

At the start of the design I decided to connect CCW to Lynn and jo 138KV both with condor to avoid using transformers. The contingency analysis showed 5 violations. To release stress from the conductors I started to connect to buses with a lot of lines, capacitor banks, loads, and Shimko and Wolen 69 looked like the best option, but both required a transformer. With more elements I decided to stick with Shimko 69. After I built the transformer, I connected CCW to SHIMKO138 and got my contingency to 1. This part gave me a lot of trouble bouncing between system loss 10.72 and 12.94 as I was switching conductor type. The issue was between SLACK345 AND JO345, the only bus that seemed to affect that line was SAVOY138. To alleviate the issue, I had to add another transformer at WOLEN69. To remove more stress from the line between SLACK345 and JO345 I decided to move CCW to SHIMKO138. Between CCW to SHIMKO and SAVOY TO SHIMKO the cardinal conductor was used. SHIMKO TO WOLEN crow conductor was used. CCW to LYNN condor conductor was used. WOLEN and SHIMKO both used transformers with a capacity of 187 MVA. The system has a loss of 9.78MW with zero violations. Four lines were used at a length of 43.45 Km.

Sebastien ST. Hilaire
EEL 4216
Final Design Project
12/05/23

N-1 CONTINGENCY REPORT

| Contingency Analysis | | | | | | | | | |
|--|---------------------------------|------|-----------|--------|------------|--------------|----------|----------|-----------------|
| Start Run Abort Load Auto Insert Save Other > | | | | | | | | | |
| Status Finished with no violations, custom monitor violations, unsolveable or aborted contingencies. Initial state restored. | | | | | | | | | |
| Contingencies Options Results | | | | | | | | | |
| Records Geo Set Columns f(x) Options | | | | | | | | | |
| | Name | Skip | Processed | Solved | Violations | Max Branch % | Min Volt | Max Volt | # of iterations |
| 1 | L_00001TIM345-00031SLACK345C1 | NO | YES | YES | 0 | | | | 4 |
| 2 | T_00001TIM345-00040TIM138C1 | NO | YES | YES | 0 | | | | 4 |
| 3 | L_00003MORO138-00040TIM138C1 | NO | YES | YES | 0 | | | | 2 |
| 4 | L_00003MORO138-00041LAUF138C1 | NO | YES | YES | 0 | | | | 2 |
| 5 | L_00005HOMER69-00018HANNAH69C1 | NO | YES | YES | 0 | | | | 2 |
| 6 | L_00005HOMER69-00044LAUF69C1 | NO | YES | YES | 0 | | | | 3 |
| 7 | L_00010RAY69-00013FERNA69C1 | NO | YES | YES | 0 | | | | 2 |
| 8 | L_00010RAY69-00019GROSS69C1 | NO | YES | YES | 0 | | | | 2 |
| 9 | T_00010RAY69-00039RAY138C1 | NO | YES | YES | 0 | | | | 4 |
| 10 | L_00012TIM69-00017PAI69C1 | NO | YES | YES | 0 | | | | 3 |
| 11 | L_00012TIM69-00018HANNAH69C1 | NO | YES | YES | 0 | | | | 2 |
| 12 | L_00012TIM69-00027HISKY69C1 | NO | YES | YES | 0 | | | | 2 |
| 13 | T_00012TIM69-00040TIM138C1 | NO | YES | YES | 0 | | | | 4 |
| 14 | T_00012TIM69-00040TIM138C2 | NO | YES | YES | 0 | | | | 4 |
| 15 | L_00013FERNA69-00055DEMAR69C1 | NO | YES | YES | 0 | | | | 1 |
| 16 | L_00014WEBER69-00034PATTEN69C1 | NO | YES | YES | 0 | | | | 2 |
| 17 | L_00014WEBER69-00044LAUF69C1 | NO | YES | YES | 0 | | | | 2 |
| 18 | L_00015SUIUC69-00016PETE69C1 | NO | YES | YES | 0 | | | | 4 |
| 19 | L_00015SUIUC69-00024HALE69C1 | NO | YES | YES | 0 | | | | 2 |
| 20 | L_00015SUIUC69-00054BLT69C1 | NO | YES | YES | 0 | | | | 1 |
| 21 | L_00015SUIUC69-00054BLT69C2 | NO | YES | YES | 0 | | | | 1 |
| 22 | L_00015SUIUC69-00054BLT69C3 | NO | YES | YES | 0 | | | | 1 |
| 23 | L_00016PETE69-00027HISKY69C1 | NO | YES | YES | 0 | | | | 2 |
| 24 | L_00017PAI69-00019GROSS69C1 | NO | YES | YES | 0 | | | | 2 |
| 25 | L_00018HANNAH69-00037AMANDA69C1 | NO | YES | YES | 0 | | | | 1 |
| 26 | L_00018HANNAH69-00037AMANDA69C2 | NO | YES | YES | 0 | | | | 1 |
| 27 | L_00020SHIMKO69-00034PATTEN69C1 | NO | YES | YES | 0 | | | | 2 |
| 28 | L_00020SHIMKO69-00048BOB69C1 | NO | YES | YES | 0 | | | | 0 |
| 29 | L_00020SHIMKO69-00050ROGER69C1 | NO | YES | YES | 0 | | | | 3 |
| 30 | L_00021WOLEN69-00048BOB69C1 | NO | YES | YES | 0 | | | | 1 |
| 31 | L_00021WOLEN69-00048BOB69C2 | NO | YES | YES | 0 | | | | 1 |
| 32 | L_00024HALE69-00044LAUF69C1 | NO | YES | YES | 0 | | | | 2 |
| 33 | T_00028JO345-00029JO138C1 | NO | YES | YES | 0 | | | | 2 |
| 34 | T_00028JO345-00029JO138C2 | NO | YES | YES | 0 | | | | 2 |
| 35 | L_00031SLACK345-00028JO345C1 | NO | YES | YES | 0 | | | | 4 |
| 36 | L_00032SAVOY138-00029JO138C1 | NO | YES | YES | 0 | | | | 2 |
| 37 | L_00029JO138-00041LAUF138C1 | NO | YES | YES | 0 | | | | 2 |
| 38 | L_00056LYNN138-00029JO138C1 | NO | YES | YES | 0 | | | | 1 |
| 39 | L_00030BUCKY138-00032SAVOY138C1 | NO | YES | YES | 0 | | | | 2 |
| 40 | L_00030BUCKY138-00041LAUF138C1 | NO | YES | YES | 0 | | | | 2 |
| 41 | T_00035SLACK138-00031SLACK345C1 | NO | YES | YES | 0 | | | | 2 |
| 42 | L_00031SLACK345-00038RAY345C1 | NO | YES | YES | 0 | | | | 4 |
| 43 | T_00033SAVOY69-00032SAVOY138C1 | NO | YES | YES | 0 | | | | 1 |
| 44 | L_00033SAVOY69-00050ROGER69C1 | NO | YES | YES | 0 | | | | 2 |
| 45 | L_00035SLACK138-00039RAY138C1 | NO | YES | YES | 0 | | | | 2 |
| 46 | L_00035SLACK138-00056LYNN138C1 | NO | YES | YES | 0 | | | | 2 |
| 47 | T_00039RAY138-00038RAY345C1 | NO | YES | YES | 0 | | | | 2 |
| 48 | T_00039RAY138-00038RAY345C2 | NO | YES | YES | 0 | | | | 2 |
| 49 | L_00039RAY138-00040TIM138C1 | NO | YES | YES | 0 | | | | 2 |

