240,490.00			$240,490.00
Subtotal Material							$563,535.43	$563,535.43
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$804,025.43**
Engineering	1	LS						$56,281.78
Surveying	1	LS						$25,000.00
Geotech	1	LS						$10,000.00
TOTAL ENGINEERING COST								**$91,281.78**
CONTINGENCY	3	%						**$26,859.22**
RIGHT OF WAY[4]	4	Acres						**$120,000.00**
TOTAL COST ESTIMATE								***$1,042,166***

NOTES:

1. Includes an allowance of 2.5% for sag and jumper make up.
2. Includes an allowance of 2.5% for sag and jumper make up.
3. Does not include substation costs.
4. Includes right of way costs at $30,000/acre, 40' right of way width.

SPANISH FORK POWER DEPARTMENT

46 KV TRANSMISSION LINE - ALTERNATE ROUTE ALONG RAILROAD TRACK MAP ID 1A

Rev. 3 (10-2013)

PROJECT: Spanish Fork 46 kV Double Circuit Line - Map ID 1						**BASIS OF ESTIMATE:**		
Along Railroad Tracks - New ROW Along 2700 North						CODE A - (Schematic Design)		
DESCRIPTION: LD and Custom Engineered Steel Poles						CODE B - (Preliminary Design)		
						CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** Craig Michaelis		
DESCRIPTION**	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
Single and Double Circuit DDE Single Poles								
1. (15) LD Steel Structure	1	LS	385.00	385.00	$15,400.00	$124,174.00	$124,174.00	$139,574.00
2. Str. 6 Custom Steel	1	EA	40.00	40.00	$1,600.00	$36,878.00	$36,878.00	$38,478.00
3. Str. 15 Custom Steel	1	EA	40.00	40.00	$1,600.00	$28,299.00	$28,299.00	$29,899.00
4. Str. 16 Custom Steel	1	EA	40.00	40.00	$1,600.00	$60,006.00	$60,006.00	$61,606.00
5. Str. 18 Custom Steel	1	EA	40.00	40.00	$1,600.00	$29,995.00	$29,995.00	$31,595.00
6. Str. 1A Custom Steel	1	EA	40.00	40.00	$1,600.00	$18,477.00	$18,477.00	$20,077.00
7. Str. 1B Custom Steel	1	EA	40.00	40.00	$1,600.00	$23,203.00	$23,203.00	$24,803.00
Climbing Ladders	1	LS					$4,000.00	$4,000.00
SUBTOTALS	1			625.00	$25,000.00		$325,032.00	
Average Labor Rate ($/Hr.)			$40.00					
Subtotal Labor								$25,000.00
Subtotal Material								$325,032.00
TOTAL COST								$350,032.00

SPANISH FORK POWER DEPARTMENT

46 KV TRANSMISSION LINE - ALTERNATE ROUTE ALONG RAILROAD TRACK MAP ID 1A

Rev. 3 (10-2013)

PROJECT: Spanish Fork 46 kV Double Circuit Line - Map ID 1						**BASIS OF ESTIMATE:**		
Along Railroad Tracks - New ROW Along 2700 North						CODE A - (Schematic Design)		
DESCRIPTION: Single Pole - Pole Top Assemblies						CODE B - (Preliminary Design)		
						CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** Craig Michaelis		
DESCRIPTION	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. 46 kV Transmission Tangent								
1. Dbl Ckt HPI - 2 1/2" Rod	15	Each	13	195.0	$7,800.00	$2,131.00	$31,965.00	$39,765.00
2. Sngl Ckt HPI - 2 1/2" Rod	0	Each	3	0.0	$0.00	$1,111.00	$0.00	$0.00
B. 46 kV Transmission Double Deadend								
1. 795 ACSR Dbl Ckt	4	Each	35	140.0	$5,600.00	$2,970.00	$11,880.00	$17,480.00
2. 795 ACSR Sngl Ckt	2	Each	35	70.0	$2,800.00	$2,340.00	$4,680.00	$7,480.00
C. Distribution Single Circuit PTAs								
1. Single Phase Tangent	17	Each	4	68.0	$2,720.00	$152.79	$2,597.43	$5,317.43
2. Single Phase DDE	5	Each	12	60.0	$2,400.00	$332.70	$1,663.50	$4,063.50
3. Three Phase Tangent	0	Each	8	0.0	$0.00	$284.72	$0.00	$0.00
4. Three Phase DDE	0	Each	20	0.0	$0.00	$142.36	$0.00	$0.00
SUBTOTALS	43			533.00	$21,320.00		$52,785.93	$74,105.93
Average Labor Rate ($/Hr.)			$40.00					
Subtotal Labor								$21,320.00
Subtotal Material								$52,785.93
TOTAL COST								$74,105.93

SPANISH FORK POWER DEPARTMENT

46 KV TRANSMISSION LINE - ALTERNATE ROUTE ALONG RAILROAD TRACK MAP ID 1A

Rev. 3 (10-2013)

PROJECT: Spanish Fork 46 kV Double Circuit Line - Map ID 1						**BASIS OF ESTIMATE:**		
DESCRIPTION: **Along Railroad Tracks - New ROW Along 2700 North Concrete Foundations/Backfill**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** Craig Michaelis		
DESCRIPTION	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT YARDS**	**TOTAL YARDS**	**TOTAL LABOR $**	**PER YARD**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. Concrete Foundations - Custom Designed Steel Poles								
1. Structure 6	1	Each	55.00	40	$16,000.00	$243.00	$13,365.00	$29,365.00
2. Structure 15	1	Each	50.00	34	$13,600.00	$243.00	$12,150.00	$25,750.00
3. Structure 16	1	Each	40.00	50	$20,000.00	$243.00	$9,720.00	$29,720.00
4. Structure 18	1	Each	65.00	50	$20,000.00	$243.00	$15,795.00	$35,795.00
5. Structure 1A	1	Each	65.00	34	$13,600.00	$243.00	$15,795.00	$29,395.00
5. Structure 1B	1	Each	40.00	34	$13,600.00	$243.00	$9,720.00	$23,320.00
SUBTOTALS	6			242.00	$96,800.00		$76,545.00	
Foundation Labor $/ Yard			$400.00					
Subtotal Labor								$96,800.00
Subtotal Material								$76,545.00
TOTAL COST								$173,345.00

* Labor includes manhours for excavation for foundations.

SPANISH FORK POWER DEPARTMENT

46 KV TRANSMISSION LINE - ALTERNATE ROUTE ALONG RAILROAD TRACK MAP ID 1A

Rev. 3 (10-2013)

PROJECT: Spanish Fork 46 kV Double Circuit Line - Map ID 1	**BASIS OF ESTIMATE:**
Along Railroad Tracks - New ROW Along 2700 North	CODE A - (Schematic Design)
DESCRIPTION: Pole Top Assembly Materials	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Config

ESTIMATOR: Les Bell **CHECKED:** Craig Michaelis

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TANGENT HPI SINGLE CIRCUIT	TANGENT HPI DOUBLE CIRCUIT	TRANS DDE SINGLE CIRCUIT	TRANS DDE DOUBLE CIRCUIT	DIST TANGENT THREE PHASE	DIST TANGENT SINGLE PHASE	DIST DDE 3 PHASE STL POLE	DIST DDE 1 PHASE STL POLE
46 kV Polymer Insulators										
2 1/2" Rod HPI Braced Post	$275.00	EA	3	6	3					
25 KIP Deadend	$65.00	EA			6	15				
Conductor Fittings										
3/8" EHS Bolted Deadend	$55.00	EA			1	1				
3/8" EHS Suspension Clamp	$35.00	EA	1	1						
795 kcmil ACSR Susp/Trunion Clamp	$45.00	EA	3	6	3	3				
795 kcmil ACSR DE Comp	$95.00	EA			6	12				
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$35.00	EA	1	1	1	1				
Y Clevis Eye - 30 KIP	$35.00	EA								
Y Clevis Ball - 30 KIP - Hot Line	$35.00	EA								
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Bolt, Nut, Dbl Coil Lock Washer, Etc.	$10.00	EA	6	12	6	12				
795 to 795 AMPACT Tap Conn	$40.00	EA			6	12				
4/0 Copper to 4/0 Cu Connector	$15.00	EA			2	2				
Dist. Wood Crossarms and Braces										
12.5 kV, 6"x6"x10'	86.5	EA					2	1		
Cross Brace - 6"x6"x10' Arm	28.73	EA					2	1		
Dist. Insulators										
Polymer DE Insulator	26.2	EA							8	4
Pin Insulator and Steel Pin	6.78	EA					8	2	4	2
Distribuiton Formed Tie	5	EA					8	2	4	2
Hardware										
Bolt, Nuts, Washers, Etc.	24	EA					2	1	2	1
Shield Wire Support Bracket	21	EA	1	1						
TOTAL MATERIAL COST			$1,111	$2,131	$2,340	$2,970	$333	$153	$285	$142

MAP ID 1B COST ESTIMATE

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

Construction Cost Estimate Summary

(10-2013)

PROJECT: Dry Creek - Woodhouse 46 kV Line	**BASIS OF ESTIMATE:**
Add 12.47 kV Distribution Underbuild	CODE A - (Schematic Design)
DESCRIPTION: Cost Estimate Summary	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	COST ($)
Wood Poles:	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
LD and Custom Steel Poles	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
46 kV Switch		Ea	40.0	0.0	$0.00	$16,000.00	$0.00	$0.00
46 kV Double Circuit Tangent	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
46 kV Double Circuit DDE	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
Dist PTAs	1	LS	372.0	372.0	$22,320.00	$13,784.42	$13,784.42	$36,104.42
____ ACSR[1] Trans Phase		Ft.	0.030	0.0	$0.00		$0.00	$0.00
477 ACSR[1] Dist Phase	16,800	Ft.	0.018	302.4	$18,144.00	$1.58	$26,544.00	$44,688.00
477 ACSR[1] Dist Neut	6,265	Ft.	0.015	94.0	$5,638.50	$1.58	$9,898.70	$15,537.20
Adder Hot Dist Cond Stringing		Ft.	0.050	0.0	$0.00		$0.00	$0.00
3/8" EHS Shield Wire[2]		Ft.	0.020	0.0	$0.00	$0.35	$0.00	$0.00
Concrete Foundations	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
Wood Pole Ground		EA	1.0	0.0	$0.00	$55.00	$0.00	$0.00
Single Down Guy	8	EA	1.0	8.0	$480.00	$65.00	$520.00	$1,000.00
Cross Plate Anchor	8	EA	2.0	16.0	$960.00	$45.00	$360.00	$1,320.00
Cutoff Exist Pole		EA	20.0	0.0	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.0	$0.00			$0.00
Remove Existing Cond		Ft.	0.02	0.0	$0.00			$0.00
Transfer Exist Cond. Cold		Ft.	0.05	0.0	$0.00			$0.00
Transfer Exist Cond. Hot		Ft.	0.15	0.0	$0.00			$0.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				792.38	$47,542.50			$47,542.50
Subtotal Material							$51,107.12	$51,107.12
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$98,649.62**
Engineering	1	LS						$14,797.44
Surveying	1	LS						$0.00
Geotech	1	LS						$0.00
TOTAL ENGINEERING COST								**$14,797.44**
CONTINGENCY	10	%						**$11,344.71**
RIGHT OF WAY[4]		Acres						**$0.00**
TOTAL COST ESTIMATE								***$124,792***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. Installed on existing transmission line, no right of way required.

