Appendix B: Stability Analysis Results

Nomenclature

K or KEW:	Kewaunee
P or POB:	Point Beach (P1 and P2)
S or SEC:	Sheboygan Energy Center
F or FOX:	Fox Energy
NAP:	North Appleton
GVL:	Granville
CYP:	Cypress
ADN:	Arcadian
FJT	Forest Junction
TH:	Thilmany
L111:	Point Beach-Sheboygan Energy Center 345 kV line
L121:	Point Beach-Forest Junction 345 kV line
Q303:	Point Beach-Kewaunee 345 kV line
L151:	Point Beach-Fox Energy 345 kV line
R304:	Kewaunee-North Appleton 345 kV line
NAPL71:	North Appleton-Werner West 345 kV line
CYP31:	Cypress-Arcadian 345 kV line
6832:	North Appleton-Fox Energy Center 345 kV line
T10:	Kewaunee T10 345/138 kV transformer
SEC31:	Sheboygan Energy Center-Granville 345 kV line
H:	High side
KWH:	Kewaunee T10 High side
KWL:	Kewaunee T10 Low side
POBxy:	Point Beach bus tie xy
Y311	North Appleton-Fitzgerald 345 kV line
CCT:	Critical Clearing Time

Note: The simulated clearing times and critical clearing times (CCT) noted in Appendix B contains planning margin described in Section 3.2

Table B.1- Stability Results for Faults Clearing in Primary Time under Intact System Conditions

Interim 1 (with G834/J023, with existing Kewaunee substation)

Intact System Fault Cleared in Primary Time - Interim Period 1 (May 2010~April 2011)									
Event File	Element Faulted	Fault Location	Faulted End Breakers	Remote Location	Remote End Breakers	Event Notes	Simulated Clearing*	High Generation	Low Generation
FltPOBSEC	L111	POB	111	SEC	1-2, 1-6	No SPS	4.5/4.5	OK	OK
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	OK	OK
FltPOBFOX	L151	POB	151	FOX	2-3, 3-4	No SPS	4.5/4.5	OK	OK
FltPOBKEW2	Q-303	POB	Q-303	KEW	Q-303, 1099, 3450	KEW SPS In	4.5/6.5	OK	OK
FltKEWPOB3r	Q-303	KEW	Q-303, 1099, 3450	POB	Q-303	KEW SPS In	6.5/4.5	OK	OK
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	OK	OK
FltFOXPOB	L151	FOX	2-3, 3-4	POB	151		4.5/4.5	OK	OK
FltFOXNAP	L6832	FOX	1-2, 6-1	NAP	34-3, 34-4, 45-4, 67-6		4.5/4.5	OK	OK
FltFOXFJT	971L71	FOX	4-5, 5-6	FJT	5-6, 7-1		4.5/4.5	OK	OK
FltSECPOB	L111	SEC	1-2, 1-6	POB	111		4.5/4.5	OK	OK
FltSECGVL	L-SEC31	SEC	1-2, 3-6	GVL	L-SEC31		4.5/6.5	OK	OK
FltCYPADN	L-CYP31	CYP	1-2, 5-6	ADN	L-CYP31		4.5/4.5	OK	OK
FLTKEWXFH2R01	T10	KWH	Q-303, 1099, 3450	KWL	1066E, 1066W	Open Q-303 at KEW	6.5/8.5	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Intact System Fault Cleared in Primary Time - Interim Period 2A (April 2011 and beyond, with existing Kewaunee)									
Event File	Element Faulted	Fault Location	Faulted End Breakers	Remote Location	Remote End Breakers	Event Notes	Simulated Clearing*	High Generation	Low Generation
FltPOBSEC	L111	POB	111	SEC	1-2, 1-6	No SPS	4.5/4.5	OK	OK
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	OK	OK
FltPOBFOX	L151	POB	151	FOX	2-3, 3-4	No SPS	4.5/4.5	OK	OK
FltPOBKEW2	Q-303	POB	Q-303	KEW	Q-303, 1099, 3450	KEW SPS In	4.5/6.5	OK	OK
FltKEWPOB3r	Q-303	KEW	Q-303, 1099, 3450	POB	Q-303	KEW SPS In	6.5/4.5	OK	OK
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	OK	OK
FltFOXPOB	L151	FOX	2-3, 3-4	POB	151		4.5/4.5	OK	OK
FltFOXNAP	L6832	FOX	1-2, 6-1	NAP	34-3, 34-4, 45-4, 67-6		4.5/4.5	OK	OK
FltFOXFJT	971L71	FOX	4-5, 5-6	FJT	5-6, 7-1		4.5/4.5	OK	OK
FltSECPOB	L111	SEC	1-2, 1-6	POB	111		4.5/4.5	OK	OK
FltSECGVL	L-SEC31	SEC	1-2, 3-6	GVL	L-SEC31		4.5/6.5	OK	OK
FltCYPADN	L-CYP31	CYP	1-2, 5-6	ADN	L-CYP31		4.5/4.5	OK	OK
FLTKEWXFH2R01	T10	KWH	Q-303, 1099, 3450	KWL	1066E, 1066W	Open Q-303 at KEW	6.5/8.5	OK	OK

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

Intact System Fault Cleared in Primary Time - Interim Period 2B (April 2011 and beyond, with Kewaunee Project)									
Event File	Element Faulted	Fault Location	Faulted End Breakers	Remote Location	Remote End Breakers	Event Notes	Simulated Clearing*	High Generation	Low Generation
FltPOBSEC	L111	POB	111	SEC	1-2, 1-6	No SPS	4.5/4.5	OK	OK
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	OK	OK
FltPOBFOX	L151	POB	151	FOX	2-3, 3-4	No SPS	4.5/4.5	OK	OK
FltPOBKEW	Q-303	POB	Q-303	KEW	Q-303 New 1 and 2	No SPSs	4.5/4.5	OK	OK
FltKEWPOB	Q-303	KEW	Q-303 New 1 and 2	POB	Q-303	No SPSs	4.5/4.5	OK	OK
FltKEWNAP	R-304	KEW	R-304 New 1 and 2	NAP	R-304		4.5/6.5	OK	OK
FltFOXPOB	L151	FOX	2-3, 3-4	POB	151		4.5/4.5	OK	OK
FltFOXNAP	L6832	FOX	1-2, 6-1	NAP	34-3, 34-4, 45-4, 67-6		4.5/4.5	OK	OK
FltFOXFJT	971L71	FOX	4-5, 5-6	FJT	5-6, 7-1		4.5/4.5	OK	OK
FltSECPOB	L111	SEC	1-2, 1-6	POB	111		4.5/4.5	OK	OK
FltSECGVL	L-SEC31	SEC	1-2, 3-6	GVL	L-SEC31		4.5/6.5	OK	OK
FltCYPADN	L-CYP31	CYP	1-2, 5-6	ADN	L-CYP31		4.5/4.5	OK	OK
FltKEWXFH	T10	KWH	T10 High Side	KWL	T10 Low Side		5.5/5.5	OK	OK

Table B.2- Stability Results for Double Circuit Single Line-to-Ground Faults Cleared in Primary Time under Intact System Conditions

Interim 1 (with G834/J023, with existing Kewaunee substation)

Event File	Fault #1	Fault #1 Location	Acceptable CCT*	Fault #2	Fault #2 Location	Simulated Clearing time	Interim Period 1 (May 2010~Apr 2011)	
							High Gen	Low Gen
DC3-111-971K51-1	L111 - Point Beach-Sheboygan 345 kV	38.5% from POB	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-111-971K51-2	L111 - Point Beach-Sheboygan 345 kV	16.3% from SEC	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	6.3% from HOG	6.5/6.5	OK	OK
DC3-111-HOLG21-1	L111 - Point Beach-Sheboygan 345 kV	SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	76.9% from HOL	6.5/6.5	OK	OK
DC3-111-HOLG21-2	L111 - Point Beach-Sheboygan 345 kV	15.7% from SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	31.4% from HOG	6.5/6.5	OK	OK
DC3-121-971K51-1	L121-Pt. Beach-Forest Junction 345 kV	FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	FJT	6.5/6.5	OK	OK
DC3-121-971K51-2	L121-Pt. Beach-Forest Junction 345 kV	42.3% from FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-SEC31-3431-1	L-SEC31 - Sheboygan-Granville 345 kV	GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	GVL	7.5/7.5	OK	OK
DC3-SEC31-3431-2	L-SEC31-Sheboygan-Granville 345 kV	26.7% from GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	25.3% from SAU	7.5/7.5	OK	OK
DC3-SEC31-8231-1	L-SEC31-Sheboygan-Granville 345 kV	43.5% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from BRT	7.5/7.5	OK	OK
DC3-SEC31-8231-2	L-SEC31-Sheboygan-Granville 345 kV	48.3% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-1	L- CYP31 - Cypress-Arcadian 345 kV	32.0% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	34.2% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	GER	7.5/7.5	OK	OK
DC3-9932-2661-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	31.5% from GER	8.5/8.5	OK	OK
DC3-9932-2661-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	GER	8.5/8.5	OK	OK
DC3-9932-9911-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	45.4% from GVL	7.5/7.5	OK	OK
DC3-9932-9911-2	L- CYP31 - Cypress-Arcadian 345 kV	ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	ADN	7.5/7.5	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Event File	Fault #1	Fault #1 Location	Acceptable CCT*	Fault #2	Fault #2 Location	Simulated Clearing time	Interim Period 2A (May 2011 ~), W existing Kew	
							High Gen	Low Gen
DC3-111-971K51-1	L111 - Point Beach-Sheboygan 345 kV	38.5% from POB	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-111-971K51-2	L111 - Point Beach-Sheboygan 345 kV	16.3% from SEC	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	6.3% from HOG	6.5/6.5	OK	OK
DC3-111-HOLG21-1	L111 - Point Beach-Sheboygan 345 kV	SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	76.9% from HOL	6.5/6.5	OK	OK
DC3-111-HOLG21-2	L111 - Point Beach-Sheboygan 345 kV	15.7% from SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	31.4% from HOG	6.5/6.5	OK	OK
DC3-121-971K51-1	L121-Pt. Beach-Forest Junction 345 kV	FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	FJT	6.5/6.5	OK	OK
DC3-121-971K51-2	L121-Pt. Beach-Forest Junction 345 kV	42.3% from FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-SEC31-3431-1	L-SEC31 - Sheboygan-Granville 345 kV	GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	GVL	7.5/7.5	OK	OK
DC3-SEC31-3431-2	L-SEC31-Sheboygan-Granville 345 kV	26.7% from GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	25.3% from SAU	7.5/7.5	OK	OK
DC3-SEC31-8231-1	L-SEC31-Sheboygan-Granville 345 kV	43.5% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from BRT	7.5/7.5	OK	OK
DC3-SEC31-8231-2	L-SEC31-Sheboygan-Granville 345 kV	48.3% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-1	L- CYP31 - Cypress-Arcadian 345 kV	32.0% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	34.2% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	GER	7.5/7.5	OK	OK
DC3-9932-2661-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	31.5% from GER	8.5/8.5	OK	OK
DC3-9932-2661-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	GER	8.5/8.5	OK	OK
DC3-9932-9911-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	45.4% from GVL	7.5/7.5	OK	OK
DC3-9932-9911-2	L- CYP31 - Cypress-Arcadian 345 kV	ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	ADN	7.5/7.5	OK	OK

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

Event File	Fault #1	Fault #1 Location	Acceptable CCT*	Fault #2	Fault #2 Location	Simulated Clearing time	Interim Period 2B (May 2011 ~), W/ new Kew	
							High Gen	Low Gen
DC3-111-971K51-1	L111 - Point Beach-Sheboygan 345 kV	38.5% from POB	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-111-971K51-2	L111 - Point Beach-Sheboygan 345 kV	16.3% from SEC	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	6.3% from HOG	6.5/6.5	OK	OK
DC3-111-HOLG21-1	L111 - Point Beach-Sheboygan 345 kV	SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	76.9% from HOL	6.5/6.5	OK	OK
DC3-111-HOLG21-2	L111 - Point Beach-Sheboygan 345 kV	15.7% from SEC	5.5/5.5	HOGL21 - Howard's Grove-Holland 138 kV	31.4% from HOG	6.5/6.5	OK	OK
DC3-121-971K51-1	L121-Pt. Beach-Forest Junction 345 kV	FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	FJT	6.5/6.5	OK	OK
DC3-121-971K51-2	L121-Pt. Beach-Forest Junction 345 kV	42.3% from FJT	5.5/5.5	971K51 - Forest Junction-Howard's Grove 138 kV	33.9% from FJT	6.5/6.5	OK	OK
DC3-SEC31-3431-1	L-SEC31 - Sheboygan-Granville 345 kV	GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	GVL	7.5/7.5	OK	OK
DC3-SEC31-3431-2	L-SEC31-Sheboygan-Granville 345 kV	26.7% from GVL	7.5/7.5	3431 - Granville-Saukville 345 kV	25.3% from SAU	7.5/7.5	OK	OK
DC3-SEC31-8231-1	L-SEC31-Sheboygan-Granville 345 kV	43.5% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from BRT	7.5/7.5	OK	OK
DC3-SEC31-8231-2	L-SEC31-Sheboygan-Granville 345 kV	48.3% from GVL	7.5/7.5	8231 - Saukville-Barton 138 kV	36.4% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-1	L- CYP31 - Cypress-Arcadian 345 kV	32.0% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	34.2% from SAU	7.5/7.5	OK	OK
DC3-9932-2642-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2642 - Saukville-Germantown 138 kV	GER	7.5/7.5	OK	OK
DC3-9932-2661-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	31.5% from GER	8.5/8.5	OK	OK
DC3-9932-2661-2	L- CYP31 - Cypress-Arcadian 345 kV	16.6% from ADN	5.5/5.5	2661 - Germantown-Bark River 138 kV	GER	8.5/8.5	OK	OK
DC3-9932-9911-1	L- CYP31 - Cypress-Arcadian 345 kV	10.8% from ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	45.4% from GVL	7.5/7.5	OK	OK
DC3-9932-9911-2	L- CYP31 - Cypress-Arcadian 345 kV	ADN	5.5/5.5	9911 - Granville-Arcadian 345 kV	ADN	7.5/7.5	OK	OK

Table B.3- Stability Results for 3-Phase Faults Cleared in Primary Time under Prior Outage Condition Units Tripping

Note: Among various contingencies evaluated, only faults with stability issues are listed in Table B.3.

