

Table UP-5-RE: U.P. Robust Economy Future –U.P. Preliminary Solutions Groups

Individual Solutions Not Common To All Solutions Groups

| U.P. Zone | Solutions Group A | | Solutions Group B | |
|-----------|-------------------|---|-------------------|---|
| | Map Item # | Solutions Description | Map Item # | Solutions Description |
| Western | W1 | Lakota Rd-Mass-Winona 138 kV rebuild (68 mi) , new Mass 138/69 kV transformer | W1a | Lakota Rd-Mass-Winona 138/69 kV rebuild (68 mi), new Mass 138/69 kV transformer |
| Western | W10 | Rebuild M38-Atlantic 69 kV line at 138 kV (22 mi), add 2 nd Atlantic 138/69 kV transformer | W12 | Winona-Atlantic 138 kV rebuild (22 mi) , add 2 nd Atlantic 138/69 kV transformer |
| Central | C1 | New Lakehead-Rapid River 138/69 kV 150 MVA + reconductor 69 kV line to Lakehead Tap | C3a | Add a 2 nd identical Chandler 138/69 kV transformer |
| Central | C12 | Rebuild Gwinn-Munising 69 kV line @ 69 kV (45 mi) | C15 | Rebuild Munising-Seney 69 kV line, new Seney-Roberts 69 kV line (34 mi, 24 mi) |
| Eastern | E3 | Add a 138 kV phase-shifting transformer at Straits (10° shift) | E3 | Add a 138 kV phase-shifting transformer at Straits (30° shift) |
| Eastern | E4 | Pine River-Straits 2x69 kV rebuild at 69/69 kV (25 mi) | | |
| Eastern | E2 | Uprate the overhead portions of Straits-McGulpin 138 kV circuits #1 & #3 to 230° F | | |
| Eastern | E20 | Add a 2 nd 8.16 MVAR 138 kV capacitor bank at Hiawatha | | |
| Eastern | E6 | Uprate Pine River-9 Mile 69 kV line 6923 to 167° F | | |

All solutions groups assume the retirement of the Munising 69 kV voltage regulator

Solutions Common to All Solutions Groups

| U.P. Zone | Map Item # | Solutions Description |
|-----------|------------|--|
| Western | W16 | Adjust the Iron Grove/Aspen 138/69 kV transformer no-load tap ratios to unity |
| Western | W15 | Add a 2 nd Iron Grove 138/69 kV transformer |
| Western | W19 | Uprate the Atlantic-Henry St. 69 kV line to 167° F |
| Western | W24 | Uprate the Ontonagon-UPPSCO Tap 69 kV line to 185° F |
| Western | W14 | Add a 2 nd M38 138 kV 8.16 MVAR capacitor bank |
| Western | W22 | Reconductor the Atlantic-Elevation St. Tap #2-Osceola 69 kV line |
| Western | W23 | Add 100% power factor correction to the Keweenaw point load |
| Western | W25 | Replace the Ontonagon 138/69 kV transformer with 60 MVA unit |
| Western | W27 | Adjust the Atlantic 138/69 kV transformer(s) LTC Vhigh/Vlow settings to 1.03/1.01 pu |
| Central | C2a | Uprate Escanaba-area 69 kV loop to 167°/200° F SE |
| Central | C18a | Reconductor Gwinn-Sawyer 69 kV line with 336 ACSR conductors |
| Central | C21 | Arnold 345 kV SS, 345/138 kV 500 MVA xfmr |
| Central | C30 | Uprate North Lake-Barnum Tap 69 kV line to 120° F |
| Central | C22 | New Escanaba 69 kV substation |
| Central | C27 | Uprate the North Lake 138/69 kV transformer #1 to 50 MVA |
| Central | C28 | Uprate the Big Q-Kingsford Metals Tap 69 kV line to 84 MVA (SS limiters) |
| Central | C29 | Uprate the Plains-Bluff View Tap 69 kV line to 46 MVA (SS limiters) |
| Central | C31 | Add 100% distribution power factor correction to the Harris point load addition |
| Central | C32 | Increase the Nordic 138/69 kV transformer LTC voltage settings by 1% |
| Eastern | E14 | Adjust the Hiawatha 138/69 kV transformer no-load tap ratios to unity |