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

0

PROJECT: Dry Creek - Woodhouse 46 kV Line						**BASIS OF ESTIMATE:**		
Add 12.47 kV Distribution Underbuild **DESCRIPTION: Wood Poles**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
DESCRIPTION**	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
Wood Poles:								
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

(10-2013)

PROJECT: Dry Creek - Woodhouse 46 kV Line		**BASIS OF ESTIMATE:**
Add 12.47 kV Distribution Underbuild		CODE A - (Schematic Design)
DESCRIPTION:	**LD and Custom Engineered Steel Poles**	CODE B - (Preliminary Design)
		CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Configuration
	ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION**	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
Single and Double Circuit DDE Custom Steel Poles:								
1. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
2. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
3. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
4. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
5. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
6. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
Wood Pole Equivalent Steel Poles:								
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
Climbing Ladders		LS		0.00	$0.00		$0.00	$0.00
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

(10-2013)

PROJECT: Dry Creek - Woodhouse 46 kV Line						BASIS OF ESTIMATE:		
Add 12.47 kV Distribution Underbuild						CODE A - (Schematic Design)		
DESCRIPTION: Single Pole - Pole Top Assemblies						CODE B - (Preliminary Design)		
						CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED:		

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 46 kV Transmission Tangent PTAs								
1. 2 Ckt HPI - 2 1/2" Rod		Each	13	0.0	$0.00	$1,378.00	$0.00	$0.00
2. 1 Ckt HPI - 2 1/2" Rod		Each	10	0.0	$0.00	$748.00	$0.00	$0.00
3. 2 Ckt BR HPI - 2 1/2" Rod		Each	16	0.0	$0.00	$2,038.00	$0.00	$0.00
4. 1 Ckt BR HPI - 2 1/2" Rod		Each	13	0.0	$0.00	$1,078.00	$0.00	$0.00
B. 46 kV Transmission Double Deadend PTAs								
1. _____ACSR Dbl Ckt		Each	35	0.0	$0.00	$3,806.00	$0.00	$0.00
2. _____ ACSR Sngl Ckt		Each	20	0.0	$0.00	$2,753.00	$0.00	$0.00
C. 12.47 kV Distribution UB Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$160.79	$0.00	$0.00
2. Single Phase DDE		Each	12	0.0	$0.00	$357.70	$0.00	$0.00
3. Three Phase Tangent	23	Each	12	276.0	$16,560.00	$531.18	$12,217.14	$28,777.14
4. Three Phase DDE	4	Each	24	96.0	$5,760.00	$391.82	$1,567.28	$7,327.28
SUBTOTALS				372.00	$22,320.00		$13,784.42	$36,104.42
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$22,320.00
Subtotal Material								$13,784.42
TOTAL COST								$36,104.42

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

(10-2013)

PROJECT: Dry Creek - Woodhouse 46 kV Line						**BASIS OF ESTIMATE:**		
Add 12.47 kV Distribution Underbuild **DESCRIPTION: Concrete Foundations/Backfill**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:**		
DESCRIPTION	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT YARDS**	**TOTAL YARDS**	**TOTAL LABOR $**	**PER YARD**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. Concrete Foundations - Custom Designed Steel Poles								
1. Structure XX'		Each				$250.00		
2. Structure XX'		Each				$250.00		
3. Structure XX'		Each				$250.00		
4. Structure XXX'		Each				$250.00		
5. Structure XXX'		Each				$250.00		
6. Structure XXX'		Each				$250.00		
SUBTOTALS	0			0.00	$0.00		$0.00	
Foundation Labor $/ Cubic Yard			$400.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

* Labor includes manhours for excavation for foundations.

COST ESTIMATE

DRY CREEK - WOODHOUSE 46 KV TRANSMISSION LINE
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 1B

(10-2013)

PROJECT: Dry Creek - Woodhouse 46 kV Line	**BASIS OF ESTIMATE:**
Add 12.47 kV Distribution Underbuild	CODE A - (Schematic Design)
DESCRIPTION: Pole Top Assembly Materials	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Config
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN HPI SNGL CKT	TAN HPI DBL CKT	TAN BR HPI SNGL CKT	TAN BR HPI DBL CKT	TRANS DDE SNGL CKT	TRANS DDE DBL CKT	DIST TAN 3 PH WOOD	DIST TAN 1 PH WOOD	DIST DDE 3 PH WOOD	DIST DDE 1 PH WOOD
46 kV Polymer Insulators												
2 1/2" Rod HPI Post	$165.00	EA	3	6			3					
2 1/2" Rod HPI Braced Post	$275.00	EA			3	6	3					
25 KIP Deadend	$75.00	EA					6	15				
Conductor Fittings												
3/8" EHS Bolted Deadend	$55.00	EA					1	1				
3/8" EHS Suspension Clamp	$35.00	EA	1	1	1	1						
____ ACSR Susp/Trunion Clamp	$45.00	EA	3	6	3	6	3	3				
____ ACSR DE Comp	$110.00	EA					6	12				
Hardware												
Y Clevis Eye - 30 KIP 90^{O}	$35.00	EA	1	1	1	1	1	1				
Y Clevis Eye - 30 KIP	$35.00	EA										
Y Clevis Ball - 30 KIP - Hot Line	$35.00	EA										
Socket Eye - 30 KIP - Hot Line	$35.00	EA										
Bolt, Nut, Dbl Coil Lock Washer, Etc.	$5.50	EA	6	6	6	6	6	12				
Connectors												
____ to ____ AMPACT Tap Conn	$85.00	EA					6	12				
____ to ____ COMP Tap Conn	$55.00	EA										
Cur to Cu Comp Connector - Grnd	$25.00	EA					2	2				
Dist. Underbuild Wood Crossarms and Braces												
6" x 6" x 10'	86.5	EA							2	1	2	2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA							2	1	2	2
Dist. Insulators												
Polymer DE Insulator	26.2	EA									8	4
Pin Insulator and Steel Pin	11.78	EA							8	2	4	2
Distribuiton Formed Tie	5	EA							8	2	4	2
Hardware												
Bolt, Nuts, Washers, Etc.	5.5	EA							6	4	8	6
Shield Wire Support Bracket	15	EA	1	1	1	1						
TOTAL MATERIAL COST			$748	$1,378	$1,078	$2,038	$2,753	$3,806	$358	$161	$531	$392

MAP ID 1C COST ESTIMATE

COST ESTIMATE

12.47 KV UNDERGROUND DISTRIBUTION CIRCUIT - 2000 FEET - MAP ID 1C

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV UG DISTRIBUTION CIRCUIT - 2000 FEET						BASIS OF ESTIMATE:		
DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100% OTHER - Conceptual Configuration		
ENGINEER: Les Bell								
	ESTIMATOR: Les Bell					CHECKED:		
	QUANTITY		LABOR			MATERIAL $		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 15 kV Cable[1.]:								
1, 750 kcmil Al.	6,100	Ft	0.020	122.00	7,320.00	$8.50	$51,850.00	$59,170.00
2. 500 kcmil Cu.		Ft	0.020	0.00	0.00	$14.00	$0.00	$0.00
B. Conduit and Fittings:								
1. 6" Sch 40 PVC	2,000	Ft	0.015	30.000	1,800.00	$3.50	$7,000.00	$8,800.00
2. 6" Stl 90^{O} Elbows	10	Ea	0.45	4.500	270.00	$105.00	$1,050.00	$1,320.00
C. Equipment and Cable Components:								
1. 15 kV 600 A Sectionalizer	4	Ea	2.0	8.000	480.00	$650.00	$2,600.00	$3,080.00
2. Grnd Sleeve 600 A Sect	4	Ea	2.8	11.000	660.00	$275.00	$1,100.00	$1,760.00
3. 600 A 15 kV NLB Elbow	24	Ea	2.8	67.200	4,032.00	$150.00	$3,600.00	$7,632.00
4. 2 Way 600 A 15 kV Jct	12	Ea	3.0	36.00	$2,160.00	$192.50	$2,310.00	$4,470.00
D. Trench & Backfill								
1. Trench and Backfill	2,000	Ft	0.2	300.00	$18,000.00			$18,000.00
2. Trench Sanding		Ft	0.1	0.00	$0.00	$0.50	$0.00	$0.00
E. Miscellaneous:								
1. Grndg 600 A 15 kV Sect	4	Ea	2.0	8.00	$480.00	$175.00	$700.00	$1,180.00
2. Grndg 600 A 15 kV Elbow	24	Ea	1.0	24.00	$1,440.00	$25.00	$600.00	$2,040.00
3. Cable Tagging	12	Ea	0.5	6.00	$360.00	$25.00	$300.00	$660.00
4. 6" Sch 40 PVC Fittings	2,000	Ft	0.005	10.000	$600.00	$0.25	$500.00	$1,100.00
5. 600 A OH/UG Riser (Existing Pole)	2	Ea	30.0	60.00	$3,600.00	$1,450.00	$2,900.00	$6,500.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				686.70	$41,202.00			$41,202.00
Subtotal Material							$74,510.00	$74,510.00
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$115,712.00**
Engineering	1	LS						$5,785.60
Surveying	1	LS						$5,000.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$10,785.60**
CONTINGENCY	10	%						**$12,649.76**
TOTAL COST ESTIMATE								***$139,147***

NOTES:

1. Includes an allowance of 1.5% for fitting installation make up.

MAP ID 2 COST ESTIMATE

Capacitor Bank Additions Cost: $115,000

Cost that is shown for capacitor bank additions came from an existing 10 year CFP budget spreadsheet that was given to ICPE from Spanish Fork. ICPE was not able to develop costs for this project since capacitor bank sizes, types, and locations are not known.

No cost estimate was developed

MAP ID 3A COST ESTIMATE

COST ESTIMATE

12.47 KV DISTRIBUTION LINE
INDUSTRIAL SUB WEST RECONDUCTOR 4/0 ACSR to 477 ACSR - MAP ID 3A

Construction Cost Estimate Summary

(10-2013)

PROJECT: Recondcutor 12.47 kV Distribtuion Line - 2400 Feet	**BASIS OF ESTIMATE:**
DESCRIPTION: Cost Estimate Summary	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		
	QTY	UNIT	UNIT MH[5.]	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
12.47 kV PTAs[5.]	1	LS	128.0	128.00	$7,680.00	$2,906.80	$2,906.80	$10,586.80
477 ACSR[1] Dist Phase	3,650	Ft.	0.025	91.25	$5,475.00	$1.43	$5,219.50	$10,694.50
4/0 ACSR[1] Dist Neut	1,225	Ft.	0.020	24.50	$1,470.00	$0.89	$1,090.25	$2,560.25
Install/Remove Hot Arms	12	Loc	6.0	72.00	$4,320.00			$4,320.00
Set Out Exist Dist Cond	24	EA	2.0	48.00	$2,880.00		$0.00	$2,880.00
Wood Pole Ground		EA	1.0	0.00	$0.00	$55.00	$0.00	$0.00
Single Down Guy	8	EA	1.0	8.00	$480.00	$65.00	$520.00	$1,000.00
Cross Plate Anchor	8	EA	2.0	16.00	$960.00	$45.00	$360.00	$1,320.00
Cutoff Exist Pole		EA	20.0	0.00	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.00	$0.00			$0.00
Remove Exist Dist Cond	4,875	Ft.	0.025	121.88	$7,312.50			$7,312.50
Trans Exist Dist Cond. Cold		Ft.	0.05	0.00	$0.00			$0.00
Trans Exist Dist Cond. Hot		Ft.	0.15	0.00	$0.00			$0.00
Labor Rate			$60					
Subtotal Labor Hours/$				509.63	$30,577.50			$30,577.50
Subtotal Material							$10,096.55	$10,096.55
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$40,674.05**
Engineering	1	LS						$2,033.70
Surveying	1	LS						
Geotech	1	LS						
TOTAL ENGINEERING COST								**$2,033.70**
CONTINGENCY	10	%						**$4,270.78**
RIGHT OF WAY[4]		Acres						
TOTAL COST ESTIMATE								***$46,979***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. No right of way required.
5. Installed hot at twice the non hot manhours.