Interim 1 (with G834/J023, with existing Kewaunee substation)

Primary Clearing Time, Prior Outage: 6832 (FOX-NAP, 38894-39556), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,F,S ***	OK

*** Stable at 5.5/4.5 with G1 restricted to 560 MW gross (G1 restriction 560 MW with R304 breaker at NAP replaced). Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: SEC31 (SEC-GVL, 39865-38870), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,S,F **	OK

** Stable at 5.5/4.5 - replace R-304 breaker at NAP. 4.5 is MECT for R304 fault at KEW. Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: POB 2-3 (POB-B23, 38898-39211), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	P1 **	P1 *

* For stability, G1 needs to be restricted to 580 MW gross
** For stability, G1 needs to be restricted to 620 MW gross

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Primary Clearing Time, Prior Outage: L111 (POB-SEC, 39433-39865), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,F ***	K,P ***

*** Stable at 5.5/4.5, Replace R-304 breaker at North Appleton. Note: MECT of R304 at Kew is 4.5

Primary Clearing Time, Prior Outage: L121 (POB-FJT, 38898-39304), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	OK	K,P^

^ Stable at 5.0/4.5 or Stable at 5.5/4.5 with G2 reduced to 620 MW-replace R304 breaker at NAP. Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: L151 (POB-FJT, 38898-39304), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	OK	K,P ^

^ Stable at 5.0/4.5 or Stable at 5.5/4.5 with G2 reduced to 620 MW gross (replace R-304B at NAP and G2 at 620 MW). Existing clearing time at faulted end is 4.5 cycles without margin
Note: Without G2 reduction, Vsag will trip P with 5.5/4.5 (P1 1.513s for 19KV, P2 1.521s for 19KV , B1B5 1st 1.083s, B1B5 2nd 1.575s). Thus, if time delay can be readjusted to avoid violation, only thing to be done is replacing R-304 breaker at NAP

Primary Clearing Time, Prior Outage: R-304 (KEW-NAP, 39630-39359), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltFOXNAP	L6832	FOX	1-2, 6-1	NAP	34-3, 34-4, 45-4, 67-6		4.5/4.5	K,P,F *	OK

* Stable at 4.0/4.5 OR Stable at 4.5/4.5 with G2 reduced to 600 MW gross. At 4.5/4.5 with G2 at 620 MW, 345 kV 2nd criteria is violated: B1: 1.583s and B2: 1.583s.

Primary Clearing Time, Prior Outage: 6832 (FOX-NAP, 38894-39556), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,F,S ^^^	K,P ^^
FLTKEWXFH2R01	T10	KWH	Q-303, 1099, 3450	KWL	1066E, 1066W	Open Q-303 at KEW	6.5/8.5	P,F ***	OK at 5.0/8.5

*** Stable at 6.0/8.5 with G2 reduced to 580 MW gross. 5.0 cycle is the existing clearing time at the high side of T10 transformer.
^^ Stable at 5.5/4.5 with G2 at 580 MW (replace R-304 breaker at NAP and reduce G2 to 580 MW gross). Existing clearing time at faulted end is 4.5 cycles without margin
^^^ Stable at 5.5/4.5 with both G1 and G2 at 540 MW (replace R-304 breaker at NAP and reduce both G1 and G2 to 540 MW). Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: SEC31 (SEC-GVL, 39865-38870), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,S,F ***	K,P ****
FLTKEWXFH2R01	T10	KWH	Q-303, 1099, 3450	KWL	1066E, 1066W	Open Q-303 at KEW	6.5/8.5	K,P,S,F ^^	K,P ^

^ Stable at 6.0/8.5 with G2 at 620 (G2 reduction to 620 gross). 5.0 cycle without margin is the existing clearing time at the high side of T10 transformer.
^^ Stable at 5.5/8.5 or Stable at 6.0/8.5 with G2 at 580 MW (G2 reduction to 580 gross). 5.0 cycle without margin is the existing clearing time at the high side of T10 transformer.
*** Stable at 5.5/4.5 with G2 580 MW - Replace R-304 breaker at NAP and G2 at 580 MW gross. Existing clearing time at faulted end is 4.5 cycles without margin
**** Stable at 5.5/4.5 with G2 at 620 MW gross. Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: POB 1-2 (POB-B12, 39433-38898), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	K,P,Fs ***	K,P ***

*** Stable at 5.5/4.5. Replace R-304 breaker at NAP. Existing clearing time at faulted end is 4.5 cycles without margin

Primary Clearing Time, Prior Outage: POB 2-3 (POB-B23, 38898-39211), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	P1 *	P1 *

* For stability, G1 needs to be restricted to 580 MW gross

Primary Clearing Time, Prior Outage: POB 4-5 (POB-B45, 38900-38901), (POB PSSs In Service) Existing KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		6.5/6.5	OK	K,P ***

*** Stable at 5.5/4.5 with G2 at 620 MW (replace R-304 breaker at NAP and reduce G2 to 620 MW). Existing clearing time at faulted end is 4.5 cycles without margin

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

Primary Clearing Time, Prior Outage: 6832 (FOX-NAP, 38894-39556), (POB PSSs In Service) New KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltKEWNAP	R-304	KEW	R-304, 3451	NAP	R-304		4.5/6.5	K,P,F*	OK

* Stable at 4.5/4.5 with G2 restricted to 600 MW gross (G2 restriction 600 MW gross with R-304 breaker at NAP replaced)

Primary Clearing Time, Prior Outage: POB 2-3 (POB-B23, 38898-39211), (POB PSSs In Service) New KEW Sub									
Event	Element	Fault	Faulted End	Remote	Remote End	Event	Simulated	High Generation	Low Generation
File	Faulted	Location	Breakers	Location	Breakers	Notes	Clearing*	Base	Base
FltPOBFJT	L121	POB	121, 123	FJT	1-2, 2-3		4.5/4.5	P1 **	P1 *

* To be stable at 4.5/4.5, G1 needs to be restricted to 580 MW gross
** To be stable at 4.5/4.5, G1 needs to be restricted to 620 MW gross

Table B.4- Stability Results for 3-Phase Faults Cleared in Delayed (Breaker Failure) Time under Intact Conditions, Units Tripping

Interim 1 (with G834/J023, with existing Kewaunee substation)

Intact System Breaker Failure Events - Interim Period 1 (May 2010~April 2011)							
Event File	Element Faulted	Fault Location	Remote Location	Event Notes	Simulated clearing time	High Gen Existing	Low Gen Existing
BFIPOBSEC	L111	POB	SEC	T1X03 Tripped, Aux Moved	3.5/10.0/4.5	OK	OK
BFIPOBFOX	L151	POB	FOX	T2X03 Tripped, Aux Moved	3.5/10.0/4.5	OK	OK
BFIPOBKEW2	Q-303	POB	KEW	Trip T10 Primary, Delay POB Split	3.5/10.0/6.5	OK	OK
BFINAPKEW	R-304	NAP	KEW	Split NAP Primary, Xformer Trip BF***	5.5/14.25/5.5	OK	OK
BFIFJTPOB	L121	FJT	POB	Trips Transformer**	3.5/10.5/4.5	OK	OK
BFIFJTCYP	971L51	FJT	CYP	Trips Line 971L71**	3.5/10.5/4.5	OK	OK
BFIFJTFOX	971l71	FJT	FOX	Trips Line 971L51**	3.5/10.5/4.5	OK	OK
BFIFOXPOB2	L151	FOX (2)	POB	BF Trips Fox Unit 1	3.5/10.5/4.5	OK	OK
BFIFOXNAP2	L6832	FOX (2)	NAP	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK
BFIFOXFJT2	971L71	FOX (2)	FJT	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK
BFISECPOB1	L111	SEC (1)	POB	Do Not Trip Gen (worst case)	3.5/10.5/4.5	OK	OK
BFISECGVL1	L-SEC31	SEC (1)	GVL	Do Not Trip Gen (worst case)	3.5/10.5/6.5	OK	OK
BFICYPADN	L-CYP31	CYP	ADN	Trips CYP Units	3.5/10.5/4.5	OK	OK
BFICYPFJT	971L51	CYP	FJT	Trips CYP Units	3.5/10.5/4.5	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Intact System Breaker Failure Events - Interim Period 2A (April 2011 and beyond, W/ existing Kewaunee)												
Event	Element	Fault	Remote	Event	Simulated	High Gen			Low Gen			
File	Faulted	Location	Location	Notes	clearing time	Existing	3.5/9.5/4.5	3.5/9.25/4.5	Existing	3.5/9.5/4.5	3.5/9.25/4.5	3.5/9.0/4.5
BFIPOBSEC	L111	POB	SEC	T1X03 Tripped, Aux Moved	3.5/10.0/4.5	K,P	P ^	OK	K,P	K,P	K,P *	OK
BFIPOBFOX	L151	POB	FOX	T2X03 Tripped, Aux Moved	3.5/10.0/4.5	OK	OK	OK	K,P***	OK	OK	OK
BFIPOBKEW2	Q-303	POB	KEW	Trip T10 Primary, Delay POB Split	3.5/10.0/6.5	See Below for Detailed Study Result for Q303 breaker failure at Point Beach						
BFINAPKEW	R-304	NAP	KEW	Split NAP Primary, Xformer Trip BF**	5.5/14.25/5.5	OK	OK	OK	OK	OK	OK	OK
BFIFJTPOB	L121	FJT	POB	Trips Transformer**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFIFJTCYP	971L51	FJT	CYP	Trips Line 971L71**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFIFJTFOX	971l71	FJT	FOX	Trips Line 971L51**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFIFOXPOB2	L151	FOX (2)	POB	BF Trips Fox Unit 1	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFIFOXNAP2	L6832	FOX (2)	NAP	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK	OK
BFIFOXFJT2	971L71	FOX (2)	FJT	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK	OK
BFISECPOB1	L111	SEC (1)	POB	Do Not Trip Gen (worst case)	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFISECGVL1	L-SEC31	SEC (1)	GVL	Do Not Trip Gen (worst case)	3.5/10.5/6.5	OK	OK	OK	OK	OK	OK	OK
BFICYPADN	L-CYP31	CYP	ADN	Trips CYP Units	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK
BFICYPFJT	971L51	CYP	FJT	Trips CYP Units	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK	OK

^19kV-1.542sec, 345kV B5-1st 1.113 sec, 345 kV B5-2nd 1.558 sec. See also *
* Stable at 3.5/9.0/4.5.Relay upgrades shown in Section 1.1 will address the issue.
** Stable at 3.5/9.5/4.5. Relay upgrades shown in Section 1.1 will address the issue.

		Detailed study result for Q303 Breaker Failure at Point Beach (Interim 2, W/O West SS, W/ existing Kewaunee) - Tested w/o 345 kV Voltage Sag Criteria, w/ 19 kV Voltage Criteria												
		High Gen						Low Gen						
		Existing	3.5/9.5/6.5	3.5/9.25/6.5	3.5/9.0/6.5	3.5/8.75/6.5	3.5/8.5/6.5	Existing	3.5/9.5/6.5	3.5/9.25/6.5	3.5/9.0/6.5	3.5/8.75/6.5	3.5/8.5/6.5	3.5/8.0/6.5
Angular Stability		P2	P2	P2*	P2	OK	OK	K,P	K,P	P**	P2	P2	P2	P2
Voltage Criteria	19 kV	OK	OK	OK	OK	P2 1.521s	OK	OK	OK	OK	OK	OK	OK	OK
	345 kV 1st	OK	OK	OK	OK	B5 1.083s	OK	OK	OK	B1 1.1s	OK	OK	OK	B5 1.029s
	345 kV 2nd	OK	OK	OK	OK	B5 1.542s	OK	OK	OK	OK	OK	OK	OK	OK

* Stable at 3.5/9.25/6.5 with G2 restricted to 620 MW.
** Stable at 3.5/9.25/6.5 with G2 restricted to 580 MW. Stable at 3.5/9.0/6.5 with G2 restricted to 600 MW
As described in Section 1.1, installing a series breaker will address the issue. The upgrade will clear a Q-303 breaker failure at Point Beach in primary time.

