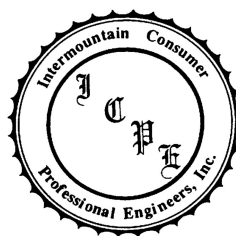


South Utah Valley Electric Service District Capital Facilities Plan

March 2019



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

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SYSTEM STUDY

System Study Overview

This electrical system study report addresses study methods and results of load flow analysis of the SESD electrical system. Substations include Sorenson, Strawberry, Arrowhead, Suter, and Loafer. There are fourteen existing 12.47 kV circuits.

The primary goal of the system study was to study system loading including during N-1 outage conditions to help the Company to plan for future growth requirements including substation upgrades and line upgrades. Recommendations for system improvements have been provided.

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 Paladin DesignBase 4.0 software.

System modeling data was developed from SESD 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 provides insight on circuit loading, substation transformer loading, distribution circuit loading, and system voltage drop. Results and recommendations are discussed in the System Load Flow Analysis and Results section of this report.

The system load flow provides insight on substation transformer loading, line loading, and system voltage drop. The study includes analyzing N-1 outage conditions. An N-1 outage condition is the loss of a major system component such as loss of a substation transformer or loss of a main line section. Results and recommendations are discussed in the System Load Flow Analysis and Results section of this report.

SYSTEM LOAD FLOW ANALYSIS AND RESULTS

System load flow studies were performed for years 2018 and 2023. The load flow studies were utilized to assess line and transformer loading conditions and system voltage conditions. Tables shown below contain projected SESD system load and projected circuit loads for years that were analyzed. A six percent load growth has been assumed for the purposes of this study. The 2018 circuit and transformer load levels shown below are based on current circuit configuration. Projects that are proposed as part of this study include new circuits and a new substation. The circuit loads shown in the table for year 2023 reflect those changes.

SESD– Projected System Peak Load		
Year	SESD Load	
	MW	MVA (0.95 PF Assumed)
2018	17,286	18,196
2023	23,133	24,350

Substation	Recloser	2018		2023	
		Amps	kVA	Amps	kVA
Sorenson – Sub #1 7.5/9.375/10.5 MVA 46 kV – 12.47 kV	R1- Palmayra	37	0.80	59	1.27
	R2 - Lakeshore North	18	0.38	40	0.86
	R3 - Lakeshore South	110	2.38	63	1.37
	R4 - Leland	11	0.23	33	0.70
	Sub Total	175	3.78	195	4.20
Strawberry – Sub #2 5/5.6/6.25/7 MVA 46 kV – 12.47 kV	R1 - Cloward	39	0.83	53	1.15
	R3 - Covered Bridge	60	1.29	74	1.60
	Sub Total	98	2.12	128	2.75
Arrowhead – Sub #3 10/12.5/14 MVA 46 kV – 12.47 kV	R-1 Arrowhead	18	0.38	20	0.43
	R-2 (Proposed)	-	-	20	0.43
	Sub Total	18	0.38	40	0.86
Suter – Sub #4 7.5/9.375/10.5 MVA 46 kV – 12.47 kV	R1 - UB East	0	0.00	22	0.48
	R2 - West Mountain	190	4.10	58	1.26
	R4 - Spring Lake	32	0.68	61	1.31
	Sub Total	221	4.78	141	3.05
Loafer –Sub #5 12/16/20/22.4 MVA 46 kV – 12.47 kV	R1 - UB East	42	0.91	57	1.23
	R2 - Woodland Hills	84	1.82	99	2.14
	R3 - Loafer Canyon	100	2.16	115	2.48
	R4 - UB West	104	2.24	118	2.55
	Sub Total	330	7.13	389	8.39
Sub #6 (Proposed) 12/16/20/22.4 MVA 46 kV – 12.47 kV	R-1 (Proposed)	-	-	90	1.94
	R-2 (Proposed)	-	-	146	3.15
	Sub Total	-	-	236	5.09
Total	Amps	842	-	1127	-
	kVA	-	18.20	-	24.35

The following table shows approximate transformer loading.

Substation Transformer	2018		2023	
	%Base	%Total	%Base	%Total
Sorenson – Sub #1 7.5/9.375/10.5 MVA 46 kV – 12.47 kV	50%	36%	56%	40%
Strawberry – Sub #2 5/6.25 MVA 46 kV – 12.47 kV	42%	34%	55%	44%
Arrowhead – Sub #3 10/11.2/12.5/14 MVA 46 kV – 12.47 kV	4%	3%	9%	6%
Suter – Sub #4 7.5/9.375/10.5 MVA 46 kV – 12.47 kV	64%	46%	41%	29%
Loafer –Sub #5 12/16/20/22.4 MVA 46 kV – 12.47 kV	59%	32%	70%	37%
Sub #6 (Proposed) 12/16/20/22.4 MVA 46 kV – 12.47 kV	-	-	42%	23%
Total City	34%	28%	37%	28%

Proposed Improvements

Proposed system improvements are summarized in the following tables. A brief description of each improvement is given along with a brief listing of the issues that the improvement helps to solve. The estimated costs are in 2019 dollars. System maps showing city and SESD boundaries and showing the locations for each proposed improvement are in the appendix. Improvements on the maps are numbered to match the numbers in the tables. A more detailed explanation of load flow results can be found in the Load Flow – Outage Cases section of the report. That section explains what outages were studied and what the results were for the outage cases.

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
1. Install line voltage regulators at Kilgore on Sorenson’s Lakeshore South circuit. Set regulators at 124 V.	Improvement: It is proposed to add an additional set of line voltage regulators at Kilgore on Sorenson’s Lakeshore South circuit. The new regulators would need to be set higher than normal at 124 V.	\$101,365
	Issues the improvement helps solve: Sorenson’s Lakeshore South circuit has voltage issues during peak loading.	
2. Relocate line voltage regulators on Sorenson’s Lakeshore South circuit. Set regulators at 124 V.	Improvement: It is proposed to relocate line voltage regulators on Sorenson’s Lakeshore South circuit so that they are closer to the substation. The regulators would need to be set higher than normal at 124 V.	\$28,897
	Issues the improvement helps solve: Sorenson’s Lakeshore South circuit has voltage issues during peak loading.	
3. Raise Sorenson’s voltage regulators to 124 V.	Improvement: It is proposed to raise Sorenson’s voltage regulators to 124 V.	NA
	Issues the improvement helps solve: Sorenson’s Lakeshore South circuit has voltage issues during peak loading.	
4. Rebuild part of Sorenson’s Lakeshore South circuit with 477 ACSR. Approximate length is 3.7 miles (19,800 feet).	Improvement: It is proposed to reconductor the #2 ACSR line sections of Sorenson’s Lakeshore South circuit to a larger 477 ACSR conductor.	\$387,765
	Issues the improvement helps solve: Sorenson’s Lakeshore South circuit has voltage issues during peak loading.	
	Future Sub 6’s R1 circuit cannot be backed up without upgrades.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
<p>5. Rebuild part of Suter's West Mountain circuit with 477 ACSR and add an overhead switch. Approximate length is 2.3 miles (12,250 feet).</p>	<p>Improvement:</p> <p>It is proposed to reconductor the 1/0 and 2/0 ACSR line sections of Suter's West Mountain circuit to a larger 477 ACSR conductor.</p> <p>A new overhead switch needs to be added as part of the reconductor work. It will be used in conjunction with the new Sub #6 discussed below. The switch will be necessary when creating the new Sub #6 R2 circuit.</p> <p>Issues the improvement helps solve:</p> <p>Suter's West Mountain circuit has voltage issues during peak loading.</p> <p>During a line or recloser outage Suter's West Mountain circuit cannot be backed up without upgrades.</p> <p>During an outage of Suter's transformer the West Mountain circuit cannot be backed up without upgrades.</p> <p>Future Sub 6's R2 circuit cannot be backed up without upgrades.</p>	<p>\$255,356</p>
<p>6. Build new Sub #6. Set voltage regulators at 124 V.</p>	<p>Improvement:</p> <p>It is proposed to build a new Sub #6 with a 12/16/20 MVA transformer. The substation might be fed from PacifiCorp. One circuit will feed part of Sorenson's Lakeshore South circuit and a second circuit will feed part of Suter's West Mountain circuit. The voltage regulators need be set at 124 V.</p> <p>Issues the improvement helps solve:</p> <p>During a line or recloser outage Sorenson's Lakeshore South circuit cannot be backed up without upgrades.</p> <p>During an outage of Sorenson transformer Lakeshore North and Lakeshore South circuits cannot be backed up without upgrades.</p> <p>During a line or recloser outage Suter's West Mountain circuit cannot be backed up without upgrades.</p> <p>During an outage of Suter's transformer the West Mountain circuit cannot be backed up without upgrades.</p>	<p>\$2,745,927</p>

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
7. Build a 477 ACSR tie line between Sorenson's Leland circuit and Sorenson's Palmyra circuit. The new line will require an overhead switch. Approximate length is 1.9 miles (10,080 feet).	Improvement: It is proposed to add a tie line between Sorenson's Leland circuit and Sorenson's Palmyra circuit. The new circuit should be 477 ACSR. The line will require a new overhead switch.	\$320,844
	Issues the improvement helps solve: During an outage of Sorenson's transformer Palmyra circuit cannot be backed up without upgrades.	
8. Rebuild part of Arrowhead's Arrowhead circuit and part of Sorenson's Leland circuit with 477 ACSR. Approximate length is 8.3 miles (43,750 feet).	Improvement: It is proposed to upgrade Arrowhead's Arrowhead circuit and Sorenson's Leland circuit from Arrowhead substation to the new tie line. Existing conductor is #6 copper and it is proposed to upgrade to 477 ACSR.	\$854,365
	Issues the improvement helps solve: During an outage of Sorenson's transformer Palmyra circuit cannot be backed up without upgrades. During a line or recloser outage Strawberry's Covered Bridge circuit cannot be backed up without upgrades. During a loss of Strawberry's transformer the Covered Bridge circuit cannot be backed up without upgrades. During a line or recloser outage Loafer's Woodland Hills circuit cannot be backed up without upgrades. During a loss of Loafer's transformer the Woodland Hills circuit cannot be backed up without upgrades.	
9. Build a 477 ACSR tie line between Strawberry's Cloward circuit and Strawberry's Covered Bridge circuit. The new line will require an overhead switch. Approximate length is 0.4 miles (1,000 feet).	Improvement: It is proposed to add a tie line and switch between Strawberry's Cloward circuit and Strawberry's Covered Bridge circuit. The new circuit should be 477 ACSR.	\$44,896
	Issues the improvement helps solve: During a line or recloser outage Strawberry's Covered Bridge circuit cannot be backed up without upgrades. During a loss of Strawberry's transformer the Covered Bridge circuit cannot be backed up without upgrades.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
10. Install line voltage regulators on Strawberry's Covered Bridge circuit.	Improvement: It is proposed to add line voltage regulators to Strawberry's Covered Bridge circuit.	\$101,365
	Issues the improvement helps solve: During a line or recloser outage Strawberry's Covered Bridge circuit cannot be backed up without upgrades. During a loss of Strawberry's transformer the Covered Bridge circuit cannot be backed up without upgrades.	
11. Install a new R2 circuit to Arrowhead sub that will come out to the East. There is an existing recloser that can be used. The new line will be 477 ACSR. Approximate length is 0.8 miles (4,180 feet).	Improvement: It is proposed to add a new R2 circuit to Arrowhead sub that will come out to the east. This will reduce the line length to feed Strawberry circuits from Arrowhead. There is an existing recloser that can be used. The new line will be 477 ACSR.	\$141,301
	Issues the improvement helps solve: During a line or recloser outage Strawberry's Covered Bridge circuit cannot be backed up without upgrades. During a loss of Strawberry's transformer the Covered Bridge circuit cannot be backed up without upgrades.	
12. Install line voltage regulators on Loafer's UB West circuit. Set regulators at 124 V.	Improvement: It is proposed to add line voltage regulators to Loafer's UB West circuit. Regulators need to be set at 124 V.	\$101,365
	Issues the improvement helps solve: During an outage Suter's Spring Lake circuit can be backed up by Loafer's UB West circuit, but there would be voltage issues. During a line or recloser outage Loafer's UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues. During a loss of Loafer's transformer the UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues. During a line or recloser outage Loafer's Loafer Canyon circuit cannot be backed up without upgrades. During a loss of Loafer's transformer the Loafer Canyon circuit cannot be backed up without upgrades.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
13. Rebuild part of Suter's Spring Lake and Loafer's UB West circuits with 477 ACSR. Approximate length is 7.3 miles (38,860 feet).	Improvement: It is proposed to upgrade a portion of Suter's Spring Lake and Loafer's UB West circuits. Existing conductor is a mix of #2 and 4/0 ACSR. It is proposed to upgrade to 477 ACSR.	\$759,644
	Issues the improvement helps solve: During a line or recloser outage Loafer's UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues. During a loss of Loafer's transformer the UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues. During a line or recloser outage Loafer's Loafer Canyon circuit cannot be backed up without upgrades. During a loss of Loafer's transformer the Loafer Canyon circuit cannot be backed up without upgrades.	
14. Build a 477 ACSR tie line between Loafer's UB East circuit and Loafer's Woodland Hills circuit. The new line will require an overhead switch. Approximate length is 1.2 miles (6,380 feet).	Improvement: It is proposed to add a tie line between Loafer's UB East circuit and Loafer's Woodland Hills circuit. The new circuit should be 477 ACSR. The new line with require a new overhead switch.	\$209,108
	Issues the improvement helps solve: During a line or recloser outage Loafer's Woodland Hills circuit cannot be backed up without upgrades. During a loss of Loafer's transformer the Woodland Hills circuit cannot be backed up without upgrades.	
15. Raise Arrowhead voltage regulators to 124 V.	Improvement: Raise Arrowhead voltage regulators to 124 V.	NA
	Issues the improvement helps solve: During a line or recloser outage Strawberry's Covered Bridge circuit cannot be backed up without upgrades. During a loss of Strawberry's transformer the Covered Bridge circuit cannot be backed up without upgrades. During a line or recloser outage Loafer's Woodland Hills circuit cannot be backed up without upgrades. During a loss of Loafer's transformer the Woodland Hills circuit cannot be backed up without upgrades.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
16. Install line voltage regulators on Loafer’s Woodland Hills circuit.	Improvement: It is proposed to add line voltage regulators to Loafer’s Woodland Hills circuit.	\$101,365
	Issues the improvement helps solve: During a line or recloser outage Loafer’s Woodland Hills circuit cannot be backed up without upgrades. During a loss of Loafer’s transformer the Woodland Hills circuit cannot be backed up without upgrades.	
17. Rebuild part of Loafer’s UB East circuit with 477 ACSR. Approximate length is 2.5 miles (13,190 feet).	Improvement: It is proposed to upgrade a portion of Loafer’s UB East circuit. Existing conductor is 4/0 ACSR. It is proposed to upgrade to 477 ACSR.	\$257,910
	Issues the improvement helps solve: During a line or recloser outage Loafer’s Woodland Hills circuit cannot be backed up without upgrades. During a loss of Loafer’s transformer the Woodland Hills circuit cannot be backed up without upgrades.	
18. Rebuild Strawberry’s Cloward circuit with 477 ACSR. Approximate length is 2.5 miles (13,430 feet).	Improvement: It is proposed to upgrade Strawberry’s Cloward circuit. Existing conductor is 4/0 ACSR. It is proposed to upgrade to 477 ACSR.	\$264,031
	Issues the improvement helps solve: Load flows for 2023 show that during a line or recloser outage Strawberry’s Covered Bridge circuit cannot be backed up without upgrades. Load flows for 2023 show that during a loss of Strawberry’s transformer the Covered Bridge circuit cannot be backed up without upgrades.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
19. Raise Suter voltage regulators to 124 V.	Improvement: Propose to raise Suter voltage regulators to 124 V.	NA
	Issues the improvement helps solve: Load flows for 2023 show that a line or recloser outage on Sub 6's R2 circuit can be backed up by Suter's West Mountain circuit, but there are voltage issues. Load flows for 2023 show that during a loss of Sub 6's transformer the R2 circuit can be backed up by Suter's West Mountain circuit, but there are voltage issues. Load flows for 2023 show that a line or recloser outage on Loafer's Loafer Canyon circuit can be backed up along with Loafer's UB West circuit by Suter's Spring Lake circuit, but there are voltage issues. Load flows for 2023 show that during a loss of Loafer transformer UB West circuit and Loafer Canyon circuits can be backed up by Suter's Spring Lake circuit, but there are voltage issues.	

Proposed System Improvements		
Proposed Improvement	Reason/Explanation	Estimated Cost
20. Build new Sub #7 in 5 to 10 years. Set voltage regulators at 124 V.	<p>Improvement:</p> <p>It is proposed to build a new Sub #7 with a 12/16/20 MVA transformer in the next five to ten years. The substation will probably not be required in the five years considered by this study, but there have been discussions of developing nearby land for residential use. The timing of this is unknown, but it is possible it could happen in the next 5 years.</p> <p>This project has been included as part of this study since locations for a potential new substation and 46 kV line routes to feed it should be considered well in advance of its need. This will allow SESD time to purchase substation land, obtain necessary line easements, and plan financially. Also substation and transmission line projects can take significant time from start to finish due to material lead times and permitting requirements.</p> <p>The substation might be fed from PacifiCorp. One circuit could feed part of Arrowhead's Arrowhead circuit and a second circuit could feed part of Loafer's UB East circuit. The voltage regulators need be set at 124 V.</p> <p>Issues the improvement helps solve:</p> <p>The primary need for the substation will come when load growth in the area requires it. This will probably be beyond the five years considered by this study.</p> <p>An option would be to build the substation sooner than is required for load growth in order to help with providing back up during outages. The substation will be centrally placed and can be used to back up Sorenson, Strawberry, Arrowhead, and Loafer substations. If the substation was built for backup purposes then projects 11, 15, 17, 18, and part of 8 could be postponed.</p>	\$2,745,927
	Total Cost	\$9,421,431

Load Flow – Outage Cases

Loss of substation transformers, reclosers, and lines were considered. Load flows were ran with outages taken one at a time. Loads from the equipment that was out of service were transferred to adjacent circuits. In several outage cases, it became apparent that system improvements were necessary. The table below lists the load flow results and discusses required system improvements. Results are based on projected peak (summer) load levels. During winter load levels the outages would not have as great of an effect.

The Comments/Results column of the following tables lists ways to restore load during a line or transformer outage. It also discusses proposed solutions if the outage creates problems. In some cases more than one option of restoring load could be possible. SESD may have developed load transfer schemes that differ from the ones shown.

SESD power factor for each circuit is not known at this time and therefore the possible need for power factor correction was not able to be evaluated. Keeping a high power factor helps support voltage during 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.

2018 Outage Cases	Comments/Results
Base Case	<p>Sorenson’s Lakeshore South circuit has voltage issues during peak loading.</p> <p>Suter’s West Mountain circuit has voltage issues during peak loading.</p>
Base Case Proposed Solutions	<p>It is proposed to add line voltage regulators at Kilgore on to Sorenson’s Lakeshore South circuit. The new regulators would need to be set higher than normal at 124 V.</p> <p>It is proposed to relocate line voltage regulators on Sorenson’s Lakeshore South circuit so that they are closer to the substation. The regulators would need to be set higher than normal at 124 V.</p> <p>It is proposed to raise Sorenson’s voltage regulators to 124 V.</p> <p>It is proposed to upgrade Sorenson’s Lakeshore South circuit. Existing #2 ACSR line sections should be upgraded to 477 ACSR.</p> <p>It is proposed to upgrade Suter’s West Mountain circuit. Existing 1/0 and 2/0 ACSR line sections should be upgraded to 477 ACSR.</p>
46 kV	<p>46 kV line out of service:</p> <p>Existing substations are located on a 46 kV looped system so each sub can be fed from one of two directions. Loss of any one 46 kV line is not a problem.</p> <p>It has been proposed to build a new Sub #6 and possibly feed it from PacifiCorp. Details of how PacifiCorp would back it up have not yet been determined.</p>
46 kV Solutions	None

2018 Outage Cases	Comments/Results
Sorenson Outage Conditions	<p>Sorenson line or recloser out of service:</p> <p>Palmyra and Lakeshore North circuits can back each other up.</p> <p>Leland circuit can be backed up by Arrowhead's Arrowhead circuit.</p> <p>Lakeshore South circuit cannot be backed up without upgrades.</p>
Sorenson Proposed Solutions	<p>Sorenson transformer out of service:</p> <p>Palmyra circuit cannot be backed up without upgrades.</p> <p>Lakeshore North circuit cannot be backed up without upgrades.</p> <p>Lakeshore South circuit cannot be backed up without upgrades.</p> <p>Leland circuit can be backed up by Arrowhead's Arrowhead circuit.</p> <p>It is proposed to build a new Sub #6 with a 12/16/20 MVA transformer. The substation might be fed from PacifiCorp. One circuit will feed part of Sorenson's Lakeshore South circuit and a second circuit will feed part of Suter's West Mountain circuit.</p> <p>Sub #6's R1 circuit can provide backup to Sorenson's Lakeshore North and Lakeshore South circuits.</p> <p>It is proposed to add a tie line between Sorenson's Leland circuit and Sorenson's Palmyra circuit. The new circuit should be 477 ACSR.</p> <p>It is proposed to upgrade Arrowhead's Arrowhead circuit and Sorenson's Leland circuit from Arrowhead substation to the new tie line. Existing conductor is #6 copper and it is proposed to upgrade to 477 ACSR.</p> <p>Arrowhead's Arrowhead circuit can use the new tie line and the upgraded line to backup Sorenson's Palmyra and Leland circuits.</p>
Strawberry Outage Conditions	<p>Strawberry line or recloser out of service:</p> <p>Cloward circuit can be backed up by Loafer's UB East circuit.</p> <p>Covered Bridge circuit cannot be backed up without upgrades.</p> <p>Strawberry transformer out of service:</p> <p>Same conditions as above.</p>

2018 Outage Cases	Comments/Results
Strawberry Proposed Solutions	<p>It is proposed to add a tie line and switch between Strawberry’s Cloward circuit and Strawberry’s Covered Bridge circuit. The new circuit should be 477 ACSR.</p> <p>It is proposed to add line voltage regulators to Strawberry’s Covered Bridge circuit.</p> <p>It is proposed to upgrade Arrowhead’s Arrowhead circuit. Existing conductor is #6 copper. It is proposed to upgrade to 477 ACSR.</p> <p>It is proposed to add a new R2 circuit to Arrowhead sub that will come out to the east. This will reduce the line length to feed Strawberry circuits from Arrowhead.</p> <p>It is proposed to raise Arrowhead voltage regulators to 124 V.</p> <p>Arrowhead’s new R2 circuit can use the new tie line, the upgraded line, and the line voltage regulators to backup Strawberry’s Cloward and Covered Bridge circuits.</p>
Arrowhead Outage Conditions	<p>Arrowhead line or recloser out of service:</p> <p>Arrowhead circuit can be backed up by Suter’s UB East circuit.</p> <p>Arrowhead transformer out of service:</p> <p>Same conditions as above.</p>
Arrowhead Proposed Solutions	None
Suter Outage Conditions	<p>Suter line or recloser out of service:</p> <p>UB East circuit currently does not have any load on it. It serves as a backup to Arrowhead’s Arrowhead circuit.</p> <p>West Mountain circuit cannot be backed up without upgrades.</p> <p>Spring Lake circuit can be backed up by Loafer’s UB West circuit, but there would be voltage issues.</p> <p>Suter transformer out of service:</p> <p>Same conditions as above.</p>

2018 Outage Cases	Comments/Results
Suter Proposed Solutions	<p>It is proposed to build a new Sub #6 with a 12/16/20 MVA transformer. The substation might be fed from PacifiCorp. One circuit will feed part of Sorenson's Lakeshore South circuit and a second circuit will feed part of Suter's West Mountain circuit. The voltage regulators need to be set at 124 V.</p> <p>It is proposed to upgrade Suter's West Mountain circuit. Line sections of 1/0 and 2/0 ACSR should be upgraded. It is proposed to upgrade to 477 ACSR.</p> <p>Sub #6's R2 circuit can use the upgraded lines can provide backup to Suter's West Mountain circuit.</p> <p>It is proposed to add line voltage regulators to Loafer's UB West circuit.</p> <p>Loafer's UB West circuit can use the line voltage regulators can to back up Spring Lake circuit.</p>
Loafer Outage Conditions	<p>Loafer line or recloser out of service:</p> <p>UB East circuit can be backed up by Strawberry's Cloward circuit.</p> <p>Woodland Hills circuit cannot be backed up without upgrades.</p> <p>Loafer Canyon circuit cannot be backed up without upgrades.</p> <p>UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues.</p> <p>Loafer transformer out of service:</p> <p>Same conditions as above.</p>
Loafer Proposed Solutions	<p>It is proposed to upgrade a portion of Suter's Spring Lake and Loafer's UB West circuits. Existing conductor is a mix of #2 and 4/0 ACSR. It is proposed to upgrade to 477 ACSR.</p> <p>It is proposed to add line voltage regulators to Loafer's UB West circuit. The regulators will need to be set higher than normal at 124 V.</p> <p>Suter's Spring Lake circuit can use the new line voltage regulators and the upgraded line to backup Loafer's UB West and Loafer Canyon circuits.</p> <p>It is proposed to add a tie line between Loafer's UB East circuit and Loafer's Woodland Hills circuit. The new circuit should be 477 ACSR.</p> <p>It is proposed to upgrade Arrowhead's Arrowhead circuit. Existing conductor is #6 copper. It is proposed to upgrade to 477 ACSR.</p> <p>It is proposed to raise Arrowhead's voltage regulators to 124 V.</p> <p>It is proposed to add line voltage regulators to Loafer's Woodland Hills circuit.</p> <p>It is proposed to upgrade a portion of Loafer's UB East circuit. Existing conductor is a 4/0 ACSR. It is proposed to upgrade to 477 ACSR.</p> <p>Arrowhead's Arrowhead circuit can use the new tie line, the new line voltage regulators, and the upgraded lines to backup Loafer's UB East and Woodland Hills circuits.</p>

2018 Outage Cases	Comments/Results
Sub 6 Outage Conditions	Sub 6 line or recloser out of service: Sub 6's R1 circuit cannot be backed up without upgrades. Sub 6's R2 circuit cannot be backed up without upgrades.
	Sub 6 transformer out of service: Same conditions as above.
Sub 6 Proposed Solutions	It is proposed to upgrade Sorenson's Lakeshore South circuit. Line sections of #2 ACSR should be upgraded. It is proposed to upgrade to 477 ACSR. Sorenson's Lakeshore South circuit can use the upgraded line sections to back up Sub 6's R1 circuit. It is proposed to upgrade Suter's West Mountain circuit. Line sections of 1/0 and 2/0 ACSR should be upgraded. It is proposed to upgrade to 477 ACSR. Suter's West Mountain circuit can use the upgraded line sections to back up Sub 6's R2 circuit.