COST ESTIMATE

12.47 KV DISTRIBUTION LINE

INDUSTRIAL SUB WEST RECONDUCTOR 4/0 ACSR to 477 ACSR - MAP ID 3A

(10-2013)

PROJECT: Recondcutor 12.47 kV Distribtuion Line - 2400 Feet						**BASIS OF ESTIMATE:**		
DESCRIPTION:	**Distribution Pole Top Assemblies**					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
	QUANTITY		**LABOR**			**MATERIAL $**		
DESCRIPTION	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. 12.47 kV Distribution Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$139.56	$0.00	$0.00
2. Single Phase DDE		Each	8	0.0	$0.00	$474.36	$0.00	$0.00
3. Three Phase Tangent	4	Each	8	32.0	$1,920.00	$258.68	$1,034.72	$2,954.72
4. Three Phase DDE	2	Each	16	32.0	$1,920.00	$936.04	$1,872.08	$3,792.08
B. 12.47 kV Distribution Double Circuit PTAs								
1. Single Phase Tangent		Each	8	0.0	$0.00	$241.35	$0.00	$0.00
2. Single Phase DDE		Each	15	0.0	$0.00	$1,006.18	$0.00	$0.00
3. Three Phase Tangent		Each	15	0.0	$0.00	$495.82	$0.00	$0.00
4. Three Phase DDE		Each	30	0.0	$0.00	$1,835.54	$0.00	$0.00
SUBTOTALS	6			64.00	$3,840.00		$2,906.80	$6,746.80
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$3,840.00
Subtotal Material								$2,906.80
TOTAL COST								$6,746.80

COST ESTIMATE

12.47 KV DISTRIBUTION LINE

INDUSTRIAL SUB WEST RECONDUCTOR 4/0 ACSR to 477 ACSR - MAP ID 3A

(10-2013)

PROJECT: Recondcutor 12.47 kV Distribtuion Line - 2400 Feet		BASIS OF ESTIMATE:
DESCRIPTION: Pole Top Assembly Materials		CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Config
	ESTIMATOR: Les Bell	CHECKED: 0

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN 3 PH SNGL CKT	TAN 3 PH DBL CKT	DDE 3 PH SNGL CKT	DDE 3 PH DBL CKT	TAN 1 PH SNGL CKT	TAN 1 PH DBL CKT	DDE 1 PH SNGL CKT	DDE 1PH DBL CKT
Conductor Deadends, Bolted										
____ ACSR PHASE	$35.00	EA			6	12			2	4
____ ACSR NEUTRAL	$35.00	EA			1	1			1	1
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$25.00	EA								
Y Clevis Eye - 30 KIP	$25.00	EA								
Eye Nut	$15.00	EA			8	16			2	4
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Connectors										
____ to ____ AMPACT Tap Conn	$85.00	EA								
____ to ____ COMP Tap Conn	$55.00	EA			4	8			2	4
Cur to Cu Comp Connector - Grnd	$25.00	EA								
Dist. Wood Crossarms and Braces										
3 3/4 x 4 3/4 x 8'	45	EA	2		2		1		1	
6" x 6" x 10'	86.5	EA		2		2		1		2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA		2		2		1		2
Cross Brace 3 3/4 x 4 3/4 x 8' Arm	20	EA	2		2		1		1	
Dist. Insulators										
Polymer DE Insulator	26.2	EA			6	12			4	8
Pin Insulator and Steel Pin	11.78	EA	6	12	3	6	2	4	2	4
Distribuiton Formed Tie	5	EA	7	13	3	6	2	4	2	4
Hardware										
Bolt, Nuts, Washers, Etc.	5.5	EA	8	8	9	10	8	8	8	8
Double Upset Bolt W/Spool Ins	15	EA	1	1			1	1		
TOTAL MATERIAL COST			$259	$496	$936	$1,836	$140	$241	$474	$1,006

MAP ID 3B COST ESTIMATE

COST ESTIMATE

12.47 KV DISTRIBUTION LINE WEST OF INDUSTRIAL SUB - MAP ID 3B

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV Dist Line West of Industrial Sub - 2400 Feet	**BASIS OF ESTIMATE:**
DESCRIPTION: Cost Estimate Summary	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100% OTHER - Conceptual Configuration
ENGINEER: Les Bell	
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
Wood Poles:	1	LS	110.0	110.00	$6,600.00	$7,271.00	$7,271.00	$13,871.00
LD Steel Poles	1	LS	0.0	0.00	$0.00	$0.00	$0.00	$0.00
12.47 kV PTAs	1	LS	88.0	88.00	$5,280.00	$2,845.48	$2,845.48	$8,125.48
477 ACSR(1) Dist Phase	7,300	Ft.	0.025	182.50	$10,950.00	$1.43	$10,439.00	$21,389.00
4/0 ACSR(1) Dist Neut	2,450	Ft.	0.020	49.00	$2,940.00	$0.89	$2,180.50	$5,120.50
Install Hot Arms		Ea	4.0	0.00	$0.00			$0.00
Set Out Exist Dist Cond		Ea	0.5	0.00	$0.00		$0.00	$0.00
Wood Pole Ground	11	EA	1.0	11.00	$660.00	$55.00	$605.00	$1,265.00
Single Down Guy		EA	1.0	0.00	$0.00	$65.00	$0.00	$0.00
Cross Plate Anchor		EA	2.0	0.00	$0.00	$45.00	$0.00	$0.00
Cutoff Exist Pole		EA	20.0	0.00	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.00	$0.00			$0.00
Remove Existing Cond		Ft.	0.02	0.00	$0.00			$0.00
Transfer Exist Cond. Cold		Ft.	0.05	0.00	$0.00			$0.00
Transfer Exist Cond. Hot		Ft.	0.15	0.00	$0.00			$0.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				440.50	$26,430.00			$26,430.00
Subtotal Material							$23,340.98	$23,340.98
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$49,770.98**
Engineering	1	LS						$4,977.10
Surveying	1	LS						$7,500.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$12,477.10**
CONTINGENCY	10	%						**$6,224.81**
RIGHT OF WAY(4)		Acres						
TOTAL COST ESTIMATE								***$68,473***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. No right of way required.

COST ESTIMATE

12.47 KV DISTRIBUTION LINE WEST OF INDUSTRIAL SUB - MAP ID 3B

(10-2013)

PROJECT: 12.47 kV Dist Line West of Industrial Sub - 2400 Feet						**BASIS OF ESTIMATE:**		
DESCRIPTION: **Wood Poles**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
DESCRIPTION**	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
Wood Poles:								
40' Class 1	11	Each	10.00	110.00	$6,600.00	$661.00	$7,271.00	$13,871.00
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
SUBTOTALS	11			110.00	$6,600.00		$7,271.00	$13,871.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$6,600.00
Subtotal Material								$7,271.00
TOTAL COST								$13,871.00

COST ESTIMATE

12.47 KV DISTRIBUTION LINE WEST OF INDUSTRIAL SUB - MAP ID 3B

(10-2013)

PROJECT: 12.47 kV Dist Line West of Industrial Sub - 2400 Feet						**BASIS OF ESTIMATE:**		
DESCRIPTION: **LD Steel Poles**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
DESCRIPTION**	**QUANTITY**		**LABOR**			**MATERIAL $**		**TOTAL COST ($)**
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	
Wood Pole Equvalent Steel Poles:								
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
Climbing Ladders		LS					$0.00	$0.00
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

12.47 KV DISTRIBUTION LINE WEST OF INDUSTRIAL SUB - MAP ID 3B

(10-2013)

PROJECT: 12.47 kV Dist Line West of Industrial Sub - 2400 Feet						BASIS OF ESTIMATE:		
DESCRIPTION: Distribution Pole Top Assemblies						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED: 0		
DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
A. 12.47 kV Distribution Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$139.56	$0.00	$0.00
2. Single Phase DDE		Each	8	0.0	$0.00	$474.36	$0.00	$0.00
3. Three Phase Tangent	11	Each	8	88.0	$5,280.00	$258.68	$2,845.48	$8,125.48
4. Three Phase DDE		Each	16	0.0	$0.00	$936.04	$0.00	$0.00
B. 12.47 kV Distribution Double Circuit PTAs								
1. Single Phase Tangent		Each	8	0.0	$0.00	$241.35	$0.00	$0.00
2. Single Phase DDE		Each	15	0.0	$0.00	$1,006.18	$0.00	$0.00
3. Three Phase Tangent		Each	15	0.0	$0.00	$495.82	$0.00	$0.00
4. Three Phase DDE		Each	30	0.0	$0.00	$1,835.54	$0.00	$0.00
SUBTOTALS				88.00	$5,280.00		$2,845.48	$8,125.48
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$5,280.00
Subtotal Material								$2,845.48
TOTAL COST								$8,125.48

COST ESTIMATE

12.47 KV DISTRIBUTION LINE WEST OF INDUSTRIAL SUB - MAP ID 3B

(10-2013)

PROJECT: 12.47 kV Dist Line West of Industrial Sub - 2400 Feet		BASIS OF ESTIMATE:
DESCRIPTION: Pole Top Assembly Materials		CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Config
ESTIMATOR: Les Bell		CHECKED: 0

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN 3 PH SNGL CKT	TAN 3 PH DBL CKT	DDE 3 PH SNGL CKT	DDE 3 PH DBL CKT	TAN 1 PH SNGL CKT	TAN 1 PH DBL CKT	DDE 1 PH SNGL CKT	DDE 1PH DBL CKT
Conductor Deadends, Bolted										
____ ACSR PHASE	$35.00	EA			6	12			2	4
____ ACSR NEUTRAL	$35.00	EA			1	1			1	1
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$25.00	EA								
Y Clevis Eye - 30 KIP	$25.00	EA								
Eye Nut	$15.00	EA			8	16			2	4
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Connectors										
____ to ____ AMPACT Tap Conn	$85.00	EA								
____ to ____ COMP Tap Conn	$55.00	EA			4	8			2	4
Cur to Cu Comp Connector - Grnd	$25.00	EA								
Dist. Wood Crossarms and Braces										
3 3/4 x 4 3/4 x 8'	45	EA	2		2		1		1	
6" x 6" x 10'	86.5	EA		2		2		1		2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA		2		2		1		2
Cross Brace 3 3/4 x 4 3/4 x 8' Arm	20	EA	2		2		1		1	
Dist. Insulators										
Polymer DE Insulator	26.2	EA			6	12			4	8
Pin Insulator and Steel Pin	11.78	EA	6	12	3	6	2	4	2	4
Distribuiton Formed Tie	5	EA	7	13	3	6	2	4	2	4
Hardware										
Bolt, Nuts, Washers, Etc.	5.5	EA	8	8	9	10	8	8	8	8
Double Upset Bolt W/Spool Ins	15	EA	1	1			1	1		
TOTAL MATERIAL COST			$259	$496	$936	$1,836	$140	$241	$474	$1,006

MAP ID 3C COST ESTIMATE

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

Construction Cost Estimate Summary

(10-2013)