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

Intact System Breaker Failure Events - Interim Period 2B (April 2011 and beyond, W/ Kewaunee Project)											
Event	Element	Fault	Remote	Event	Simulated	High Gen		Low Gen			
File	Faulted	Location	Location	Notes	clearing time	Existing	3.5/9.5/4.5	Existing	3.5/9.5/4.5	3.5/9.25/4.5	3.5/9.0/4.5
BFIPOBSEC	L111	POB	SEC	T1X03 Tripped, Aux Moved	3.5/10.0/4.5	P,K	OK	P,K	P,K	P,K **	OK
BFIPOBFOX	L151	POB	FOX	T2X03 Tripped, Aux Moved	3.5/10.0/4.5	OK	OK	P,K *	OK	OK	OK
BFIPOBKEW	Q-303	POB	KEW	Future: Delay POB Split, No T10 Trip	3.5/10.0/4.5	OK	OK	P2	P2 *	OK	OK
BFIKEWPOB	Q-303	KEW	POB	Delay KEW T10 Trip	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK
BFIKEWNAP2	R-304	KEW	NAP	Delay KEW T10 Trip	3.5/10.0/6.5	OK	OK	P,K ***	OK	OK	OK
BFIKEWXFH2	KEW T10	KWH	KWL	Future (Existng No BF possible)	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK
BFINAPKEW2	R-304	NAP	KEW	Split NAP Primary, Xformer Trip BF**	5.5/14.25/4.5	OK	OK	OK	OK	OK	OK
BFIFJTPOB	L121	FJT	POB	Trips Transformer**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFIFJTCYP	971L51	FJT	CYP	Trips Line 971L71**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFIFJTFOX	971l71	FJT	FOX	Trips Line 971L51**	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFIFOXPOB2	L151	FOX (2)	POB	BF Trips Fox Unit 1	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFIFOXNAP2	L6832	FOX (2)	NAP	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK
BFIFOXFJT2	971L71	FOX (2)	FJT	BF Trips Fox Unit 2	3.5/10.0/4.5	OK	OK	OK	OK	OK	OK
BFISECPOB1	L111	SEC (1)	POB	Do Not Trip Gen (worst case)	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFISECGVL1	L-SEC31	SEC (1)	GVL	Do Not Trip Gen (worst case)	3.5/10.5/6.5	OK	OK	OK	OK	OK	OK
BFICYPADN	L-CYP31	CYP	ADN	Trips CYP Units	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK
BFICYPFJT	971L51	CYP	FJT	Trips CYP Units	3.5/10.5/4.5	OK	OK	OK	OK	OK	OK

* Relay upgrades or installing a series breaker described in Section 1.1 will address the issue.
** Relay upgrades described in Section 1.1 will address the issue
*** Relay upgrades described in Section 1.1 will address the issue

Table B.5- Stability Results for Point Beach Bus Single Line-to-Ground Faults Cleared in Delayed Time under Intact Conditions

Interim 1 (with G834/J023, with existing Kewaunee substation)

Fault Location	Breaker Failure Element tripped	Simulated Clearing	Interim 1	
			High Gen	Low Gen
POB Bus 1	POB-SEC	4.75/24.5	OK	OK
POB Bus 1	POB Bus 1-2	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-1	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-3	4.75/12.5	OK	OK
POB Bus 3	POB Bus 3-2	4.75/12.5	OK	OK
POB Bus 3	POB-KEW	4.75/12.5	OK	OK
POB Bus 3	POB Bus 3-4	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-3	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-5	4.75/12.5	OK	OK
POB Bus 5	POB Bus 5-4	4.75/12.5	OK	OK
POB Bus 5	POB-FOX	4.75/24.5	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Fault Location	Breaker Failure Element tripped	Simulated Clearing	Interim 2A w/ Existing KEW	
			High Gen	Low Gen
POB Bus 1	POB-SEC	4.75/24.5	OK	OK
POB Bus 1	POB Bus 1-2	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-1	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-3	4.75/12.5	OK	P2 angular, 345KV B5**
POB Bus 3	POB Bus 3-2	4.75/12.5	OK	OK
POB Bus 3	POB-KEW	4.75/24.5	OK	OK
POB Bus 3	POB Bus 3-4	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-3	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-5	4.75/12.5	OK	OK
POB Bus 5	POB Bus 5-4	4.75/12.5	OK	OK
POB Bus 5	POB-FOX	4.75/24.5	OK	OK

** Stable at 4.75/12.0. As described in Section 1.1, Change Relay setting (without Breaker Failure relay replacement) for Failure of Point Beach Bus Tie 2-3 to no more than 11 cycle total breaker failure clearing time for bus faults

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

POB SLG Bus Faults with Breaker Failure (PSSs In)

Fault Location	Breaker Failure Element tripped	Simulated Clearing	Interim 2B w/ New KEW	
			High Gen	Low Gen
POB Bus 1	POB-SEC	4.75/24.5	OK	OK
POB Bus 1	POB Bus 1-2	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-1	4.75/12.5	OK	OK
POB Bus 2	POB Bus 2-3	4.75/12.5	OK	OK
POB Bus 3	POB Bus 3-2	4.75/12.5	OK	OK
POB Bus 3	POB-KEW	4.75/12.5	OK	OK
POB Bus 3	POB Bus 3-4	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-3	4.75/12.5	OK	OK
POB Bus 4	POB Bus 4-5	4.75/12.5	OK	OK
POB Bus 5	POB Bus 5-4	4.75/12.5	OK	OK
POB Bus 5	POB-FOX	4.75/24.5	OK	OK

Table B.6- Stability Results for GSU Single Line-to-Ground Faults Cleared in Delayed Time under Intact Conditions, Units Tripping

Interim 1 (with G834/J023, with existing Kewaunee substation)

POB GSU BF Faults			Interim 1	
Fault Location	Breaker Failure Element tripped	Simulated Clearing	High Gen	Low Gen
POB Unit 1 GSU	POB Bus 2	4.5/13.5/14.0*	OK	OK
POB Unit 2 GSU	POB Bus 4	4.5/13.5	OK	OK

* - Primary Clearing Time/Bus Breaker Failure Time/Line Breaker Failure Time (GSU #1 Only)

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

POB GSU BF Faults			Interim 2 (w/ existing KEW)	
Fault Location	Breaker Failure Element tripped	Simulated Clearing	High Gen	Low Gen
POB Unit 1 GSU	POB Bus 2	4.5/13.5/14.0*	OK	OK
POB Unit 2 GSU	POB Bus 4	4.5/13.5	OK	OK

* - Primary Clearing Time/Bus Breaker Failure Time/Line Breaker Failure Time (GSU #1 Only)

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

POB GSU BF Faults			Interim 2 (w/ new KEW)	
Fault Location	Breaker Failure Element tripped	Simulated Clearing	High Gen	Low Gen
POB Unit 1 GSU	POB Bus 2	4.5/13.5/14.0*	OK	OK
POB Unit 2 GSU	POB Bus 4	4.5/13.5	OK	OK

* - Primary Clearing Time/Bus Breaker Failure Time/Line Breaker Failure Time (GSU #1 Only)

Table B.7- Stability Results for Auxiliary Transformer High Side Single Line-to-Ground Faults Cleared in Delayed Time under Intact Conditions, Units Tripping

Interim 1 (with G834/J023, with existing Kewaunee substation)

Faulted Element	Breaker Failure Element Tripped	Interim 1	
		High Gen	Low Gen
		5.1/24.5	5.1/24.5
POB AUX1 HS	POB-SEC @ SEC	OK	OK
POB AUX2 HS	POB-FOX @ FOX	OK	OK
Faulted Element	Breaker Failure Element Tripped	5.1/13.3*	5.1/13.3*
POB AUX1 HS	POB Bus 2**	OK	OK
POB AUX2 HS	POB Bus 4***	OK	OK

* - The Stability Model Time Step is 0.25 cycles, so a 13.3 cycle fault actually clears in 13.5 cycles.
** - POB-Forest Junction 345 kV line Trips, POB Generator 1 is Isolated.
*** - POB Generator 2 is isolated

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

Faulted Element	Breaker Failure Element Tripped	Interim 2A	
		High Gen	Low Gen
		5.1/24.5	5.1/24.5
POB AUX1 HS	POB-SEC @ SEC	OK	OK
POB AUX2 HS	POB-FOX @ FOX	OK	OK
Faulted Element	Breaker Failure Element Tripped	5.1/13.3*	5.1/13.3*
POB AUX1 HS	POB Bus 2**	OK	OK
POB AUX2 HS	POB Bus 4***	OK	OK

* - The Stability Model Time Step is 0.25 cycles, so a 13.3 cycle fault actually clears in 13.5 cycles.
** - POB-Forest Junction 345 kV line Trips, POB Generator 1 is Isolated.
*** - POB Generator 2 is isolated

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

Faulted Element	Breaker Failure Element Tripped	Interim 2B	
		High Gen	Low Gen
		5.1/24.5	5.1/24.5
POB AUX1 HS	POB-SEC @ SEC	OK	OK
POB AUX2 HS	POB-FOX @ FOX	OK	OK
Faulted Element	Breaker Failure Element Tripped	5.1/13.3*	5.1/13.3*
POB AUX1 HS	POB Bus 2**	OK	OK
POB AUX2 HS	POB Bus 4***	OK	OK

* - The Stability Model Time Step is 0.25 cycles, so a 13.3 cycle fault actually clears in 13.5 cycles.
** - POB-Forest Junction 345 kV line Trips, POB Generator 1 is Isolated.
*** - POB Generator 2 is isolated

Table B.8- Stability Results for GSU Three Phase 345 kV Faults Cleared in Primary (5.5 cycles, including 1 cycle margin) Time under Intact and Prior Outage Conditions, Units Tripping

Interim 1 (with G834/J023, with existing Kewaunee substation)

		Interim 1	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU1	None	OK	OK
FltPBGSU1	111	OK	OK
FltPBGSU1	121	OK	OK
FltPBGSU1	151	OK	OK
FltPBGSU1	Q-303	OK	OK
FltPBGSU1	R-304	OK	OK
FltPBGSU1	6832	OK	OK
FltPBGSU1	971L71	OK	OK
FltPBGSU1	L-SEC31	OK	OK
FltPBGSU1	L-CYP31	OK	OK
FltPBGSU1	T10	OK	OK
FltPBGSU1	NAPL71	OK	OK
FltPBGSU1	971L51	OK	OK
FltPBGSU1	Y-311	OK	OK
FltPBGSU1	B12	OK	OK
FltPBGSU1	B23	OK	OK
FltPBGSU1	B34	OK	OK
FltPBGSU1	B45	OK	OK

5.5 cyles (1-cycle margin).

		Interim 1	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU2	None	OK	OK
FltPBGSU2	111	OK	OK
FltPBGSU2	121	OK	OK
FltPBGSU2	151	OK	OK
FltPBGSU2	Q-303	OK	OK
FltPBGSU2	R-304	OK	OK
FltPBGSU2	6832	OK	OK
FltPBGSU2	971L71	OK	OK
FltPBGSU2	L-SEC31	OK	OK
FltPBGSU2	L-CYP31	OK	OK
FltPBGSU2	T10	OK	OK
FltPBGSU2	NAPL71	OK	OK
FltPBGSU2	971L51	OK	OK
FltPBGSU2	Y-311	OK	OK
FltPBGSU2	B12	OK	OK
FltPBGSU2	B23	OK	OK
FltPBGSU2	B34	OK	OK
FltPBGSU2	B45	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

		Interim 2A (w/ existing KEW)	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU1	None	OK	OK
FltPBGSU1	111	OK	OK
FltPBGSU1	121	OK	OK
FltPBGSU1	151	OK	OK
FltPBGSU1	Q-303	OK	OK
FltPBGSU1	R-304	OK	OK
FltPBGSU1	6832	OK	OK
FltPBGSU1	971L71	OK	OK
FltPBGSU1	L-SEC31	OK	OK
FltPBGSU1	L-CYP31	OK	OK
FltPBGSU1	T10	OK	OK
FltPBGSU1	NAPL71	OK	OK
FltPBGSU1	971L51	OK	OK
FltPBGSU1	Y-311	OK	OK
FltPBGSU1	B12	OK	OK
FltPBGSU1	B23	OK	OK
FltPBGSU1	B34	OK	OK
FltPBGSU1	B45	OK	OK

5.5 cyles (1-cycle margin).

		Interim 2A (w/ existing KEW)	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU2	None	OK	OK
FltPBGSU2	111	OK	OK
FltPBGSU2	121	OK	OK
FltPBGSU2	151	OK	OK
FltPBGSU2	Q-303	OK	OK
FltPBGSU2	R-304	OK	OK
FltPBGSU2	6832	OK	OK
FltPBGSU2	971L71	OK	OK
FltPBGSU2	L-SEC31	OK	OK
FltPBGSU2	L-CYP31	OK	OK
FltPBGSU2	T10	OK	OK
FltPBGSU2	NAPL71	OK	OK
FltPBGSU2	971L51	OK	OK
FltPBGSU2	Y-311	OK	OK
FltPBGSU2	B12	OK	OK
FltPBGSU2	B23	OK	OK
FltPBGSU2	B34	OK	OK
FltPBGSU2	B45	OK	OK

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

		Interim 2B (w/ new KEW)	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU1	None	OK	OK
FltPBGSU1	111	OK	OK
FltPBGSU1	121	OK	OK
FltPBGSU1	151	OK	OK
FltPBGSU1	Q-303	OK	OK
FltPBGSU1	R-304	OK	OK
FltPBGSU1	6832	OK	OK
FltPBGSU1	971L71	OK	OK
FltPBGSU1	L-SEC31	OK	OK
FltPBGSU1	L-CYP31	OK	OK
FltPBGSU1	T10	OK	OK
FltPBGSU1	NAPL71	OK	OK
FltPBGSU1	971L51	OK	OK
FltPBGSU1	Y-311	OK	OK
FltPBGSU1	B12	OK	OK
FltPBGSU1	B23	OK	OK
FltPBGSU1	B34	OK	OK
FltPBGSU1	B45	OK	OK

5.5 cyles (1-cycle margin).

