Presque Isle Remedial Action Tripping Scheme Year 2007 System Conditions

March 21, 2007

3/21/2007

Preliminary Results - Subject to Change



RATS Relay S	etting, Chan	ges due to Stal						
		Presque Isle to Empire		Presque Isle	e to National	Presque Isle to Empire		
Fault Location	Fault Type	Existing	New Stability	Existing	New Stability	Existing	New Stability	
0-25%	3PG	2	3	2	3	2	3	
	2PG	3	3	2	3	3	3	
	1PG	3	No Trip Sent	3	No Trip Sent	3	No Trip Sent	
	OPG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
25-100%	3PG	3	No Trip Sent	3	No Trip Sent	3	No Trip Sent	
	2PG	3	No Trip Sent	3	No Trip Sent	3	No Trip Sent	
	1PG	3	No Trip Sent	3	No Trip Sent	3	No Trip Sent	
	OPG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
		Presque Is	le to Cedar	Presque Isle	e to Freeman			
Fault Location	Fault Type	Existing	New Stability	Existing	New Stability			
0-35%	3PG	2	3	2	3			
	2PG	3	3	3	3			
	1PG	3	No Trip Sent	3	No Trip Sent			
	OPG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent			
35-100%	3PG	3	No Trip Sent	3	No Trip Sent			
	2PG	3	No Trip Sent	3	No Trip Sent			
	1PG	3	No Trip Sent	3	No Trip Sent			
	OPG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent			
		Presque Isle	to Perch Lake					
Fault Location	Fault Type	Existing	New Stability					
0-30%	3PG	2	3					
	2PG	3	3					
	1PG	3	No Trip Sent					
	OPG	No Trip Sent	No Trip Sent					
30-50%	3PG	3	No Trip Sent					
	2PG	3	No Trip Sent					
	1PG	3	No Trip Sent					
	OPG	No Trip Sent	No Trip Sent					
50-100%	3PG	No Trip Sent	No Trip Sent					
	2PG	No Trip Sent	No Trip Sent					
	1PG	No Trip Sent	No Trip Sent					
	OPG	No Trip Sent	No Trip Sent					
$\overline{07}$		D	roliminary	ubject to				