2023 Outage Cases (After Upgrades)	Comments/Results
Base Case	No Problems
Base Case Proposed Solutions	None
46 kV	<p>46 kV line out of service:</p> <p>Existing substations are located on a 46 kV looped system so each sub can be fed from one of two directions. Loss of any one 46 kV line is not a problem.</p> <p>It has been proposed to build new Sub #6 and new Sub #7 and possibly feed them from PacifiCorp. Details of how PacifiCorp would back them up have not yet been determined.</p>
46 kV Solutions	None
Sorenson Outage Conditions	<p>Sorenson line or recloser out of service:</p> <p>Palmyra and Lakeshore North circuits can back each other up.</p> <p>Lakeshore South circuit can be backed up by Sub 6.</p> <p>Leland circuit can be backed up by Arrowhead's Arrowhead circuit.</p>
	<p>Sorenson transformer out of service:</p> <p>Sorenson's Lakeshore North and Lakeshore South circuits can be backed up by Sub #6's R1 circuit.</p> <p>Palmyra and Leland circuits can be backed up by Arrowhead's R2 circuit.</p>
Sorenson Proposed Solutions	None
Strawberry Outage Conditions	<p>Strawberry line or recloser out of service:</p> <p>Cloward and Covered Bridge circuits can back each other up.</p>
	<p>Strawberry transformer out of service:</p> <p>Cloward and Covered Bridge circuits can be backed up by Arrowhead's R2 circuit, but voltages are marginal.</p>
Strawberry Proposed Solutions	<p>It is proposed to upgrade Strawberry's Cloward circuit. Existing conductor is 4/0 ACSR. It is proposed to upgrade to 477 ACSR.</p> <p>Arrowhead's R2 circuit can use the upgraded line sections to back up Cloward and Covered Bridge circuits.</p>
Arrowhead Outage Conditions	<p>Arrowhead line or recloser out of service:</p> <p>Arrowhead circuit can be backed up by Suter's UB East circuit.</p> <p>New R2 circuit can be picked up by Loafer's UB East circuit.</p>
	<p>Arrowhead transformer out of service:</p> <p>Same conditions as above.</p>
Arrowhead Proposed Solutions	None

2023 Outage Cases (After Upgrades)	Comments/Results
Suter Outage Conditions	<p>Suter line or recloser out of service:</p> <p>UB East circuit can be backed up by Arrowhead's Arrowhead circuit.</p> <p>West Mountain circuit can be backed up by Sub #6's R2 circuit.</p> <p>Spring Lake circuit can be backed up by Loafer's UB West circuit.</p> <p>Suter transformer out of service:</p> <p>Same conditions as above.</p>
Suter Proposed Solutions	None
Loafer Outage Conditions	<p>Loafer line or recloser out of service:</p> <p>UB East circuit can be backed up by Arrowhead's R2 circuit.</p> <p>Woodland Hills circuit can be backed up by Loafer's UB East circuit.</p> <p>UB West circuit can be backed up by Suter's Spring Lake circuit.</p> <p>Loafer Canyon circuit can be backed up along with UB West circuit by Suter's Spring Lake circuit, but cannot be backed up just by itself. There are voltage issues.</p> <p>Loafer transformer out of service:</p> <p>UB East and Woodland Hills circuits can be backed up by Arrowhead's R2 circuit.</p> <p>UB West circuit and Loafer Canyon circuits can be backed up by Suter's Spring Lake circuit, but there are voltages issues.</p>
Loafer Proposed Solutions	<p>It is proposed to raise Suter's voltage regulators to 124 V.</p> <p>Suter's Spring Lake circuit can use the raised line voltage regulators to backup Loafer's UB West and Loafer Canyon circuits.</p>
Sub 6 Outage Conditions	<p>Sub 6 line or recloser out of service:</p> <p>Sub 6's R1 circuit can be backed up by Sorenson's Lakeshore South circuit.</p> <p>Sub 6's R2 circuit can be backed up by Suter's West Mountain circuit, but there are voltage issues.</p> <p>Sub 6 transformer out of service:</p> <p>Same conditions as above.</p>
Sub 6 Proposed Solutions	<p>Propose to raise Suter voltage regulators to 124 V.</p> <p>Suter's West Mountain circuit can use the raised voltage regulators to backup Sub 6's R2 circuit.</p>

2023 Outage Cases (After Upgrades)	Comments/Results
Sub 7 (Proposed in 5 to 10 years)	<p>It is proposed to build a new Sub #7 with a 12/16/20 MVA transformer in the next five to ten years. The substation will probably not be required in the five years considered by this study, but there have been discussions of developing nearby land for residential use. The timing of this is unknown, but it is possible it could happen in the next 5 years.</p> <p>This project has been included as part of this study since locations for a potential new substation and 46 kV line routes to feed it should be considered well in advance of its need. This will allow SESD time to purchase substation land, obtain necessary line easements, and plan financially. Also substation and transmission line projects can take significant time from start to finish due to material lead times and permitting requirements.</p> <p>The substation might be fed from PacifiCorp. One circuit could feed part of Arrowhead's Arrowhead circuit and a second circuit could feed part of Loafer's UB East circuit. The voltage regulators need be set at 124 V.</p> <p>An option would be to build the substation sooner than is required for load growth in order to help with providing back up during outages. The substation will be centrally placed and can be used to back up Sorenson, Strawberry, Arrowhead, and Loafer substations. If the substation was built for backup purposes then projects 11, 15, 17, 18, and part of 8 could be postponed.</p>

SYSTEM MODELING

To perform a comprehensive load flow, fault analysis, and protective device coordination study, system computer modeling is necessary. System modeling data was developed from SESD provided system data. The model is based on the assumption that provided transformer data, generator data, system maps and data (conductor sizes, system configurations, line lengths, etc.) are reflective of actual field conditions.

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.

SESD - 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 CU	130	0.41860	0.14619	0.55504	0.50731	0.00000
#4 CU	180	0.26297	0.16106	0.39011	0.47674	0.00000
#4	140	0.42430	0.14280	0.56133	0.50536	0.00000
#2 CU	230	0.16695	0.13922	0.28220	0.41123	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
2/0	270	0.13318	0.12981	0.25114	0.35013	0.00000
4/0	340	0.08369	0.12443	0.16195	0.35568	0.00000
266	460	0.06634	0.11038	0.13447	0.35267	0.00000
477	670	0.03718	0.11085	0.08206	0.31913	0.00000

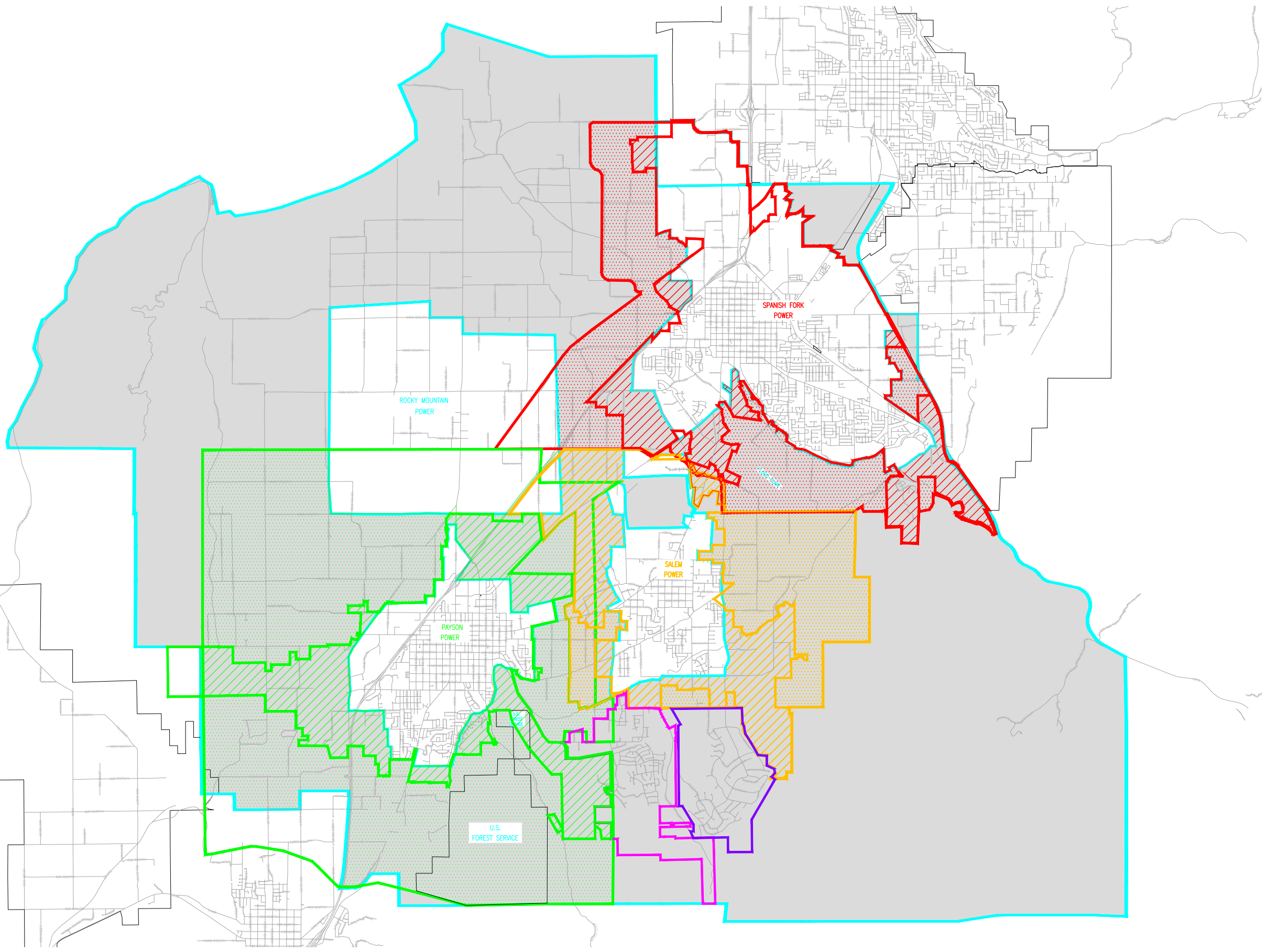
SESD - 12.47 kV Underground						
Conductor Size	Ampacity (Amps)	Z(+) Ohms/1000'		Z(0) Ohms/1000'		1/2 Bpu mmho/1000'
		R	X	R	X	
1/0	175	0.21100	0.05150	0.36800	0.06500	0.01204
4/0	255	0.10800	0.04630	0.32200	0.09500	0.01517

SESD – Substation Transformer Data			
Transformer	MVA Rating	Voltage Rating	%Z @ Nominal
Sorenson	7.5/9.375/10.5 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 7.7%
Strawberry	5/6.25 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 8.04%
Arrowhead	10/11.2/12.5/14 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 7.41%
Suter	7.5/9.375/10.5 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 6.63%
Loafer	12/16/20/22.4 MVA	46-12.47 kV Delta-Gnd-Y	Z1 = 6.72%

APPENDICES

1. System Maps
2. Cost Estimates
3. Load Flow Studies
4. Model Input Data

APPENDIX 1 – SYSTEM MAPS



LEGEND	
	ELK RIDGE CITY BOUNDARY
	PAYSON CITY BOUNDARY
	PAYSON CITY
	PAYSON CITY ANNEXATION
	SALEM CITY BOUNDARY
	SALEM CITY
	SALEM CITY ANNEXATION
	SESD BOUNDARY
	SESD
	SPANISH FORK CITY BOUNDARY
	SPANISH FORK CITY
	SPANISH FORK CITY ANNEXATION
	WOODLAND HILLS CITY BOUNDARY

NOTE:
1. PAYSON CITY ANNEXATION BOUNDARY OVERLAPS SALEM AND ELK RIDGE BOUNDARIES

Salt Mountain Consumer Professional Engineers, Inc.
CONSULTING ENGINEERS
1140 E. SOUTH UTAH AVE.
MIDWINTER, UTAH 84047
PHONE (801) 225-1111 FAX 888-0088

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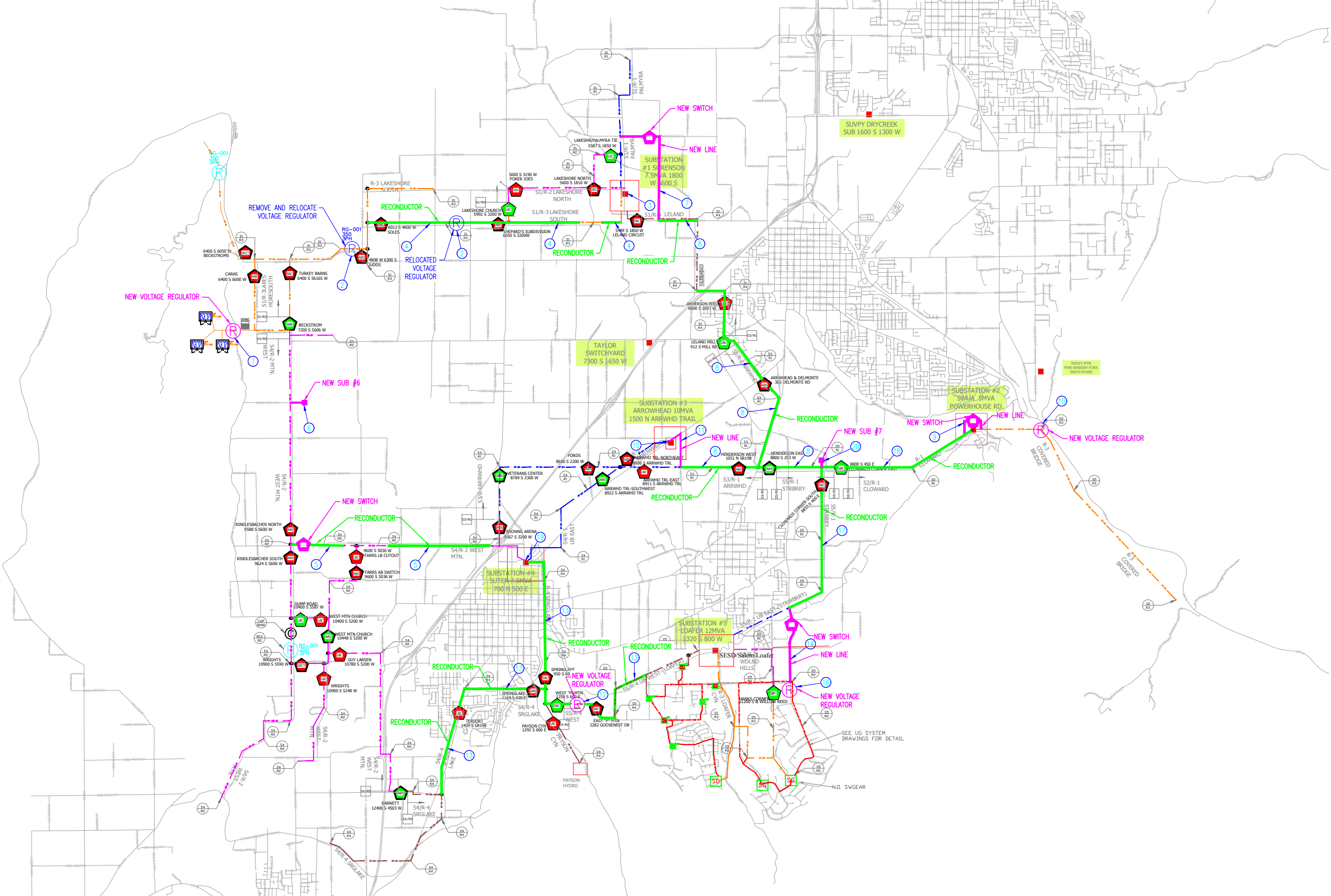
No.	Description	By	Date	App.	Chk.	Date
A	PRELIMINARY	RF	01/05/19	CBM	Dwn.	RF
					Engr.	MF
					App.	CBM
					Date	--
REVISIONS						
Proj. No:	555-002	Scale:	NTS			

Title: SESD-GENERAL PLAN									
SESD AND CITY BOUNDARIES									
Drawing No.	Rev.								
E100	A								



LEGEND	
	RECONDUCTOR
	NEW LINE
	RELOCATE

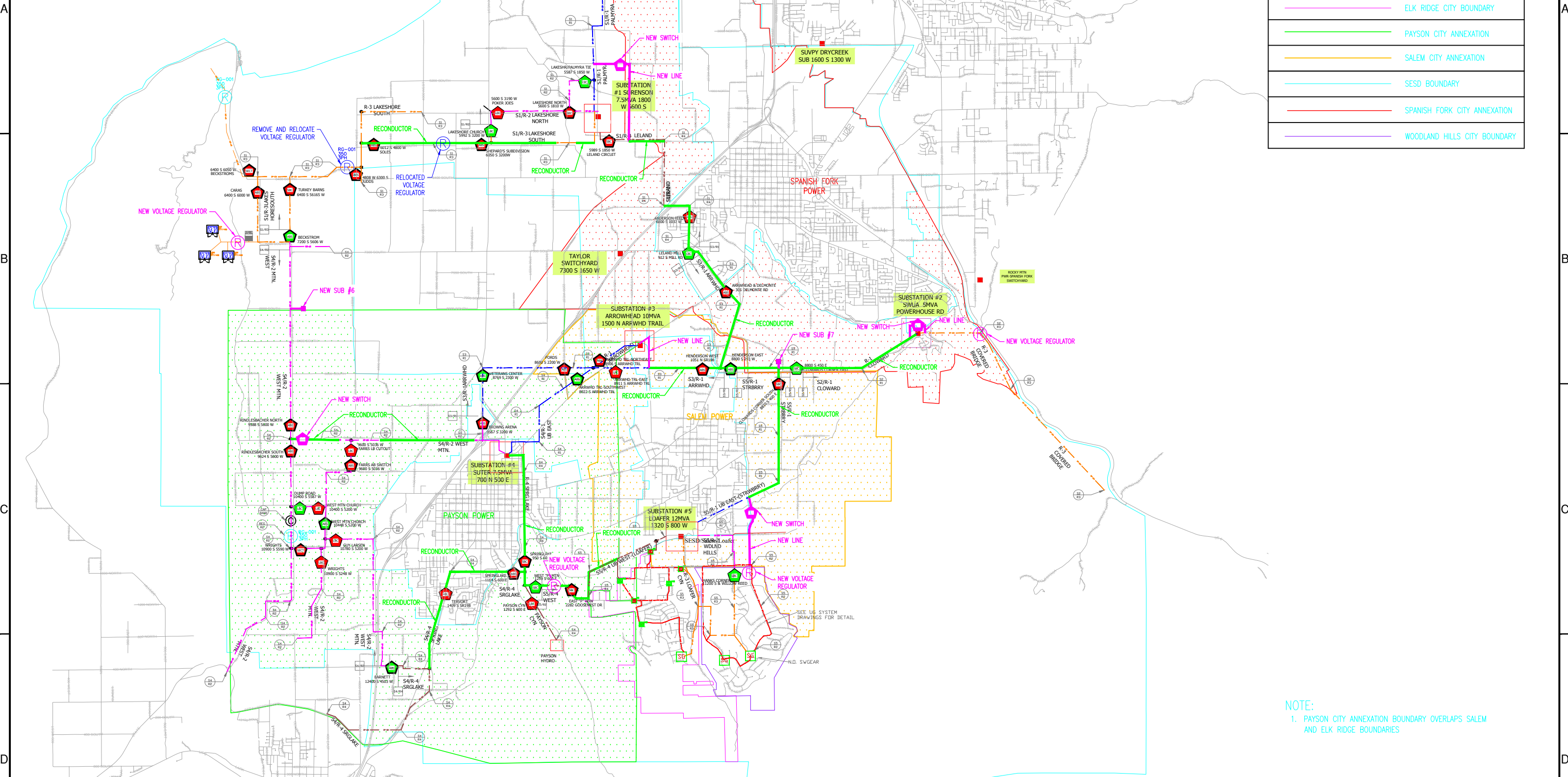
- NOTES:
1. INSTALL LINE VOLTAGE REGULATORS.
 2. RELOCATE VOLTAGE REGULATORS.
 3. RAISE SORENSON'S VOLTAGE REGULATORS TO 124V.
 4. REBUILD LINE TO 477 ACSR.
 5. REBUILD LINE TO 477 ACSR AND ADD OVERHEAD SWITCH.
 6. BUILD SUB #6. SET REGULATORS AT 124V.
 7. BUILD 477 ACSR TIE LINE AND ADD OVERHEAD SWITCH.
 8. REBUILD LINE TO 477 ACSR.
 9. BUILD 477 ACSR TIE LINE AND ADD OVERHEAD SWITCH.
 10. INSTALL LINE VOLTAGE REGULATORS.
 11. INSTALL NEW ARROWHEAD CIRCUIT.
 12. INSTALL LINE VOLTAGE REGULATORS.
 13. REBUILD LINE TO 477 ACSR.
 14. BUILD 477 ACSR TIE LINE AND ADD OVERHEAD SWITCH.
 15. RAISE ARROWHEAD'S VOLTAGE REGULATORS TO 124V.
 16. INSTALL LINE VOLTAGE REGULATORS.
 17. REBUILD LINE TO 477 ACSR.
 18. REBUILD LINE TO 477 ACSR.
 19. RAISE SUTER'S VOLTAGE REGULATORS TO 124V.
 20. BUILD SUB #7.



<p>Intermountain Consumer Professional Engineers, Inc. CONSULTING ENGINEERS 1445 E. SOUTH UNION AVE. MIDVALE, UTAH 84047 PH: (801) 255-1111 FAX: 566-0088</p>		<p>Title: SESD-GENERAL PLAN SESD PROPOSED PROJECTS</p>																													
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No.	Description	By	Date	App.	Chk.	Date																									
A	PRELIMINARY	RF	01/05/19	CBM	Dwn.	RF																									
					Engr.	MF																									
					App.	CBM																									
<p>Project No: 555-002 Scale: 1"=5000'</p>		<p>Drawing No. E101 Rev. A</p>																													



LEGEND	
	RECONDUCTOR
	NEW LINE
	ELK RIDGE CITY BOUNDARY
	PAYSON CITY ANNEXATION
	SALEM CITY ANNEXATION
	SESD BOUNDARY
	SPANISH FORK CITY ANNEXATION
	WOODLAND HILLS CITY BOUNDARY



NOTE:
1. PAYSON CITY ANNEXATION BOUNDARY OVERLAPS SALEM AND ELK RIDGE BOUNDARIES



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No.	Description	By	Date	App.	Chk.	App.	Date	Scale
A	PRELIMINARY	RF	01/05/19	CBM	Dwn.	RF	Date 01/02/19	Engr. MF Date 01/02/19
REVISIONS								
Proj. No: 555-002 Scale NTS								

Title:		SESD-GENERAL PLAN	
		SESD PROPOSED PROJECTS AND CITY BOUNDARIES	
Drawing No.	Rev.	E102 A	

APPENDIX 2 – COST ESTIMATES

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Voltage Regulators at Kilgore - Map ID 1					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
Regulators	3	EA	10.0	30.00	\$3,000.00	\$21,000.00	\$63,000.00	\$66,000.00
Structure & Switches	1	EA	20.0	20.00	\$2,000.00	\$12,000.00	\$12,000.00	\$14,000.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				50.00	\$5,000.00			\$5,000.00
Subtotal Material							\$75,000.00	\$75,000.00
Sales and Use Tax (8%)								\$6,400.00
Equipment								\$750.00
TOTAL ESTIMATED CONSTRUCTION COST								\$87,150.00
Engineering	1	LS						\$5,000.00
CONTINGENCY	10	%						\$9,215.00
TOTAL COST ESTIMATE								\$101,365

Notes & Comments:

1 - The above estimate is based on preliminary information.

2 - No engineering has been conducted.