PROJECT: 46 kV Line West of Industrial Sub	**BASIS OF ESTIMATE:**
Add 12.47 kV Distribution Underbuild - 1200 Feet	CODE A - (Schematic Design)
DESCRIPTION: Cost Estimate Summary	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	COST ($)
Wood Poles:	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
LD and Custom Steel Poles	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
46 kV Switch		Ea	40.0	0.0	$0.00	$16,000.00	$0.00	$0.00
46 kV Double Circuit Tangent	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
46 kV Double Circuit DDE	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
Dist PTAs	1	LS	120.0	120.0	$7,200.00	$3,970.72	$3,970.72	$11,170.72
____ ACSR[1] Trans Phase		Ft.	0.030	0.0	$0.00		$0.00	$0.00
477 ACSR[1] Dist Phase	6,700	Ft.	0.018	120.6	$7,236.00	$1.58	$10,586.00	$17,822.00
477 ACSR[1] Dist Neut	2,250	Ft.	0.015	33.8	$2,025.00	$1.58	$3,555.00	$5,580.00
Adder Hot Dist Cond Stringing		Ft.	0.050	0.0	$0.00		$0.00	$0.00
3/8" EHS Shield Wire[2]		Ft.	0.020	0.0	$0.00	$0.35	$0.00	$0.00
Concrete Foundations	1	LS	0.0	0.0	$0.00	$0.00	$0.00	$0.00
Wood Pole Ground		EA	1.0	0.0	$0.00	$55.00	$0.00	$0.00
Single Down Guy	8	EA	1.0	8.0	$480.00	$65.00	$520.00	$1,000.00
Cross Plate Anchor	8	EA	2.0	16.0	$960.00	$45.00	$360.00	$1,320.00
Cutoff Exist Pole		EA	20.0	0.0	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.0	$0.00			$0.00
Remove Existing Cond		Ft.	0.02	0.0	$0.00			$0.00
Transfer Exist Cond. Cold		Ft.	0.05	0.0	$0.00			$0.00
Transfer Exist Cond. Hot		Ft.	0.15	0.0	$0.00			$0.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				298.35	$17,901.00			$17,901.00
Subtotal Material							$18,991.72	$18,991.72
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$36,892.72**
Engineering	1	LS						$5,533.91
Surveying	1	LS						$0.00
Geotech	1	LS						$0.00
TOTAL ENGINEERING COST								**$5,533.91**
CONTINGENCY	10	%						**$4,242.66**
RIGHT OF WAY[4]		Acres						**$0.00**
TOTAL COST ESTIMATE								***$46,669***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. Installed on existing transmission line, no right of way required.

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

0

PROJECT: 46 kV Line West of Industrial Sub						**BASIS OF ESTIMATE:**		
Add 12.47 kV Distribution Underbuild - 1200 Feet **DESCRIPTION: Wood Poles**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
DESCRIPTION**	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
Wood Poles:								
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

(10-2013)

PROJECT: 46 kV Line West of Industrial Sub		**BASIS OF ESTIMATE:**
DESCRIPTION:	**Add 12.47 kV Distribution Underbuild - 1200 Feet** **LD and Custom Engineered Steel Poles**	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Configuration
	ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION**	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
Single and Double Circuit DDE Custom Steel Poles:								
1. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
2. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
3. Structure XX'		Each		0.00	$0.00		$0.00	$0.00
4. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
5. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
6. Structure XXX'		Each		0.00	$0.00		$0.00	$0.00
Wood Pole Equivalent Steel Poles:								
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
____' Class LD___		Each		0.00	$0.00		$0.00	$0.00
Climbing Ladders		LS		0.00	$0.00		$0.00	$0.00
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

(10-2013)

PROJECT: 46 kV Line West of Industrial Sub						**BASIS OF ESTIMATE:**		
Add 12.47 kV Distribution Underbuild - 1200 Feet						CODE A - (Schematic Design)		
DESCRIPTION: Single Pole - Pole Top Assemblies						CODE B - (Preliminary Design)		
						CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:**		
	QUANTITY		**LABOR**			**MATERIAL $**		
DESCRIPTION	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. 46 kV Transmission Tangent PTAs								
1. 2 Ckt HPI - 2 1/2" Rod		Each	13	0.0	$0.00	$1,378.00	$0.00	$0.00
2. 1 Ckt HPI - 2 1/2" Rod		Each	10	0.0	$0.00	$748.00	$0.00	$0.00
3. 2 Ckt BR HPI - 2 1/2" Rod		Each	16	0.0	$0.00	$2,038.00	$0.00	$0.00
4. 1 Ckt BR HPI - 2 1/2" Rod		Each	13	0.0	$0.00	$1,078.00	$0.00	$0.00
B. 46 kV Transmission Double Deadend PTAs								
1. _____ACSR Dbl Ckt		Each	35	0.0	$0.00	$3,806.00	$0.00	$0.00
2. _____ ACSR Sngl Ckt		Each	20	0.0	$0.00	$2,753.00	$0.00	$0.00
C. 12.47 kV Distribution UB Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$160.79	$0.00	$0.00
2. Single Phase DDE		Each	12	0.0	$0.00	$357.70	$0.00	$0.00
3. Three Phase Tangent	6	Each	12	72.0	$4,320.00	$531.18	$3,187.08	$7,507.08
4. Three Phase DDE	2	Each	24	48.0	$2,880.00	$391.82	$783.64	$3,663.64
SUBTOTALS				120.00	$7,200.00		$3,970.72	$11,170.72
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$7,200.00
Subtotal Material								$3,970.72
TOTAL COST								$11,170.72

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

(10-2013)

PROJECT: 46 kV Line West of Industrial Sub						**BASIS OF ESTIMATE:**		
Add 12.47 kV Distribution Underbuild - 1200 Feet **DESCRIPTION: Concrete Foundations/Backfill**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:**		
DESCRIPTION	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT YARDS**	**TOTAL YARDS**	**TOTAL LABOR $**	**PER YARD**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. Concrete Foundations - Custom Designed Steel Poles								
1. Structure XX'		Each				$250.00		
2. Structure XX'		Each				$250.00		
3. Structure XX'		Each				$250.00		
4. Structure XXX'		Each				$250.00		
5. Structure XXX'		Each				$250.00		
6. Structure XXX'		Each				$250.00		
SUBTOTALS	0			0.00	$0.00		$0.00	
Foundation Labor $/ Cubic Yard			$400.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

* Labor includes manhours for excavation for foundations.

COST ESTIMATE

46 KV TRANSMISSION LINE WEST OF INDUSTRIAL SUB
ADD 12.47 KV DISTRIBUTION UNDERBUILD - MAP ID 3C

(10-2013)

PROJECT: 46 kV Line West of Industrial Sub	**BASIS OF ESTIMATE:**
Add 12.47 kV Distribution Underbuild - 1200 Feet	CODE A - (Schematic Design)
DESCRIPTION: Pole Top Assembly Materials	CODE B - (Preliminary Design)
	CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Config
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN HPI SNGL CKT	TAN HPI DBL CKT	TAN BR HPI SNGL CKT	TAN BR HPI DBL CKT	TRANS DDE SNGL CKT	TRANS DDE DBL CKT	DIST TAN 3 PH WOOD	DIST TAN 1 PH WOOD	DIST DDE 3 PH WOOD	DIST DDE 1 PH WOOD
46 kV Polymer Insulators												
2 1/2" Rod HPI Post	$165.00	EA	3	6			3					
2 1/2" Rod HPI Braced Post	$275.00	EA			3	6	3					
25 KIP Deadend	$75.00	EA					6	15				
Conductor Fittings												
3/8" EHS Bolted Deadend	$55.00	EA					1	1				
3/8" EHS Suspension Clamp	$35.00	EA	1	1	1	1						
____ ACSR Susp/Trunion Clamp	$45.00	EA	3	6	3	6	3	3				
____ ACSR DE Comp	$110.00	EA					6	12				
Hardware												
Y Clevis Eye - 30 KIP 90^{O}	$35.00	EA	1	1	1	1	1	1				
Y Clevis Eye - 30 KIP	$35.00	EA										
Y Clevis Ball - 30 KIP - Hot Line	$35.00	EA										
Socket Eye - 30 KIP - Hot Line	$35.00	EA										
Bolt, Nut, Dbl Coil Lock Washer, Etc.	$5.50	EA	6	6	6	6	6	12				
Connectors												
____ to ____ AMPACT Tap Conn	$85.00	EA					6	12				
____ to ____ COMP Tap Conn	$55.00	EA										
Cur to Cu Comp Connector - Grnd	$25.00	EA					2	2				
Dist. Underbuild Wood Crossarms and Braces												
6" x 6" x 10'	86.5	EA							2	1	2	2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA							2	1	2	2
Dist. Insulators												
Polymer DE Insulator	26.2	EA									8	4
Pin Insulator and Steel Pin	11.78	EA							8	2	4	2
Distribuiton Formed Tie	5	EA							8	2	4	2
Hardware												
Bolt, Nuts, Washers, Etc.	5.5	EA							6	4	8	6
Shield Wire Support Bracket	15	EA	1	1	1	1						
TOTAL MATERIAL COST			$748	$1,378	$1,078	$2,038	$2,753	$3,806	$358	$161	$531	$392

MAP ID 3D COST ESTIMATE

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - 6100 FEET - Map ID 3D

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV Distribtuion Line - 6100 Feet	**BASIS OF ESTIMATE:**
DESCRIPTION: Cost Estimate Summary	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR:	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
Wood Poles:	1	LS	260.0	260.00	$15,600.00	$18,703.00	$18,703.00	$34,303.00
LD Steel Poles	1	LS	0.0	0.00	$0.00	$0.00	$0.00	$0.00
12.47 kV PTAs	1	LS	216.0	216.00	$12,960.00	$7,821.72	$7,821.72	$20,781.72
477 ACSR(1) Dist Phase	16,200	Ft.	0.025	405.00	$24,300.00	$1.43	$23,166.00	$47,466.00
4/0 ACSR(1) Dist Neut	5,400	Ft.	0.020	108.00	$6,480.00	$0.89	$4,806.00	$11,286.00
Install Hot Arms		Ea	4.0	0.00	$0.00			$0.00
Set Out Exist Dist Cond		Ea	0.5	0.00	$0.00		$0.00	$0.00
Wood Pole Ground	25	EA	1.0	25.00	$1,500.00	$55.00	$1,375.00	$2,875.00
Single Down Guy	4	EA	1.0	4.00	$240.00	$65.00	$260.00	$500.00
Cross Plate Anchor	4	EA	2.0	8.00	$480.00	$45.00	$180.00	$660.00
Cutoff Exist Pole		EA	20.0	0.00	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.00	$0.00			$0.00
Remove Existing Cond		Ft.	0.02	0.00	$0.00			$0.00
Transfer Exist Cond. Cold		Ft.	0.05	0.00	$0.00			$0.00
Transfer Exist Cond. Hot		Ft.	0.15	0.00	$0.00			$0.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				1,026.00	$61,560.00			$61,560.00
Subtotal Material							$56,311.72	$56,311.72
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$117,871.72**
Engineering	1	LS						$11,787.17
Surveying	1	LS						$7,500.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$19,287.17**
CONTINGENCY	10	%						**$13,715.89**
RIGHT OF WAY(4)		Acres						
TOTAL COST ESTIMATE								***$150,875***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. No right of way required.