RATS Relay Setting, Changes due to Stability							
		Empire t	o Forsyth				
Fault Location	Fault Type	Existing	New Stability				
0-70%	3PG	2	No Trip Sent				
	2PG	3	No Trip Sent				
	1PG	3	No Trip Sent				
	OPG	No Trip Sent	No Trip Sent				
70-100%	3PG	3	No Trip Sent				
	2PG	3	No Trip Sent				
	1PG	3	No Trip Sent				
	OPG	No Trip Sent	No Trip Sent				
		Cedar to	National	Freeman	to Cedar	Cedar t	o Tilden
Fault Location	Fault Type	Cedar to Existing	National New Stability	Freeman Existing	to Cedar New Stability	Cedar t Existing	o Tilden New Stability
Fault Location D-100%	Fault Type 3PG	Cedar to Existing 3	National New Stability <mark>No Trip Sent</mark>	Freeman Existing 3	to Cedar New Stability <mark>No Trip Sent</mark>	Cedar t Existing 3	o Tilden New Stability No Trip Sent
Fault Location 0-100%	Fault Type 3PG 2PG	Cedar to Existing 3 3	National New Stability No Trip Sent No Trip Sent	Freeman Existing 3 3	to Cedar New Stability No Trip Sent No Trip Sent	Cedar t Existing 3 3	o Tilden New Stability No Trip Sent No Trip Sent
Fault Location 0-100%	Fault Type 3PG 2PG 1PG	Cedar to Existing 3 3 3	National New Stability No Trip Sent No Trip Sent No Trip Sent	Freeman Existing 3 3 3	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent	Cedar t Existing 3 3 3	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent
Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG	Cedar to Existing 3 3 3 No Trip Sent	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent	Freeman Existing 3 3 3 No Trip Sent	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent	Cedar t Existing 3 3 3 No Trip Sent	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent
Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG	Cedar to Existing 3 3 3 No Trip Sent	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent	Freeman Existing 3 3 3 No Trip Sent	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent	Cedar t Existing 3 3 3 No Trip Sent	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent
Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG	Cedar to Existing 3 3 3 No Trip Sent Tilden to	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National	Freeman Existing 3 3 3 No Trip Sent Empire to	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent	Cedar t Existing 3 3 3 No Trip Sent White Clay	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent
Fault Location 0-100% Fault Location	Fault Type 3PG 2PG 1PG 0PG Fault Type	Cedar to Existing 3 3 3 No Trip Sent Tilden to Existing	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National New Stability	Freeman Existing 3 3 No Trip Sent Empire to Existing	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent No Trip Sent New Stability	Cedar t Existing 3 3 3 No Trip Sent White Clay Existing	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent to Morgan New Stability
Fault Location 0-100% Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG Fault Type 3PG	Cedar to Existing 3 3 No Trip Sent Tilden to Existing 3	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National New Stability No Trip Sent	Freeman Existing 3 3 No Trip Sent Empire to Existing 3	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National New Stability No Trip Sent	Cedar t Existing 3 3 No Trip Sent White Clay Existing 3	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent to Morgan New Stability No Trip Sent
Fault Location 0-100% Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG Fault Type 3PG 2PG	Cedar to Existing 3 3 No Trip Sent Tilden to Existing 3 3	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National New Stability No Trip Sent No Trip Sent	Freeman Existing 3 3 No Trip Sent Empire to Existing 3 3	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent New Stability No Trip Sent No Trip Sent	Cedar t Existing 3 3 No Trip Sent White Clay Existing 3 3	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent to Morgan New Stability No Trip Sent No Trip Sent
Fault Location 0-100% Fault Location 0-100%	Fault Type 3PG 2PG 1PG 0PG PG Fault Type 3PG 2PG 1PG	Cedar to Existing 3 3 No Trip Sent Tilden to Existing 3 3 3	National New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent National New Stability No Trip Sent No Trip Sent No Trip Sent	Freeman Existing 3 3 No Trip Sent Empire to Existing 3 3 3	to Cedar New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent New Stability No Trip Sent No Trip Sent No Trip Sent	Cedar t Existing 3 3 No Trip Sent White Clay Existing 3 3 3	o Tilden New Stability No Trip Sent No Trip Sent No Trip Sent No Trip Sent New Stability No Trip Sent No Trip Sent No Trip Sent

RATS Relay Setting, Changes due to Stability								
		Plains t	o Arnold	Plains to	Amberg	Plains to Nordic		
Fault Location	Fault Type	Existing	New Stability	Existing	New Stability	Existing	New Stability	
0-100%	3PG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
	2PG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
	1PG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
	OPG	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	No Trip Sent	
		Plains to M	organ 345kV					
Fault Location	Fault Type	Existing	New Stability					
0-100%	3PG	3	3					
	2PG	3	3					
	1PG	3	3					
	OPG	3	3					

RATS Relay Setting, Elements that may change for Thermal Issues									
Presque Isle t	to Dead Riv	/er 138kV					Plair	ns 345kV/138kV	V Xfmr
Fault Location	Fault Type	Existing	New Stability	Thermal	Fault Loca	Fault Type	Existing	New Stability	Thermal
0-100%	3PG	1	1	1	0-100%	3PG	2	No Trip Sent	3
	2PG	1	1	1		2PG	2	No Trip Sent	3
	1PG	2	2	1		1PG	3	No Trip Sent	3
	OPG	2	3	1		OPG	3	No Trip Sent	3
Dead River 34	I5kV to Pla	ins 345kV							
Fault Location	Fault Type	Existing	New Stability	Thermal					
0-40%	3PG	2	2	1					
	2PG	2	2	1					
	1PG	3	3	1					
	OPG	3	3	1					
40-100%	3PG	2	2	1					
	2PG	2	2	1					
	1PG	3	3	1					
	OPG	3	3	1					