3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Relocate Voltage Regulators - Map ID 2					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
Demo Regulators	1	LS	20.0	20.00	\$2,000.00	\$0.00	\$0.00	\$2,000.00
Relocate Regulators	1	LS	30.0	30.00	\$3,000.00	\$0.00	\$0.00	\$3,000.00
Structure & Switches	1	EA	20.0	20.00	\$2,000.00	\$12,000.00	\$12,000.00	\$14,000.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				70.00	\$7,000.00			\$7,000.00
Subtotal Material							\$12,000.00	\$12,000.00
Sales and Use Tax (8%)								\$1,520.00
Equipment								\$750.00
TOTAL ESTIMATED CONSTRUCTION COST								\$21,270.00
Engineering	1	LS						\$5,000.00
CONTINGENCY	10	%						\$2,627.00
TOTAL COST ESTIMATE								\$28,897

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Upgrade Lakeshore South - Map ID 4					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	19,800	Ft.	0.045	891.00	\$89,100.00	\$3.80	\$75,240.00	\$164,340.00
Hardware	80	EA	3.0	240.00	\$24,000.00	\$175.00	\$14,000.00	\$38,000.00
Spread Out Exist Dist Cond	80	EA	6.0	480.00	\$48,000.00	\$0.00	\$0.00	\$48,000.00
Remove Exist Dist Cond	19,800	Ft.	0.010	198.00	\$19,800.00	\$0.00	\$0.00	\$19,800.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				1,809.00	\$180,900.00			\$180,900.00
Subtotal Material							\$89,240.00	\$89,240.00
Sales and Use Tax (8%)								\$21,611.20
Equipment								\$34,650.00
TOTAL ESTIMATED CONSTRUCTION COST								\$326,401.20
Engineering		1 LS						\$26,112.10
CONTINGENCY		10 %						\$35,251.33
TOTAL COST ESTIMATE								\$387,765

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Upgrade West Mountain - Map ID 5					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	12,250	Ft.	0.045	551.25	\$55,125.00	\$3.80	\$46,550.00	\$101,675.00
Hardware	50	EA	3.0	150.00	\$15,000.00	\$175.00	\$8,750.00	\$23,750.00
Spread Out Exist Dist Cond	50	EA	6.0	300.00	\$30,000.00	\$0.00	\$0.00	\$30,000.00
Remove Exist Dist Cond	12,250	Ft.	0.010	122.50	\$12,250.00	\$0.00	\$0.00	\$12,250.00
12.47 Switch	1	EA	40.0	40.00	\$4,000.00	\$7,500.00	\$7,500.00	\$11,500.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				1,163.75	\$116,375.00			\$116,375.00
Subtotal Material							\$62,800.00	\$62,800.00
Sales and Use Tax (8%)								\$14,334.00
Equipment								\$21,437.50
TOTAL ESTIMATED CONSTRUCTION COST								\$214,946.50
Engineering	1	LS						\$17,195.72
CONTINGENCY	10	%						\$23,214.22
TOTAL COST ESTIMATE								\$255,356

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE						DATE PREPARED: 2/28/2019		
PROJECT: Sub 6 - Map ID 6						BASIS FOR ESTIMATE		
DESCRIPTION:						CODE A (Schematic Design)		
ENGINEER : ICPE						CODE B (Preliminary Design)		
ESTIMATOR: Mac Fillingim						CODE C (Final Design) 100%		
CHECKED: Craig Michaelis						OTHER--Conceptual Configuration		
DESCRIPTION	QUANTITY		LABOR			MATERIAL (\$)		TOTAL ESTIMATE
	NO. UNITS	UNIT MEAS	Avg. Labor Rate: \$100.00			PER UNIT	TOTAL MATERIAL	
			PER UNIT	TOTAL Man Hr.	TOTAL LABOR (\$)			
Major Equipment								
46 kV - 12.47kV Transformer 12/16/20 MVA w/LTC	1	EA	80	80.00	\$8,000.00	\$500,000.00	\$500,000.00	\$508,000.00
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	4	EA	60	240.00	\$24,000.00	\$12,000.00	\$48,000.00	\$72,000.00
46 kV Disconnect Switch	6	EA	12	72.00	\$7,200.00	\$2,500.00	\$15,000.00	\$22,200.00
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	\$758,300.00
Metering / Relaying / SCADA								
46 kV Metering (PTs & CTs)	1	LS	60	60.00	\$6,000.00	\$68,000.00	\$68,000.00	\$74,000.00
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)	2	LS	100	200.00	\$20,000.00	\$30,000.00	\$60,000.00	\$80,000.00
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	\$75,000.00	\$75,000.00	\$95,000.00
							Total	\$316,000.00
Steel Structures								
46 kV Deadend Structure	1	EA	40.00	40.00	\$4,000.00	\$49,700.00	\$49,700.00	\$53,700.00
46 kV Switch Structure	1	EA	16.00	16.00	\$1,600.00	\$12,375.00	\$12,375.00	\$13,975.00
46 kV Metering Structure	1	EA	80.00	80.00	\$8,000.00	\$58,250.00	\$58,250.00	\$66,250.00
15 kV Switch Structure	1	EA	16.00	16.00	\$1,600.00	\$4,193.75	\$4,193.75	\$5,793.75
15 kV Recloser Structure	3	EA	16.00	48.00	\$4,800.00	\$4,950.00	\$14,850.00	\$19,650.00
Static Wire Pole	1	EA	8.00	8.00	\$800.00	\$7,975.00	\$7,975.00	\$8,775.00
Switch Platform	4	EA	4.00	16.00	\$1,600.00	\$1,100.00	\$4,400.00	\$6,000.00
							Total	\$174,143.75
Concrete Foundations								
46 kV Deadend Structure	2	EA	16	32.00	\$3,200.00	\$6,270.00	\$12,540.00	\$15,740.00
15 kV Switch Structure	2	EA	8	16.00	\$1,600.00	\$2,640.00	\$5,280.00	\$6,880.00
15 kV Recloser Structure	3	EA	8	24.00	\$2,400.00	\$2,860.00	\$8,580.00	\$10,980.00
Static Wire Pole	1	EA	4	4.00	\$400.00	\$4,730.00	\$4,730.00	\$5,130.00
Transformer Containment	1	EA	80	80.00	\$8,000.00	\$99,400.00	\$99,400.00	\$107,400.00
46 kV Breaker Pad	1	EA	8	8.00	\$800.00	\$4,200.00	\$4,200.00	\$5,000.00
Control Building	1	EA	24	24.00	\$2,400.00	\$14,000.00	\$14,000.00	\$16,400.00
							Total	\$167,530.00
Control Building								
Prefabricated Control Building - 14' x 20'	1	EA	80	80.00	\$8,000.00	\$98,200.00	\$98,200.00	\$106,200.00
Control Building Equipment	1	LS	16	16.00	\$1,600.00	\$12,500.00	\$12,500.00	\$14,100.00
125 VDC Battery System	1	EA	32	32.00	\$3,200.00	\$28,000.00	\$28,000.00	\$31,200.00
Control Building AC Systems	1	LS	80	80.00	\$8,000.00	\$11,750.00	\$11,750.00	\$19,750.00
							Total	\$171,250.00
Substation Bus & Material								
46 kV Bus & Fittings	1	LS	80	80.00	\$8,000.00	\$25,000.00	\$25,000.00	\$33,000.00
15 kV Bus & Fittings	1	LS	240	240.00	\$24,000.00	\$50,000.00	\$50,000.00	\$74,000.00
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	\$167,900.00
Substation Conduit & Cable								
600 Volt Conduit & Cable	1	LS	240	240.00	\$24,000.00	\$62,500.00	\$62,500.00	\$86,500.00
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	\$17,500.00	\$17,500.00	\$23,500.00
							Total	\$143,750.00
Substation Grounding								
Station Ground Grid	1	LS	320	320.00	\$32,000.00	\$65,000.00	\$65,000.00	\$97,000.00
							Total	\$97,000.00
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	\$30,000.00	\$30,000.00	\$38,000.00
Substation Land	0	LS	0	0.00	\$0.00	\$0.00	\$0.00	\$0.00
							Total	\$110,000.00
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	\$55,000.00	\$55,000.00	\$55,000.00
							Total	\$72,000.00
Subtotals				3,314.0	\$331,400.00		\$1,846,473.75	
Subtotal Labor + Material								\$2,177,873.75
Equipment								\$46,396.00
Contingency (10%)								\$222,426.98
Engineering								\$125,000.00
Tax (8%)								\$174,229.90
TOTAL ESTIMATE								\$2,745,926.63

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 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Estimate assumes the substation land is owned by the City and initial site grading has been completed.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Tie Line - Leland to Palmyra - Map ID 7					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
12.47 kV PTAs	41	LS	7.000	287.00	\$28,700.00	\$410.00	\$16,810.00	\$45,510.00
4 - 477 ACSR Dist Conductors	10,080	Ft.	0.045	453.60	\$45,360.00	\$3.80	\$38,304.00	\$83,664.00
Wood Poles	41	EA	8.0	328.00	\$32,800.00	\$925.00	\$37,925.00	\$70,725.00
Pole Guys and Anchors	20	LS	7.0	140.00	\$14,000.00	\$300.00	\$6,000.00	\$20,000.00
12.47 Switch	1	EA	40.0	40.00	\$4,000.00	\$7,500.00	\$7,500.00	\$11,500.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				1,248.60	\$124,860.00			\$124,860.00
Subtotal Material							\$106,539.00	\$106,539.00
Sales and Use Tax (8%)								\$18,511.92
Equipment								\$20,160.00
TOTAL ESTIMATED CONSTRUCTION COST								\$270,070.92
Engineering	1	LS						\$21,605.67
CONTINGENCY	10	%						\$29,167.66
TOTAL COST ESTIMATE								\$320,844

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.

COST ESTIMATE						DATE PREPARED: 2/28/2019		
PROJECT: Upgrade Arrowhead - Map ID 8						BASIS OF ESTIMATE:		
DESCRIPTION: Cost Estimate Summary						CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%		
ENGINEER: Mac Fillingim						OTHER - Conceptual Configuration		
			ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis		
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	43,750	Ft.	0.045	1,968.75	\$196,875.00	\$3.80	\$166,250.00	\$363,125.00
Hardware	175	EA	3.0	525.00	\$52,500.00	\$175.00	\$30,625.00	\$83,125.00
Spread Out Exist Dist Cond	175	EA	6.0	1,050.00	\$105,000.00	\$0.00	\$0.00	\$105,000.00
Remove Exist Dist Cond	43,750	Ft.	0.010	437.50	\$43,750.00	\$0.00	\$0.00	\$43,750.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				3,981.25	\$398,125.00			\$398,125.00
Subtotal Material							\$196,875.00	\$196,875.00
Sales and Use Tax (8%)								\$47,600.00
Equipment								\$76,562.50
TOTAL ESTIMATED CONSTRUCTION COST								\$719,162.50
Engineering		1 LS						\$57,533.00
CONTINGENCY		10 %						\$77,669.55
TOTAL COST ESTIMATE								\$854,365

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Tie Line - Cloward to Covered Bridge - Map ID 9					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
12.47 kV PTAs	4	LS	7.000	28.00	\$2,800.00	\$410.00	\$1,640.00	\$4,440.00
4 - 477 ACSR Dist Conductors	1,000	Ft.	0.045	45.00	\$4,500.00	\$3.80	\$3,800.00	\$8,300.00
Wood Poles	4	EA	8.0	32.00	\$3,200.00	\$925.00	\$3,700.00	\$6,900.00
Pole Guys and Anchors	2	LS	7.0	14.00	\$1,400.00	\$300.00	\$600.00	\$2,000.00
12.47 Switch	1	EA	40.0	40.00	\$4,000.00	\$7,500.00	\$7,500.00	\$11,500.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				159.00	\$15,900.00			\$15,900.00
Subtotal Material							\$17,240.00	\$17,240.00
Sales and Use Tax (8%)								\$2,651.20
Equipment								\$2,000.00
TOTAL ESTIMATED CONSTRUCTION COST								\$37,791.20
Engineering	1	LS						\$3,023.30
CONTINGENCY	10	%						\$4,081.45
TOTAL COST ESTIMATE								\$44,896

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Voltage Regulators on Covered Bridge - Map ID 10					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
Regulators	3	EA	10.0	30.00	\$3,000.00	\$21,000.00	\$63,000.00	\$66,000.00
Structure & Switches	1	EA	20.0	20.00	\$2,000.00	\$12,000.00	\$12,000.00	\$14,000.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				50.00	\$5,000.00			\$5,000.00
Subtotal Material							\$75,000.00	\$75,000.00
Sales and Use Tax (8%)								\$6,400.00
Equipment								\$750.00
TOTAL ESTIMATED CONSTRUCTION COST								\$87,150.00
Engineering	1	LS						\$5,000.00
CONTINGENCY	10	%						\$9,215.00
TOTAL COST ESTIMATE								\$101,365

Notes & Comments:

1 - The above estimate is based on preliminary information.

2 - No engineering has been conducted.

3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Arrowhead R2 Circuit - Map ID 11					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
12.47 kV PTAs	17	LS	7.000	119.00	\$11,900.00	\$410.00	\$6,970.00	\$18,870.00
4 - 477 ACSR Dist Conductors	4,180	Ft.	0.045	188.10	\$18,810.00	\$3.80	\$15,884.00	\$34,694.00
Wood Poles	17	EA	8.0	136.00	\$13,600.00	\$925.00	\$15,725.00	\$29,325.00
Pole Guys and Anchors	8	LS	7.0	56.00	\$5,600.00	\$300.00	\$2,400.00	\$8,000.00
12.47 Switch	1	EA	40.0	40.00	\$4,000.00	\$7,500.00	\$7,500.00	\$11,500.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				539.10	\$53,910.00			\$53,910.00
Subtotal Material							\$48,479.00	\$48,479.00
Sales and Use Tax (8%)								\$8,191.12
Equipment								\$8,360.00
TOTAL ESTIMATED CONSTRUCTION COST								\$118,940.12
Engineering	1	LS						\$9,515.21
CONTINGENCY	10	%						\$12,845.53
TOTAL COST ESTIMATE								\$141,301

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Voltage Regulators on UB West - Map ID 12					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
Regulators	3	EA	10.0	30.00	\$3,000.00	\$21,000.00	\$63,000.00	\$66,000.00
Structure & Switches	1	EA	20.0	20.00	\$2,000.00	\$12,000.00	\$12,000.00	\$14,000.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				50.00	\$5,000.00			\$5,000.00
Subtotal Material							\$75,000.00	\$75,000.00
Sales and Use Tax (8%)								\$6,400.00
Equipment								\$750.00
TOTAL ESTIMATED CONSTRUCTION COST								\$87,150.00
Engineering	1	LS						\$5,000.00
CONTINGENCY	10	%						\$9,215.00
TOTAL COST ESTIMATE								\$101,365

Notes & Comments:

1 - The above estimate is based on preliminary information.

2 - No engineering has been conducted.

3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Upgrade Spring Lake & UB West - Map ID 13					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	38,860	Ft.	0.045	1,748.70	\$174,870.00	\$3.80	\$147,668.00	\$322,538.00
Hardware	156	EA	3.0	468.00	\$46,800.00	\$175.00	\$27,300.00	\$74,100.00
Spread Out Exist Dist Cond	156	EA	6.0	936.00	\$93,600.00	\$0.00	\$0.00	\$93,600.00
Remove Exist Dist Cond	38,860	Ft.	0.010	388.60	\$38,860.00	\$0.00	\$0.00	\$38,860.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				3,541.30	\$354,130.00			\$354,130.00
Subtotal Material							\$174,968.00	\$174,968.00
Sales and Use Tax (8%)								\$42,327.84
Equipment								\$68,005.00
TOTAL ESTIMATED CONSTRUCTION COST								\$639,430.84
Engineering		1 LS						\$51,154.47
CONTINGENCY		10 %						\$69,058.53
TOTAL COST ESTIMATE								\$759,644

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Tie Line - UB East to Woodland Hills - Map ID 14					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
12.47 kV PTAs	26	LS	7.000	182.00	\$18,200.00	\$410.00	\$10,660.00	\$28,860.00
4 - 477 ACSR Dist Conductors	6,380	Ft.	0.045	287.10	\$28,710.00	\$3.80	\$24,244.00	\$52,954.00
Wood Poles	26	EA	8.0	208.00	\$20,800.00	\$925.00	\$24,050.00	\$44,850.00
Pole Guys and Anchors	13	LS	7.0	91.00	\$9,100.00	\$300.00	\$3,900.00	\$13,000.00
12.47 Switch	1	EA	40.0	40.00	\$4,000.00	\$7,500.00	\$7,500.00	\$11,500.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				808.10	\$80,810.00			\$80,810.00
Subtotal Material							\$70,354.00	\$70,354.00
Sales and Use Tax (8%)								\$12,093.12
Equipment								\$12,760.00
TOTAL ESTIMATED CONSTRUCTION COST								\$176,017.12
Engineering	1	LS						\$14,081.37
CONTINGENCY	10	%						\$19,009.85
TOTAL COST ESTIMATE								\$209,108

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Voltage Regulators on Woodland Hills - Map ID 16					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design) CODE B - (Preliminary Design) CODE C - (Final Design) 100%			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
Regulators	3	EA	10.0	30.00	\$3,000.00	\$21,000.00	\$63,000.00	\$66,000.00
Structure & Switches	1	EA	20.0	20.00	\$2,000.00	\$12,000.00	\$12,000.00	\$14,000.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				50.00	\$5,000.00			\$5,000.00
Subtotal Material							\$75,000.00	\$75,000.00
Sales and Use Tax (8%)								\$6,400.00
Equipment								\$750.00
TOTAL ESTIMATED CONSTRUCTION COST								\$87,150.00
Engineering	1	LS						\$5,000.00
CONTINGENCY	10	%						\$9,215.00
TOTAL COST ESTIMATE								\$101,365

Notes & Comments:

1 - The above estimate is based on preliminary information.

2 - No engineering has been conducted.

3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Upgrade UB East - Map ID 17					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
			ESTIMATOR: Mac Fillingim		CHECKED: Craig Michaelis			
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	13,190	Ft.	0.045	593.55	\$59,355.00	\$3.80	\$50,122.00	\$109,477.00
Hardware	53	EA	3.0	159.00	\$15,900.00	\$175.00	\$9,275.00	\$25,175.00
Spread Out Exist Dist Cond	53	EA	6.0	318.00	\$31,800.00	\$0.00	\$0.00	\$31,800.00
Remove Exist Dist Cond	13,190	Ft.	0.010	131.90	\$13,190.00	\$0.00	\$0.00	\$13,190.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				1,202.45	\$120,245.00			\$120,245.00
Subtotal Material							\$59,397.00	\$59,397.00
Sales and Use Tax (8%)								\$14,371.36
Equipment								\$23,082.50
TOTAL ESTIMATED CONSTRUCTION COST								\$217,095.86
Engineering		1 LS						\$17,367.67
CONTINGENCY		10 %						\$23,446.35
TOTAL COST ESTIMATE								\$257,910

Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE					DATE PREPARED: 2/28/2019			
PROJECT: Upgrade Cloward - Map ID 18					BASIS OF ESTIMATE:			
DESCRIPTION: Cost Estimate Summary					CODE A - (Schematic Design)			
					CODE B - (Preliminary Design)			
ENGINEER: Mac Fillingim					OTHER - Conceptual Configuration			
ESTIMATOR: Mac Fillingim			CHECKED: Craig Michaelis					
DESCRIPTION	QUANTITY		LABOR			MATERIAL \$		TOTAL COST (\$)
	QTY	UNIT	UNIT MH ⁽⁵⁾	TOTAL MH	TOTAL LABOR \$	PER UNIT	TOTAL MATERIAL	
4 - 477 ACSR Dist Conductors	13,430	Ft.	0.045	604.35	\$60,435.00	\$3.80	\$51,034.00	\$111,469.00
Hardware	55	EA	3.0	165.00	\$16,500.00	\$175.00	\$9,625.00	\$26,125.00
Spread Out Exist Dist Cond	55	EA	6.0	330.00	\$33,000.00	\$0.00	\$0.00	\$33,000.00
Remove Exist Dist Cond	13,430	Ft.	0.010	134.30	\$13,430.00	\$0.00	\$0.00	\$13,430.00
Labor Rate			\$100					
Subtotal Labor Hours/\$				1,233.65	\$123,365.00			\$123,365.00
Subtotal Material							\$60,659.00	\$60,659.00
Sales and Use Tax (8%)								\$14,721.92
Equipment								\$23,502.50
TOTAL ESTIMATED CONSTRUCTION COST								\$222,248.42
Engineering	1	LS						\$17,779.87
CONTINGENCY	10	%						\$24,002.83
TOTAL COST ESTIMATE								\$264,031

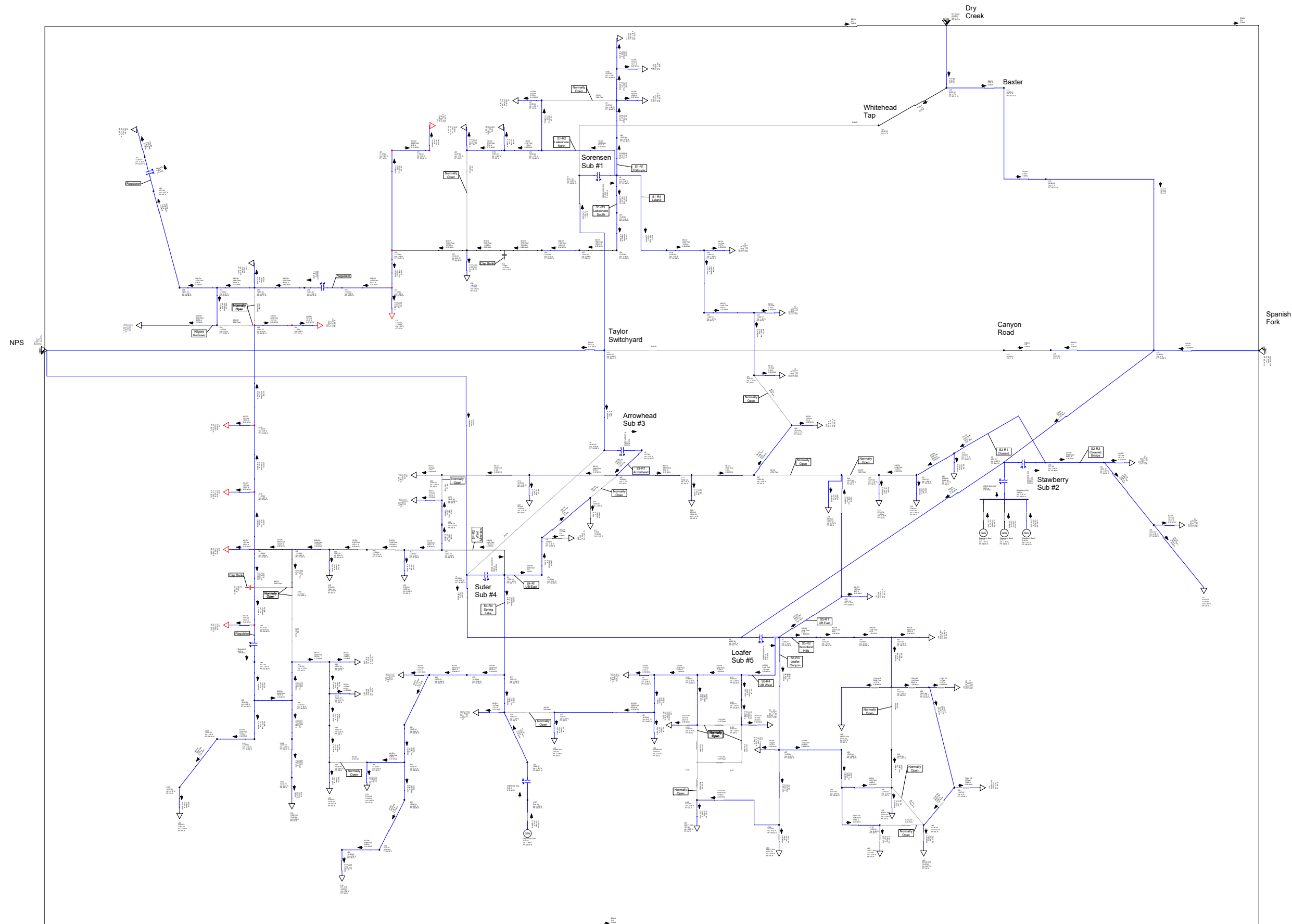
Notes & Comments:

- 1 - The above estimate is based on preliminary information.
- 2 - No engineering has been conducted.
- 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
- 4 - Right of way costs are not included in cost estimate.
- 5 - Cost estimate assumes that existing wood poles and cross arms are adequate for new conductor and can be reused.