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - 6100 FEET - Map ID 3D

(10-2013)

PROJECT: 12.47 kV Distribtuion Line - 6100 Feet						**BASIS OF ESTIMATE:**		
DESCRIPTION: **Wood Poles**						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
	QUANTITY		**LABOR**			**MATERIAL $**		
DESCRIPTION**	**QTY**	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
Wood Poles:								
40' Class 1	23	Each	10.00	230.00	$13,800.00	$661.00	$15,203.00	$29,003.00
65' Class H1	2	Each	15.00	30.00	$1,800.00	$1,750.00	$3,500.00	$5,300.00
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
____' Class ___		Each						
SUBTOTALS	25			260.00	$15,600.00		$18,703.00	$34,303.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$15,600.00
Subtotal Material								$18,703.00
TOTAL COST								$34,303.00

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - 6100 FEET - Map ID 3D

(10-2013)

PROJECT: 12.47 kV Distribtuion Line - 6100 Feet						BASIS OF ESTIMATE:		
DESCRIPTION: LD Steel Poles						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED: 0		
	QUANTITY		LABOR			MATERIAL $		
DESCRIPTION**	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
Wood Pole Equvalent Steel Poles:								
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
____' Class LD___		Each						
Climbing Ladders		LS					$0.00	$0.00
SUBTOTALS	0			0.00	$0.00		$0.00	$0.00
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$0.00
Subtotal Material								$0.00
TOTAL COST								$0.00

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - 6100 FEET - Map ID 3D

(10-2013)

PROJECT: 12.47 kV Distribtuion Line - 6100 Feet						BASIS OF ESTIMATE:		
DESCRIPTION: Distribution Pole Top Assemblies						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED: 0		
DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
A. 12.47 kV Distribution Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$139.56	$0.00	$0.00
2. Single Phase DDE		Each	8	0.0	$0.00	$474.36	$0.00	$0.00
3. Three Phase Tangent	23	Each	8	184.0	$11,040.00	$258.68	$5,949.64	$16,989.64
4. Three Phase DDE	2	Each	16	32.0	$1,920.00	$936.04	$1,872.08	$3,792.08
B. 12.47 kV Distribution Double Circuit PTAs								
1. Single Phase Tangent		Each	8	0.0	$0.00	$241.35	$0.00	$0.00
2. Single Phase DDE		Each	15	0.0	$0.00	$1,006.18	$0.00	$0.00
3. Three Phase Tangent		Each	15	0.0	$0.00	$495.82	$0.00	$0.00
4. Three Phase DDE		Each	30	0.0	$0.00	$1,835.54	$0.00	$0.00
SUBTOTALS				216.00	$12,960.00		$7,821.72	$20,781.72
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$12,960.00
Subtotal Material								$7,821.72
TOTAL COST								$20,781.72

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - 6100 FEET - Map ID 3D

(10-2013)

PROJECT: 12.47 kV Distribtuion Line - 6100 Feet		BASIS OF ESTIMATE:
DESCRIPTION: Pole Top Assembly Materials		CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Config
ESTIMATOR: 0		CHECKED: 0

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN 3 PH SNGL CKT	TAN 3 PH DBL CKT	DDE 3 PH SNGL CKT	DDE 3 PH DBL CKT	TAN 1 PH SNGL CKT	TAN 1 PH DBL CKT	DDE 1 PH SNGL CKT	DDE 1PH DBL CKT
Conductor Deadends, Bolted										
____ ACSR PHASE	$35.00	EA			6	12			2	4
____ ACSR NEUTRAL	$35.00	EA			1	1			1	1
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$25.00	EA								
Y Clevis Eye - 30 KIP	$25.00	EA								
Eye Nut	$15.00	EA			8	16			2	4
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Connectors										
____ to ____ AMPACT Tap Conn	$85.00	EA								
____ to ____ COMP Tap Conn	$55.00	EA			4	8			2	4
Cur to Cu Comp Connector - Grnd	$25.00	EA								
Dist. Wood Crossarms and Braces										
3 3/4 x 4 3/4 x 8'	45	EA	2		2		1		1	
6" x 6" x 10'	86.5	EA		2		2		1		2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA		2		2		1		2
Cross Brace 3 3/4 x 4 3/4 x 8' Arm	20	EA	2		2		1		1	
Dist. Insulators										
Polymer DE Insulator	26.2	EA			6	12			4	8
Pin Insulator and Steel Pin	11.78	EA	6	12	3	6	2	4	2	4
Distribuiton Formed Tie	5	EA	7	13	3	6	2	4	2	4
Hardware										
Bolt, Nuts, Washers, Etc.	5.5	EA	8	8	9	10	8	8	8	8
Double Upset Bolt W/Spool Ins	15	EA	1	1			1	1		
TOTAL MATERIAL COST			$259	$496	$936	$1,836	$140	$241	$474	$1,006

MAP ID 3E COST ESTIMATE

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor #2 and 1/0 ACSR to 477 ACSR - Map ID 3E

Construction Cost Estimate Summary

(10-2013)

PROJECT: Reconductor 12.47 kV Distribtuion Line - 5300 Feet	**BASIS OF ESTIMATE:**
DESCRIPTION: Cost Estimate Summary	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL
	QTY	UNIT	UNIT MH[5.]	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	COST ($)
12.47 kV PTAs[5.]	1	LS	464.0	464.00	$27,840.00	$10,013.80	$10,013.80	$37,853.80
477 ACSR[1] Dist Phase	16,200	Ft.	0.025	405.00	$24,300.00	$1.43	$23,166.00	$47,466.00
4/0 ACSR[1] Dist Neut	5,400	Ft.	0.020	108.00	$6,480.00	$0.89	$4,806.00	$11,286.00
Install/Remove Hot Arms	46	Loc	6.0	276.00	$16,560.00			$16,560.00
Set Out Exist Dist Cond	92	EA	2.0	184.00	$11,040.00		$0.00	$11,040.00
Wood Pole Ground		EA	1.0	0.00	$0.00	$55.00	$0.00	$0.00
Single Down Guy	28	EA	1.0	28.00	$1,680.00	$65.00	$1,820.00	$3,500.00
Cross Plate Anchor	28	EA	2.0	56.00	$3,360.00	$45.00	$1,260.00	$4,620.00
Cutoff Exist Pole		EA	20.0	0.00	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.00	$0.00			$0.00
Remove Exist Dist Cond	21,600	Ft.	0.025	540.00	$32,400.00			$32,400.00
Trans Exist Dist Cond. Cold		Ft.	0.05	0.00	$0.00			$0.00
Trans Exist Dist Cond. Hot		Ft.	0.15	0.00	$0.00			$0.00
Labor Rate			$60					
Subtotal Labor Hours/$				2,061.00	$123,660.00			$123,660.00
Subtotal Material							$41,065.80	$41,065.80
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$164,725.80**
Engineering	1	LS						$8,236.29
Surveying	1	LS						
Geotech	1	LS						
TOTAL ENGINEERING COST								**$8,236.29**
CONTINGENCY	10	%						**$17,296.21**
RIGHT OF WAY[4]		Acres						
TOTAL COST ESTIMATE								***$190,258***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. No right of way required.
5. Installed hot at twice the non hot manhours.

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor #2 and 1/0 ACSR to 477 ACSR - Map ID 3E

(10-2013)

PROJECT: Reconductor 12.47 kV Distribtuion Line - 5300 Feet						BASIS OF ESTIMATE:		
DESCRIPTION: Distribution Pole Top Assemblies						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED: 0		
DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL COST ($)
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	
A. 12.47 kV Distribution Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$139.56	$0.00	$0.00
2. Single Phase DDE		Each	8	0.0	$0.00	$474.36	$0.00	$0.00
3. Three Phase Tangent	17	Each	8	136.0	$8,160.00	$258.68	$4,397.56	$12,557.56
4. Three Phase DDE	6	Each	16	96.0	$5,760.00	$936.04	$5,616.24	$11,376.24
B. 12.47 kV Distribution Double Circuit PTAs								
1. Single Phase Tangent		Each	8	0.0	$0.00	$241.35	$0.00	$0.00
2. Single Phase DDE		Each	15	0.0	$0.00	$1,006.18	$0.00	$0.00
3. Three Phase Tangent		Each	15	0.0	$0.00	$495.82	$0.00	$0.00
4. Three Phase DDE		Each	30	0.0	$0.00	$1,835.54	$0.00	$0.00
SUBTOTALS	23			232.00	$13,920.00		$10,013.80	$23,933.80
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$13,920.00
Subtotal Material								$10,013.80
TOTAL COST								$23,933.80

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor #2 and 1/0 ACSR to 477 ACSR - Map ID 3E

(10-2013)

PROJECT: Reconductor 12.47 kV Distribtuion Line - 5300 Feet									**BASIS OF ESTIMATE:**	
DESCRIPTION:	**Pole Top Assembly Materials**								CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%	
ENGINEER: Les Bell									OTHER - Conceptual Config	
	ESTIMATOR: Les Bell								**CHECKED:** 0	
DESCRIPTION	**MATERIAL**		**UNIT MATERIALS QUANTITIES**							
	$	**UNIT**	**TAN 3 PH SNGL CKT**	**TAN 3 PH DBL CKT**	**DDE 3 PH SNGL CKT**	**DDE 3 PH DBL CKT**	**TAN 1 PH SNGL CKT**	**TAN 1 PH DBL CKT**	**DDE 1 PH SNGL CKT**	**DDE 1PH DBL CKT**
Conductor Deadends, Bolted										
____ ACSR PHASE	$35.00	EA			6	12			2	4
____ ACSR NEUTRAL	$35.00	EA			1	1			1	1
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$25.00	EA								
Y Clevis Eye - 30 KIP	$25.00	EA								
Eye Nut	$15.00	EA			8	16			2	4
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Connectors										
____ to ____ AMPACT Tap Conn	$85.00	EA								
____ to ____ COMP Tap Conn	$55.00	EA			4	8			2	4
Cur to Cu Comp Connector - Grnd	$25.00	EA								
Dist. Wood Crossarms and Braces										
3 3/4 x 4 3/4 x 8'	45	EA	2		2		1		1	
6" x 6" x 10'	86.5	EA		2		2		1		2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA		2		2		1		2
Cross Brace 3 3/4 x 4 3/4 x 8' Arm	20	EA	2		2		1		1	
Dist. Insulators										
Polymer DE Insulator	26.2	EA			6	12			4	8
Pin Insulator and Steel Pin	11.78	EA	6	12	3	6	2	4	2	4
Distribuiton Formed Tie	5	EA	7	13	3	6	2	4	2	4
Hardware										
Bolt, Nuts, Washers, Etc.	5.5	EA	8	8	9	10	8	8	8	8
Double Upset Bolt W/Spool Ins	15	EA	1	1			1	1		
TOTAL MATERIAL COST			$259	$496	$936	$1,836	$140	$241	$474	$1,006

MAP ID 4 COST ESTIMATE

New Woodhouse Transformer Cost: $1,213,590

Woodhouse Transformer addition based on actual costs obtained from Spanish Fork

No cost estimate was developed

MAP ID 5 COST ESTIMATE

COST ESTIMATE

DATE PREPARED: 11/12/2013

PROJECT:
Future Leland Substation - Map ID 5

DESCRIPTION:

ENGINEER : ICPE

BASIS FOR ESTIMATE
CODE A (Schematic Design)
CODE B (Preliminary Design)
CODE C (Final Design) 100%
OTHER--Conceptual Configuration