		Interim 2B (w/ new KEW)	
Fault	Prior Outage	High Gen	Low Gen
FltPBGSU2	None	OK	OK
FltPBGSU2	111	OK	OK
FltPBGSU2	121	OK	OK
FltPBGSU2	151	OK	OK
FltPBGSU2	Q-303	OK	OK
FltPBGSU2	R-304	OK	OK
FltPBGSU2	6832	OK	OK
FltPBGSU2	971L71	OK	OK
FltPBGSU2	L-SEC31	OK	OK
FltPBGSU2	L-CYP31	OK	OK
FltPBGSU2	T10	OK	OK
FltPBGSU2	NAPL71	OK	OK
FltPBGSU2	971L51	OK	OK
FltPBGSU2	Y-311	OK	OK
FltPBGSU2	B12	OK	OK
FltPBGSU2	B23	OK	OK
FltPBGSU2	B34	OK	OK
FltPBGSU2	B45	OK	OK

Table B.9- Stability Results for Auxiliary Transformer High Side 3-Phase Faults Cleared in Primary Time (6.1 cycles, including 1 cycle margin) under Intact and Prior Outage Conditions

Interim 1 (with G834/J023, with existing Kewaunee substation)

		High Generation	Low Generation
Fault	Prior Outage	Interim 1 5.75/6.1	Interim 1 5.75/6.1
FltPOBAX1	None	OK	OK
FltPOBAX1	111	OK	OK
FltPOBAX1	121	OK	OK
FltPOBAX1	151	OK	OK
FltPOBAX1	Q-303	OK	OK
FltPOBAX1	R-304	OK	OK
FltPOBAX1	6832	OK	OK
FltPOBAX1	971L71	OK	OK
FltPOBAX1	L-SEC31	OK*	OK
FltPOBAX1	L-CYP31	OK	OK
FltPOBAX1	T10	OK	OK
FltPOBAX1	NAPL71	OK	OK
FltPOBAX1	971L51	OK	OK
FltPOBAX1	Y-311	OK	OK
FltPOBAX1	B12	OK	OK
FltPOBAX1	B23	OK	OK
FltPOBAX1	B34	OK	OK
FltPOBAX1	B45	OK	OK

*SEC Gens Isolated

		High Generation	Low Generation
Fault	Prior Outage	Interim 1 5.75/6.1	Interim 1 5.75/6.1
FltPOBAX2	None	OK	OK
FltPOBAX2	111	OK	OK
FltPOBAX2	121	OK	OK
FltPOBAX2	151	OK	OK
FltPOBAX2	Q-303	OK	OK
FltPOBAX2	R-304	OK	OK
FltPOBAX2	6832	OK	OK
FltPOBAX2	971L71	OK	OK
FltPOBAX2	L-SEC31	OK	OK
FltPOBAX2	L-CYP31	OK	OK
FltPOBAX2	T10	OK	OK
FltPOBAX2	NAPL71	OK	OK
FltPOBAX2	971L51	OK	OK
FltPOBAX2	Y-311	OK	OK
FltPOBAX2	B12	OK	OK
FltPOBAX2	B23	OK	OK
FltPOBAX2	B34	OK**	OK**
FltPOBAX2	B45	OK	OK

**POB GEN 2 Isolated

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

		High Generation	Low Generation
Fault	Prior Outage	Interim 2A w/ existing KEW 5.75/6.1	Interim 2A w/ existing KEW 5.75/6.1
FltPOBAX1	None	OK	OK
FltPOBAX1	111	OK	OK
FltPOBAX1	121	OK	K,P agnular, 345KV B5 (Stable 5.5/6.0)
FltPOBAX1	151	OK	OK
FltPOBAX1	Q-303	OK	OK
FltPOBAX1	R-304	K,P (Stable 5.5/6.0)	K,P (Stable 5.5/6.0)
FltPOBAX1	6832	K,P,F (Stable 5.0/6.0)	OK
FltPOBAX1	971L71	OK	OK
FltPOBAX1	L-SEC31	OK*	OK
FltPOBAX1	L-CYP31	K,P,F (Stable 5.0/6.0)	OK
FltPOBAX1	T10	OK	OK
FltPOBAX1	NAPL71	K,P,F (Stable 5.5/6.0)	OK
FltPOBAX1	971L51	OK	OK
FltPOBAX1	Y-311	K,P,F (Stable 5.5/6.0)	OK
FltPOBAX1	B12	OK	OK
FltPOBAX1	B23	OK	OK
FltPOBAX1	B34	OK	OK
FltPOBAX1	B45	OK	OK

*SEC Gens Isolated

		High Generation	Low Generation
Fault	Prior Outage	Interim 2A w/ existing KEW 5.75/6.1	Interim 2A w/ existing KEW 5.75/6.1
FltPOBAX2	None	OK	OK
FltPOBAX2	111	OK	K,P (Stable 5.5/6.0)
FltPOBAX2	121	K,P (Stable 5.5/6.0)	K,P (Stable 5.0/6.0)
FltPOBAX2	151	OK	OK
FltPOBAX2	Q-303	OK	OK
FltPOBAX2	R-304	K,P (Stable 5.5/6.0)	K,P (Stable 5.0/6.0)
FltPOBAX2	6832	OK	OK
FltPOBAX2	971L71	OK	OK
FltPOBAX2	L-SEC31	K,P,S (Stable 5.0/6.0)	K,P (Stable 5.5/6.0)
FltPOBAX2	L-CYP31	OK	OK
FltPOBAX2	T10	OK	OK
FltPOBAX2	NAPL71	OK	OK
FltPOBAX2	971L51	OK	OK
FltPOBAX2	Y-311	OK	OK
FltPOBAX2	B12	OK	K,P (Stable 5.5/6.0)
FltPOBAX2	B23	OK	OK
FltPOBAX2	B34	OK**	OK**
FltPOBAX2	B45	OK	OK

**POB GEN 2 Isolated

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

		High Generation	Low Generation
Fault	Prior Outage	Interim 2B w/ new KEW 5.75/6.1	Interim 2 B w// new KEW 5.75/6.1
FltPOBAX1	None	OK	OK
FltPOBAX1	111	OK	OK
FltPOBAX1	121	OK	OK
FltPOBAX1	151	OK	OK
FltPOBAX1	Q-303	OK	OK
FltPOBAX1	R-304	K,P (5.5/6.0 stable)	K,P (5.5/6.0 stable)
FltPOBAX1	6832	K,P,F (5.0/6.0 stable)	OK
FltPOBAX1	971L71	OK	OK
FltPOBAX1	L-SEC31	OK*	OK
FltPOBAX1	L-CYP31	K,P,F (5.0/6.0 stable)	OK
FltPOBAX1	T10	OK	OK
FltPOBAX1	NAPL71	K,P,F (5.5/6.0 stable)	OK
FltPOBAX1	971L51	OK	OK
FltPOBAX1	Y-311	K,P,F (5.5/6.0 stable)	OK
FltPOBAX1	B12	OK	OK
FltPOBAX1	B23	OK	OK
FltPOBAX1	B34	OK	OK
FltPOBAX1	B45	OK	OK

*SEC Gens Isolated

		High Generation	Low Generation
Fault	Prior Outage	Interim 2B w/ new KEW 5.75/6.1	Interim 2 B w// new KEW 5.75/6.1
FltPOBAX2	None	OK	OK
FltPOBAX2	111	OK	P (uv 19 kV at 1.521sec, 345 kV B1 1st-1.096 sec, 2nd-1.562 sec) (5.5/6.0 stable)
FltPOBAX2	121	P1 (uv 345kV B1 1st-1.183sec, 2nd-1.571 sec) (5.5/6.0 stable)	K,P (5.0/6.0 stable)
FltPOBAX2	151	OK	OK
FltPOBAX2	Q-303	OK	OK
FltPOBAX2	R-304	OK	K,P (5.0/6.0 stable)
FltPOBAX2	6832	OK	OK
FltPOBAX2	971L71	OK	OK
FltPOBAX2	L-SEC31	K,P,S (5.0/6.0 stable)	K,P (5.5/6.0 stable)
FltPOBAX2	L-CYP31	OK	OK
FltPOBAX2	T10	OK	OK
FltPOBAX2	NAPL71	OK	OK
FltPOBAX2	971L51	OK	OK
FltPOBAX2	Y-311	OK	OK
FltPOBAX2	B12	OK	K,P (5.5/6.0 stable)
FltPOBAX2	B23	OK	OK
FltPOBAX2	B34	OK**	OK**
FltPOBAX2	B45	OK	OK

**POB GEN 2 isolated

Table B.10- Stability Results for Kewaunee and Point Beach Generation Outage under Intact Conditions

Interim 1 (with G834/J023, with existing Kewaunee substation)

UNIT TRIP		Interim 1	
UNIT TRIP	Trip time (sec)	High Gen	Low Gen
POBG1trip	0.15	OK	OK
POBG2trip	0.15	OK	OK
POBG1G2trip	0.15	OK	OK
KEWG1trip	0.15	OK	OK

Interim 2A (with G834/J023 and G833/J022, with existing Kewaunee substation)

UNIT TRIP		Interim 2A (w/ existing KEW)	
UNIT TRIP	Trip time (sec)	High Gen	Low Gen
POBG1trip	0.15	OK	OK
POBG2trip	0.15	OK	OK
POBG1G2trip	0.15	OK	OK
KEWG1trip	0.15	OK	OK

Interim 2B (with G834/J023 and G833/J022, with new Kewaunee substation)

UNIT TRIP		Interim 2B (w/ new KEW)	
UNIT TRIP	Trip time (sec)	High Gen	Low Gen
POBG1	0.15	OK	OK
POBG2	0.15	OK	OK
POBG1G2	0.15	OK	OK
KEW	0.15	OK	OK

Appendix C: Competing Wind Generators

Queue Number	Control Area	MW	Commercial Operation Date (From 3-31-2009 status report)	Geographical Location
G384	WPS	99	TBD (suspended)	Kewaunee-Mishicot 138 kV line
G427	WEC	98	TBD (suspended)	Cypress 345 kV Substation
G590	WEC	98	TBD (suspended)	Tecumseh Rd 138 kV Substation
G611	WEC	99	12-31-2011	Elkhart Lake-Forest Junction 138 kV line
G773	WPS	150	12-01-2012	Forest Junction-Lost Dauphin 138 kV line

Appendix D: Operating Restrictions

With all stability upgrades assumed in-service and the Minimum Excitation Limiter settings for Point Beach and Kewaunee units modified, generation restrictions identified for each interim period are:

- During Interim 1 period (2010 after G834/J023 – 2011 before G833/J022)
  iii. G1 at 560 MW (gross) under prior outage condition of 6832 (North Appleton-Fox River 345 kV line)
  iv. G1 at 580 MW (gross) under prior outage condition of Point Beach Bus Tie 2-3

- During Interim 2A period (Without Kewaunee project, 2011 after G833/J022 – beyond)
  viii. G2 at 620 MW (gross) under prior outage of 121 (Point Beach-Forest Junction 345 kV line)
  ix. G2 at 620 MW (gross) under prior outage of 151 (Point Beach-Fox River 345 kV line)
  x. G2 at 600 MW (gross) under prior outage of R304 (Kewaunee-North Appleton 345 kV line)
  xi. Both G1 and G2 at 540 MW (gross) under prior outage of 6832 (North Appleton-Fox River 345 kV line)
  xii. G2 at 580 MW (gross) under prior outage of SEC31 (Sheboygan Energy Center-Granville 345 kV line)
  xiii. G1 at 580 MW (gross) under prior outage of Point Beach Bus Tie 2-3
  xiv. G2 at 620 MW (gross) under prior outage of Point Beach Bus Tie 4-5

- During Interim 2B period (With Kewaunee project, 2011 after G833/J022 – beyond)
  i. G2 at 600 MW (gross) under prior outage condition of 6832 (North Appleton-Fox River 345 kV line)
  ii. G1 at 580 MW (gross) under prior outage condition of Point Beach Bus Tie 2-3

Appendix E: Short Circuit / Breaker Duty Analysis Results

Table E.1 – Maximum and Minimum Fault Duties at the G833-4 Point of Interconnection

	Maximum Fault Duty (Amps)		Minimum Fault Duty* (Amps)	
	Single-phase	Three-Phase	Single-phase	Three-Phase
Scenario 1 = Existing system	23293.9	21160.4	9288	11100.6
Scenario 2 = Existing with new GSU of POB G2 (Fall 2009~May 2010)	23878.5	21419.7	9288	11100.6
Scenario 3 = With G834 (J023) and new GSU of POB G1 (May 2010~May 2011)	24516	21758.5	9288	11100.6
Scenario 4 = With G833/4 (J022/3) with existing Kewaunee (May 2011~beyond)	24660.4	21927.2	9288	11100.6
Scenario 5 = With G833/4 (J022/3) with new Kewaunee (May 2011~beyond)	24801.6	22017	9288.2	11100.7
** Scenario 6 = With G833/4 (J022/3) with new Kewaunee and potential East sub	25448.4	22749.3	9786.8	11954.8
** Scenario 7 = With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion	26615.1	23988.7	10915.9	13402.2

* POB G1 and G2 offline and Q-303 out of service

** Scenario 6 and 7 were also studied to provide maximum and minimum fault duties that may appear due to potential future transmission reinforcement.

Table E.2 – Thevenin Equivalent Impedances in Ohms corresponding to Maximum Fault Duty

	Pos Seq.	Neg. Seq.	Zero Seq.
Scenario 1 = Existing system	0.492146+ j 9.400272	0.563439+ j 9.4053	0.589203+ j 6.794582
Scenario 2 = Existing with new GSU of POB G2 (Fall 2009~May 2010)	0.47915+ j 9.28685	0.547887+ j 9.291845	0.530596+ j 6.397666
Scenario 3 = With G834 (J023) and new GSU of POB G1 (May 2010~May 2011)	0.476195+ j 9.141977	0.648689+ j 9.140315	0.480063+ j 6.038944
Scenario 4 = With G833/4 (J022/3) with existing Kewaunee (May 2011~beyond)	0.480694+ j 9.071247	0.754597+ j 9.060422	0.480063+ j 6.038944
Scenario 5 = With G833/4 (J022/3) with new Kewaunee (May 2011~beyond)	0.500629+ j 9.033035	0.774579+ j 9.021229	0.483616+ j 5.974935
** Scenario 6 = With G833/4 (J022/3) with new Kewaunee and potential East sub	0.483549 + j 8.742337	0.734901 + j 8.732362	0.491449 + j 5.944132
** Scenario 7 = With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion	0.455713 + j 8.290790	0.685388 + j 8.282391	0.496780 + j 5.818807

** These scenarios were also studied to provide maximum and minimum fault duties that may appear due to potential future transmission reinforcement.