COST ESTIMATE						DATE PREPARED: 2/28/2019		
PROJECT: Sub 7 - Map ID 20						BASIS FOR ESTIMATE		
DESCRIPTION:						CODE A (Schematic Design)		
ENGINEER : ICPE						CODE B (Preliminary Design)		
ESTIMATOR: Mac Fillingim						CODE C (Final Design) 100%		
CHECKED: Craig Michaelis						OTHER--Conceptual Configuration		
DESCRIPTION	QUANTITY		LABOR			MATERIAL (\$)		TOTAL ESTIMATE
	NO. UNITS	UNIT MEAS	Avg. Labor Rate: \$100.00			PER UNIT	TOTAL MATERIAL	
			PER UNIT	TOTAL Man Hr.	TOTAL LABOR (\$)			
Major Equipment								
46 kV - 12.47kV Transformer 12/16/20 MVA w/LTC	1	EA	80	80.00	\$8,000.00	\$500,000.00	\$500,000.00	\$508,000.00
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	4	EA	60	240.00	\$24,000.00	\$12,000.00	\$48,000.00	\$72,000.00
46 kV Disconnect Switch	6	EA	12	72.00	\$7,200.00	\$2,500.00	\$15,000.00	\$22,200.00
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	\$758,300.00
Metering / Relaying / SCADA								
46 kV Metering (PTs & CTs)	1	LS	60	60.00	\$6,000.00	\$68,000.00	\$68,000.00	\$74,000.00
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)	2	LS	100	200.00	\$20,000.00	\$30,000.00	\$60,000.00	\$80,000.00
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	\$75,000.00	\$75,000.00	\$95,000.00
							Total	\$316,000.00
Steel Structures								
46 kV Deadend Structure	1	EA	40.00	40.00	\$4,000.00	\$49,700.00	\$49,700.00	\$53,700.00
46 kV Switch Structure	1	EA	16.00	16.00	\$1,600.00	\$12,375.00	\$12,375.00	\$13,975.00
46 kV Metering Structure	1	EA	80.00	80.00	\$8,000.00	\$58,250.00	\$58,250.00	\$66,250.00
15 kV Switch Structure	1	EA	16.00	16.00	\$1,600.00	\$4,193.75	\$4,193.75	\$5,793.75
15 kV Recloser Structure	3	EA	16.00	48.00	\$4,800.00	\$4,950.00	\$14,850.00	\$19,650.00
Static Wire Pole	1	EA	8.00	8.00	\$800.00	\$7,975.00	\$7,975.00	\$8,775.00
Switch Platform	4	EA	4.00	16.00	\$1,600.00	\$1,100.00	\$4,400.00	\$6,000.00
							Total	\$174,143.75
Concrete Foundations								
46 kV Deadend Structure	2	EA	16	32.00	\$3,200.00	\$6,270.00	\$12,540.00	\$15,740.00
15 kV Switch Structure	2	EA	8	16.00	\$1,600.00	\$2,640.00	\$5,280.00	\$6,880.00
15 kV Recloser Structure	3	EA	8	24.00	\$2,400.00	\$2,860.00	\$8,580.00	\$10,980.00
Static Wire Pole	1	EA	4	4.00	\$400.00	\$4,730.00	\$4,730.00	\$5,130.00
Transformer Containment	1	EA	80	80.00	\$8,000.00	\$99,400.00	\$99,400.00	\$107,400.00
46 kV Breaker Pad	1	EA	8	8.00	\$800.00	\$4,200.00	\$4,200.00	\$5,000.00
Control Building	1	EA	24	24.00	\$2,400.00	\$14,000.00	\$14,000.00	\$16,400.00
							Total	\$167,530.00
Control Building								
Prefabricated Control Building - 14' x 20'	1	EA	80	80.00	\$8,000.00	\$98,200.00	\$98,200.00	\$106,200.00
Control Building Equipment	1	LS	16	16.00	\$1,600.00	\$12,500.00	\$12,500.00	\$14,100.00
125 VDC Battery System	1	EA	32	32.00	\$3,200.00	\$28,000.00	\$28,000.00	\$31,200.00
Control Building AC Systems	1	LS	80	80.00	\$8,000.00	\$11,750.00	\$11,750.00	\$19,750.00
							Total	\$171,250.00
Substation Bus & Material								
46 kV Bus & Fittings	1	LS	80	80.00	\$8,000.00	\$25,000.00	\$25,000.00	\$33,000.00
15 kV Bus & Fittings	1	LS	240	240.00	\$24,000.00	\$50,000.00	\$50,000.00	\$74,000.00
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	\$167,900.00
Substation Conduit & Cable								
600 Volt Conduit & Cable	1	LS	240	240.00	\$24,000.00	\$62,500.00	\$62,500.00	\$86,500.00
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	\$17,500.00	\$17,500.00	\$23,500.00
							Total	\$143,750.00
Substation Grounding								
Station Ground Grid	1	LS	320	320.00	\$32,000.00	\$65,000.00	\$65,000.00	\$97,000.00
							Total	\$97,000.00
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	\$30,000.00	\$30,000.00	\$38,000.00
Substation Land	0	LS	0	0.00	\$0.00	\$0.00	\$0.00	\$0.00
							Total	\$110,000.00
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	\$55,000.00	\$55,000.00	\$55,000.00
							Total	\$72,000.00
Subtotals				3,314.0	\$331,400.00		\$1,846,473.75	
Subtotal Labor + Material								\$2,177,873.75
Equipment								\$46,396.00
Contingency (10%)								\$222,426.98
Engineering								\$125,000.00
Tax (8%)								\$174,229.90
TOTAL ESTIMATE								\$2,745,926.63

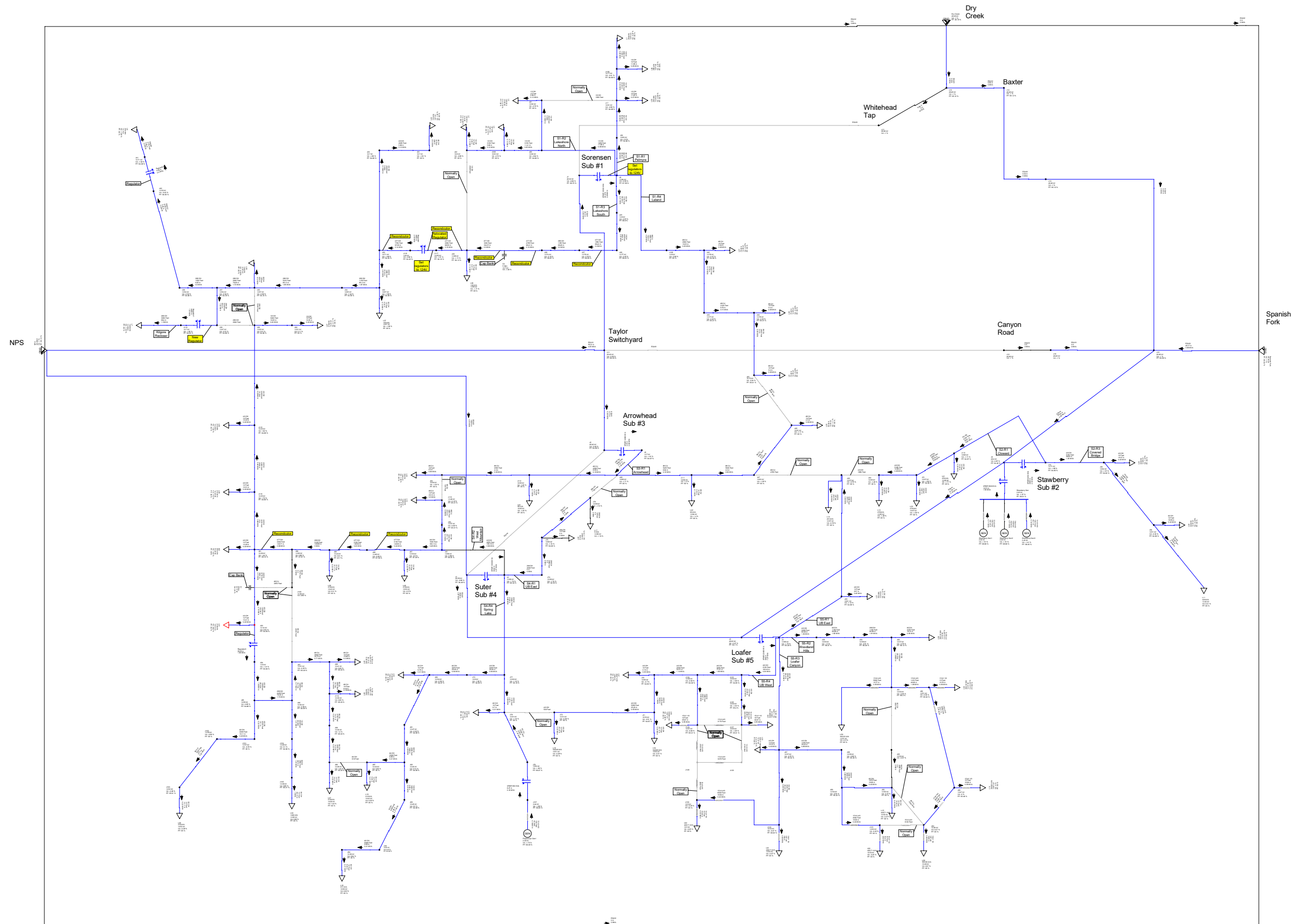
- Notes:
- 1 - Foundation estimate is based on the site having good soil conditions without water.
 - 2 - Incoming 46 kV Line & 15kV Distribution Circuits are not included.
 - 3 - Costs shown are as of 2/28/19. Market conditions are volatile and can have a significant impact on actual costs at the time on construction.
 - 4 - Estimate assumes the substation land is owned by the City and initial site grading has been completed.

APPENDIX 3 – LOAD FLOW STUDIES



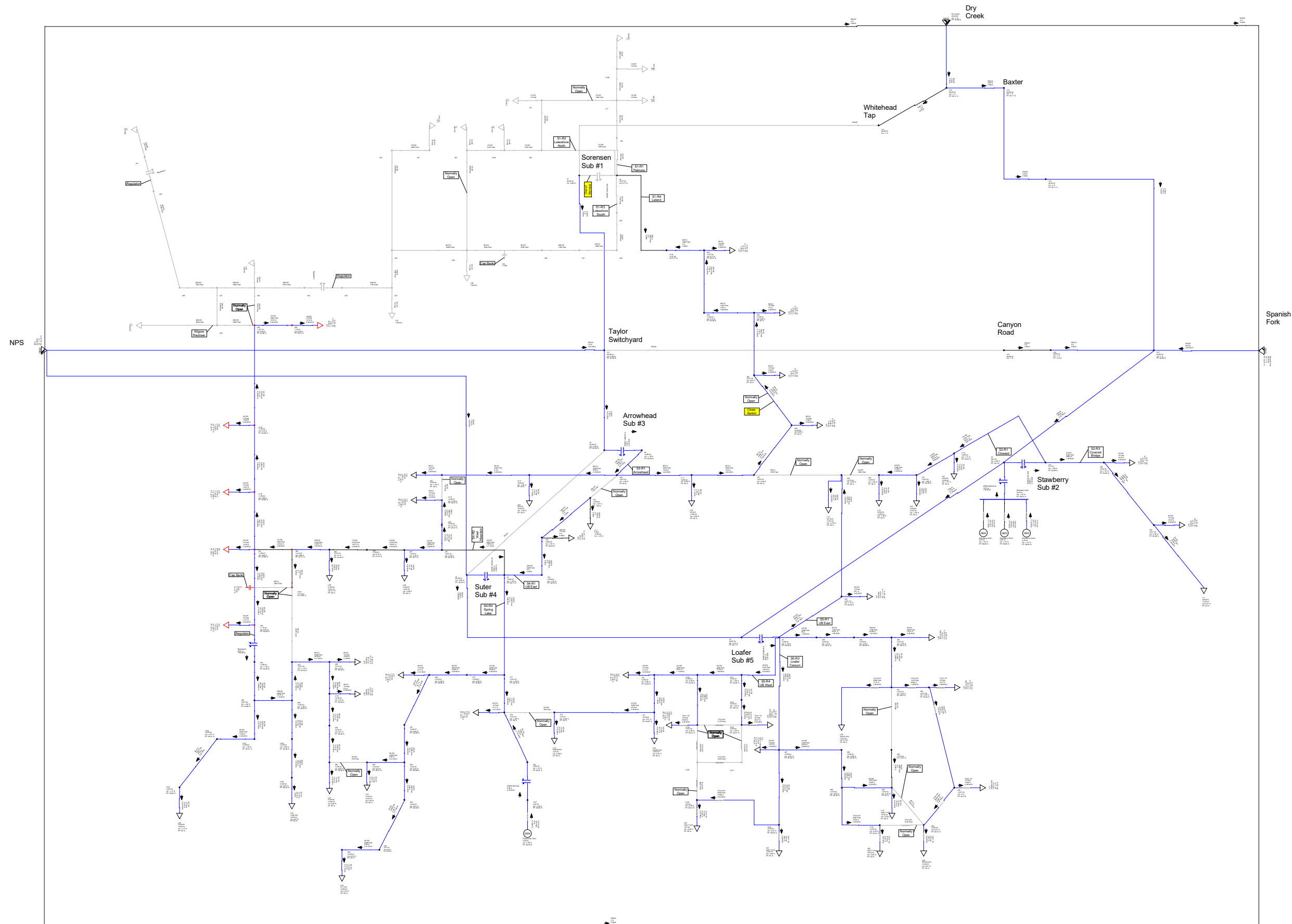
SESD - 2018
Base Case

1. Sorenson's Lakeshore South circuit has voltage issues during peak loading.
2. Suter's West Mountain circuit has voltage issues during peak loading.

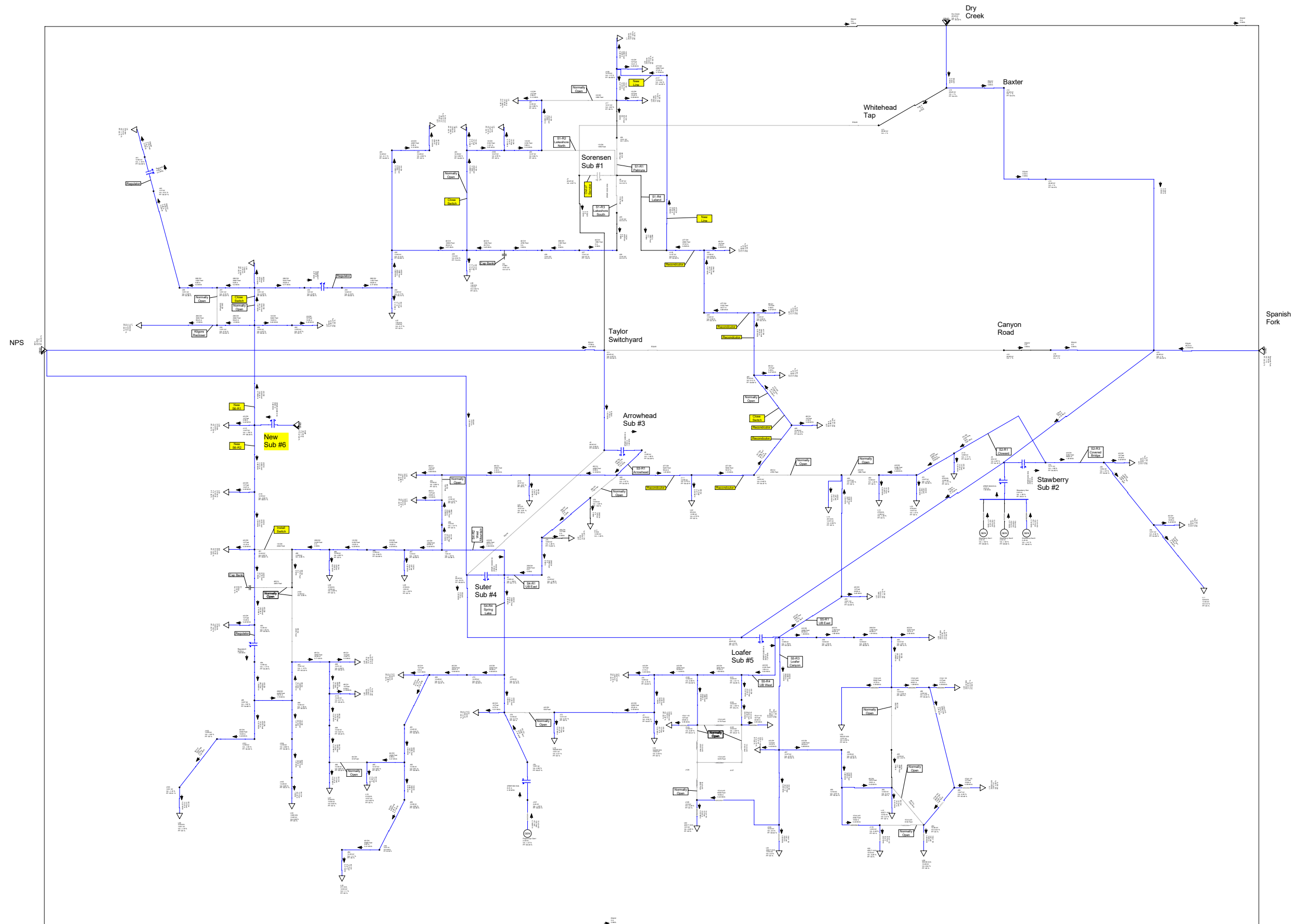


SESD - 2018
Base Case
After Upgrades

1. It is proposed to add line voltage regulators at Kilgore on Sorensen's Lakeshore South circuit. The regulators would need to be set at 124 V.
2. It is proposed to relocate line voltage regulators on Sorensen's Lakeshore South circuit to be closer to the substation. The regulators would need to be set at 124 V.
3. It is proposed to raise Sorensen's voltage regulators to 124 V.
4. It is proposed to upgrade Sorensen's Lakeshore South circuit.
5. It is proposed to upgrade Suter's West Mountain circuit.

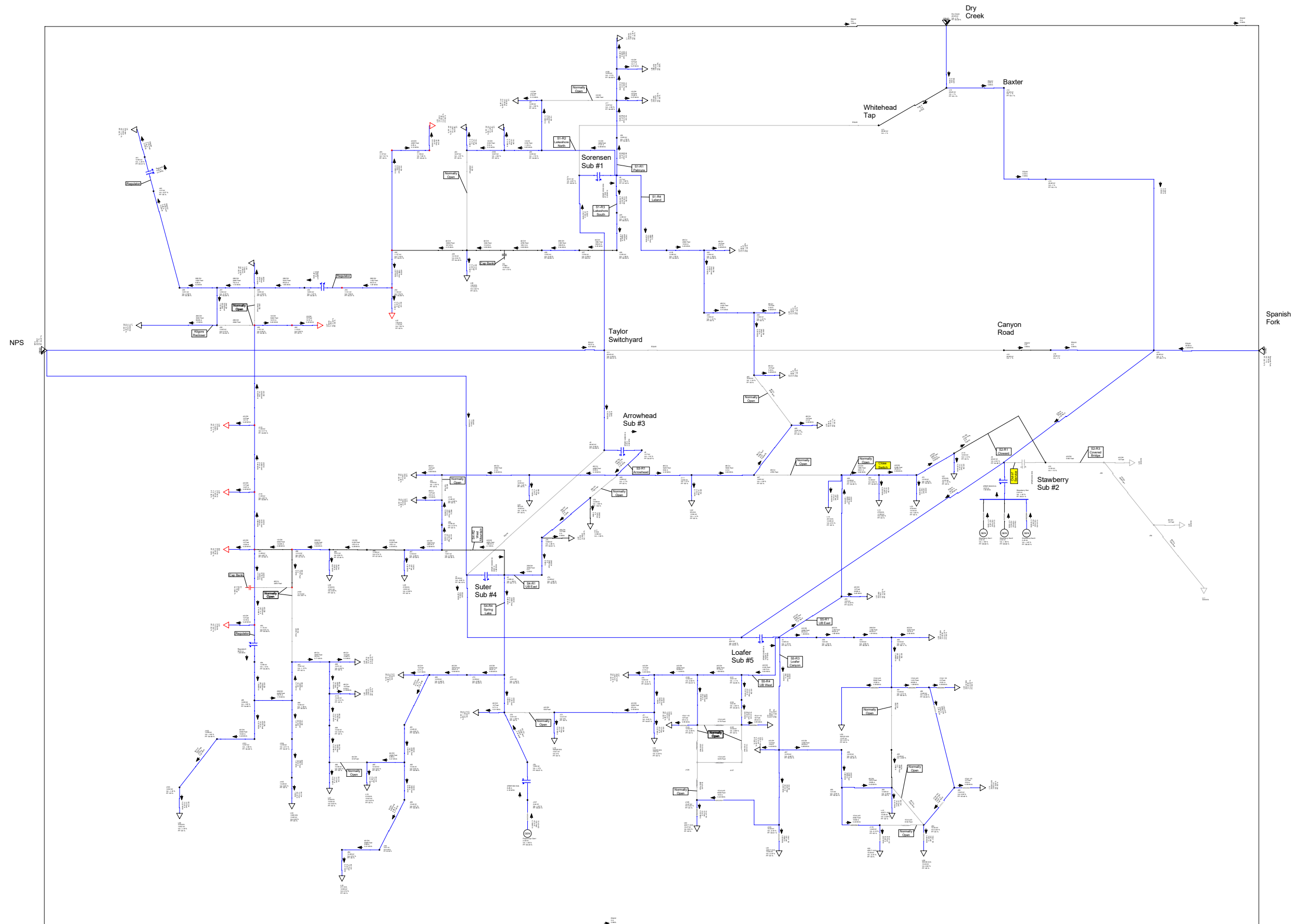


- SESD - 2018
 Sorenson Transformer Out of Service
1. Palmyra circuit cannot be backed up.
 2. Lakeshore North circuit cannot be backed up.
 3. Lakeshore South circuit cannot be backed up.
 4. Leland circuit can be backed up by Arrowhead's Arrowhead circuit.



SESD - 2018
 Sorenson Transformer Out of Service
 After Upgrades

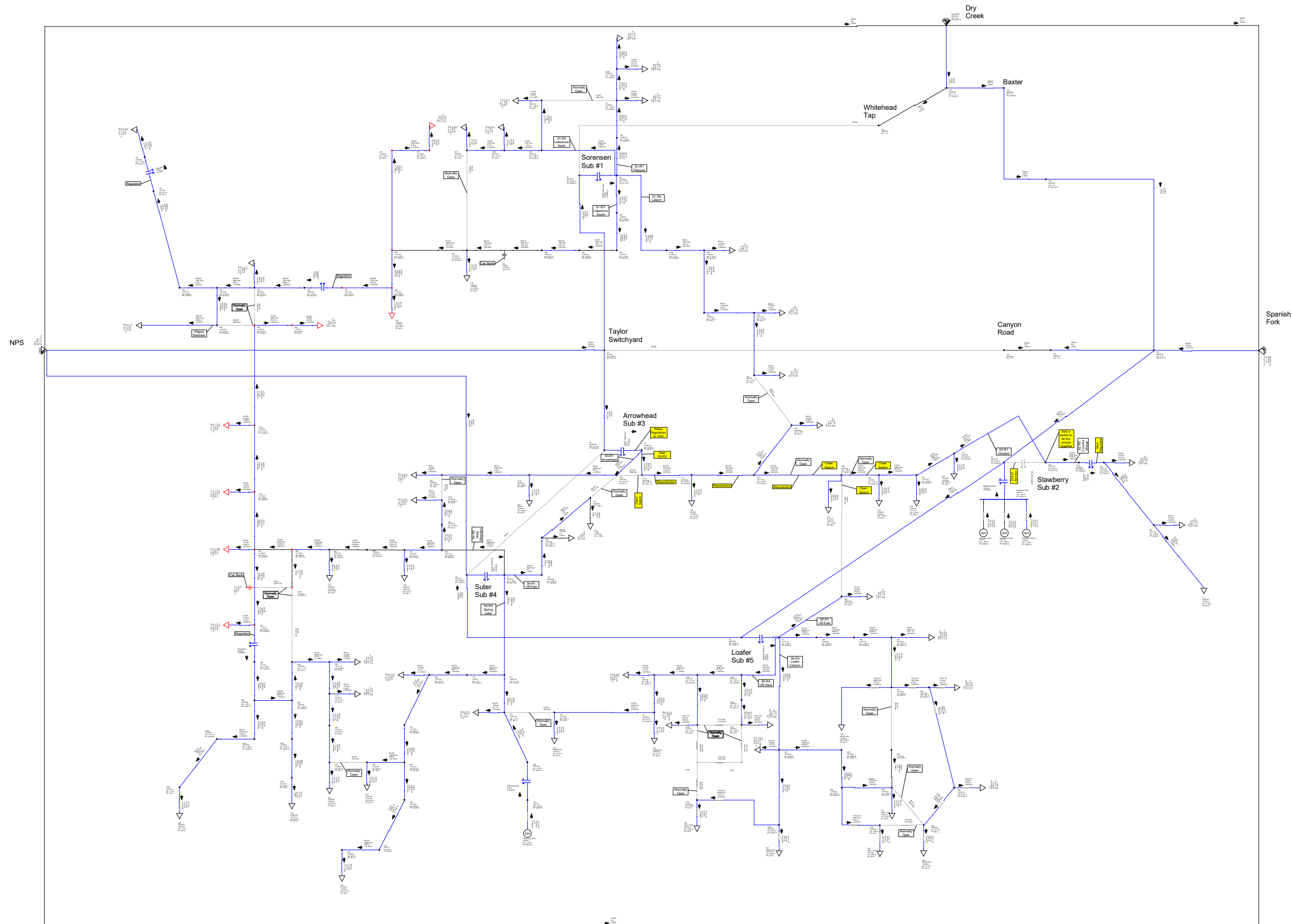
1. Build new Sub #6.
2. Add tie line between Sorenson's Leland circuit and Sorenson's Palmyra circuit.
3. Upgrade Arrowhead's Arrowhead circuit and Sorenson's Leland circuit from Arrowhead substation to the new tie line.
4. Lakeshore North and Lakeshore South circuits can be backed up by Sub #6's R1 circuit.
5. Leland and Palmyra circuits can be backed up by Arrowhead's Arrowhead circuit.