Example of Thermal Constraints

Table	8H	Contingenc	y: Dead River - Pl	ains 345 kV 🔄 👘						
Monitored line (ratings in MVA)	SN	SE	WN	WE						
Empire - Forsyth	195	202	201	229						
					-	1	1	1		
Season				100 Peak W to E	100 Peak W to E	100 Peak W to E	100 Peak W to E	100 Peak W to E	100 Peak W to E	100 Peak W to E
Mine load (MVV)				20	20	20	150	150	150	300
Presq. Output (MVV)				556	487	413	556	531	442	556
Flow North (MVV)				442	3/7	306	316	292	208	168
Flow North + Mine (MVV)				462	397	326	466	442	358	468
Marquette Net Export (MVV)				30	30	30	30	30	30	30
MW tripped for Level 1 (curve)				235	172	103	239	215	134	240
MW tripped for Level 2 (curve)				192	101	0	124	95	0	107
MW tripped for Level 3 (curve)				89	0	O	28	0	l o	13
Empire-Forsyth Over load %	No mine loa	d trip		167	134	113	112	106	82	68
Required lower PIPP (MW)	No mine loa	d trip		365	360	360	490	490	490	556
Required MW reduction	No mine loa	d trip		191	127	53	66	41	0	0
	500(474	407	445		400	405	440
Empire-Forsyth Over load %	50% mine lo	oad trip		1/4	137	115	141	130	105	116
Required lower PIPP (MVV)	50% mine lo	oad trip		350	350	350	400	400	400	490
Required MVV reduction	50% mine id	oad trip		206	137	63	156	131	42	66
Empire-Forsyth Over load %	100% mine	load trip		Not Converged	141	119	Not Converged	157	127	Not Converged
Required lower PIPP (MW)		load trip		325 Ŭ	325	325	325	325	325	325 Ŭ
Required MW reduction	100% mine	load trip		231	162	88	231	206	117	231
Worst Case % Loading Beyond E	xisting RATS			130	139	127	127	128	130	132
	Flt location	Flt type	% mine load trip	Required Level	Required Level	Required Level	Required Level	Required Level	Required Level	Required Level
Deed Diver Distre	0.4- 400/	200	100		D > 1 /C1 M00A		2 × 1 /107 MM			
Dead River - Plains	01040%		100	2 -> 1 (39 1V1VV)	2->1 (01 IVIVV)	2->1 (00 IVIVV)	2 -> 1 (107 1010)	ין 2 - > ד (דוד אועע ר > 1 ספ אמות	12-21 (117 MMV) 15 54 745 MMA	(Z-> (Z4 ₩₩ ▼⊃
		2FG72FF	50	2 -> 1 (14 1V1VV)	∠-> (30 IVIVV) 2 > 1 (407 M00)	2->1 (03 1V1VV) 2 > 1 (53 M/MA	2 - 2 1 (32 10100)	2-21 (30 10100)	Z - 2 T (42 IVIVV) Zo	2
		ing anon ling	0	3 -> 2 (102 MM) 2 -> 2 (102 MM)	1 3 - 2 I (IZ7 IVIVV 1 3 - 5 I (137 MAN)	1 3 - 2 1 (53 IVIVV) 1 3 - 2 1 (53 IVIVV)	3 - 2 2 (30 IVIVV) 2 < 2 (30 IVIVV)	13-22 (41 IVIVV) 12 5 7 (41 MANA)		3 73
		obeu iine	U	3 -> 2 (102 MM	n o-≥i (i∠n wivv]	3 - 2 T (55 IVIVV) 	3 - 2 (30 IVIVV)	3 -> 2 (41 WIVV)	3	3
	40 to 100%	3PG	50	2->1 (14 MW)	2->1 (36 MW)	2->1 (63 MW)	2->1 (32 MW)	2->1 (36 MW)	2->1 (42 MW)	2
		2PG / 2PP	0	2	2->1 (26 MW)	2->1 (53 MW)	2	2	2	2
		1PG	0	3 -> 2 (102 MW	/] 3 -> 1 (127 MW	∫3->1 (53 MW)	3->2 (38 MW)	3->2 (41 MW)	3	3
		open line	0	3 -> 2 (102 MW	/3->1 (127 MW	3->1 (53 MVV)	3->2 (38 MW)	3->2 (41 MW)	3	3
Presque Isle - Dead River	0 to 100%	386	100	1	1	1	1	1	1	1
r residue isle - Deau Kivel	0.10.10070	2PG / 2PP	100		1		1	1	1	
		1PG	50	2-> 1 (14 MMA)	2-> 1 (36 MMA)	2-> 1 (63 MMA)	2-> 1 (32 MMA)	2-> 1 (36 MMA)	2-> 1 (42 MMA)	2
		open line	0	2	2->1 (26 MW)	2->1 (53 MW)	2	2	2	2
2/24/2007			 Dral	inne inn ann í D				1		