ESTIMATOR: Mac Fillingim
CHECKED: Craig Michaelis

Avg. Labor Rate: $100.00

DESCRIPTION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS	LABOR PER UNIT	LABOR TOTAL Man Hr.	LABOR TOTAL LABOR ($)	MATERIAL ($) PER UNIT	MATERIAL ($) TOTAL MATERIAL	TOTAL ESTIMATE
Major Equipment								
46 kV - 12.47kV Transformer 12/16/20 MVA w/LTC	1	EA	80	80.00	$8,000.00	$750,000.00	$750,000.00	$758,000.00
46 kV Breaker	1	EA	45	45.00	$4,500.00	$55,500.00	$55,500.00	$60,000.00
46 kV Group Operated Switch	1	EA	60	60.00	$6,000.00	$12,000.00	$12,000.00	$18,000.00
15 kV Reclosers	3	EA	32	96.00	$9,600.00	$25,000.00	$75,000.00	$84,600.00
15 kV Group Operated Switch	1	EA	40	40.00	$4,000.00	$7,500.00	$7,500.00	$11,500.00
							Total	**$932,100.00**
Metering / Relaying / SCADA								
15 kV Metering (PTs & CTs)	1	LS	40	40.00	$4,000.00	$18,000.00	$18,000.00	$22,000.00
Relay Panel - Transformer Diff (Installation & Wire Terminations)	1	LS	80	80.00	$8,000.00	$35,000.00	$35,000.00	$43,000.00
Relay Panel - Recloser Control (Installation & Wire Terminations)	1	LS	100	100.00	$10,000.00	$30,000.00	$30,000.00	$40,000.00
Relay Panel - Meter Panel (Installation & Wire Terminations)	1	LS	40	40.00	$4,000.00	$20,000.00	$20,000.00	$24,000.00
SCADA Equipment & Programming	1	LS	200	200.00	$20,000.00	$15,000.00	$15,000.00	$35,000.00
							Total	**$164,000.00**
Steel Structures								
46 kV Deadend Structure	1	EA	40.00	40.00	$4,000.00	$27,000.00	$27,000.00	$31,000.00
46 kV Switch Structure	1	EA	16.00	16.00	$1,600.00	$3,375.00	$3,375.00	$4,975.00
15 kV Metering Structure	1	EA	16.00	16.00	$1,600.00	$7,500.00	$7,500.00	$9,100.00
15 kV Switch Structure	1	EA	16.00	16.00	$1,600.00	$3,812.50	$3,812.50	$5,412.50
15 kV Recloser Structure	3	EA	16.00	48.00	$4,800.00	$4,500.00	$13,500.00	$18,300.00
Static Wire Pole	1	EA	8.00	8.00	$800.00	$7,250.00	$7,250.00	$8,050.00
Switch Platform	2	EA	4.00	8.00	$800.00	$1,000.00	$2,000.00	$2,800.00
							Total	**$79,637.50**
Concrete Foundations								
46 kV Deadend Structure	2	EA	16	32.00	$3,200.00	$3,705.00	$7,410.00	$10,610.00
15 kV Switch Structure	2	EA	8	16.00	$1,600.00	$1,560.00	$3,120.00	$4,720.00
15 kV Recloser Structure	3	EA	8	24.00	$2,400.00	$1,690.00	$5,070.00	$7,470.00
Static Wire Pole	1	EA	4	4.00	$400.00	$2,795.00	$2,795.00	$3,195.00
Transformer Containment	1	EA	80	80.00	$8,000.00	$78,100.00	$78,100.00	$86,100.00
46 kV Breaker Pad	1	EA	8	8.00	$800.00	$3,300.00	$3,300.00	$4,100.00
Control Building	1	EA	24	24.00	$2,400.00	$11,000.00	$11,000.00	$13,400.00
							Total	**$129,595.00**
Control Building								
Prefabricated Control Building	1	EA	80	80.00	$8,000.00	$45,000.00	$45,000.00	$53,000.00
Control Building Equipment	1	LS	16	16.00	$1,600.00	$7,500.00	$7,500.00	$9,100.00
125 VDC Battery System	1	EA	32	32.00	$3,200.00	$15,000.00	$15,000.00	$18,200.00
Control Building AC Systems	1	LS	80	80.00	$8,000.00	$11,750.00	$11,750.00	$19,750.00
							Total	**$100,050.00**
Substation Bus & Material								
46 kV Bus & Fittings	1	LS	80	80.00	$8,000.00	$15,000.00	$15,000.00	$23,000.00
15 kV Bus & Fittings	1	LS	240	240.00	$24,000.00	$30,000.00	$30,000.00	$54,000.00
Recloser Bypass Switches	18	EA	4	72.00	$7,200.00	$800.00	$14,400.00	$21,600.00
Recloser Fused Switches	9	EA	4	36.00	$3,600.00	$2,100.00	$18,900.00	$22,500.00
Station Lightning Protection	1	LS	32	32.00	$3,200.00	$2,500.00	$2,500.00	$5,700.00
46 kV Lightning Arresters	3	EA	4	12.00	$1,200.00	$1,500.00	$4,500.00	$5,700.00
9 kV Lightning Arresters	9	EA	1	9.00	$900.00	$500.00	$4,500.00	$5,400.00
							Total	**$137,900.00**
Substation Conduit & Cable								
600 Volt Conduit & Cable	1	LS	240	240.00	$24,000.00	$32,500.00	$32,500.00	$56,500.00
15 kV 6" Conduit (15 kV cable not included)	1	LS	120	160.00	$16,000.00	$17,750.00	$17,750.00	$33,750.00
Station Service (Transformer, Disconnect, Conduit/Cable)	1	LS	60	60.00	$6,000.00	$7,500.00	$7,500.00	$13,500.00
							Total	**$103,750.00**
Substation Grounding								
Station Ground Grid	1	LS	320	320.00	$32,000.00	$40,000.00	$40,000.00	$72,000.00
							Total	**$72,000.00**
Substation Site Work								
Site Grubbing & Fill	1	LS	80	80.00	$8,000.00	$25,000.00	$25,000.00	$33,000.00
Site Surface gravel	1	LS	80	80.00	$8,000.00	$15,000.00	$15,000.00	$23,000.00
Site Roads	1	LS	40	40.00	$4,000.00	$12,000.00	$12,000.00	$16,000.00
Substation Fence (Chain Link)	1	LS	80	80.00	$8,000.00	$20,000.00	$20,000.00	$28,000.00
Substation Land	0	LS	0	0.00	$0.00	$0.00	$0.00	$0.00
							Total	**$100,000.00**
Miscellaneous								
Contractor Mobilization	1	LS	0	0.00	$0.00	$10,000.00	$10,000.00	$10,000.00
Contractor Bonding	1	LS	0	0.00	$0.00	$7,000.00	$7,000.00	$7,000.00
Substation Testing & Commissioning	1	LS	0	0.00	$0.00	$35,000.00	$35,000.00	$35,000.00
							Total	**$52,000.00**
	Subtotals			**2,870.0**	**$287,000.00**		**$1,584,032.50**	
Subtotal Labor + Material								**$1,871,032.50**
Equipment				574		70		**$40,180.00**
Contingency (10%)								**$191,121.25**
Engineering								**$75,000.00**
TOTAL ESTIMATE								**$2,177,333.75**

Notes:
1 - Foundation estimate is based on the site having good soil conditions without water.
2 - Incoming 46 kV Line & 15kV Distribution Circuits are not included
3 - Costs shown are as of 11/12/13. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

MAP ID 6 COST ESTIMATE

COST ESTIMATE

12.47 KV UNDERGROUND DISTRIBUTION CIRCUIT
River Ridge Lane & Delmonte Road - MAP ID 6

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV UG Distribution Circuit						BASIS OF ESTIMATE:		
River Ridge Land & Delmonte Road DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					CHECKED:		
DESCRIPTION	QUANTITY		LABOR			MATERIAL $		
	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 15 kV Cable(1.):								
1, 750 kcmil Al.		Ft	0.020	0.00	0.00	$8.50	$0.00	$0.00
2. 500 kcmil Cu.	15400	Ft	0.020	308.00	18,480.00	$14.00	$215,600.00	$234,080.00
3. Remove exist 4/0 Al	15400	Ft	0.010	154.00	9,240.00			$9,240.00
B. Conduit and Fittings:								
1. 6" Sch 40 PVC		Ft	0.015	0.000	0.00	$3.50	$0.00	$0.00
2. 4" Stl 90^{O} Elbows	20	Ea	0.45	9.000	540.00	$65.00	$1,300.00	$1,840.00
C. Equipment and Cable Components:								
1. 15 kV 600 A Sectionalizer	9	Ea	2.0	18.000	1,080.00	$650.00	$5,850.00	$6,930.00
2. Grnd Sleeve 600 A Sect	9	Ea	2.8	24.750	1,485.00	$275.00	$2,475.00	$3,960.00
3. 600 A 15 kV NLB Elbow	54	Ea	2.8	151.200	9,072.00	$150.00	$8,100.00	$17,172.00
4. 2 Way 600 A 15 kV Jct	27	Ea	3.0	81.00	$4,860.00	$192.50	$5,197.50	$10,057.50
5. Remove 200 A Equip	9	Ea	10.0	90.000	5,400.00			$5,400.00
D. Trench & Backfill								
1. Trench and Backfill		Ft	0.2	0.00	$0.00			$0.00
2. Trench Sanding		Ft	0.1	0.00	$0.00	$0.50	$0.00	$0.00
E. Miscellaneous:								
1. Grndg 600 A 15 kV Sect	9	Ea	2.0	18.00	$1,080.00	$175.00	$1,575.00	$2,655.00
2. Grndg 600 A 15 kV Elbow	54	Ea	1.0	54.00	$3,240.00	$25.00	$1,350.00	$4,590.00
3. Cable Tagging	9	Ea	0.5	4.50	$270.00	$25.00	$225.00	$495.00
4. 6" Sch 40 PVC Fittings		Ft	0.005	0.000	$0.00	$0.25	$0.00	$0.00
5. 600 A OH/UG Riser (Existing Pole)	2	Ea	30.0	60.00	$3,600.00	$1,450.00	$2,900.00	$6,500.00
6. Remove 200 A OH/UG Riser (Existing Pole)	2	Ea	25.0	50.00	$3,000.00			$3,000.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				1,022.45	$61,347.00			$61,347.00
Subtotal Material							$244,572.50	$244,572.50
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$305,919.50**
Engineering	1	LS						$15,295.98
Surveying	1	LS						$5,000.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$20,295.98**
CONTINGENCY	10	%						**$32,621.55**
TOTAL COST ESTIMATE								***$358,837***

NOTES:

1. Includes an allowance of 1.5% for fitting installation make up.

MAP ID 7 COST ESTIMATE

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor 1/0 ACSR to 477 ACSR - Main Street (SR-198) - Map ID 7

Construction Cost Estimate Summary

(10-2013)

PROJECT: Recond 12.47 kV Distribution Line - SR98 - 3800 Feet	**BASIS OF ESTIMATE:**
DESCRIPTION: Cost Estimate Summary	CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell	OTHER - Conceptual Configuration
ESTIMATOR: Les Bell	**CHECKED:**

DESCRIPTION	QUANTITY		LABOR			MATERIAL $		TOTAL
	QTY	UNIT	UNIT MH[5.]	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	COST ($)
12.47 kV PTAs[5.]	1	LS	464.0	464.00	$27,840.00	$10,013.80	$10,013.80	$37,853.80
477 ACSR[1] Dist Phase	11,600	Ft.	0.025	290.00	$17,400.00	$1.43	$16,588.00	$33,988.00
4/0 ACSR[1] Dist Neut	3,900	Ft.	0.020	78.00	$4,680.00	$0.89	$3,471.00	$8,151.00
Install/Remove Hot Arms	46	Loc	6.0	276.00	$16,560.00			$16,560.00
Set Out Exist Dist Cond	92	EA	2.0	184.00	$11,040.00		$0.00	$11,040.00
Wood Pole Ground		EA	1.0	0.00	$0.00	$55.00	$0.00	$0.00
Single Down Guy	24	EA	1.0	24.00	$1,440.00	$65.00	$1,560.00	$3,000.00
Cross Plate Anchor	24	EA	2.0	48.00	$2,880.00	$45.00	$1,080.00	$3,960.00
Cutoff Exist Pole		EA	20.0	0.00	$0.00			$0.00
Remove Exist Pole		EA	10.0	0.00	$0.00			$0.00
Remove Exist Dist Cond	15,500	Ft.	0.025	387.50	$23,250.00			$23,250.00
Trans Exist Dist Cond. Cold		Ft.	0.05	0.00	$0.00			$0.00
Trans Exist Dist Cond. Hot		Ft.	0.15	0.00	$0.00			$0.00
Labor Rate			$60					
Subtotal Labor Hours/$				1,751.50	$105,090.00			$105,090.00
Subtotal Material							$32,712.80	$32,712.80
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$137,802.80**
Engineering	1	LS						$6,890.14
Surveying	1	LS						
Geotech	1	LS						
TOTAL ENGINEERING COST								**$6,890.14**
CONTINGENCY	10	%						**$14,469.29**
RIGHT OF WAY[4]		Acres						
TOTAL COST ESTIMATE								***$159,162***

NOTES:

1. Includes an allowance of 1.5% for sag and jumper make up.
2. Includes an allowance of 1.5% for sag and jumper make up.
3. Does not include substation costs.
4. No right of way required.
5. Installed hot at twice the non hot manhours.