SESD - 2018
 Strawberry Transformer Out of Service

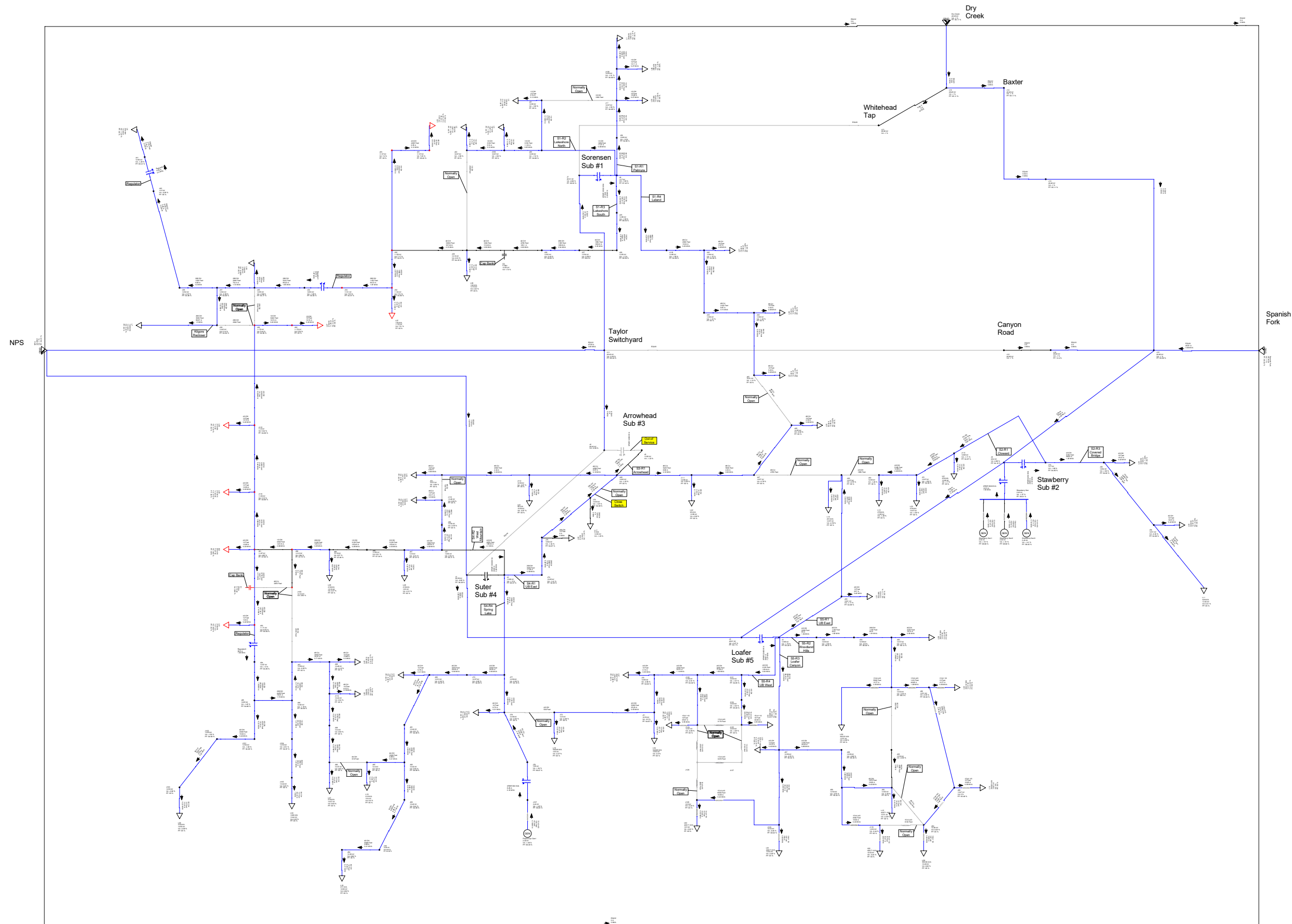
1. Cloward circuit can be backed up by
 Loafer's UB East circuit.

2. Covered Bridge circuit cannot be
 backed up.



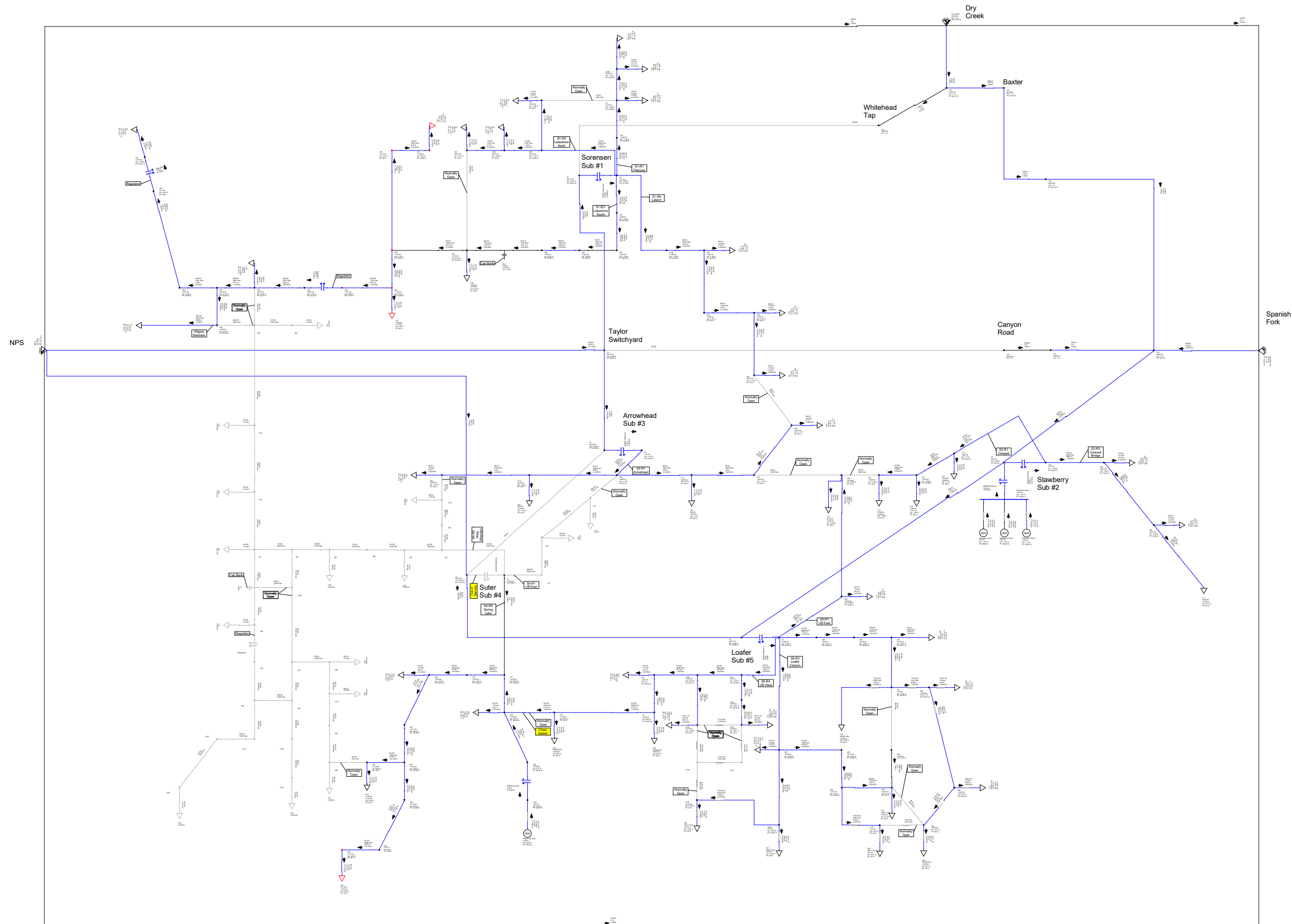
SESD - 2018
 Strawberry Transformer Out of Service
 After Upgrades

1. It is proposed to add a tie line and switch between Strawberry's Cloward circuit and Strawberry's Covered Bridge circuit.
2. It is proposed to add line voltage regulators to Strawberry's Covered Bridge circuit.
3. It is proposed to reconductor Arrowhead's Arrowhead circuit.
4. It is proposed to add a new R2 circuit coming out to the East of Arrowhead.
5. It is proposed to raise Arrowhead's voltage regulators to 124 V.
6. Cloward and Covered Bridge circuits can be backed up by Arrowhead's R2 circuit.



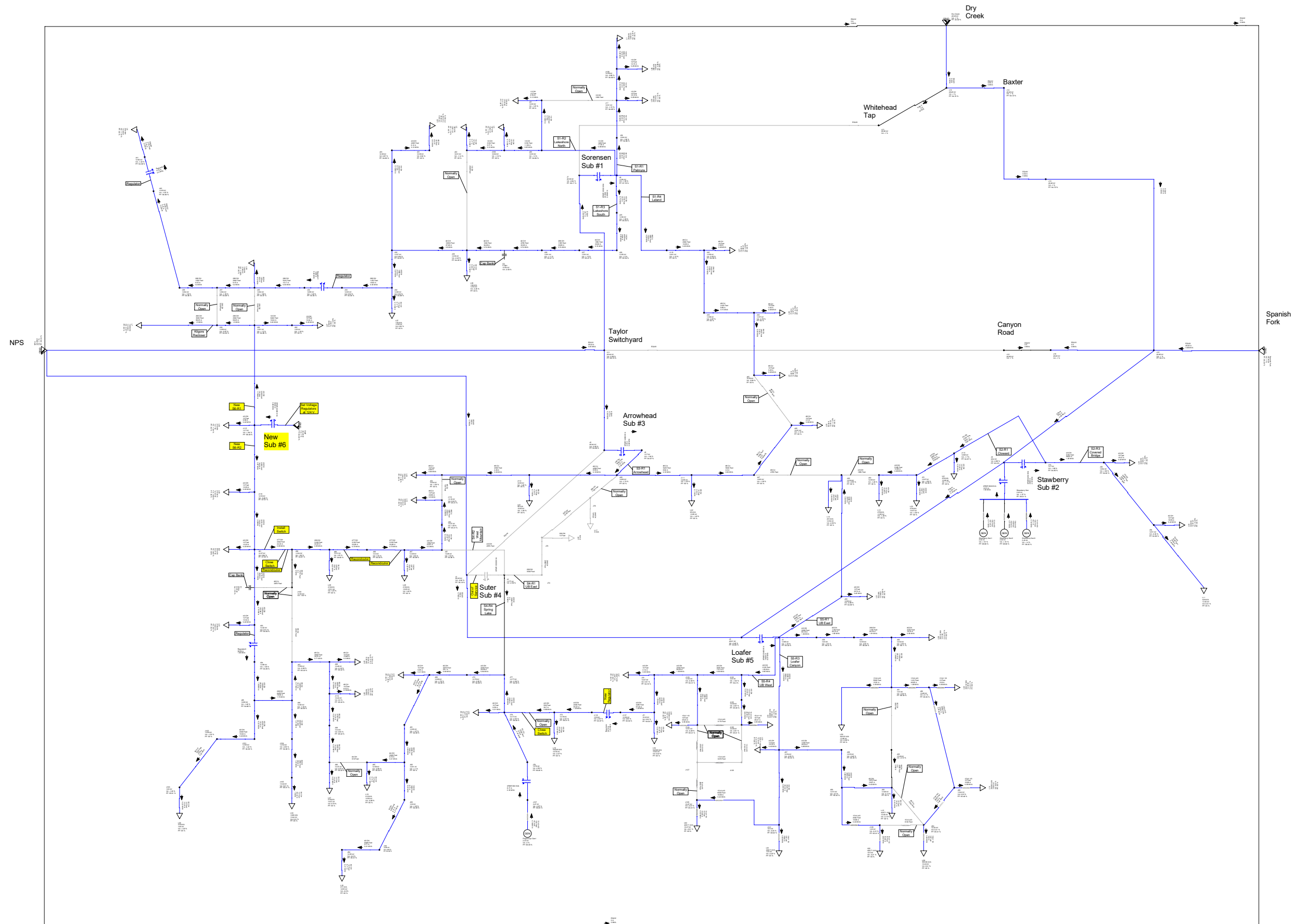
SESD - 2018
 Arrowhead Transformer Out of Service

1. Arrowhead circuit can be backed up by Suter's UB East circuit.



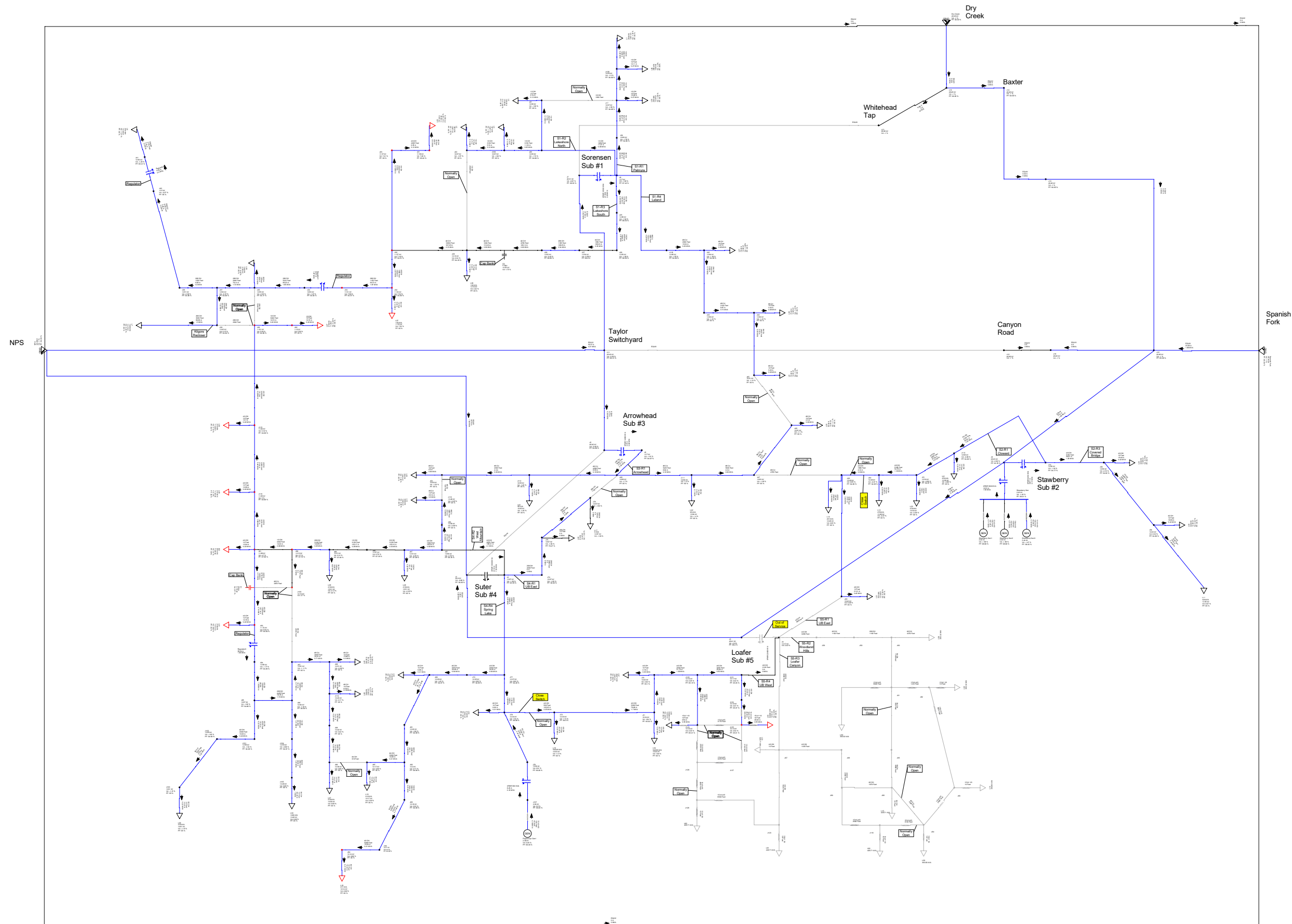
SESD - 2018
Suter Transformer Out of Service

1. UB East circuit currently does not have any load on it. It serves as a backup to Arrowhead's Arrowhead circuit.
2. West Mountain circuit cannot be backed up.
3. Spring Lake circuit can be backed up by Loافر's UB West circuit, but there would be voltage issues.



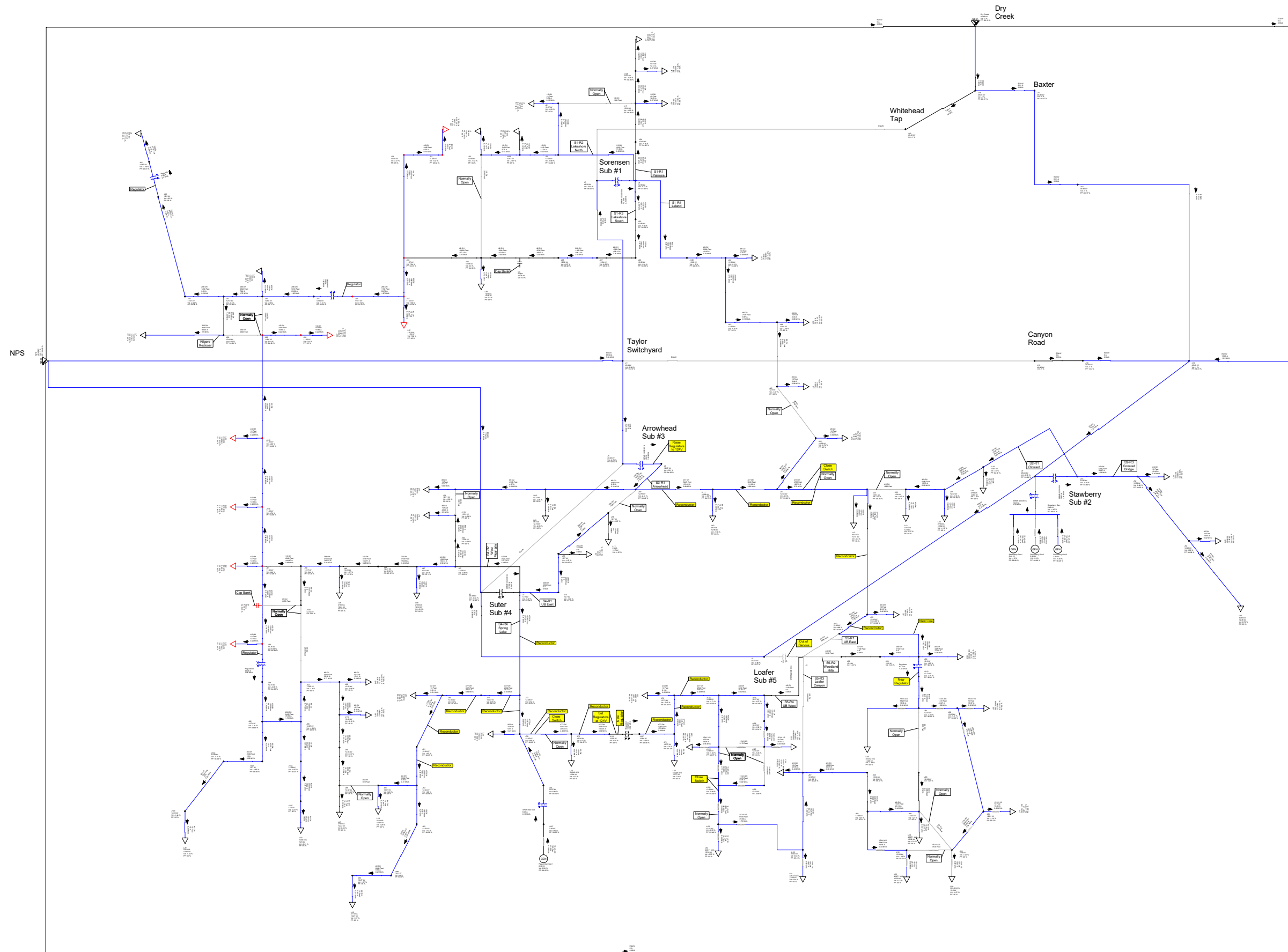
SESD - 2018
 Suter Transformer Out of Service
 After Upgrades

1. Build new Sub #6. Set voltage regulators at 124 V.
2. Upgrade Suter's West Mountain circuit.
3. Install line voltage regulators to Loافر's UB West circuit.
4. UB East circuit currently does not have any load on it. It serves as a backup to Arrowhead's Arrowhead circuit.
5. West Mountain circuit can be backed up by Sub #6's R2 circuit.
6. Spring Lake circuit can be backed up by Loافر's UB West circuit.



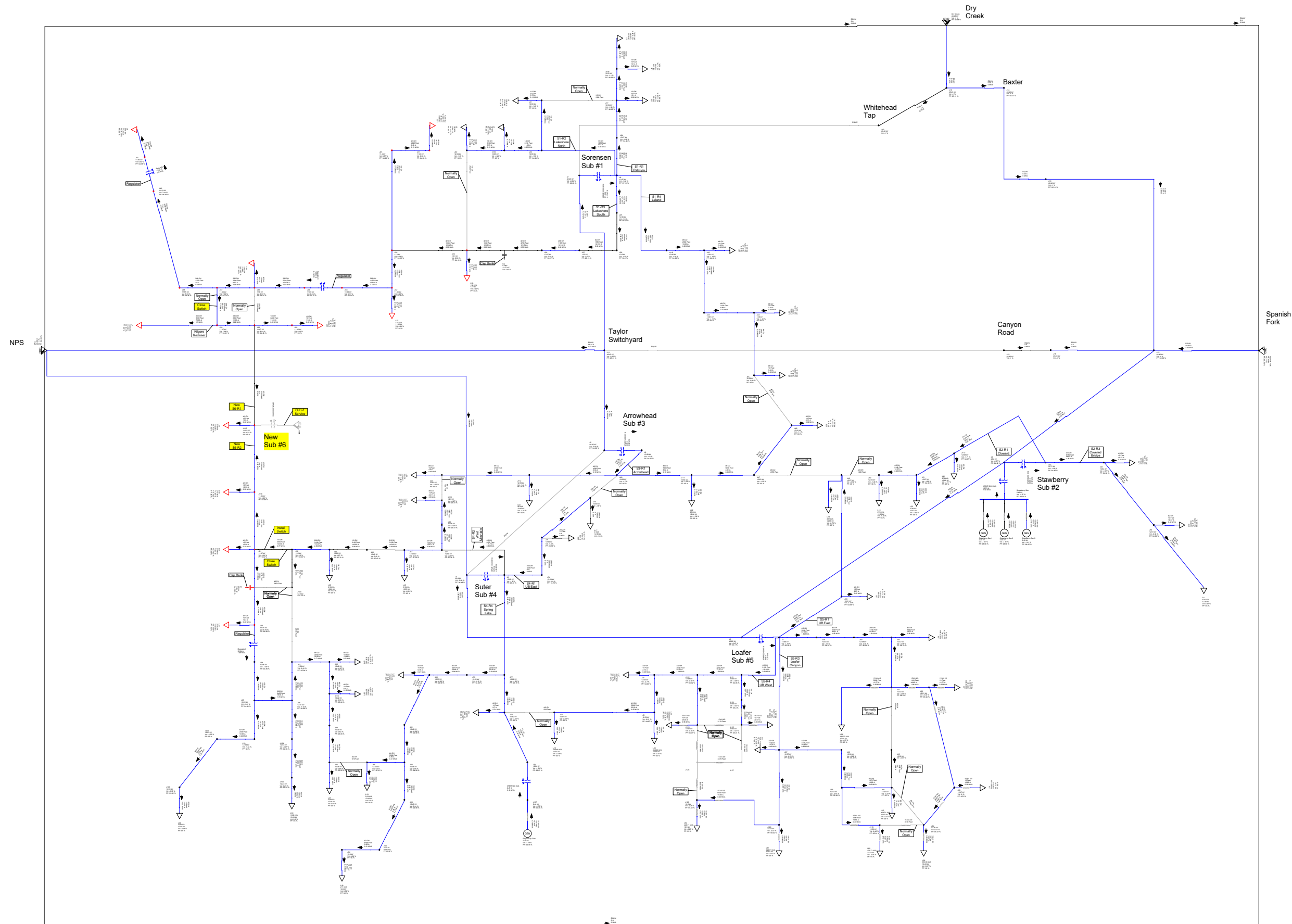
SESD - 2018
Loafer Transformer Out of Service

1. UB East circuit can be backed up by Strawberry's Cloward circuit.
2. Woodland Hills circuit cannot be backed up.
3. Loafer Canyon circuit cannot be backed up.
4. UB West circuit can be backed up by Suter's Spring Lake circuit, but there are voltage issues.