Breaker Fault Duty Analysis (Red Cell for >1% Increase in Fault Current, Pink Cell for <5% in Breaker Margin)

				Three Phase Fault Analysis																				
				Derated Breaker Rating	Symmetrical Fault Current (amps)							Change in Fault Current from Scenario 1 (Existing)						Breaker Margin (%)						
Substation	Bus Name	KV	Breaker	(kA)	Scenario 1: Existing system	Scenario 2: Existing with new GSU of POB G2 (Fall 2009-May 2010)	Scenario 3: With G834 (J023) and new GSU of POB G1 (May 2010-May 2011)	Scenario 4: With G833/4 (J022/3) with existing Kewaunee (May 2011-beyond)	Scenario 5: With G833/4 (J022/3) with new Kewaunee (May 2011-beyond)	Scenario 6: With G833/4 (J022/3) with new Kewaunee and potential East sub	Scenario 7: With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion	Scenario 2 (%)	Scenario 3 (%)	Scenario 4 (%)	Scenario 5 (%)	Scenario 6 (%)	Scenario 7 (%)	Scenario 1: Existing system	Scenario 2: Existing with new GSU of POB G2 (Fall 2009-May 2010)	Scenario 3: With G834 (J023) and new GSU of POB G1 (May 2010-May 2011)	Scenario 4: With G833/4 (J022/3) with existing Kewaunee (May 2011-beyond)	Scenario 5: With G833/4 (J022/3) with new Kewaunee (May 2011-beyond)	Scenario 6: With G833/4 (J022/3) with new Kewaunee and potential East sub	Scenario 7: With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion
FOREST_JUNCTION	ForestJct_4	138	BSK-45 (Transf 2)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_1	138	BSK-12 (KK971K11)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_2	138	BSK-23 (KK971K21)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_3	138	BSK-34 (KK971K31)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_5	138	BSK-56 (KK8222)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_6	138	BSK-67 (E-57)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_8	138	BSK-89 (Transf 1)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_9	138	BSK-910 (KK971K91)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_10	138	BSK-1011 (KK4035)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct_11	138	BSK-1112 (KK72851)	50	35599	35853	35931	35969	35867	35926	37101	0.7%	0.9%	1.0%	0.8%	0.9%	4.2%	24	22.3	22.2	22.4	23.8	23.7	19.2
FOREST_JUNCTION	ForestJct1	345	BS-L12 (Transf 2)	50	18716	18875	18961	19002	18887	18986	22991	0.8%	1.3%	1.5%	0.9%	1.4%	22.8%	62.6	62.2	62.1	62	62.2	62	54
FOREST_JUNCTION	ForestJct2	345	BS-L23 (L121)	50	18716	18875	18961	19002	18887	18986	22991	0.8%	1.3%	1.5%	0.9%	1.4%	22.8%	62.6	62.2	62.1	62	62.2	62	54
FOREST_JUNCTION	ForestJct3	345	BS-L45 (Transf 1)	50	18716	18875	18961	19002	18887	18986	22991	0.8%	1.3%	1.5%	0.9%	1.4%	22.8%	62.6	62.2	62.1	62	62.2	62	54
FOREST_JUNCTION	ForestJct5	345	BS-L56 (L971L51)	50	18716	18875	18961	19002	18887	18986	22991	0.8%	1.3%	1.5%	0.9%	1.4%	22.8%	62.6	62.2	62.1	62	62.2	62	54
FOREST_JUNCTION	ForestJct7	345	BS-L71(971L71)	50	18716	18875	18961	19002	18887	18986	22991	0.8%	1.3%	1.5%	0.9%	1.4%	22.8%	62.6	62.2	62.1	62	62.2	62	54
FOX_RIVER_SWITCH_Y	AR FOX_Bus_3	345	BSL-34	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
FOX_RIVER_SWITCH_Y	AR FOX_Bus_5	345	BSL-56	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
FOX_RIVER_SWITCH_Y	AR FOX_Bus_1	345	BSL-12	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
FOX_RIVER_SWITCH_Y	AR FOX_GSU1_311	345	BSL-45	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
FOX_RIVER_SWITCH_Y	AR FOX_GSU2_311	345	BSL-61	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
FOX_RIVER_SWITCH_Y	AR FOX_Bus_2	345	BSL-23	50	21345	21580	21681	21730	21556	21648	22987	1.1%	1.6%	1.8%	1.0%	1.4%	7.7%	57	55.4	55.3	55.4	56.9	56.7	54
NORTH_APPLETON	NAP_Bus_G4	138	LINE 6842	63	39630	40880	40961	41000	39791	39841	40461	3.2%	3.4%	3.5%	0.4%	0.5%	2.1%	37.1	32.9	32.9	32.9	36.8	36.8	35.8
NORTH_APPLETON	NAP_Bus_G4	138	K37	63	39555	40815	40898	40938	39720	39769	40428	3.2%	3.4%	3.5%	0.4%	0.5%	2.2%	37.2	32.4	32.4	32.4	37	36.9	35.8
NORTH_APPLETON	NAP_Bus_G4	138	TRF 1, 138 KV	63	37422	38655	38721	38753	37560	37598	38165	3.3%	3.5%	3.6%	0.4%	0.5%	2.0%	40.6	36.1	36	36.1	40.4	40.3	39.4
NORTH_APPLETON	NAP_Bus_G5	138	TRF 2, 138 KV	63	36817	38045	38108	38139	36950	36987	37536	3.3%	3.5%	3.6%	0.4%	0.5%	2.0%	41.6	37.5	37.4	37.4	41.3	41.3	40.4
NORTH_APPLETON	NAP_Bus_G5	138	LINE 6851	63	39737	41000	41084	41125	39906	39956	40629	3.2%	3.4%	3.5%	0.4%	0.6%	2.2%	36.9	32.3	32.3	32.3	36.7	36.6	35.5
NORTH_APPLETON	NAP_Bus_G6	138	TRF 3, 138 KV	63	37531	38660	38726	38758	37670	37708	38171	3.0%	3.2%	3.3%	0.4%	0.5%	1.7%	40.4	37.2	37.2	37.2	40.2	40.1	39.4
NORTH_APPLETON	NAP_Bus_G4	138	CAP 4	63	41005	42266	42350	42392	41177	41227	41902	3.1%	3.3%	3.4%	0.4%	0.5%	2.2%	34.9	30.5	30.4	30.4	34.6	34.6	33.5
NORTH_APPLETON	NAP_Bus_G4	138	BUS SECT 4-5	63	33172	34114	34170	34197	33286	33319	33800	2.8%	3.0%	3.1%	0.3%	0.4%	1.9%	47.3	43	42.9	42.9	47.2	47.1	46.3
NORTH_APPLETON	NAP_Bus_G4	138	6843 GCB	63	39717	40954	41036	41076	39883	39932	40569	3.1%	3.3%	3.4%	0.4%	0.5%	2.2%	37	32.9	32.8	32.8	36.7	36.6	35.6
NORTH_APPLETON	NAP_Bus_G5	138	CAP 5	63	41005	42266	42350	42392	41177	41227	41902	3.1%	3.3%	3.4%	0.4%	0.5%	2.2%	34.9	30.5	30.4	30.4	34.6	34.6	33.5
NORTH_APPLETON	NAP_Bus_G5	138	BUS SECT 5-6	63	33729	34573	34628	34655	33840	33874	34236	2.5%	2.7%	2.7%	0.3%	0.4%	1.5%	46.5	43.2	43.1	43.2	46.3	46.2	45.7
NORTH_APPLETON	NAP_Bus_G5	138	LINE 6853	63	38944	40171	40252	40291	39107	39156	39803	3.2%	3.4%	3.5%	0.4%	0.5%	2.2%	38.2	33.7	33.6	33.6	37.9	37.8	36.8
NORTH_APPLETON	NAP_Bus_G6	138	CAP 6	63	41005	42266	42350	42392	41177	41227	41902	3.1%	3.3%	3.4%	0.4%	0.5%	2.2%	34.9	30.5	30.4	30.4	34.6	34.6	33.5
NORTH_APPLETON	NAP_Bus_G6	138	6862 GCB	63	39720	40964	41046	41085	39884	39933	40573	3.1%	3.3%	3.4%	0.4%	0.5%	2.1%	37	32.8	32.7	32.7	36.7	36.6	35.6
NORTH_APPLETON	NAP_Bus_G6	138	LINE I113	63	38391	39646	39724	39762	38546	38594	39200	3.3%	3.5%	3.6%	0.4%	0.5%	2.1%	39.1	34.1	34.1	34.1	38.8	38.7	37.8
NORTH_APPLETON	NAP_345B_L1	345	BUS SECT 12-1	40	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	43.5	42.2	42.1	42.1	43.1	43	41.7
NORTH_APPLETON	NAP_345B_L34	345	BS34-4	40	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	43.5	42.2	42.1	42.1	43.1	43	41.7
NORTH_APPLETON	NAP_345B_L1	345	LINE R304	39.8	20599	20971	21017	21040	20692	20741	21201	1.8%	2.0%	2.1%	0.5%	0.7%	2.9%	38.4	31.8	31.7	31.7	38.3	38.2	36.8
NORTH_APPLETON	NAP_345B_L81	345	BS 81-8	39.8	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	31.9	25.2	25.1	25.1	31.7	31.6	30.1
NORTH_APPLETON	NAP_345B_L12	345	BUS SECT 12-2	40	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	43.5	42.2	42.1	42.1	43.1	43	41.7
NORTH_APPLETON	NAP_345B_L1	345	BS 81-1	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L4	345	BS 45-4	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L6	345	BS 67-6	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L67	345	BS 67-7	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L3	345	BS 34-3	38	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	38.9	33.2	33	33	38.7	38.6	37.3
NORTH_APPLETON	NAP_345B_L7	345	BS 78-7	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L78	345	BS 78-8	50	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	54.8	53.7	53.6	53.6	54.5	54.4	53.4
NORTH_APPLETON	NAP_345B_L2	345	BUS SECT 23-2	42	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	35.4	29.1	28.9	29	35.2	35.1	33.7
NORTH_APPLETON	NAP_345B_L23	345	BUS SECT 23-3	42	22585	22982	23065	23106	22759	22814	23313	1.8%	2.1%	2.3%	0.8%	1.0%	3.2%	35.4	29.1	28.9	29	35.2	35.1	33.7
POINT_BEACH	POINT_BCH_B1	345	BS 1-2	40	18618	18875	19214	19383	19478	19502	21978	1.4%	3.2%	4.1%	4.6%	4.7%	18.0%	48.8	47.6	47.7	48.9	49.1	49	43
POINT_BEACH	POINT_BCH_B2	345	BS 2-3	40	14119	14340	14353	14522	14716	14724	14930	1.6%	1.7%	2.9%	4.2%	4.3%	5.7%	62.4	61.2	61.2	62.6	62.4	62.4	61.9
POINT_BEACH	POINT_BCH_B3	345	BS 3-4	40	16687	16755	17094	17106	17265	18077	19423	0.4%	2.4%	2.5%	3.5%	8.3%	16.4%	56.1	55.8	56.4	56.4	56.3	54.5	51.2
POINT_BEACH	POINT_BCH_B4	345	BS 4-5	40	18970	19193	19537	19706	19853	20651	21968	1.2%	3.0%	3.9%	4.7%	8.9%	15.8%	48	47	47.1	48.4	48.3	46.5	43.3
POINT_BEACH	POINT_BCH_B1	345	LINE 111	50	18618	18875	19214	19383	19478	19502	21978	1.4%	3.2%	4.1%	4.6%	4.7%	18.0%	59	58	58.2	59.1	59.2	59.2	54.4
POINT_BEACH	POINT_BCH_B2	345	LINE 121(Bkr 121)	50	18935	19166	19504	19673	19840	20624	22212	1.2%	3.0%	3.9%	4.8%	8.9%	17.3%	58.4	57.5	57.7	58.7	58.6	57.1	54
POINT_BEACH	POINT_BCH_B2	345	LINE 123(Bkr 123)	50	18935	19166	19504	19673	19840	20624	22212	1.2%	3.0%	3.9%	4.8%	8.9%	17.3%	58.4	57.5	57.7	58.7	58.6	57.1	54
POINT_BEACH	POINT_BCH_B3	345	LINE Q303	50	16320	16530	16869	17037	16994	17843	19180	1.3%	3.4%	4.4%	4.1%	9.3%	17.5%	64	63.2	63.3	64.3	64.5	63	60.4
POINT_BEACH	POINT_BCH_B5	345	LINE 151	50	19069	19298	19636	19805	19952	20748	22064	1.2%	3.0%	3.9%	4.6%	8.8%	15.7%	58.2	57.3	57.5	58.5	58.4	56.9	54.4
SHEBOYGAN ENERGY C	EN SEC_Bus_1	345	BT12	50	10050	10065	10082	10090	10091	20139	22623	0.1%	0.3%	0.4%	0.4%	100.4%	125.1%	79.3	79.2	79.2	79.2	79.2	59	54.2
SHEBOYGAN ENERGY C	EN SEC_Bus_1	345	BT16	50	10050	10065	10082	10090	10091	20139	22623	0.1%	0.3%	0.4%	0.4%	100.4%	125.1%	79.3	79.2	79.2	79.2	79.2	59	54.2
SHEBOYGAN ENERGY C	EN SEC_ Bus 3	345	BT36	50	10050	10065	10082	10090	10091	20139	22623	0.1%	0.3%	0.4%	0.4%	100.4%	125.1%	79.3	79.2	79.2	79.2	79.2	59	54.2
EDGEWATER	EDG 138	138	470-S	20	16219	16220	16221	16222	16222	17501	22485	0.0%	0.0%	0.0%	0.0%	7.9%	38.6%	1	1	1	1	1	-7.4	-54.4
EDGEWATER	EDG 138	138	847-S	40	17544	17545	17546	17547	17547	19663	22434	0.0%	0.0%	0.0%	0.0%	12.1%	27.9%	46	46	46	46	46	39.3	31.7
EDGEWATER	EDG 138	138	370-S	40	12844	12845	12846	12846	12846	13495	18961	0.0%	0.0%	0.0%	0.0%	5.1%	47.6%	61.5	61.5	61.5	61.5	61.5	59.4	44.9
EDGEWATER	EDG 138	138	861-S	40	19867	19868	19870	19871	19871	22104	26671	0.0%	0.0%	0.0%	0.0%	11.3%	34.2%	40	40	40	40	40	33	20.6
EDGEWATER	EDG 138	138	843-S	40	19870	19871	19873	19874	19874	22107	26590	0.0%	0.0%	0.0%	0.0%	11.3%	33.8%	40	40	40	40	40	33	20.8
EDGEWATER	EDG 138	138	854-S	40	19870	19871	19873	19874	19874	22107	26591	0.0%	0.0%	0.0%	0.0%	11.3%	33.8%	40	40	40	40	40	33	20.8
EDGEWATER	EDG 138	138	884-S	40	17724	17725	17726	17727	17727	19374	23506	0.0%	0.0%	0.0%	0.0%	9.3%	32.6%	45.9	45.9	45.9	45.9	45.9	40.6	29.7
EDGEWATER	EDG 138	138	865-S	40	19867	19868	19870	19871	19871	22104	26671	0.0%	0.0%	0.0%	0.0%	11.3%	34.2%	40	40	40	40	40	33	20.6
EDGEWATER	EDG 138	138	826-S	40	22290	22291	22293	22294	22294	25060	28605	0.0%	0.0%	0.0%	0.0%	12.4%	28.3%	32.6	32.6	32.6	32.6	32.6	24	14.8
EDGEWATER	EDGEWATER	345	311-S	40	10893	10894	10894	10895	10895	16472	17994	0.0%	0.0%	0.0%	0.0%	51.2%	65.2%	57.7	57.7	57.7	57.7	57.7	37.6	32.2
EDGEWATER	EDGEWATER	345	313-S	40	10403	10404	10405	10406	10406	17878	19695	0.0%	0.0%	0.0%	0.0%	71.9%	89.3%	59.5	59.5	59.5	59.5	59.5	32.7	26.4
EDGEWATER	EDGEWATER	345	465-S	50	14743	14744	14747	14748	14748	19519	21804	0.0%	0.0%	0.0%	0.0%	32.4%	47.9%	68.8	68.7	68.7	68.7	68.7	59.1	54.8
EDGEWATER	EDGEWATER	345	2523-S	50	14837	14839	14841	14843	14843	19615	21926	0.0%	0.0%	0.0%	0.0%	32.2%	47.8%	68.6	68.6	68.6	68.6	68.6	59	54.6
EDGEWATER	EDGEWATER	345	302-S	40	14837	14839	14841	14843	14843	19615	21926	0.0%	0.0%	0.0%	0.0%	32.2%	47.8%	49.3	49.3	49.3	49.3	49.3	33.8	26.8
EDGEWATER	EDGEWATER	345	303-S	40	14837	14839	14841	14843	14843	19615	21926	0.0%	0.0%	0.0%	0.0%	32.2%	47.8%	49.3	49.3	49.3	49.3	49.3	33.8	26.8
EDGEWATER	EDGEWATER	345	304-S	40	14837	14839	14841	14843	14843	19615	21926	0.0%	0.0%	0.0%	0.0%	32.2%	47.8%	49.3	49.3	49.3	49.3	49.3	33.8	26.8
EDGEWATER	EDGEWATER	345	308-S	40	14837	14839	14841	14843	14843	19615	21926	0.0%	0.0%	0.0%	0.0%	32.2%	47.8%	49.3	49.3	49.3	49.3	49.3	33.8	26.8
KEWAUNEE	KEW 138kV	138	F-84	37	10846	10857	10878	10889	20489	20639	20960	0.1%	0.3%	0.4%	88.7%	90.3%	93.3%	65.1	65	65	65.1	34.3	33.8	32.8
KEWAUNEE	KEW 138kV	138	Y-51	37.2	11489	11500	11522	11532	21077	21246	21569	0.1%	0.3%	0.4%	83.5%	84.9%	87.7%	63.6	63.5	63.5	63.6	33	32.5	31.5
KEWAUNEE	KEW 138kV	138	1066E	38.9	13820	13832	13858	13870	23143	23316	23660	0.1%	0.3%	0.4%	67.5%	68.7%	71.2%	59.2	59.2	59.2	59.3	30.6	30.1	29.1
KEWAUNEE	KEW 138kV	138	1066W	38.9	13820	13832	13858	13870	23143	23316	23660	0.1%	0.3%	0.4%	67.5%	68.7%	71.2%	59.2	59.2	59.2	59.3	30.6	30.1	29.1
KEWAUNEE	KEW 138kV	138	22	40	13820	13832	13858	13870	23143	23316	23660	0.1%	0.3%	0.4%	67.5%	68.7%	71.2%	60.4	60.3	60.3	60.4	32.5	32.1	31.1
KEWAUNEE	KEWAUNEE B1	345	R-304	38	16413	16518	16728	16832	17155	17649	18480	0.6%	1.9%	2.6%	4.5%	7.5%	12.6%	42.2	41.7	41.6	42	41.2	39.8	37.3
KEWAUNEE	KEWAUNEE B1	345	3450	40	13752	13855	14065	14168	14514	15307	16140	0.7%	2.3%	3.0%	7.7%	11.3%	17.4%	56.6	56.1	56.1	56.8	52.6	51.3	49
KEWAUNEE	KEWAUNEE B1	345	3451	40	16413	16518	16728	16832	17418	17852	18683	0.6%	1.9%	2.6%	6.1%	8.8%	13.8%	45.1	44.7	44.6	45	47.2	46.1	43.8
KEWAUNEE	KEWAUNEE B2	345	Q-303	40	12737	12839	13047	13149	13149	13661	14504	0.8%	2.4%	3.2%	3.2%	7.3%	13.9%	59.4	58.9	58.9	59.5	59.5	58.2	56
KEWAUNEE	KEWAUNEE B2	345	1099	40	18125	18233	18450	18558	19613	20045	20878	0.6%	1.8%	2.4%	8.2%	10.6%	15.2%	39.8	39.4	39.2	39.7	36.8	35.7	33.3
S FONDULAC	S FONDULAC	138	382-S	40	23124	23125	23128	23129	23129	23727	24061	0.0%	0.0%	0.0%	0.0%	2.6%	4.1%	31.2	31.2	31.1	31.1	31.1	29.4	28.5
S FONDULAC	S FONDULAC	138	314-S	40	22612	22614	22617	22618	22618	23334	24100	0.0%	0.0%	0.0%	0.0%	3.2%	6.6%	32.6	32.6	32.6	32.5	32.5	30.5	28.6
S FONDULAC	S FONDULAC	138	336-S	40	23183	23184	23187	23188	23188	23833	24386	0.0%	0.0%	0.0%	0.0%	2.8%	5.2%	31	31	31	31	31	29.1	27.8
S FONDULAC	S FONDULAC	138	304-S	40	24512	24514	24517	24519	24519	25226	25953	0.0%	0.0%	0.0%	0.0%	2.9%	5.9%	27.7	27.7	27.7	27.7	27.7	25.7	23.9
S FONDULAC	S FONDULAC	138	1772-S	40	24512	24514	24517	24519	24519	25226	25953	0.0%	0.0%	0.0%	0.0%	2.9%	5.9%	27.7	27.7	27.7	27.7	27.7	25.7	23.9
S FONDULAC	S FONDULAC	138	1979-S	40	24512	24514	24517	24519	24519	25226	25953	0.0%	0.0%	0.0%	0.0%	2.9%	5.9%	27.7	27.7	27.7	27.7	27.7	25.7	23.9
S FONDULAC	S FONDULAC	138	1809-S	40	24512	24514	24517	24519	24519	25226	25953	0.0%	0.0%	0.0%	0.0%	2.9%	5.9%	27.7	27.7	27.7	27.7	27.7	25.7	23.9
S FONDULAC	S FONDULAC	138	320-S	40	24512	24514	24517	24519	24519	25226	25953	0.0%	0.0%	0.0%	0.0%	2.9%	5.9%	27.7	27.7	27.7	27.7	27.7	25.7	23.9
S FONDULAC	SFL 345	345	92-S	37.5	14942	14945	14951	14954	14954	16803	17096	0.0%	0.1%	0.1%	0.1%	12.5%	14.4%	50.7	50.6	50.6	50.6	50.6	45.2	44.5
S FONDULAC	SFL 345	345	52-S	40	14942	14945	14951	14954	14954	16803	17096	0.0%	0.1%	0.1%	0.1%	12.5%	14.4%	53.7	53.7	53.7	53.7	53.7	48.7	47.9
S FONDULAC	SFL 345	345	74-S	40	14942	14945	14951	14954	14954	16803	17096	0.0%	0.1%	0.1%	0.1%	12.5%	14.4%	53.7	53.7	53.7	53.7	53.7	48.7	47.9
S FONDULAC	SFL 345	345	86-S	40	14942	14945	14951	14954	14954	16803	17096	0.0%	0.1%	0.1%	0.1%	12.5%	14.4%	53.7	53.7	53.7	53.7	53.7	48.7	47.9