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor 1/0 ACSR to 477 ACSR - Main Street (SR-198) - Map ID 7

(10-2013)

PROJECT: Recond 12.47 kV Distribution Line - SR98 - 3800 Feet						**BASIS OF ESTIMATE:**		
DESCRIPTION:	**Distribution Pole Top Assemblies**					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Les Bell						OTHER - Conceptual Configuration		
	ESTIMATOR: Les Bell					**CHECKED:** 0		
DESCRIPTION	**QUANTITY**		**LABOR**			**MATERIAL $**		
	QTY	**UNIT**	**UNIT MH**	**TOTAL MH**	**TOTAL LABOR $**	**PER UNIT**	**TOTAL MATERIAL**	**TOTAL COST ($)**
A. 12.47 kV Distribution Single Circuit PTAs								
1. Single Phase Tangent		Each	4	0.0	$0.00	$139.56	$0.00	$0.00
2. Single Phase DDE		Each	8	0.0	$0.00	$474.36	$0.00	$0.00
3. Three Phase Tangent	17	Each	8	136.0	$8,160.00	$258.68	$4,397.56	$12,557.56
4. Three Phase DDE	6	Each	16	96.0	$5,760.00	$936.04	$5,616.24	$11,376.24
B. 12.47 kV Distribution Double Circuit PTAs								
1. Single Phase Tangent		Each	8	0.0	$0.00	$241.35	$0.00	$0.00
2. Single Phase DDE		Each	15	0.0	$0.00	$1,006.18	$0.00	$0.00
3. Three Phase Tangent		Each	15	0.0	$0.00	$495.82	$0.00	$0.00
4. Three Phase DDE		Each	30	0.0	$0.00	$1,835.54	$0.00	$0.00
SUBTOTALS	23			232.00	$13,920.00		$10,013.80	$23,933.80
Average Labor Rate ($/Hr.)			$60.00					
Subtotal Labor								$13,920.00
Subtotal Material								$10,013.80
TOTAL COST								$23,933.80

COST ESTIMATE

12.47 KV DISTRIBUTION LINE - Reconductor 1/0 ACSR to 477 ACSR - Main Street (SR-198) - Map ID 7

(10-2013)

PROJECT: Recond 12.47 kV Distribution Line - SR98 - 3800 Feet		BASIS OF ESTIMATE:
DESCRIPTION: Pole Top Assembly Materials		CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%
ENGINEER: Les Bell		OTHER - Conceptual Config
ESTIMATOR: Les Bell		CHECKED: 0

DESCRIPTION	MATERIAL $	MATERIAL UNIT	UNIT MATERIALS QUANTITIES: TAN 3 PH SNGL CKT	TAN 3 PH DBL CKT	DDE 3 PH SNGL CKT	DDE 3 PH DBL CKT	TAN 1 PH SNGL CKT	TAN 1 PH DBL CKT	DDE 1 PH SNGL CKT	DDE 1PH DBL CKT
Conductor Deadends, Bolted										
____ ACSR PHASE	$35.00	EA			6	12			2	4
____ ACSR NEUTRAL	$35.00	EA			1	1			1	1
Hardware										
Y Clevis Eye - 30 KIP 90^{O}	$25.00	EA								
Y Clevis Eye - 30 KIP	$25.00	EA								
Eye Nut	$15.00	EA			8	16			2	4
Socket Eye - 30 KIP - Hot Line	$35.00	EA								
Connectors										
____ to ____ AMPACT Tap Conn	$85.00	EA								
____ to ____ COMP Tap Conn	$55.00	EA			4	8			2	4
Cur to Cu Comp Connector - Grnd	$25.00	EA								
Dist. Wood Crossarms and Braces										
3 3/4 x 4 3/4 x 8'	45	EA	2		2		1		1	
6" x 6" x 10'	86.5	EA		2		2		1		2
Cross Brace - 6" x 6" x 10' X-Arm	28.73	EA		2		2		1		2
Cross Brace 3 3/4 x 4 3/4 x 8' Arm	20	EA	2		2		1		1	
Dist. Insulators										
Polymer DE Insulator	26.2	EA			6	12			4	8
Pin Insulator and Steel Pin	11.78	EA	6	12	3	6	2	4	2	4
Distribuiton Formed Tie	5	EA	7	13	3	6	2	4	2	4
Hardware										
Bolt, Nuts, Washers, Etc.	5.5	EA	8	8	9	10	8	8	8	8
Double Upset Bolt W/Spool Ins	15	EA	1	1			1	1		
TOTAL MATERIAL COST			$259	$496	$936	$1,836	$140	$241	$474	$1,006

MAP ID 8 COST ESTIMATE

COST ESTIMATE

DATE PREPARED: 11/12/2013

PROJECT:
Future Bonner Substation - Map ID 8

DESCRIPTION:

ENGINEER : ICPE

BASIS FOR ESTIMATE
CODE A (Schematic Design)
CODE B (Preliminary Design)
CODE C (Final Design) 100%
OTHER--Conceptual Configuration

ESTIMATOR: Mac Fillingim
CHECKED: Craig Michaelis

Avg. Labor Rate: $100.00

DESCRIPTION	QUANTITY NO. UNITS	QUANTITY UNIT MEAS	LABOR PER UNIT	LABOR TOTAL Man Hr.	LABOR TOTAL LABOR ($)	MATERIAL ($) PER UNIT	MATERIAL ($) TOTAL MATERIAL	TOTAL ESTIMATE
Major Equipment								
46 kV - 12.47kV Transformer 12/16/20 MVA w/LTC	1	EA	80	80.00	$8,000.00	$750,000.00	$750,000.00	$758,000.00
46 kV Breaker	1	EA	45	45.00	$4,500.00	$55,500.00	$55,500.00	$60,000.00
46 kV Group Operated Switch	1	EA	60	60.00	$6,000.00	$12,000.00	$12,000.00	$18,000.00
15 kV Reclosers	3	EA	32	96.00	$9,600.00	$25,000.00	$75,000.00	$84,600.00
15 kV Group Operated Switch	1	EA	40	40.00	$4,000.00	$7,500.00	$7,500.00	$11,500.00
							Total	**$932,100.00**
Metering / Relaying / SCADA								
15 kV Metering (PTs & CTs)	1	LS	40	40.00	$4,000.00	$18,000.00	$18,000.00	$22,000.00
Relay Panel - Transformer Diff (Installation & Wire Terminations)	1	LS	80	80.00	$8,000.00	$35,000.00	$35,000.00	$43,000.00
Relay Panel - Recloser Control (Installation & Wire Terminations)	1	LS	100	100.00	$10,000.00	$30,000.00	$30,000.00	$40,000.00
Relay Panel - Meter Panel (Installation & Wire Terminations)	1	LS	40	40.00	$4,000.00	$20,000.00	$20,000.00	$24,000.00
SCADA Equipment & Programming	1	LS	200	200.00	$20,000.00	$15,000.00	$15,000.00	$35,000.00
							Total	**$164,000.00**
Steel Structures								
46 kV Deadend Structure	1	EA	40.00	40.00	$4,000.00	$27,000.00	$27,000.00	$31,000.00
46 kV Switch Structure	1	EA	16.00	16.00	$1,600.00	$3,375.00	$3,375.00	$4,975.00
15 kV Metering Structure	1	EA	16.00	16.00	$1,600.00	$7,500.00	$7,500.00	$9,100.00
15 kV Switch Structure	1	EA	16.00	16.00	$1,600.00	$3,812.50	$3,812.50	$5,412.50
15 kV Recloser Structure	3	EA	16.00	48.00	$4,800.00	$4,500.00	$13,500.00	$18,300.00
Static Wire Pole	1	EA	8.00	8.00	$800.00	$7,250.00	$7,250.00	$8,050.00
Switch Platform	2	EA	4.00	8.00	$800.00	$1,000.00	$2,000.00	$2,800.00
							Total	**$79,637.50**
Concrete Foundations								
46 kV Deadend Structure	2	EA	16	32.00	$3,200.00	$3,705.00	$7,410.00	$10,610.00
15 kV Switch Structure	2	EA	8	16.00	$1,600.00	$1,560.00	$3,120.00	$4,720.00
15 kV Recloser Structure	3	EA	8	24.00	$2,400.00	$1,690.00	$5,070.00	$7,470.00
Static Wire Pole	1	EA	4	4.00	$400.00	$2,795.00	$2,795.00	$3,195.00
Transformer Containment	1	EA	80	80.00	$8,000.00	$78,100.00	$78,100.00	$86,100.00
46 kV Breaker Pad	1	EA	8	8.00	$800.00	$3,300.00	$3,300.00	$4,100.00
Control Building	1	EA	24	24.00	$2,400.00	$11,000.00	$11,000.00	$13,400.00
							Total	**$129,595.00**
Control Building								
Prefabricated Control Building	1	EA	80	80.00	$8,000.00	$45,000.00	$45,000.00	$53,000.00
Control Building Equipment	1	LS	16	16.00	$1,600.00	$7,500.00	$7,500.00	$9,100.00
125 VDC Battery System	1	EA	32	32.00	$3,200.00	$15,000.00	$15,000.00	$18,200.00
Control Building AC Systems	1	LS	80	80.00	$8,000.00	$11,750.00	$11,750.00	$19,750.00
							Total	**$100,050.00**
Substation Bus & Material								
46 kV Bus & Fittings	1	LS	80	80.00	$8,000.00	$15,000.00	$15,000.00	$23,000.00
15 kV Bus & Fittings	1	LS	240	240.00	$24,000.00	$30,000.00	$30,000.00	$54,000.00
Recloser Bypass Switches	18	EA	4	72.00	$7,200.00	$800.00	$14,400.00	$21,600.00
Recloser Fused Switches	9	EA	4	36.00	$3,600.00	$2,100.00	$18,900.00	$22,500.00
Station Lightning Protection	1	LS	32	32.00	$3,200.00	$2,500.00	$2,500.00	$5,700.00
46 kV Lightning Arresters	3	EA	4	12.00	$1,200.00	$1,500.00	$4,500.00	$5,700.00
9 kV Lightning Arresters	9	EA	1	9.00	$900.00	$500.00	$4,500.00	$5,400.00
							Total	**$137,900.00**
Substation Conduit & Cable								
600 Volt Conduit & Cable	1	LS	240	240.00	$24,000.00	$32,500.00	$32,500.00	$56,500.00
15 kV 6" Conduit (15 kV cable not included)	1	LS	120	160.00	$16,000.00	$17,750.00	$17,750.00	$33,750.00
Station Service (Transformer, Disconnect, Conduit/Cable)	1	LS	60	60.00	$6,000.00	$7,500.00	$7,500.00	$13,500.00
							Total	**$103,750.00**
Substation Grounding								
Station Ground Grid	1	LS	320	320.00	$32,000.00	$40,000.00	$40,000.00	$72,000.00
							Total	**$72,000.00**
Substation Site Work								
Site Grubbing & Fill	1	LS	80	80.00	$8,000.00	$25,000.00	$25,000.00	$33,000.00
Site Surface gravel	1	LS	80	80.00	$8,000.00	$15,000.00	$15,000.00	$23,000.00
Site Roads	1	LS	40	40.00	$4,000.00	$12,000.00	$12,000.00	$16,000.00
Substation Fence (Chain Link)	1	LS	80	80.00	$8,000.00	$20,000.00	$20,000.00	$28,000.00
Substation Land	0	LS	0	0.00	$0.00	$0.00	$0.00	$0.00
							Total	**$100,000.00**
Miscellaneous								
Contractor Mobilization	1	LS	0	0.00	$0.00	$10,000.00	$10,000.00	$10,000.00
Contractor Bonding	1	LS	0	0.00	$0.00	$7,000.00	$7,000.00	$7,000.00
Substation Testing & Commissioning	1	LS	0	0.00	$0.00	$35,000.00	$35,000.00	$35,000.00
							Total	**$52,000.00**
	Subtotals			**2,870.0**	**$287,000.00**		**$1,584,032.50**	
Subtotal Labor + Material								**$1,871,032.50**
Equipment				574		70		**$40,180.00**
Contingency (10%)								**$191,121.25**
Engineering								**$75,000.00**
TOTAL ESTIMATE								**$2,177,333.75**