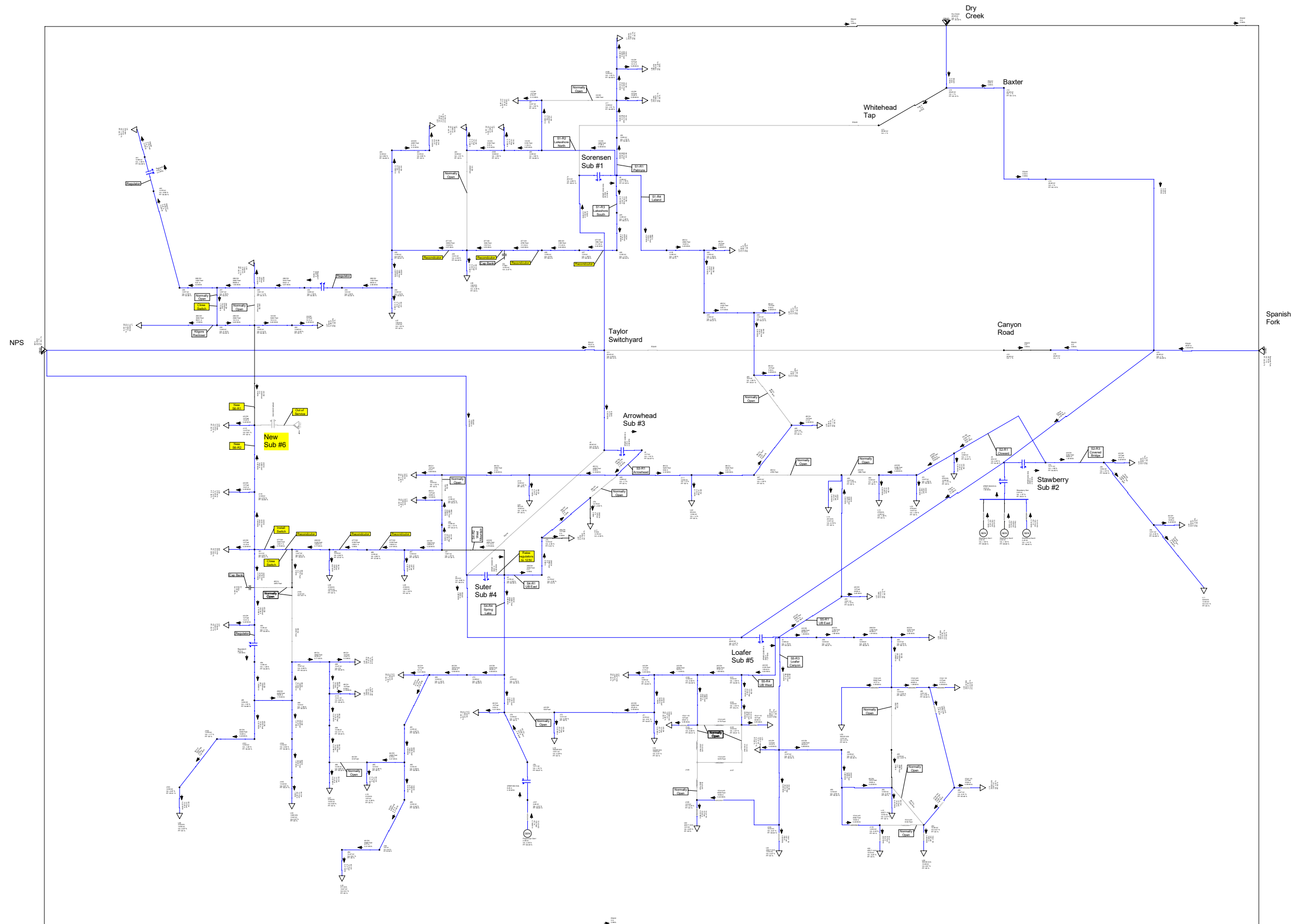
SESD - 2018
Loafer Transformer Out of Service
After Upgrades

1. Upgrade Suter's Spring Lake and Loafer's UB West circuits.
2. Install line voltage regulators to Loafer's UB West circuit. Set at 124 V.
3. Add tie line between Loafer's UB East circuit and Loafer's Woodland Hills circuit.
4. Upgrade Arrowhead's Arrowhead circuit.
5. Raise Arrowhead's voltage regulators to 124 V.
6. Add line voltage regulators to Loafer's Woodland Hills circuit.
7. Upgrade UB East circuit.
8. UB West and Loafer Canyon circuits can be backed up by Suter's Spring Lake circuit.
9. UB East and Woodland Hills circuits can be backed up by Arrowhead's Arrowhead circuit.



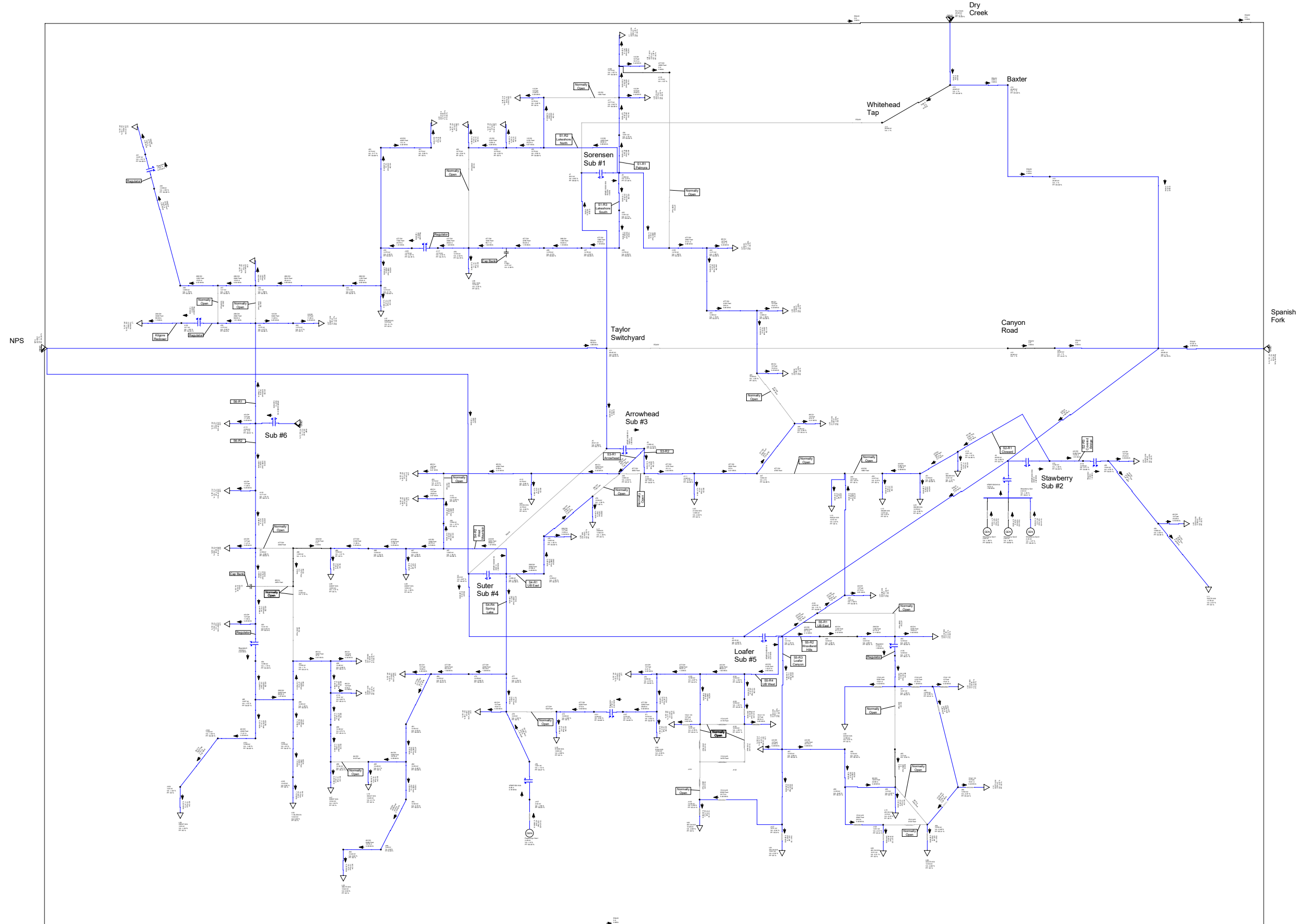
SESD - 2018
 Sub 6 Transformer Out of Service

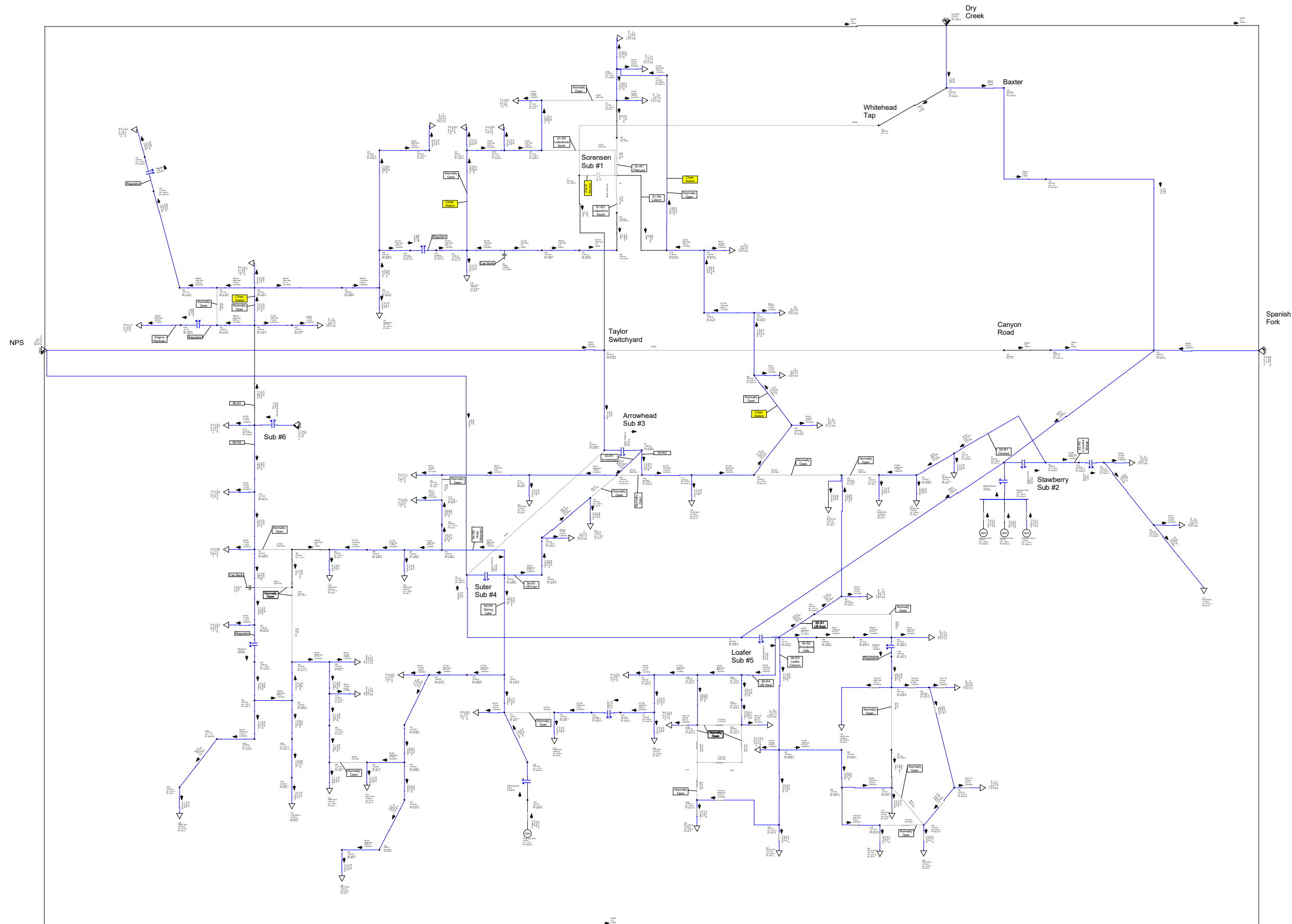
1. R1 circuit cannot be backed up.
2. R2 circuit cannot be backed up.



SESD - 2018
 Sub 6 Transformer Out of Service
 After Upgrades

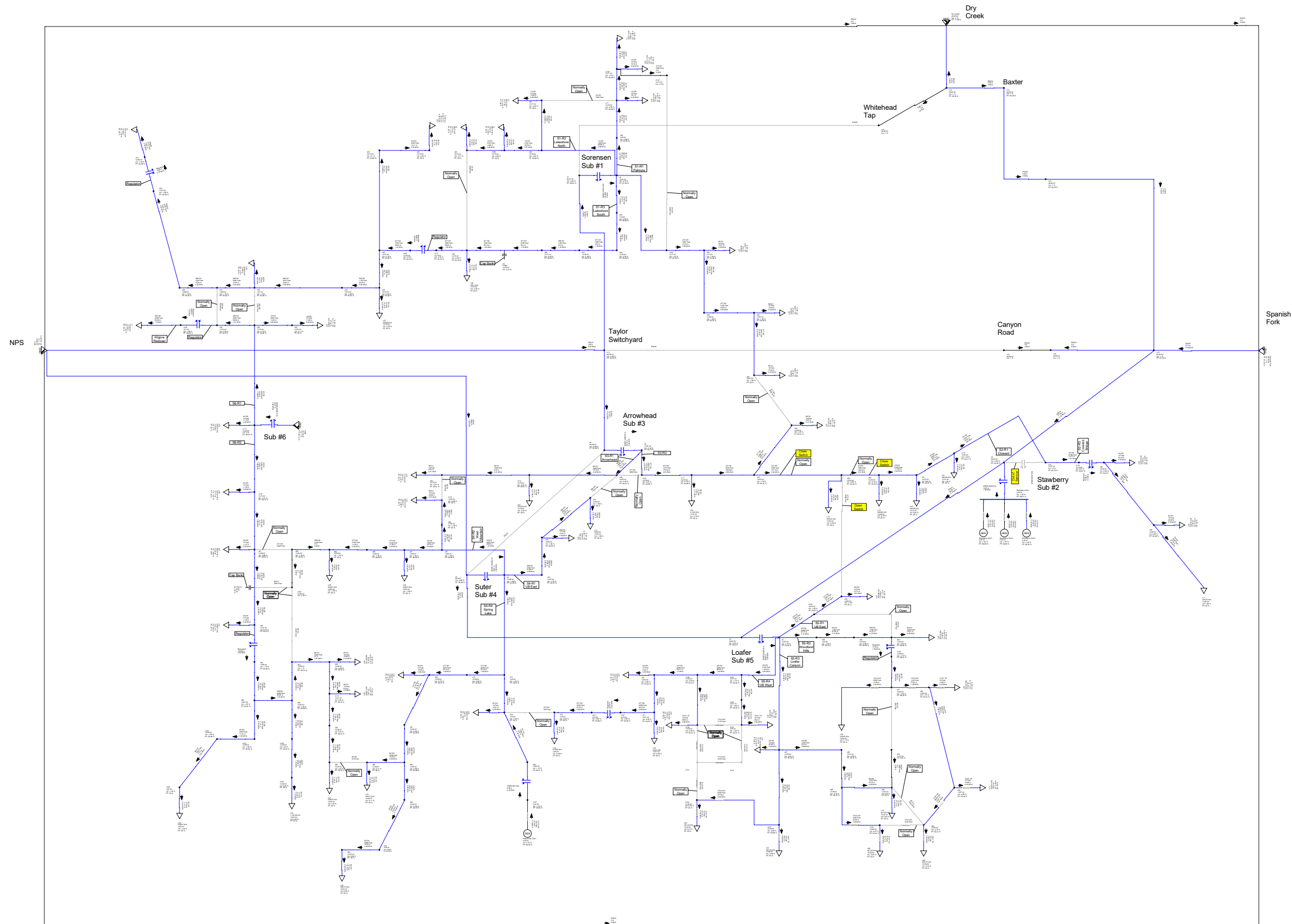
1. It is proposed to upgrade Sorensen's Lakeshore South circuit.
2. It is proposed to upgrade Suter's West Mountain circuit.
3. R1 circuit can be backed up by Sorensen's Lakeshore South circuit.
4. R2 circuit can be backed up by Suter's West Mountain circuit.





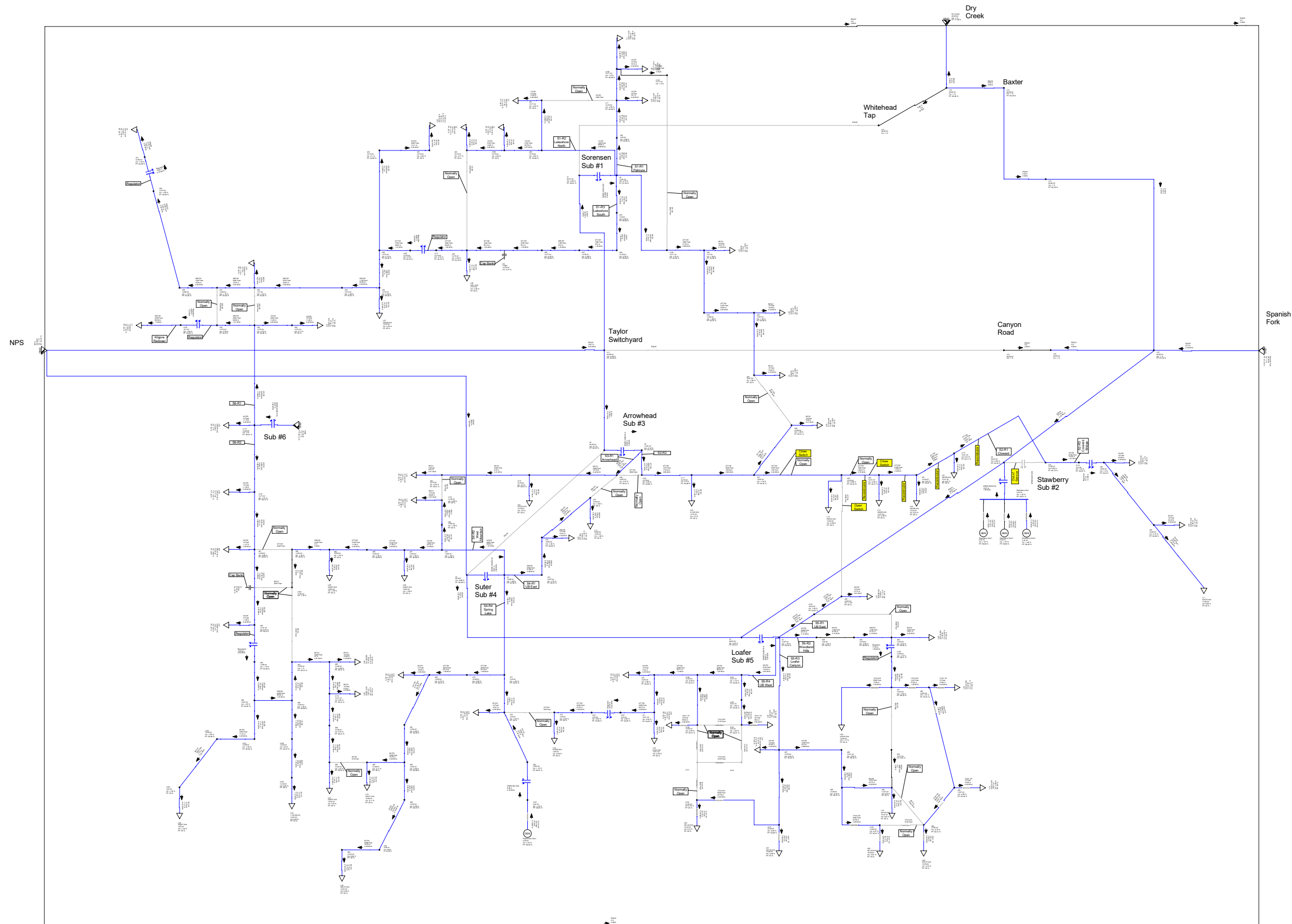
SESD - 2023
 Sorenson Transformer Out of Service

1. Lakeshore North and Lakeshore South circuits can be backed up by Sub #6's R1 circuit.
2. Palmyra and Leland circuits can be backed up by Arrowhead's R2 circuit.



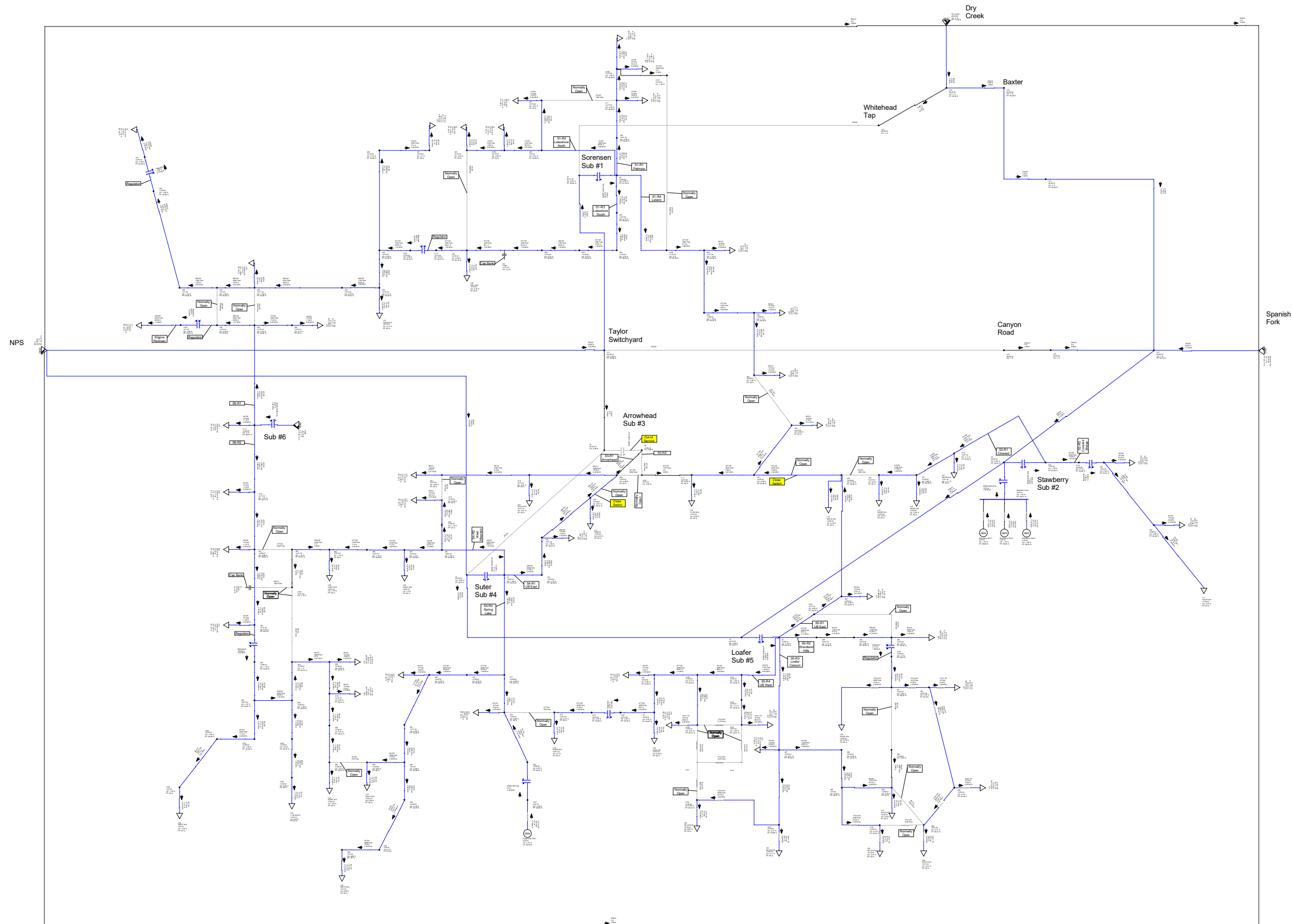
SESD - 2023
 Strawberry Transformer Out of Service

1. Cloward and Covered Bridge circuits can be backed up by Arrowhead's R2 circuit, but voltages are marginal.



SESD - 2023
 Strawberry Transformer Out of Service
 After Upgrades

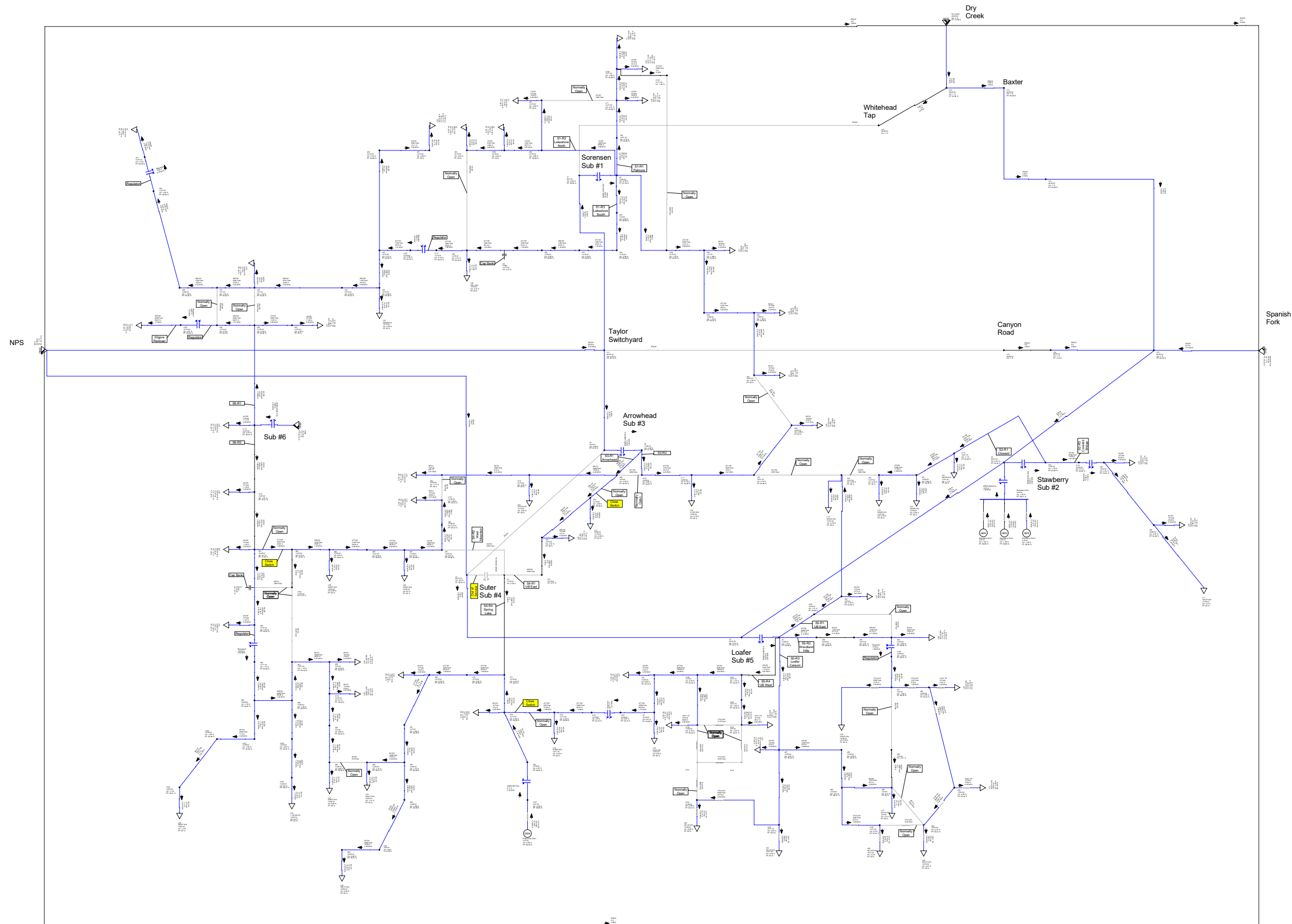
1. Reconductor Stawberry's Cloward circuit.
2. Cloward and Covered Bridge circuits can be backed up by Arrowhead's R2 circuit.