3/21/2007

Preliminary Results - Subject to Change

Presque Isle output vs. Voltage



Notes:

- 1. ML is the total Empire + Tilden mine load in MW.
- 2. 345 open means the Dead River Plains 345kV line is out of service
- 3. Transformer LTCs were locked due to convergence issues with letting them adjust at high PI output.
- 4. Switch shunts, phase shifters, and DC ties were allowed to adjust normally.

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3/21/2007
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Preliminary Results - Subject to Change

Potential Green Bay Area Issues for Level 1 Tripping

Case	Peak, W-E Bias
Mine load (MW)	300
Presq. Output (MW)	556
Flow North (MW)	168
Flow North + Mine (MW)	468
Marquette Net Export (MW)	30
MW tripped for Level 1 (curve)	240
MW tripped for Level 2 (curve)	107
MW tripped for Level 3 (curve)	13

High W-E Bias

High Bias							
MW reduced	New PI Output	NAP-LWN overload	PUL-STI overload				
240	316	104%	102%				
288	268	110%	112%				
292	264	111%	113%				

High W-E Bias less 1000MW transfer from ComEd to METC

High Bias-1000MW							
MW reduced	New PI Output	NAP-LWN overload	PUL-STI overload				
240	316	101%	98%				
288	268	107%	107%				
292	264	108%	108%				

Notes:

1.PI=556-240=316MW. 240MW is the calculated value for a level 1 trip when PI is at 556MW and the mines are at 300MW.

2.PI=556-288=268MW. 288MW is the calculated value with 20% additional.

3.PI=556-292=264MW. When all units are at Pmax, it's impossible to trip exactly 240MW or 288MW. The Flow South page on EMS implies PI will select units 3 and 4 first, 5 and 6 second, and 7, 8, or 9 last. The choice is up to PI, of course, but 292MW is the loss of units 3-6 at Pmax.

Other thermal issues

• Plains 345/138-kv Transformer Results

Table 16	Analysis of Plains 345/138 kV transformer for the loss of Plains-Morgan 345 kV									
	Ratings	Mine load		% load		Flow	% ovi at	% ovl at	% ovl at 530	% ovi at
Senario	(MVA)	(MW)	PIPP (MW)	tripped	% ovi	North	550 MW	540 MW	MW	520 MW
100% peak										
East to West	250	20	556	0	103	448	101	99	97	95
100% peak										
East to West	250	20	556	50	105	448	103	101	99	97
100% peak		J		·				[
Split	250	20	556	0	105	448	104	101	99	97
100% peak										
Split	250	20	556	50	107	448	105	103	101	99
Comments: Level 3 trip addresses Plains transformer overloading for all conditions.										

 Dead River-Plains 345-kV contingency could overload Presque Isle-Perch Lake but Level 1 trip will mitigate as well