				Single Phase Fault Analysis																				
				Derated Breaker Rating	Symmetrical Fault Current (amps)							Change in Fault Current from Scenario 1 (Existing)						Breaker Margin (%)						
Substation	Bus Name	KV	Breaker	(kA)	Scenario 1: Existing system	Scenario 2: Existing with new GSU of POB G2 (Fall 2009-May 2010)	Scenario 3: With G834 (J023) and new GSU of POB G1 (May 2010-May 2011)	Scenario 4: With G833/4 (J022/3) with existing Kewaunee (May 2011-beyond)	Scenario 5: With G833/4 (J022/3) with new Kewaunee (May 2011-beyond)	Scenario 6: With G833/4 (J022/3) with new Kewaunee and potential East sub	Scenario 7: With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion	Scenario 2 (%)	Scenario 3 (%)	Scenario 4 (%)	Scenario 5 (%)	Scenario 6 (%)	Scenario 7 (%)	Scenario 1: Existing system	Scenario 2: Existing with new GSU of POB G2 (Fall 2009-May 2010)	Scenario 3: With G834 (J023) and new GSU of POB G1 (May 2010-May 2011)	Scenario 4: With G833/4 (J022/3) with existing Kewaunee (May 2011-beyond)	Scenario 5: With G833/4 (J022/3) with new Kewaunee (May 2011-beyond)	Scenario 6: With G833/4 (J022/3) with new Kewaunee and potential East sub	Scenario 7: With G833/4 (J022/3) with new Kewaunee and potential East/North sub with line conversion
FOREST_JUNCTION	ForestJct_4	138	BSK-45 (Transf 2)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_1	138	BSK-12 (KK971K11)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_2	138	BSK-23 (KK971K21)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_3	138	BSK-34 (KK971K31)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_5	138	BSK-56 (KK8222)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_6	138	BSK-67 (E-57)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_8	138	BSK-89 (Transf 1)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_9	138	BSK-910 (KK971K91)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_10	138	BSK-1011 (KK4035)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct_11	138	BSK-1112 (KK72851)	50	36810	37008	37072	37100	37024	37060	38439	0.5%	0.7%	0.8%	0.6%	0.7%	4.4%	23.5	22.2	22.3	22.6	23.9	23.8	19.7
FOREST_JUNCTION	ForestJct1	345	BS-L12 (Transf 2)	50	17947	18065	18129	18154	18081	18141	21666	0.7%	1.0%	1.2%	0.7%	1.1%	20.7%	64.1	63.9	63.7	63.7	63.8	63.7	56.7
FOREST_JUNCTION	ForestJct2	345	BS-L23 (L121)	50	17947	18065	18129	18154	18081	18141	21666	0.7%	1.0%	1.2%	0.7%	1.1%	20.7%	64.1	63.9	63.7	63.7	63.8	63.7	56.7
FOREST_JUNCTION	ForestJct3	345	BS-L45 (Transf 1)	50	17947	18065	18129	18154	18081	18141	21666	0.7%	1.0%	1.2%	0.7%	1.1%	20.7%	64.1	63.9	63.7	63.7	63.8	63.7	56.7
FOREST_JUNCTION	ForestJct5	345	BS-L56 (L971L51)	50	17947	18065	18129	18154	18081	18141	21666	0.7%	1.0%	1.2%	0.7%	1.1%	20.7%	64.1	63.9	63.7	63.7	63.8	63.7	56.7
FOREST_JUNCTION	ForestJct7	345	BS-L71(971L71)	50	17947	18065	18129	18154	18081	18141	21666	0.7%	1.0%	1.2%	0.7%	1.1%	20.7%	64.1	63.9	63.7	63.7	63.8	63.7	56.7
FOX_RIVER_SWITCH_Y	AR FOX_Bus_3	345	BSL-34	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
FOX_RIVER_SWITCH_Y	AR FOX_Bus_5	345	BSL-56	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
FOX_RIVER_SWITCH_Y	AR FOX_Bus_1	345	BSL-12	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
FOX_RIVER_SWITCH_Y	AR FOX_GSU1_311	345	BSL-45	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
FOX_RIVER_SWITCH_Y	AR FOX_GSU2_311	345	BSL-61	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
FOX_RIVER_SWITCH_Y	AR FOX_Bus_2	345	BSL-23	50	21507	21703	21784	21817	21682	21744	22847	0.9%	1.3%	1.4%	0.8%	1.1%	6.2%	57	56.5	56.4	56.4	56.6	56.5	54.3
NORTH_APPLETON	NAP_Bus_G4	138	LINE 6842	63	37910	39056	39111	39135	38028	38059	38602	3.0%	3.2%	3.2%	0.3%	0.4%	1.8%	39.8	36.1	36.1	36.2	39.6	39.6	38.7
NORTH_APPLETON	NAP_Bus_G4	138	K37	63	37924	39078	39135	39160	38045	38077	38633	3.0%	3.2%	3.3%	0.3%	0.4%	1.9%	39.8	35.6	35.6	35.7	39.6	39.6	38.7
NORTH_APPLETON	NAP_Bus_G4	138	TRF 1, 138 KV	63	35313	36446	36490	36509	35410	35435	35929	3.2%	3.3%	3.4%	0.3%	0.3%	1.7%	43.9	40	40	40.1	43.8	43.8	43
NORTH_APPLETON	NAP_Bus_G5	138	TRF 2, 138 KV	63	34332	35460	35501	35520	34423	34446	34926	3.3%	3.4%	3.5%	0.3%	0.3%	1.7%	45.5	42	41.9	42	45.4	45.3	44.6
NORTH_APPLETON	NAP_Bus_G5	138	LINE 6851	63	38079	39234	39292	39318	38202	38235	38805	3.0%	3.2%	3.3%	0.3%	0.4%	1.9%	39.6	35.5	35.5	35.6	39.4	39.3	38.4
NORTH_APPLETON	NAP_Bus_G6	138	TRF 3, 138 KV	63	35370	36440	36484	36504	35467	35491	35923	3.0%	3.1%	3.2%	0.3%	0.3%	1.6%	43.9	40.7	40.7	40.8	43.7	43.7	43
NORTH_APPLETON	NAP_Bus_G4	138	CAP 4	63	39205	40358	40416	40442	39330	39362	39933	2.9%	3.1%	3.2%	0.3%	0.4%	1.9%	37.8	33.9	33.9	34	37.6	37.5	36.6
NORTH_APPLETON	NAP_Bus_G4	138	BUS SECT 4-5	63	31681	32532	32570	32587	31764	31785	32234	2.7%	2.8%	2.9%	0.3%	0.3%	1.7%	49.7	45.8	45.7	45.8	49.6	49.5	48.8
NORTH_APPLETON	NAP_Bus_G4	138	6843 GCB	63	38033	39171	39228	39252	38154	38186	38751	3.0%	3.1%	3.2%	0.3%	0.4%	1.9%	39.6	35.9	35.9	36.1	39.4	39.4	38.5
NORTH_APPLETON	NAP_Bus_G5	138	CAP 5	63	39205	40358	40416	40442	39330	39362	39933	2.9%	3.1%	3.2%	0.3%	0.4%	1.9%	37.8	33.9	33.9	34	37.6	37.5	36.6
NORTH_APPLETON	NAP_Bus_G5	138	BUS SECT 5-6	63	32056	32847	32885	32902	32137	32158	32538	2.5%	2.6%	2.6%	0.3%	0.3%	1.5%	49.1	45.8	45.8	45.9	49	49	48.4
NORTH_APPLETON	NAP_Bus_G5	138	LINE 6853	63	37364	38493	38549	38574	37484	37515	37951	3.0%	3.2%	3.2%	0.3%	0.4%	1.6%	40.7	36.7	36.7	36.8	40.5	40.5	39.8
NORTH_APPLETON	NAP_Bus_G6	138	CAP 6	63	39205	40358	40416	40442	39330	39362	39933	2.9%	3.1%	3.2%	0.3%	0.4%	1.9%	37.8	33.9	33.9	34	37.6	37.5	36.6
NORTH_APPLETON	NAP_Bus_G6	138	6862 GCB	63	37859	39000	39055	39080	37978	38009	38573	3.0%	3.2%	3.2%	0.3%	0.4%	1.9%	39.9	36.1	36.1	36.2	39.7	39.7	38.8
NORTH_APPLETON	NAP_Bus_G6	138	LINE l113	63	36922	38073	38127	38151	37036	37068	37593	3.1%	3.3%	3.3%	0.3%	0.4%	1.8%	41.4	37.1	37	37.2	41.2	41.2	40.3
NORTH_APPLETON	NAP_345B_L1	345	BUS SECT 12-1	40	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	48.1	47.3	47.1	47.1	47.8	47.7	46.9
NORTH_APPLETON	NAP_345B_L34	345	BS34-4	40	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	48.1	47.3	47.1	47.1	47.8	47.7	46.9
NORTH_APPLETON	NAP_345B_L1	345	LINE R304	39.8	18925	19239	19268	19280	18984	19014	19343	1.7%	1.8%	1.9%	0.3%	0.5%	2.2%	42.4	37.9	37.9	38	42.6	42.5	41.4
NORTH_APPLETON	NAP_345B_L81	345	BS 81-8	39.8	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	36.8	32.5	32.4	32.6	37.1	37	35.9
NORTH_APPLETON	NAP_345B_L12	345	BUS SECT 12-2	40	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	48.1	47.3	47.1	47.1	47.8	47.7	46.9
NORTH_APPLETON	NAP_345B_L1	345	BS 81-1	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L4	345	BS 45-4	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L6	345	BS 67-6	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L67	345	BS 67-7	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L3	345	BS 34-3	38	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	46.1	42.5	42.5	42.6	46.3	46.3	45.3
NORTH_APPLETON	NAP_345B_L7	345	BS 78-7	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L78	345	BS 78-8	50	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	58.5	57.8	57.7	57.7	58.3	58.2	57.5
NORTH_APPLETON	NAP_345B_L2	345	BUS SECT 23-2	42	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	40.1	35.9	35.9	36.1	40.4	40.3	39.2
NORTH_APPLETON	NAP_345B_L23	345	BUS SECT 23-3	42	20755	21088	21141	21164	20873	20906	21256	1.6%	1.9%	2.0%	0.6%	0.7%	2.4%	40.1	35.9	35.9	36.1	40.4	40.3	39.2