SESD - 2023
 Arrowhead Transformer Out of Service

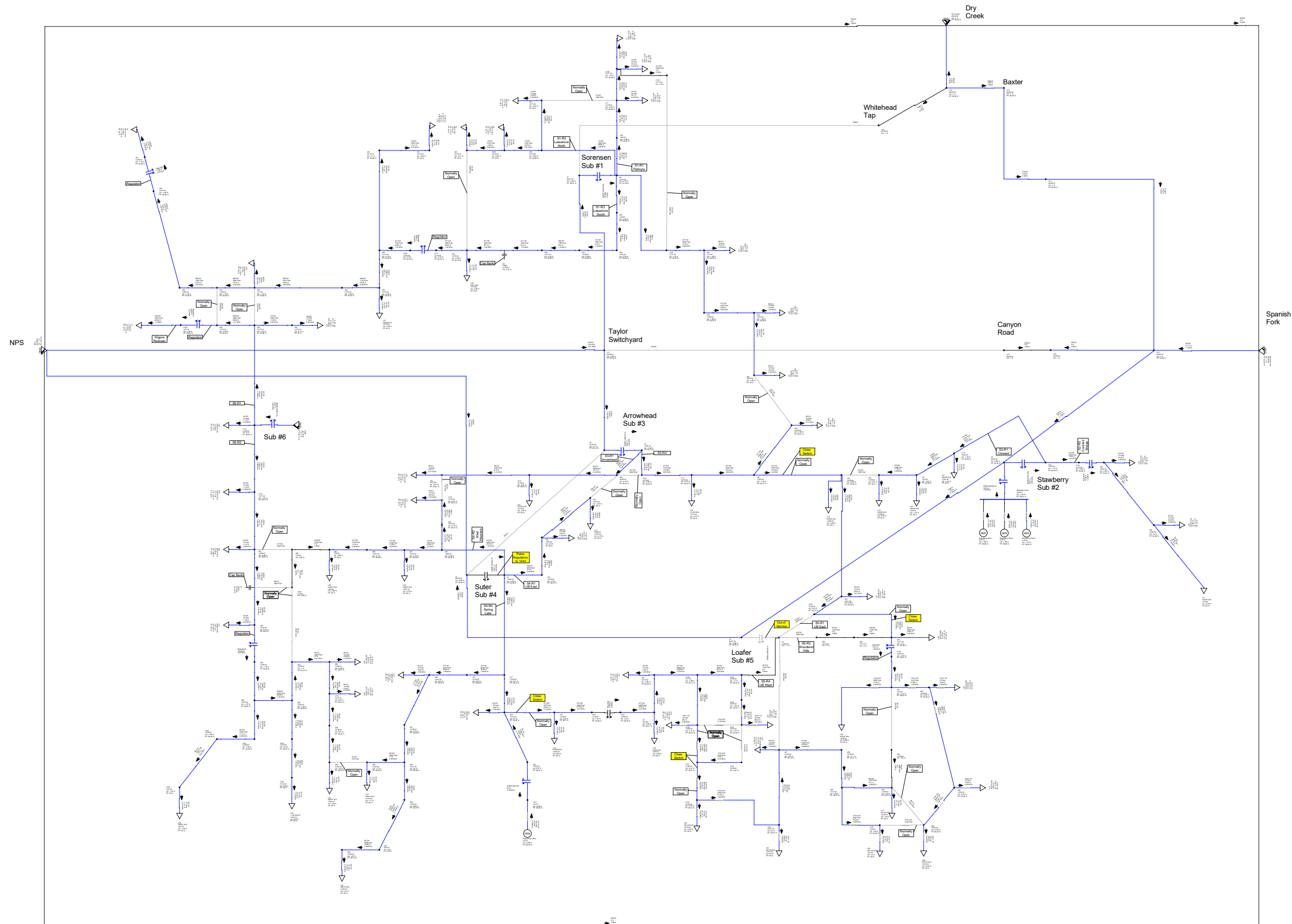
1. Arrowhead circuit can be backed up by Suter's UB East circuit.

2. New R2 circuit can be backed up by Loaffer's UB East circuit.



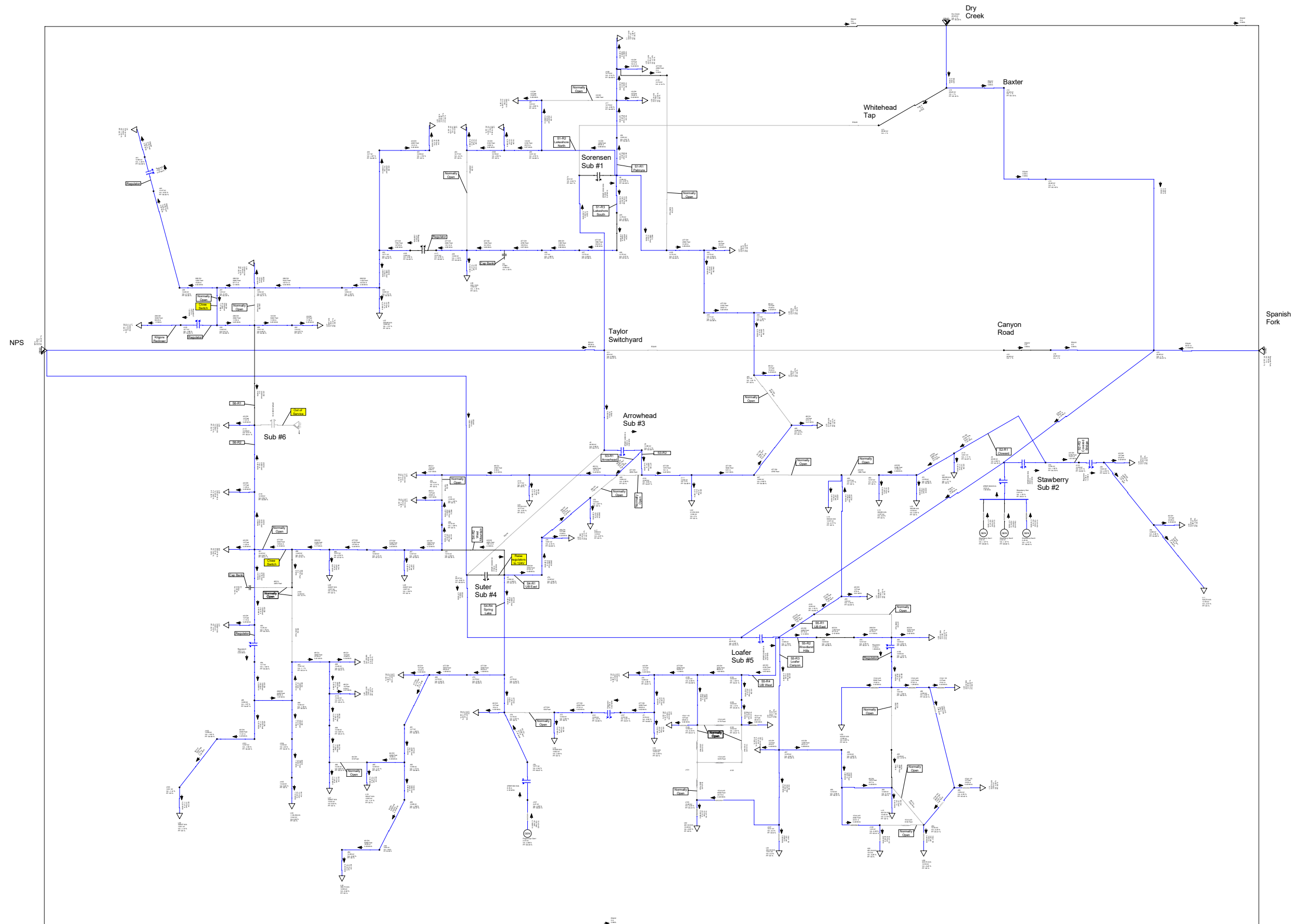
SESD - 2023
 Suter Transformer Out of Service

1. UB East circuit can be backed up by Arrowhead's Arrowhead circuit.
2. West Mountain circuit can be backed up by Sub #6's R2 circuit.
3. Spring Lake circuit can be backed up by Lofer's UB West circuit.



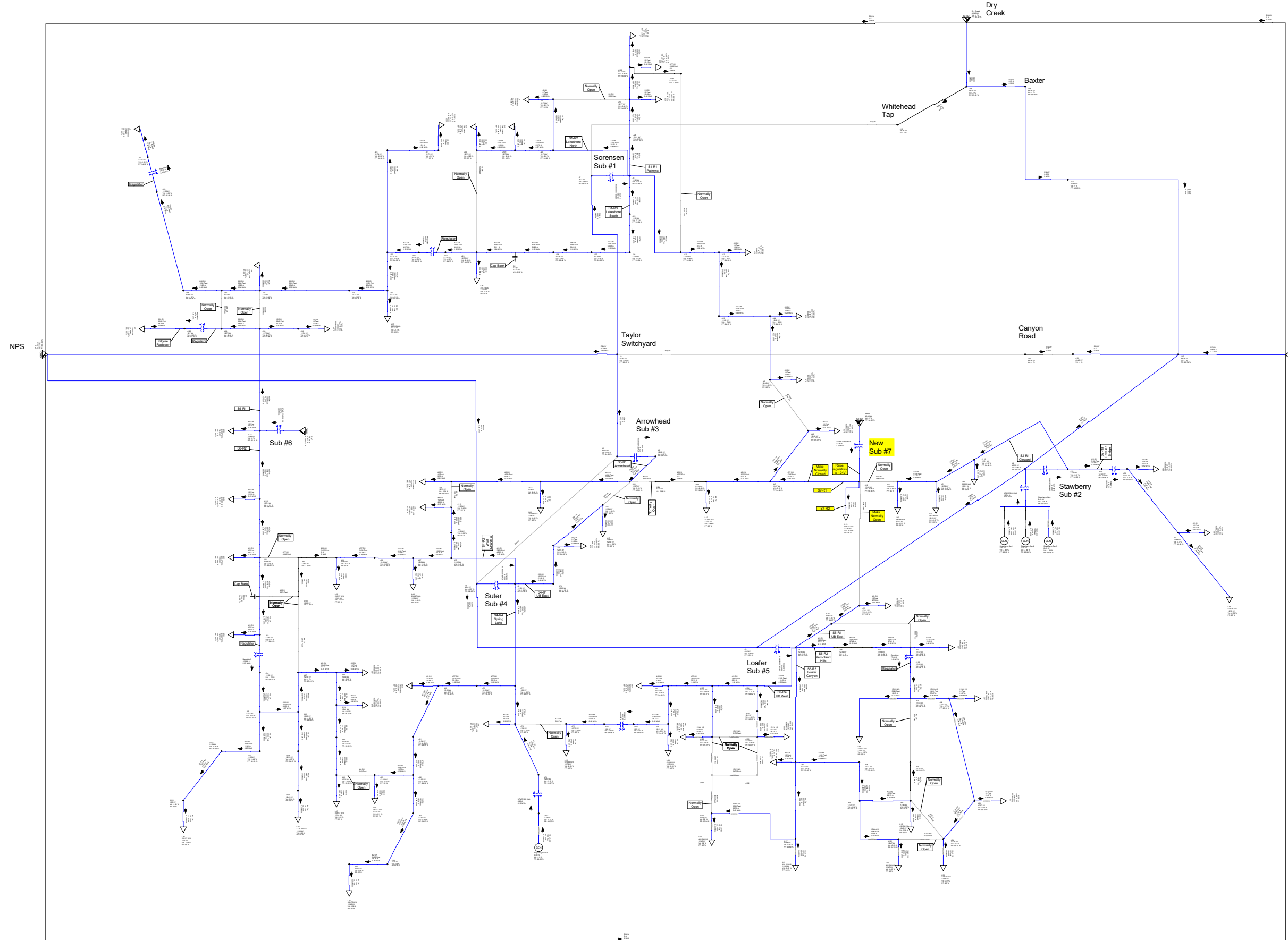
SESD - 2023
Loafer Transformer Out of Service

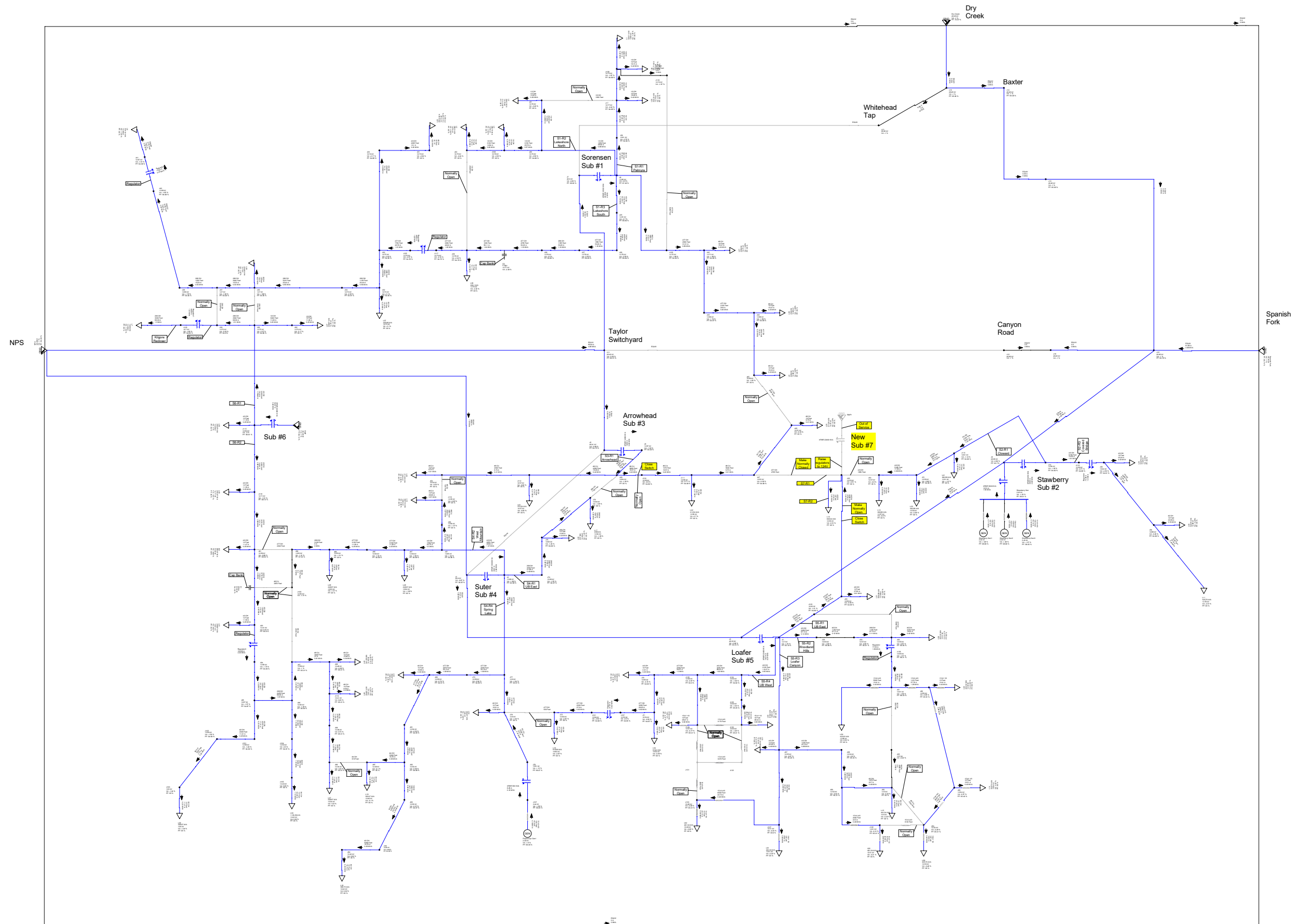
1. UB East and Woodland Hills circuits can be backed up by Arrowhead's R2 circuit.
2. UB West and Loafer Canyon circuits can be backed up by Suter's Spring Lake circuit, but there are voltage issues.
3. Suter's voltage regulators need to be raised to 124 V to help support the voltage.



SESD - 2023
 Sub 6 Transformer Out of Service

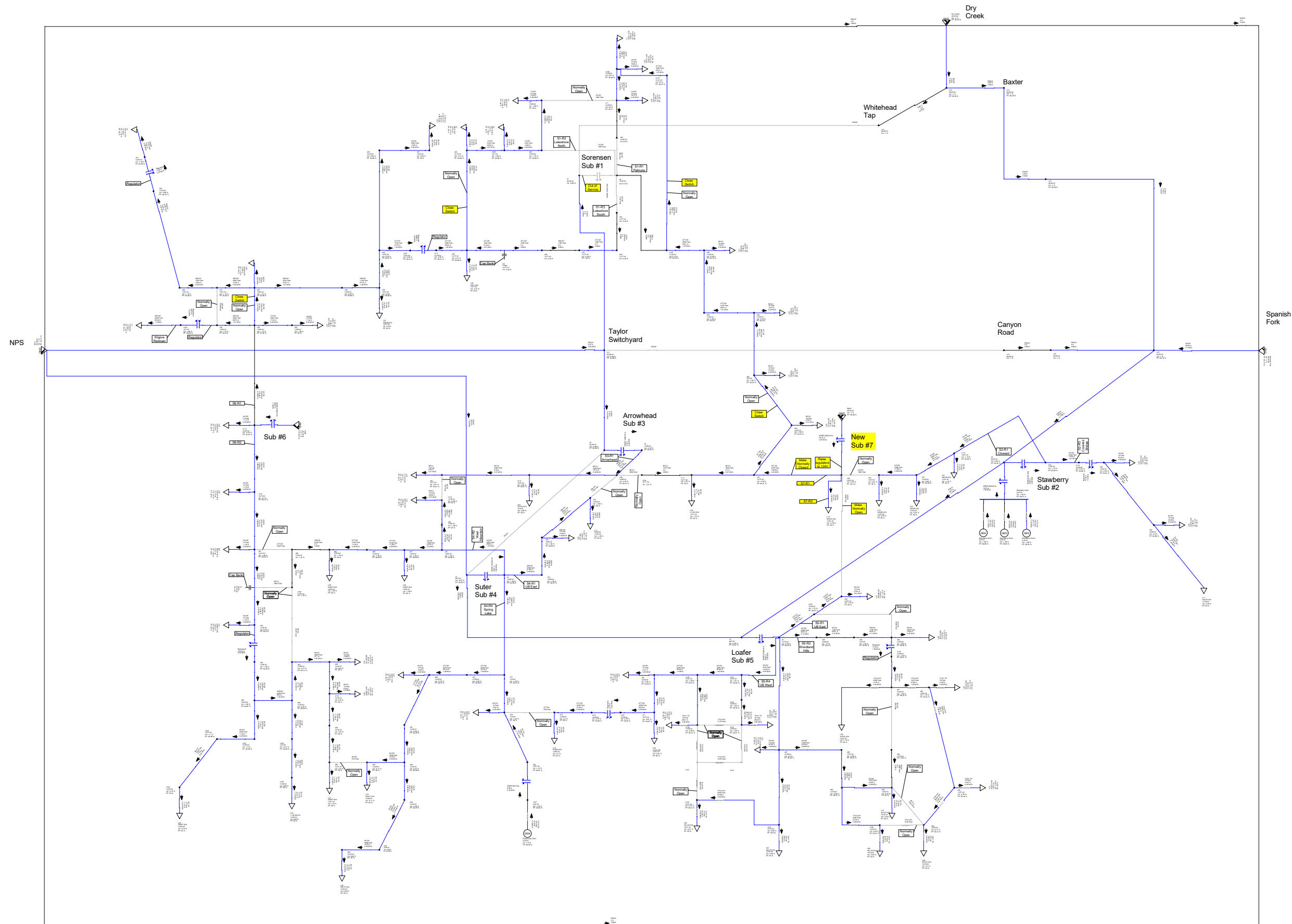
1. R1 circuit can be backed up by Sorenson's Lakeshore South circuit.
2. R2 circuit can be backed up by Suter's West Mountain circuit, but there are voltage issues.
3. Suter's voltage regulators need to be raised to 124 V to help support the voltage.





SESD - 2023
 Add Sub 7
 Sub 7 Transformer Out of Service

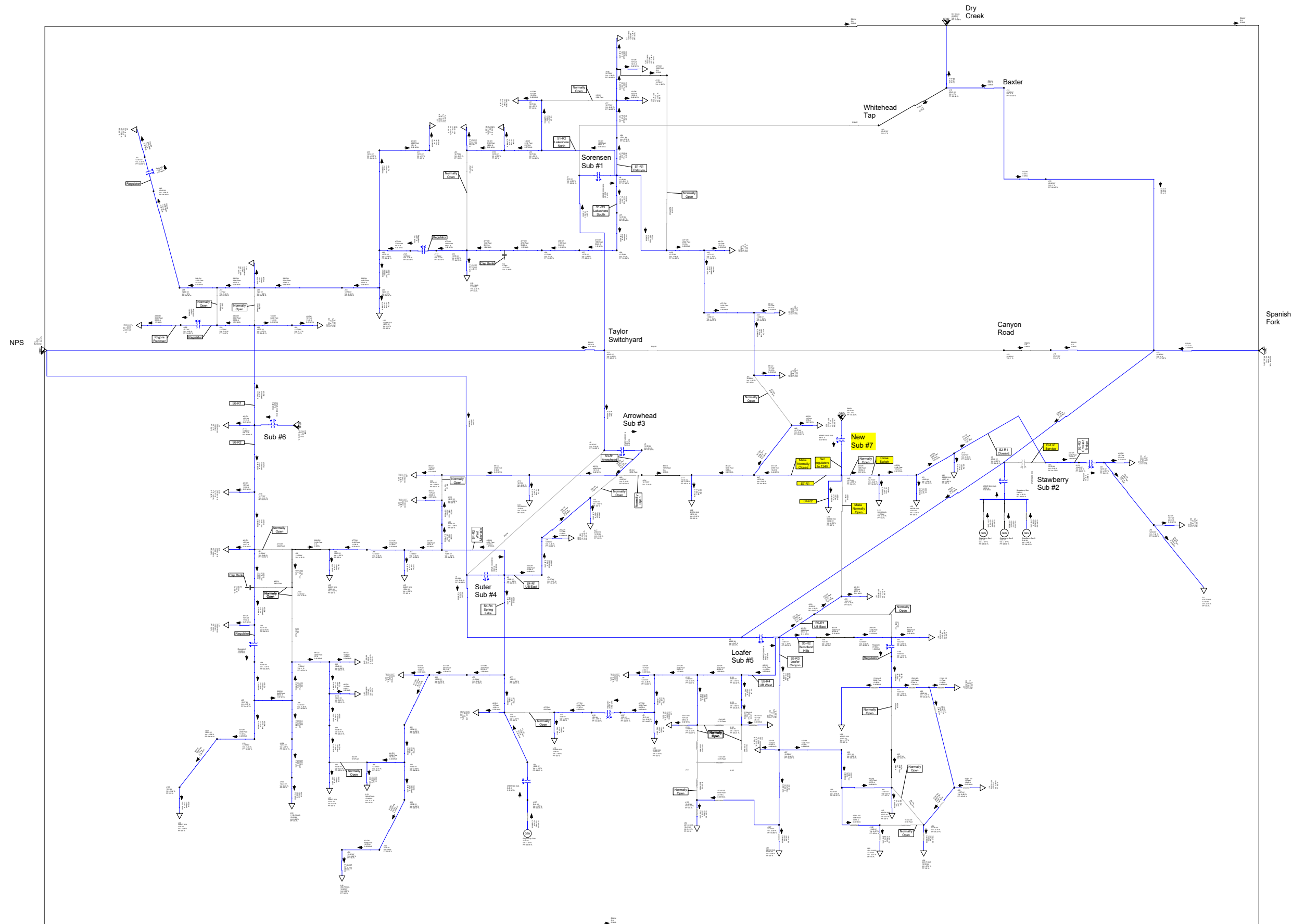
1. R1 circuit can be backed up by Arrowhead's Arrowhead circuit.
2. R2 circuit can be backed up by Loafer's UB East circuit.