Notes:
1 - Foundation estimate is based on the site having good soil conditions without water.
2 - Incoming 46 kV Line & 15kV Distribution Circuits are not included
3 - Costs shown are as of 11/12/13. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

MAP ID 9 COST ESTIMATE

COST ESTIMATE

12.47 KV UNDERGROUND DISTRIBUTION CIRCUIT - 1100 EAST - MAP ID 9

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV UG Distribution Circuit - 1100 East						BASIS OF ESTIMATE:		
DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100% OTHER - Conceptual Configuration		
ENGINEER: Les Bell								
	ESTIMATOR: Les Bell					CHECKED:		
	QUANTITY		LABOR			MATERIAL $		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 15 kV Cable[1.]:								
1, 750 kcmil Al.		Ft	0.020	0.00	0.00	$8.50	$0.00	$0.00
2. 500 kcmil Cu.	8000	Ft	0.020	160.00	9,600.00	$14.00	$112,000.00	$121,600.00
2. Remove 4/0 AWG Al.	8000	Ft	0.010	80.00	4,800.00			$4,800.00
B. Conduit and Fittings:								
1. 6" Sch 40 PVC		Ft	0.015	0.000	0.00	$3.50	$0.00	$0.00
2. 4" Stl 90^{O} Elbows	12	Ea	0.45	5.400	324.00	$65.00	$780.00	$1,104.00
C. Equipment and Cable Components:								
1. 15 kV 600 A Sectionalizer	5	Ea	2.0	10.000	600.00	$650.00	$3,250.00	$3,850.00
2. Grnd Sleeve 600 A Sect	5	Ea	2.8	13.750	825.00	$275.00	$1,375.00	$2,200.00
3. 600 A 15 kV NLB Elbow	30	Ea	2.8	84.000	5,040.00	$150.00	$4,500.00	$9,540.00
4. 2 Way 600 A 15 kV Jct	15	Ea	3.0	45.00	$2,700.00	$192.50	$2,887.50	$5,587.50
5. Remove 200 A Equip	5	Ea	10.0	50.000	3,000.00			$3,000.00
D. Trench & Backfill								
1. Trench and Backfill		Ft	0.2	0.00	$0.00			$0.00
2. Trench Sanding		Ft	0.1	0.00	$0.00	$0.50	$0.00	$0.00
E. Miscellaneous:								
1. Grndg 600 A 15 kV Sect	5	Ea	2.0	10.00	$600.00	$175.00	$875.00	$1,475.00
2. Grndg 600 A 15 kV Elbow	30	Ea	1.0	30.00	$1,800.00	$25.00	$750.00	$2,550.00
3. Cable Tagging	5	Ea	0.5	2.50	$150.00	$25.00	$125.00	$275.00
4. 6" Sch 40 PVC Fittings		Ft	0.005	0.000	$0.00	$0.25	$0.00	$0.00
5. 600 A OH/UG Riser (Existing Pole)	2	Ea	30.0	60.00	$3,600.00	$1,450.00	$2,900.00	$6,500.00
6. Remove 200 A OH/UG Riser (Existing Pole)	2	Ea	25.0	50.00	$3,000.00			$3,000.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				600.65	$36,039.00			$36,039.00
Subtotal Material							$129,442.50	$129,442.50
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$165,481.50**
Engineering	1	LS						$8,274.08
Surveying	1	LS						$5,000.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$13,274.08**
CONTINGENCY	10	%						**$17,875.56**
TOTAL COST ESTIMATE								***$196,631***

NOTES:

1. Includes an allowance of 1.5% for fitting installation make up.

MAP ID 10 COST ESTIMATE

COST ESTIMATE

12.47 KV UNDERGROUND DISTRIBUTION CIRCUIT - 2300 EAST - MAP ID 10

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV UG Distribution Circuit - 2300 East						BASIS OF ESTIMATE:		
DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100% OTHER - Conceptual Configuration		
ENGINEER: Les Bell								
	ESTIMATOR: Les Bell					CHECKED:		
	QUANTITY		LABOR			MATERIAL $		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 15 kV Cable[1.]:								
1, 750 kcmil Al.		Ft	0.020	0.00	0.00	$8.50	$0.00	$0.00
2. 500 kcmil Cu.	10500	Ft	0.020	210.00	12,600.00	$14.00	$147,000.00	$159,600.00
3. Remove exist 4/0 Al	10500	Ft	0.010	105.00	6,300.00			$6,300.00
B. Conduit and Fittings:								
1. 6" Sch 40 PVC		Ft	0.015	0.000	0.00	$3.50	$0.00	$0.00
2. 4" Stl 90^{O} Elbows	20	Ea	0.45	9.000	540.00	$65.00	$1,300.00	$1,840.00
C. Equipment and Cable Components:								
1. 15 kV 600 A Sectionalizer	6	Ea	2.0	12.000	720.00	$650.00	$3,900.00	$4,620.00
2. Grnd Sleeve 600 A Sect	6	Ea	2.8	16.500	990.00	$275.00	$1,650.00	$2,640.00
3. 600 A 15 kV NLB Elbow	36	Ea	2.8	100.800	6,048.00	$150.00	$5,400.00	$11,448.00
4. 2 Way 600 A 15 kV Jct	18	Ea	3.0	54.00	$3,240.00	$192.50	$3,465.00	$6,705.00
5. Remove 200 A Equip	6	Ea	10.0	60.000	3,600.00			$3,600.00
D. Trench & Backfill								
1. Trench and Backfill		Ft	0.2	0.00	$0.00			$0.00
2. Trench Sanding		Ft	0.1	0.00	$0.00	$0.50	$0.00	$0.00
E. Miscellaneous:								
1. Grndg 600 A 15 kV Sect	6	Ea	2.0	12.00	$720.00	$175.00	$1,050.00	$1,770.00
2. Grndg 600 A 15 kV Elbow	36	Ea	1.0	36.00	$2,160.00	$25.00	$900.00	$3,060.00
3. Cable Tagging	6	Ea	0.5	3.00	$180.00	$25.00	$150.00	$330.00
4. 6" Sch 40 PVC Fittings		Ft	0.005	0.000	$0.00	$0.25	$0.00	$0.00
5. 600 A OH/UG Riser (Existing Pole)	2	Ea	30.0	60.00	$3,600.00	$1,450.00	$2,900.00	$6,500.00
6. Remove 200 A OH/UG Riser (Existing Pole)	2	Ea	25.0	50.00	$3,000.00			$3,000.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				728.30	$43,698.00			$43,698.00
Subtotal Material							$167,715.00	$167,715.00
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$211,413.00**
Engineering	1	LS						$10,570.65
Surveying	1	LS						$5,000.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$15,570.65**
CONTINGENCY	10	%						**$22,698.37**
TOTAL COST ESTIMATE								***$249,682***

NOTES:

1. Includes an allowance of 1.5% for fitting installation make up.

MAP ID 11 COST ESTIMATE

COST ESTIMATE

12.47 KV UNDERGROUND DISTRIBUTION CIRCUIT - US-6 - MAP ID 11

Construction Cost Estimate Summary

(10-2013)

PROJECT: 12.47 kV UG Distribution Circuit - US-6						BASIS OF ESTIMATE:		
DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100% OTHER - Conceptual Configuration		
ENGINEER: Les Bell								
	ESTIMATOR: Les Bell					CHECKED:		
	QUANTITY		LABOR			MATERIAL $		
DESCRIPTION	QTY	UNIT	UNIT MH	TOTAL MH	TOTAL LABOR $	PER UNIT	TOTAL MATERIAL	TOTAL COST ($)
A. 15 kV Cable[1.]:								
1, 750 kcmil Al.		Ft	0.020	0.00	0.00	$8.50	$0.00	$0.00
2. 500 kcmil Cu.	8300	Ft	0.020	166.00	9,960.00	$14.00	$116,200.00	$126,160.00
3. Remove exist 4/0 Al	8300	Ft	0.010	83.00	4,980.00			$4,980.00
B. Conduit and Fittings:								
1. 6" Sch 40 PVC		Ft	0.015	0.000	0.00	$3.50	$0.00	$0.00
2. 4" Stl 90^{O} Elbows	16	Ea	0.45	7.200	432.00	$65.00	$1,040.00	$1,472.00
C. Equipment and Cable Components:								
1. 15 kV 600 A Sectionalizer	7	Ea	2.0	14.000	840.00	$650.00	$4,550.00	$5,390.00
2. Grnd Sleeve 600 A Sect	7	Ea	2.8	19.250	1,155.00	$275.00	$1,925.00	$3,080.00
3. 600 A 15 kV NLB Elbow	42	Ea	2.8	117.600	7,056.00	$150.00	$6,300.00	$13,356.00
4. 2 Way 600 A 15 kV Jct	21	Ea	3.0	63.00	$3,780.00	$192.50	$4,042.50	$7,822.50
5. Remove 200 A Equip	7	Ea	10.0	70.000	4,200.00			$4,200.00
D. Trench & Backfill								
1. Trench and Backfill		Ft	0.2	0.00	$0.00			$0.00
2. Trench Sanding		Ft	0.1	0.00	$0.00	$0.50	$0.00	$0.00
E. Miscellaneous:								
1. Grndg 600 A 15 kV Sect	7	Ea	2.0	14.00	$840.00	$175.00	$1,225.00	$2,065.00
2. Grndg 600 A 15 kV Elbow	42	Ea	1.0	42.00	$2,520.00	$25.00	$1,050.00	$3,570.00
3. Cable Tagging	7	Ea	0.5	3.50	$210.00	$25.00	$175.00	$385.00
4. 6" Sch 40 PVC Fittings		Ft	0.005	0.000	$0.00	$0.25	$0.00	$0.00
5. 600 A OH/UG Riser (Existing Pole)	2	Ea	30.0	60.00	$3,600.00	$1,450.00	$2,900.00	$6,500.00
6. Remove 200 A OH/UG Riser (Existing Pole)	2	Ea	25.0	50.00	$3,000.00			$3,000.00
Labor Rate			$60.00					
Subtotal Labor Hours/$				709.55	$42,573.00			$42,573.00
Subtotal Material							$139,407.50	$139,407.50
Sales and Use Tax								$0.00
TOTAL ESTIMATED CONSTRUCTION COST								**$181,980.50**
Engineering	1	LS						$9,099.03
Surveying	1	LS						$5,000.00
Geotech	1	LS						
TOTAL ENGINEERING COST								**$14,099.03**
CONTINGENCY	10	%						**$19,607.95**
TOTAL COST ESTIMATE								***$215,687***

NOTES:

1. Includes an allowance of 1.5% for fitting installation make up.