POINT_BEACH	POINT_BCH_B1	345	BS 1-2	40	20835	21412	22044	22189	22332	22307	24545	2.8%	5.8%	6.5%	7.2%	7.1%	17.8%	44.7	42.5	42.4	44.5	44.2	44.2	38.6
POINT_BEACH	POINT_BCH_B2	345	BS 2-3	40	15080	15677	15687	15822	16054	16060	16224	4.0%	4.0%	4.9%	6.5%	6.5%	7.6%	61.1	58.7	58.7	60.4	59.9	59.8	59.4
POINT_BEACH	POINT_BCH_B3	345	BS 3-4	40	17363	17413	18159	18167	18376	19028	20223	0.3%	4.6%	4.6%	5.8%	9.6%	16.5%	55.9	55.6	54.6	54.6	54.1	52.4	49.4
POINT_BEACH	POINT_BCH_B4	345	BS 4-5	40	20995	21544	22171	22318	22507	23216	24464	2.6%	5.6%	6.3%	7.2%	10.6%	16.5%	43.8	41.8	42	44.2	43.7	42	38.8
POINT_BEACH	POINT_BCH_B1	345	LINE 111	50	20990	21561	22188	22335	22476	22415	24648	2.7%	5.7%	6.4%	7.1%	6.8%	17.4%	55.4	53.7	53.7	55.3	55	55.2	50.7
POINT_BEACH	POINT_BCH_B2	345	LINE 121(Bkr 121)	50	21054	21598	22219	22367	22572	23275	24857	2.6%	5.5%	6.2%	7.2%	10.5%	18.1%	54.9	53.2	53.3	55.3	54.9	53.4	50.3
POINT_BEACH	POINT_BCH_B2	345	LINE 123(Bkr 123)	50	21054	21598	22219	22367	22572	23275	24857	2.6%	5.5%	6.2%	7.2%	10.5%	18.1%	54.9	53.2	53.3	55.3	54.9	53.4	50.3
POINT_BEACH	POINT_BCH_B3	345	LINE Q303	50	17990	18529	19156	19303	19265	20016	21267	3.0%	6.5%	7.3%	7.1%	11.3%	18.2%	60.8	59.3	59.3	61.4	61.5	60	57.5
POINT_BEACH	POINT_BCH_B5	345	LINE 151	50	21192	21734	22356	22504	22692	23404	24854	2.6%	5.5%	6.2%	7.1%	10.4%	16.3%	54.6	53	53.1	55	54.6	53.2	50.7
SHEBOYGAN ENERGY C	EN SEC_Bus_1	345	BT12	50	9077	9088	9100	9104	9105	18379	20492	0.1%	0.3%	0.3%	0.3%	102.5%	125.8%	81.5	81.4	81.5	81.5	81.5	63.1	59
SHEBOYGAN ENERGY C	EN SEC_Bus_1	345	BT16	50	9077	9088	9100	9104	9105	18379	20492	0.1%	0.3%	0.3%	0.3%	102.5%	125.8%	81.5	81.4	81.5	81.5	81.5	63.2	59
SHEBOYGAN ENERGY C	EN SEC_ Bus 3	345	BT36	50	9077	9088	9100	9104	9105	18379	20492	0.1%	0.3%	0.3%	0.3%	102.5%	125.8%	81.5	81.4	81.5	81.5	81.5	63.2	59
EDGEWATER	EDG 138	138	470-S	20	18100	18101	18102	18102	18102	19266	23518	0.0%	0.0%	0.0%	0.0%	6.4%	29.9%	-14	-14	-14	-14	-14	-21.6	-46
EDGEWATER	EDG 138	138	847-S	40	20229	20230	20231	20232	20232	22261	24605	0.0%	0.0%	0.0%	0.0%	10.1%	21.6%	38	38	38	38	38	29.5	22.3
EDGEWATER	EDG 138	138	370-S	40	14314	14314	14315	14315	14315	14804	19493	0.0%	0.0%	0.0%	0.0%	4.1%	36.2%	56.7	56.7	56.7	56.7	56.7	55	42.7
EDGEWATER	EDG 138	138	861-S	40	22423	22423	22425	22426	22426	24508	28492	0.0%	0.0%	0.0%	0.0%	9.3%	27.1%	30.1	30	30	30	30	23.4	12
EDGEWATER	EDG 138	138	843-S	40	22479	22480	22481	22482	22482	24570	28467	0.0%	0.0%	0.0%	0.0%	9.3%	26.6%	29.9	29.9	29.9	29.9	29.9	23.3	12.1
EDGEWATER	EDG 138	138	854-S	40	22483	22484	22485	22488	22488	24578	28491	0.0%	0.0%	0.0%	0.0%	9.3%	26.7%	29.9	29.9	29.9	29.9	29.9	23.3	12.1
EDGEWATER	EDG 138	138	884-S	40	19239	19239	19240	19241	19241	20653	23992	0.0%	0.0%	0.0%	0.0%	7.3%	24.7%	39.3	39.3	39.3	39.3	39.3	34.7	25.3
EDGEWATER	EDG 138	138	865-S	40	22421	22422	22423	22424	22424	24506	28490	0.0%	0.0%	0.0%	0.0%	9.3%	27.1%	30.1	30.1	30	30	30	23.4	12
EDGEWATER	EDG 138	138	826-S	40	24451	24451	24453	24454	24454	26990	30091	0.0%	0.0%	0.0%	0.0%	10.4%	23.1%	23.8	23.8	23.7	23.7	23.7	15.7	7.2
EDGEWATER	EDGEWATER	345	311-S	40	13030	13031	13032	13033	13033	18277	19643	0.0%	0.0%	0.0%	0.0%	40.3%	50.8%	49.2	49.2	49.2	49.2	49.2	29	24
EDGEWATER	EDGEWATER	345	313-S	40	12772	12773	12774	12775	12775	19526	21121	0.0%	0.0%	0.0%	0.0%	52.9%	65.4%	50.2	50.2	50.2	50.2	50.2	24.8	18.7
EDGEWATER	EDGEWATER	345	485-S	50	16478	16478	16480	16481	16481	21021	23066	0.0%	0.0%	0.0%	0.0%	27.6%	40.0%	63.8	63.8	63.8	63.8	63.8	54.5	50.5
EDGEWATER	EDGEWATER	345	2523-S	50	16671	16672	16674	16675	16675	21235	23310	0.0%	0.0%	0.0%	0.0%	27.4%	39.8%	63.3	63.3	63.3	63.3	63.3	54	49.8
EDGEWATER	EDGEWATER	345	302-S	40	16671	16672	16674	16675	16675	21235	23310	0.0%	0.0%	0.0%	0.0%	27.4%	39.8%	40.7	40.7	40.7	40.7	40.7	25.6	19
EDGEWATER	EDGEWATER	345	303-S	40	16671	16672	16674	16675	16675	21235	23310	0.0%	0.0%	0.0%	0.0%	27.4%	39.8%	40.7	40.7	40.7	40.7	40.7	25.6	19
EDGEWATER	EDGEWATER	345	304-S	40	16671	16672	16674	16675	16675	21235	23310	0.0%	0.0%	0.0%	0.0%	27.4%	39.8%	40.7	40.7	40.7	40.7	40.7	25.6	19
EDGEWATER	EDGEWATER	345	308-S	40	16671	16672	16674	16675	16675	21235	23310	0.0%	0.0%	0.0%	0.0%	27.4%	39.8%	40.7	40.7	40.7	40.7	40.7	25.6	19
KEWAUNEE	KEW 138kV	138	F-84	37	10827	10841	10863	10870	21876	22008	22260	0.1%	0.3%	0.4%	102.1%	103.3%	105.6%	65.1	65	65.1	65.4	31.7	31.2	30.3
KEWAUNEE	KEW 138kV	138	Y-51	37.2	11335	11350	11372	11379	22308	22527	22778	0.1%	0.3%	0.4%	97.6%	98.7%	101.0%	63.9	63.8	63.9	64.2	30.7	30.2	29.3
KEWAUNEE	KEW 138kV	138	1066E	38.9	13287	13304	13328	13336	24273	24401	24863	0.1%	0.3%	0.4%	82.7%	83.6%	85.6%	60.5	60.4	60.5	60.8	29	28.8	27.7
KEWAUNEE	KEW 138kV	138	1066W	38.9	13287	13304	13328	13336	24273	24401	24863	0.1%	0.3%	0.4%	82.7%	83.6%	85.6%	60.5	60.4	60.5	60.8	29	28.6	27.7
KEWAUNEE	KEW 138kV	138	22	40	13287	13304	13328	13336	24273	24401	24863	0.1%	0.3%	0.4%	82.7%	83.6%	85.6%	61.6	61.5	61.6	61.9	31	30.8	29.7
KEWAUNEE	KEWAUNEE B1	345	R-304	38	17279	17442	17676	17753	18252	18828	19268	0.9%	2.3%	2.7%	5.6%	7.8%	11.5%	40.7	40.1	40.4	42.2	40.7	39.5	37.5
KEWAUNEE	KEWAUNEE B1	345	3450	40	12752	12963	13202	13261	14206	14514	15063	1.6%	3.5%	4.0%	11.4%	13.8%	18.0%	64	63.4	63.2	63.9	57.9	57	55.5
KEWAUNEE	KEWAUNEE B1	345	3451	40	17279	17442	17676	17753	18252	18828	19268	0.9%	2.3%	2.7%	5.6%	7.8%	11.5%	43.7	43.2	43.4	45.2	43.7	42.6	40.7
KEWAUNEE	KEWAUNEE B2	345	Q-303	40	11572	11779	12028	12065	12065	12382	12890	1.8%	3.9%	4.4%	4.4%	7.0%	11.4%	68.9	68.4	68	68.3	68.3	67.8	68.4
KEWAUNEE	KEWAUNEE B2	345	1099	40	18557	18731	18974	19049	20389	20705	21323	0.9%	2.2%	2.7%	9.9%	11.6%	14.9%	40.1	39.5	39.7	41.4	37.5	36.4	34.6
S FONDULAC	S FONDULAC	138	382-S	40	26259	26260	26262	26263	26263	26825	27141	0.0%	0.0%	0.0%	0.0%	2.2%	3.4%	17.5	17.5	17.5	17.5	17.5	15.8	14.9
S FONDULAC	S FONDULAC	138	314-S	40	25856	25858	25860	25861	25861	26552	27220	0.0%	0.0%	0.0%	0.0%	2.7%	5.3%	19.3	19.3	19.3	19.3	19.3	17.2	15.4
S FONDULAC	S FONDULAC	138	336-S	40	26222	26224	26226	26227	26227	26880	27375	0.0%	0.0%	0.0%	0.0%	2.5%	4.4%	17.6	17.6	17.6	17.6	17.6	15.6	14.3
S FONDULAC	S FONDULAC	138	304-S	40	27573	27574	27577	27578	27578	28262	28909	0.0%	0.0%	0.0%	0.0%	2.5%	4.8%	13.9	13.9	13.9	13.9	13.9	11.9	10.1
S FONDULAC	S FONDULAC	138	1772-S	40	27573	27574	27577	27578	27578	28262	28909	0.0%	0.0%	0.0%	0.0%	2.5%	4.8%	13.9	13.9	13.9	13.9	13.9	11.9	10.1
S FONDULAC	S FONDULAC	138	1979-S	40	27573	27574	27577	27578	27578	28262	28909	0.0%	0.0%	0.0%	0.0%	2.5%	4.8%	13.9	13.9	13.9	13.9	13.9	11.9	10.1
S FONDULAC	S FONDULAC	138	1809-S	40	27573	27574	27577	27578	27578	28262	28909	0.0%	0.0%	0.0%	0.0%	2.5%	4.8%	13.9	13.9	13.9	13.9	13.9	11.9	10.1
S FONDULAC	S FONDULAC	138	320-S	40	27573	27574	27577	27578	27578	28262	28909	0.0%	0.0%	0.0%	0.0%	2.5%	4.8%	13.9	13.9	13.9	13.9	13.9	11.9	10.1
S FONDULAC	SFL 345	345	92-S	37.5	12163	12165	12167	12169	12169	13221	13376	0.0%	0.0%	0.0%	0.0%	8.7%	10.0%	57.7	57.6	57.6	57.6	57.6	54.5	54
S FONDULAC	SFL 345	345	52-S	40	12163	12165	12167	12169	12169	13221	13376	0.0%	0.0%	0.0%	0.0%	8.7%	10.0%	60.3	60.3	60.3	60.3	60.3	57.3	56.9
S FONDULAC	SFL 345	345	74-S	40	12163	12165	12167	12169	12169	13221	13376	0.0%	0.0%	0.0%	0.0%	8.7%	10.0%	60.3	60.3	60.3	60.3	60.3	57.3	56.9
S FONDULAC	SFL 345	345	86-S	40	12163	12165	12167	12169	12169	13221	13376	0.0%	0.0%	0.0%	0.0%	8.7%	10.0%	60.3	60.3	60.3	60.3	60.3	57.3	56.9

