

**Table UP-5-DW: DOE 20% Wind Future – U.P. Preliminary Solutions Groups**

**Individual Solutions Not Common To All Solutions Groups**

U.P. Zone	Solutions Group A		Solutions Group B		Solutions Group C	
	Map Item #	Solutions Description	Map Item #	Solutions Description	Map Item #	Solutions Description
Western	W1	Lakota Rd.-Mass-Winona 69 kV rebuild at 138 kV (68 mi)	W1a	Lakota Rd.-Mass-Winona 69 kV rebuild at 138/69 kV (68 mi)	W17	New Winona-Perch Lake 138 kV line (68 mi)
Western	W9	M38-Atlantic 69 kV line rebuild at 69 kV (22 mi)	W10	M38-Atlantic 69 kV line (22 mi) rebuild at 138 kV, add a 2 <sup>nd</sup> identical 138/69 kV transformer at Atlantic	W9	M38-Atlantic 69 kV line rebuild at 69 kV (22 mi)
Western					W20	Reconductor the Mass-Bruce Crossing 69 kV line (18.6 mi)
Central	C21	New Arnold 345 kV SS, 345/138 kV 500 MVA xfmr	C21	New Arnold 345 kV SS, 345/138 kV 500 MVA xfmr	C9	New Chalk Hills-New Page 1-ckt 138 kV line (50 mi)
Central	C8	New Chandler-New Page 2-ckt 138 kV lines (6 mi ea)	C8	New Chandler-New Page 2-ckt 138 kV lines (6 mi ea)	C7	New Chandler-New Page 1-ckt 138 kV line (6 mi)
Central	C15	Rebuild Munising-Seney 69 kV line, new Seney-Roberts 69 kV line (34 mi, 24 mi)	C14	Rebuild Munising-Seney-Blaney 69 kV line (52 mi)	C13	Rebuild the Forsyth-Gwinn-Munising 69 kV line (45 mi) at 138 kV, add a 2 <sup>nd</sup> identical 138/69 kV transformer at Munising
Central					C24	Add a 2 <sup>nd</sup> identical 138/69 kV transformer at Forsyth
Eastern	E4	Rebuild the Pine River-Straits double-circuit 69 kV lines (25 mi ea) at 69 kV, 138 kV standards	E4	Rebuild the Pine River-Straits double-circuit 69 kV lines (25 mi ea) at 69 kV, 138 kV standards	E3	Add a 138 kV phase-shifting transformer at Straits (10° shift)

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

Note: Solutions Group C, which originally included a new 138 kV line between Ironwood (Xcel) and Ontonagon, resulted in unacceptable voltage and loading performance within the Xcel system. It was replaced with the Winona-Perch Lake 138 kV line option.

**Solutions Common to All Solutions Groups**

U.P. Zone	Map Item #	Solutions Description
Western	W14	Add a 2 <sup>nd</sup> M38 138 kV 8.16 MVAR capacitor bank
Western	W15	Add a 2 <sup>nd</sup> Iron Grove 138/69 kV transformer
Western	W16	Adjust the Iron Grove/Aspen 138/69 kV xfmr fixed tap ratios to unity
Western	W18	New Elevation St. 69 kV substation
Western	W19	Uprate Atlantic-Henry St. 69 kV line to 167° F (48 MVA)
Central	C5	New Page 138 kV SS + 2 138/69 kV transformers
Central	C6	New Page 138 kV 16.33 MVAR capacitor bank
Central	C3	Replace Chandler 138/69 kV xfmr with 150 MVA
Central	C22	New Escanaba 69 kV substation
Central	C23	Uprate Delta-Mead 69 kV line to 200° F
Central	C10	New Forsyth-Gwinn 69 kV line #2 (0.8 mi)
Central	C18	Uprate Gwinn-Sawyer 69 kV line to 167° F
Central	C25	Uprate the Escanaba #1 69 kV line (Delta-Escanaba) to 55 MVA
Central	C26	Uprate the Escanaba #2 69 kV line (Delta-West Side Tap-Escanaba) to 55 MVA
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)
Eastern	E14	Adjust the Hiawatha 138/69 kV transformer no-load tap ratios to unity