Sebastien ST. Hilaire
EEL 4216
Final Design Project
12/05/23

NUMBER AND LENGTH OF TRANSMISSION LINE

| BUS | LENGTH(Km) | LINE TYPE | COST |
|-----------------|------------|-------------------|-------------------|
| CCW TO SHIMKO | 6.43 | CARDINAL | 1,993,300 |
| SAVOY TO SHIMKO | 9.65 | CARDINAL | 2,991,500 |
| SHIMKO TO WOLEN | 19.31 | CROW | 5,213,700 |
| CCW TO LYNN | 8.046 | CONDOR | 2,333,340 |
| | | FIXED COST | 800,000 |
| | | TOTAL COST | 13,281,840 |

TRANSFORMER COST

187 MVA (2) - \$2,400,000

BUS WORK

Upgrade 69-kV substation to 138/69 kV (2) - \$400,000

PROFIT

$((9.79(\text{NEW LOSS}) - 9.78(\text{SYSTEM LOSS})) * 24 \text{ HOUR/DAY} * (365 \text{ DAY/YEAR} * (5+1 \text{ LEAP YEAR}))) * 55 = 28908$

PROJECT TOTAL COST

\$16,081,840 w/ 28908 PROFIT

CONCLUSION

I was more focused on making the design work with no violation of the cost of everything into consideration. Looking at everything my first approach would be to use the cardinal line only on short distance and see if I'm able to use the cheaper lines on longer distances. As well as using cheaper transformer. Another approach is making the system work first then see what you can alter lowering your cost. In all, balancing a given budget vs making the system work there will be tough decisions along the way of developing a project.