SESD - 2023
 Add Sub 7
 Sorenson Transformer Out of Service

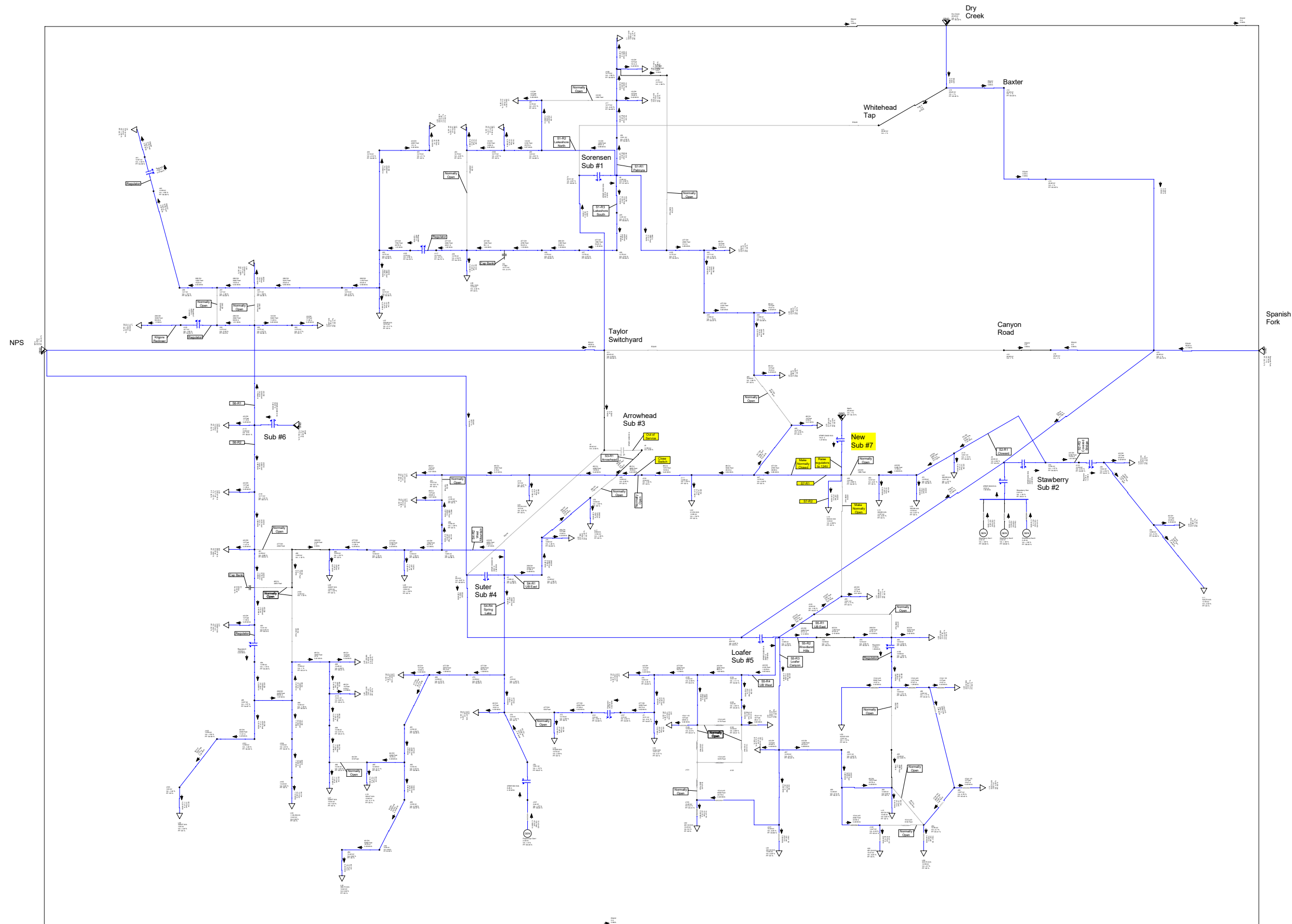
1. Lakeshore North and Lakeshore South circuits can be backed up by Sub #6's R1 circuit.

2. Palmyra and Leland circuits can be backed up by Sub 7's R1 circuit.



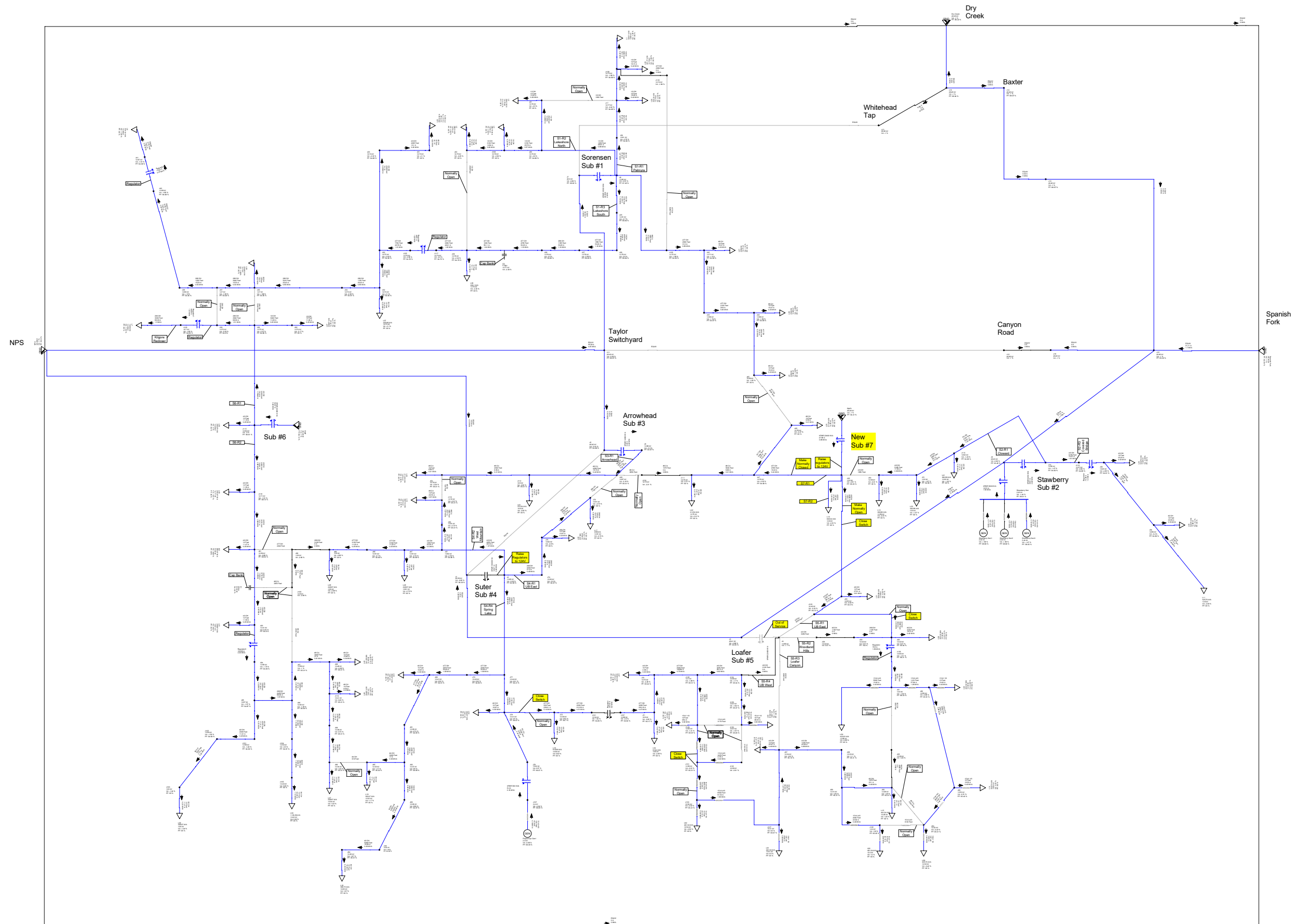
SESD - 2023
 Add Sub 7
 Strawberry Transformer Out of service

1. Cloward and Covered Bridge circuits
 can be backed up by Sub 7's R2 circuit.



SESD - 2023
 Add Sub 7
 Arrowhead Transformer Out of Service

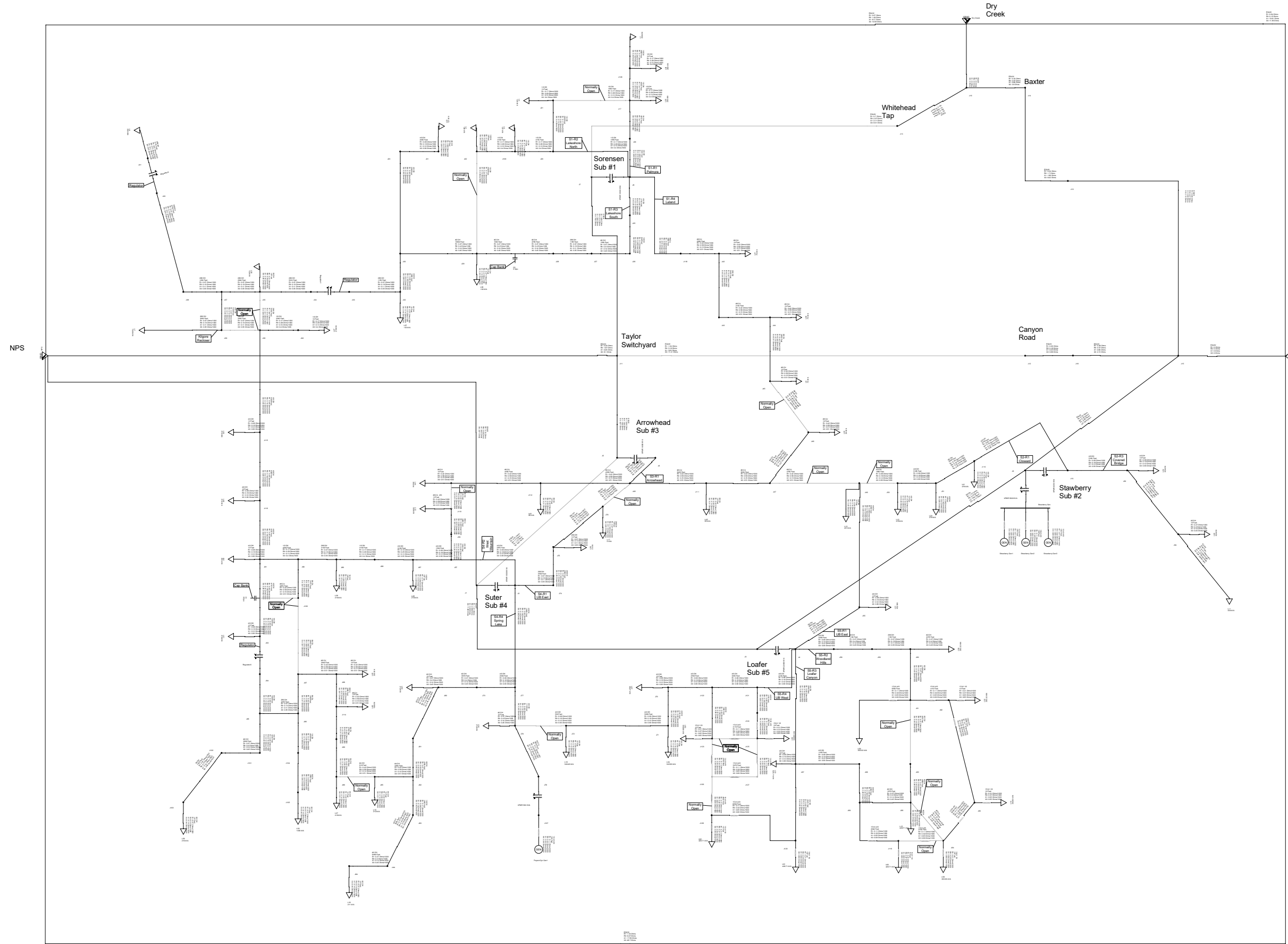
1. Arrowhead circuit can be backed up by Sub 7's R1 circuit.



SESD - 2023
 Add Sub 7
 Loafer Transformer Out of Service

1. UB East and Woodland Hills circuits can be backed up by Sub 7's R2 circuit.
2. UB West and Loafer Canyon circuits can be backed up by Suter's Spring Lake circuit, but there are voltage issues.
3. Suter's voltage regulators need to be raised to 124 V to help support the voltage.

APPENDIX 4 – MODEL INPUT DATA



Paladin DesignBase

3-Phase Short Circuit v6.70.00

Project No. : Page : 1
Project Name: Date : 02/22/2019
Title : Time : 09:54:43 pm
Drawing No. : Company :
Revision No.: Engineer:
Jobfile Name: 555-002 SESD 2018 INPUT DATA Check by:
Scenario : 1 : Date :

System Summary

Base MVA : 100.000
System Frequency(Hz) : 60

of Total Buses : 199
of Active Buses : 196
of Total Branches : 199

of Active Sources : 7
of Active Motors : 0
of Active Shunts : 61
of Transformers : 10
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

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-----
Utility/Power Company Data
-----

```

Bus Name	System			X"/R	Ground
	V	Cd	SCkVA		
Dry Creek		46000	PC 998494.8-3P	14.396(+)	Solid
	Actual V.->	46000	863444.8-LL	14.233(-)	
			1151707-LG	10.262(0)	
NPS		46000	PC 793883.0-3P	18.524(+)	Solid
	Actual V.->	46000	687043.7-LL	18.254(-)	
			1050654-LG	11.219(0)	
Spanish Fork		46000	PC 1504911-3P	16.019(+)	Solid
	Actual V.->	46000	1303640-LL	15.743(-)	
			1875791-LG	10.531(0)	

 Generator Data

Bus Name	System V	Cd	kVA	%X	X/R	Ground Ohms	
PaysonCyn Gen1	2400	GS	450.00	4.085	29.00	(+) "	Solid
Actual V.->	13800			7.197	29.00	(+) '	
				34.29	29.00	(+)	
				4.085	29.00	(-)	
				0.324	29.00	(0)	
Strawberry Gen1	2400	GS	1945.0	4.085	29.00	(+) "	Solid
Actual V.->	13800			7.197	29.00	(+) '	
				34.29	29.00	(+)	
				4.085	29.00	(-)	
				0.324	29.00	(0)	
Strawberry Gen2	2400	GS	1945.0	4.085	29.00	(+) "	Solid
Actual V.->	13800			7.197	29.00	(+) '	
				34.29	29.00	(+)	
				4.085	29.00	(-)	
				0.324	29.00	(0)	
Strawberry Gen3	2400	GS	450.00	4.085	29.00	(+) "	Solid
Actual V.->	13800			7.197	29.00	(+) '	
				34.29	29.00	(+)	
				4.085	29.00	(-)	
				0.324	29.00	(0)	

 Transformers Data

Branch Name	Cd Device Type	kVA	%R	%X	Nameplt V	Ground Ohms
Arrowhead	TR XFMR 14000 KVA	14000	1.037	10.37	(+)	46000 Delta
			1.037	10.37	(0)	12470 Y-Solid
			%Z = 10.43 X/R = 10.00		(+)	
Loafer	TR XFMR 22400 KVA	22400	1.254	12.54	(+)	46000 Delta
			1.254	12.54	(0)	12470 Y-Solid
			%Z = 12.60 X/R = 10.00		(+)	
Payson Gen	TR XFMR 500 KVA	500.00	0.500	5.000	(+)	12470 Delta
			0.500	5.000	(0)	2400 Y-Solid
			%Z = 5.025 X/R = 10.00		(+)	
Regulator1	TR Regulator1	5000.0	0.500	0.500	(+)	12470 Y-Solid
			0.500	0.500	(0)	12470 Y-Solid
			%Z = 0.707 X/R = 1.000		(+)	
Regulator2	TR Regulator2	5000.0	0.500	0.500	(+)	12470 Y-Solid
			0.500	0.500	(0)	12470 Y-Solid
			%Z = 0.707 X/R = 1.000		(+)	
Regulator3	TR Regulator3	5000.0	0.500	0.500	(+)	12470 Y-Solid
			0.500	0.500	(0)	12470 Y-Solid
			%Z = 0.707 X/R = 1.000		(+)	
Sorensen	TR XFMR 10500 KVA	10500	1.078	10.78	(+)	46000 Delta
			1.078	10.78	(0)	12470 Y-Solid
			%Z = 10.83 X/R = 10.00		(+)	
Strawberry	TR XFMR 6250 KVA	6250.0	1.005	10.05	(+)	46000 Delta
			1.005	10.05	(0)	12470 Y-Solid
			%Z = 10.10 X/R = 10.00		(+)	
Strawberry1	TR XFMR 5000 KVA	5000.0	0.700	7.000	(+)	46000 Delta
			0.700	7.000	(0)	2400 Y-Solid
			%Z = 7.035 X/R = 10.00		(+)	
Suter	TR XFMR 10500 KVA	10500	0.928	9.280	(+)	46000 Delta
			0.928	9.280	(0)	12470 Y-Solid
			%Z = 9.326 X/R = 10.00		(+)	

 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
380	15 kV-4/0	1410	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
381	15 kV-4/0	5850	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
382	15 kV-4/0	2600	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
383	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
384	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
385	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
386	15 kV-4/0	5620	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
387	15 kV-4/0	2640	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
389	15 kV-4/0	1520	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
395	15 kV-4/0	6500	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
396	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
397	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
398	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
399	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
400	15 kV 1/0	10	0.2068 0.3607	0.0515 0.6500	(+) (0)	0.01204 20.0
OH10	EQUIV	1000	0.9863 2.9230	3.0473 11.995	(+) (0)	20.0
OH100	266 OH	3730	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH101	266 OH	10	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH102	4/0 OH	10345	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH103	4/0 OH	1110	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH104	#2 CU	5500	0.1637 0.2768	0.1392 0.4112	(+) (0)	20.0
OH105	4/0 OH	2000	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH106	#2 OH	3970	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0

 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
OH107	#2 OH	6170	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH108	#2 OH	2055	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH109	1/0 OH	1830	0.1644	0.1327 (+)		20.0
			0.2796	0.4035 (0)		
OH11	EQUIV	1000	1.2422	3.8384 (+)		20.0
			3.6819	15.109 (0)		
OH110	#2 OH	4050	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH111	#2 OH	6480	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH112	#4 OH	3300	0.4159	0.1428 (+)		20.0
			0.5502	0.5054 (0)		
OH114	#2 OH	10	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH115	4/0 OH	2870	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH116	4/0 OH	1500	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH117	2/0 OH	3100	0.1305	0.1298 (+)		20.0
			0.2462	0.3501 (0)		
OH118	1/0 OH	3100	0.1644	0.1327 (+)		20.0
			0.2796	0.4035 (0)		
OH119	266 OH	3100	0.0650	0.1104 (+)		20.0
			0.1318	0.3527 (0)		
OH12	EQUIV	1000	0.3196	0.9873 (+)		20.0
			0.9471	3.8867 (0)		
OH120	1/0 OH	4940	0.1644	0.1327 (+)		20.0
			0.2796	0.4035 (0)		
OH121	4/0 OH	5300	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH122	1/0 OH	3240	0.1644	0.1327 (+)		20.0
			0.2796	0.4035 (0)		
OH123	4/0 OH	6710	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH124	4/0 OH	1250	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH125	4/0 OH	1000	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH126	266 OH	2455	0.0650	0.1104 (+)		20.0
			0.1318	0.3527 (0)		
OH127	#6 CU	1095	0.4105	0.1462 (+)		20.0
			0.5443	0.5073 (0)		
OH128	#6 CU	3940	0.4105	0.1462 (+)		20.0
			0.5443	0.5073 (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
OH129	#6 CU	3800	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH130	#4 OH	3550	0.4159 0.5502	0.1428 0.5054	(+) (0)	20.0
OH131	#6 CU	7475	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH134	4/0 OH	4230	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH135	#2 OH	2000	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH136	#2 OH	7025	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH137	1/0 OH	4930	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH138	#2 OH	3780	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH139	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH14	EQUIV	1000	0.0251 0.1560	0.2260 0.6803	(+) (0)	20.0
OH140	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH141	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH142	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH143	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH144	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH145	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH146	266 OH	10	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH147	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH148	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH149	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH150	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH151	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH152	4/0 OH	4525	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0

 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
OH153	#2 OH	1000	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH154	#4 OH	10	0.4159 0.5502	0.1428 0.5054	(+) (0)	20.0
OH155	1/0 OH	4000	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH156	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH157	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH158	1/0 OH	3150	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH159	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH16	EQUIV	1000	0.3091 0.9158	0.9547 3.7580	(+) (0)	20.0
OH160	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH161	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH162	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH163	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH164	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH165	4/0 OH	2600	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH166	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH167	#6 CU	5000	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH168	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH169	#6 CU	4560	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH17	EQUIV	1000	0.3207 0.9504	0.9907 3.8996	(+) (0)	20.0
OH170	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH171	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH173	#6 CU	3780	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH174	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0

 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
OH175	#6 CU	10	0.4105	0.1462 (+)		20.0
			0.5443	0.5073 (0)		
OH176	#4 OH	10	0.4159	0.1428 (+)		20.0
			0.5502	0.5054 (0)		
OH177	1/0 OH	10	0.1644	0.1327 (+)		20.0
			0.2796	0.4035 (0)		
OH178	4/0 OH	5515	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH179	4/0 OH	5300	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH18	EQUIV	1000	0.0803	0.6627 (+)		20.0
			0.5602	2.1537 (0)		
OH180	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH181	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH182	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH183	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH184	#2 OH	10	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH185	#2 OH	10	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH187	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH188	4/0 OH	10	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH189	4/0 OH	3450	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH19	EQUIV	1000	0.0002	0.0002 (+)		20.0
			0.0002	0.0002 (0)		
OH190	#6 CU	2930	0.4105	0.1462 (+)		20.0
			0.5443	0.5073 (0)		
OH191	4/0 OH	2500	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH192	4/0 OH	1900	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH193	4/0 OH	1210	0.0820	0.1244 (+)		20.0
			0.1588	0.3557 (0)		
OH194	#2 OH	4370	0.2618	0.1378 (+)		20.0
			0.3953	0.4524 (0)		
OH20	EQUIV	1000	0.0002	0.0002 (+)		20.0
			0.0002	0.0002 (0)		
OH21	EQUIV	1000	0.2838	0.2596 (+)		20.0
			1.8288	8.1022 (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
OH22	EQUIV	1000	0.1720 0.5053	0.5267 2.0663	(+) (0)	20.0
OH23	EQUIV	1000	0.0803 0.5602	0.6627 2.1537	(+) (0)	20.0
OH24	EQUIV	1000	0.2396 1.6704	1.9761 6.4216	(+) (0)	20.0
OH25	EQUIV	1000	0.6308 0.1423	10.814 11.853	(+) (0)	20.0
OH26	EQUIV	1000	0.2651 1.4571	8.1718 10.588	(+) (0)	20.0
OH27	1/0 OH	1970	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH28	EQUIV	1000	1.5046 8.8877	17.556 48.701	(+) (0)	20.0
OH29	1/0 OH	3850	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH30	1/0 OH	1855	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH31	1/0 OH	2620	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH33	1/0 OH	3100	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH35	1/0 OH	10	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH36	4/0 OH	550	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH37	4/0 OH	1730	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH38	1/0 OH	840	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH39	#2 OH	1580	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH40	266 OH	1185	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH41	#2 OH	4785	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH42	#2 OH	10630	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH43	4/0 OH	2560	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH44	4/0 OH	4925	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH45	4/0 OH	1985	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH46	266 OH	1150	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0

 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
OH47	266	OH	5010	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH49	266	OH	2640	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH50	266	OH	1230	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH51	266	OH	5340	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH53	266	OH	6735	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH54	266	OH	3000	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH55	266	OH	2715	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH56	#6	CU	4030	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH57	266	OH	5425	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH58	#6	CU	2120	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH59	#6	CU	3850	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH61	#6	CU	5635	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH62	#6	CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH63	266	OH	4400	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH64	#6	CU	5425	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH66	4/0	OH	9290	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH68	4/0	OH	5185	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH69	4/0	OH	2745	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH70	4/0	OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH71	4/0	OH	5160	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH72	1/0	OH	9000	0.1644 0.2796	0.1327 0.4035	(+) (0)	20.0
OH73	#2	OH	7520	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH74	#6	CU	4500	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0

 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
OH75	#6 CU	4280	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH76	4/0 OH	1550	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH77	#6 CU	10	0.4105 0.5443	0.1462 0.5073	(+) (0)	20.0
OH78	4/0 OH	8950	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH79	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH8	EQUIV	1000	0.3514 1.0412	1.0855 4.2728	(+) (0)	20.0
OH80	4/0 OH	3280	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH81	#2 OH	1100	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH82	266 OH	1100	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH83	#2 OH	1140	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH85	#2 OH	4865	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH87	4/0 OH	5940	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH88	4/0 OH	1035	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH89	4/0 OH	2350	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH9	EQUIV	1000	0.8763 2.0902	2.0180 7.6242	(+) (0)	20.0
OH90	#2 OH	1970	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH91	#2 OH	10	0.2618 0.3953	0.1378 0.4524	(+) (0)	20.0
OH92	4/0 OH	2120	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH93	4/0 OH	2175	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH94	4/0 OH	5260	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH96	4/0 OH	10	0.0820 0.1588	0.1244 0.3557	(+) (0)	20.0
OH97	266 OH	3500	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0
OH98	266 OH	2980	0.0650 0.1318	0.1104 0.3527	(+) (0)	20.0

 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
UG19	15	kV-4/0	100	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
UG20	15	kV-4/0	100	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
UG21	15	kV-4/0	100	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0
UG22	15	kV-4/0	100	0.1059 0.3156	0.0463 0.0950	(+) (0)	0.01517 20.0