Appendix F: Study Criteria

Study Criteria

F.1 Contingencies

For stability analysis, a set of branches in the vicinity of the generator/power plant of concern is selected as contingencies, based on engineering judgment. Fault analysis is performed for the following six categories of contingency conditions:

1. Three-phase fault cleared in primary time with an otherwise intact system.
2. Three-phase fault cleared in delayed clearing time (i.e. breaker failure conditions) with an otherwise intact system.
3. Three-phase fault cleared in primary clearing time with a pre-existing outage of any other transmission element.
4. Single Line Ground (SLG) bus section fault cleared in primary clearing time with an otherwise intact system.
5. SLG internal breaker fault cleared in primary clearing time with an otherwise intact system.
6. SLG fault of double circuits on common tower cleared in primary time with an otherwise intact system.

For power flow analysis, contingencies include:

1. N-1 contingencies – all lines and transformers operated at 69kV and above in the following control areas/zones: ATC Planning Zones 1-5 and ties to those zones and all branches of voltage level 69kV and above in the Dairyland Power Cooperative, Northern States Power Control Area, Commonwealth Edison, and Alliant Energy West control areas.
2. Selected N-2 and multiple contingencies that ATCLLC has determined to be significant.

F.2 Monitored Elements

F.2.1 Intact System, N-1, N-2 and Special Multiple Contingency Evaluation Using Linear Transfer Analysis Methods

All load carrying elements operated at 69kV and above in the following control areas/zones were studied: ATCLLC Planning Zones 1-5 and ties to those zones, and all branches of voltage level 69kV and above in the Dairyland Power Cooperative, Northern States Power Control Area, Commonwealth Edison, and Alliant Energy West control areas.

A Transmission Reliability Margin (TRM) of 5% must be applied to the MVA ratings of each monitored ATCLLC element. Violations reported will be based upon the adjusted MVA rating.

F.3 Thermal Loading Criteria

F.3.1 Injection Violations

Generation injection violations include: 1) thermal violations of the transmission elements that connect the Generator to the rest of the transmission network (outlet congestion); 2) thermal violations of the transmission elements that have a transfer distribution factor (TDF) $\geq$ 5% for NERC Category A (system intact) conditions and TDF $\geq$ 20% for NERC Category B contingencies anywhere in the studied system in relation to real power injected at the Point of Interconnection (POI) when delivered to all of MISO; or 3) thermal violations created by the loss of a transmission element connected to the generator interconnection substation.

F.3.2 Operating Restriction Calculation

$$\text{Allowable Output} = \frac{\text{Equipment Rating} - [\text{Line Flow} - (\text{Generation Output} * \text{TDF})]}{\text{TDF}}$$

F.4 Steady State Under Voltage Criteria

F.4.1 Intact System, N-1 and Special Multiple Contingency Evaluation Using ACCC

Under intact system conditions, the voltage magnitude of all transmission system buses with a decrease of 0.01 per unit due to the Generator must not be lower than 0.95 per unit. Under contingency conditions, the voltage magnitude of all transmission system buses with a decrease of 0.01 per unit, due to the Generator, must not be lower than 0.90 per unit.

F.4.2 N-2 Contingency Evaluation

Power flow solutions must converge for a selected number of N-2 contingencies in the electrical proximity of the studied Generator. Divergence of a power flow solution indicates potential voltage collapse. A "fix" must be identified for any non-converging power flow simulation and may include generator operating restrictions. [Note: Non-convergence may be due to solution settings such as switched shunt operation and/or LTC action.]

F.5 Angular Stability Criteria

Critical Clearing Time (CCT) is a period relative to the start of a fault, within which all generators in the system remain stable (synchronized). CCT is obtained from simulation. Maximum Expected Clearing Time (MECT) determines a period of time that is needed to clear a fault using the existing system facilities. MECT is dictated by the existing system facilities. In any contingency, if the computed CCT is less than the MECT plus a margin determined by ATC (1.0 cycle for studies using estimated generator data and 0.5 cycles for studies using confirmed generator data), it is considered an unstable situation and is unacceptable. Otherwise, it is considered acceptable transient stability performance.

Longer time-domain simulations must be performed on faults cleared at the CCT to examine dynamic stability. Simulations will typically cover 20 seconds of system dynamics and machine angle oscillations must meet the damping criteria in the ATC Planning Criteria.

Note that ATC stability criteria and NERC stability criteria differ on the study assumptions used for breaker failure analysis. ATC study criterion models breaker failure by modeling a three-phase fault during the primary time, reduced to SLG fault if the failed breaker is an Independent Pole Operated (IPO) breaker during delayed clearing and cleared at the end of the delayed clearing time. On the other hand, NERC study criterion assumes a single line-to-ground fault for the entire breaker failure analysis. Hence, the CCT computed from ATC stability criteria is always less than or equal to the value computed using the NERC study criteria. This report assumes ATC stability criteria unless otherwise stated.

The time-domain simulations must also be reviewed for compliance with the transient and dynamic voltage standards in the ATC Planning Criteria. Voltages of all transmission system buses must recover to be at least 70% of the nominal system voltages immediately after fault removal and 80% of the nominal system voltages in 2.0 second after fault removal.

Appendix G: Estimated Allowable MW Output from G834 or G833 under Spring/Fall or Winter Emergency Ratings

- Allowable output from G834/J023 between May 2010 and April 2011 (before G833/J022 in service) with Spring/Fall emergency ratings considered

Limiting Element	Spring/Fall Existing Rating (MVA)	Contingency	PRE MVA[1]	POST MVA[1]	DF	REQ'D RATING	Allowable MW
Point Beach-Sheboygan Energy Center 345-kV line	968	Cypress-Arcadian 345-kV line	516.2	540.5	23.37%	568.94	1726.145
Cypress-Arcadian 345-kV line	968	Point Beach-Sheboygan Energy Center 345-kV line	498.7	519.3	19.80%	546.61	2125.758

- Allowable output from G834/J023 between May 2010 and April 2011 (before G833/J022 in service) with Winter emergency rating considered

Limiting Element	Winter Existing Rating (MVA)	Contingency	PRE MVA[1]	POST MVA[1]	DF	REQ'D RATING	Allowable MW
Point Beach-Sheboygan Energy Center 345-kV line	1311	Cypress-Arcadian 345-kV line	516.2	540.5	23.37%	568.94	3120.454
Cypress-Arcadian 345-kV line	1076	Point Beach-Sheboygan Energy Center 345-kV line	498.7	519.3	19.80%	546.61	2643.939

1. The Pre and Post MVA flow were re-estimated from the previous interim operations study report in order to calculate new required ratings and new allowable MW output. The old values in the previous study report was obtained from Table A.5

New Pre MVA = old Pre MVA

New Post MVA = old Post MVA + 6 MW x DF

- Allowable output from G833/J022 beyond May 2011 (w/ G834/J023 assumed in service) with Spring/Fall emergency ratings considered

Limiting Element	Spring/Fall Existing Rating (MVA)	Contingency	PRE MVA[2]	POST MVA[3]	DF	REQ'D RATING	Allowable MW
Point Beach-Sheboygan Energy Center 345-kV line	968	Cypress-Arcadian 345-kV line	540.6	566.0	24.90%	595.77	1522.112
Cypress-Arcadian 345-kV line	968	Point Beach-Sheboygan Energy Center 345-kV line	520.1	543.2	22.71%	571.81	1759.302

- Allowable output from G833/J022 beyond May 2011 (w/ G834/J023 assumed in service) with Winter emergency rating considered

Limiting Element	Winter Existing Rating (MVA)	Contingency	PRE MVA[2]	POST MVA[3]	DF	REQ'D RATING	Allowable MW
Point Beach-Sheboygan Energy Center 345-kV line	1311	Cypress-Arcadian 345-kV line	540.6	566.0	24.90%	595.77	2830.747
Cypress-Arcadian 345-kV line	1076	Point Beach-Sheboygan Energy Center 345-kV line	520.1	543.2	22.71%	571.81	2211.085

2. The Pre MVA flow was re-estimated from the previous interim operations study report in order to calculate new required ratings and new allowable MW output. The old values in the previous study report was obtained from Table A.5
New Pre MVA = old Pre MVA + 6 MW x DF

3. The Post MVA flow was re-estimated from the previous interim operations study report in order to calculate new required ratings and new allowable MW output. The old value in the previous study report was from the case (Scenario 5 with G833/834 and all wind 100%, with 2011 Kewaunee modeled)
New Post MVA = old Post MVA + 12 MW x DF

Note: The results shown in the above tables are based on 50% peak load cases.

Appendix H: Summary Table of Stability Study Result

			Interim Period 1 (G834/J023 - 642.96 MW gross)					Interim Period 2 (G834-3 /J022-3 - each 642.96 MW gross, with existing KEW)					Interim Period 2 (G834-3/J022-3 - each 642.96 MW gross, with New KEW)				
				Potential Solutions					Potential Solutions					Potential Solutions			
Type of Fault	Fault causing problems	Prior Outage	System Problem	Generation Restriction (MW gross)	Other Upgrade	Tested Clearing Time with potential solutions	Comments	System Problem	Generation Restriction (MW gross)	Other Upgrade Required	Tested Clearing Time with potential solutions	Comments	System Problem	Generation Restriction (MW gross)	Other Upgrade Required	tested clearing time with potential solutions	Comments
Breaker failure	L111 @ P		none					K,P	G2 620 at all times (see comments)	SEL 352 and SEL 421 relay (see comment)	3.5/9.25/4.5	9.0 tested clearing time is needed to avoid G2 restriction. Per ATC Protection, 9.0 tested clearing time can be achieved with the relay upgrade	K,P	G2 620 at all times (see comments)	SEL 352 and SEL 421 relay (see comments)	3.5/9.25/4.5	9.0 tested clearing time is needed to avoid G2 restriction. Per ATC Protection, 9.0 tested clearing time can be achieved with the relay upgrade
	L151 @ P							K,P		SEL 352 and SEL 421 relay	3.5/9.5/4.5		K,P		SEL 352 and SEL 421 relay	3.5/9.5/4.5	
	Q-303 @ P							K,P	G2 580 at all times (see comments)	SEL 352 and SEL 421 relay (see comment)	3.5/9.25/6.5	P2 tripped even at 8.0 cycle tested clearing time. To avoid G2 restriction, install a series breaker. With 9.0 cycle tested clearing time, G2 600 MW at all times	K,P		SEL 352 and SEL 421 relay	3.5/9.25/4.5	
	R-304 @ K							none					K,P		Replace R-304 breaker at NAP	3.5/9.5/4.5	W/ Kewaunee project, breaker failure clearing time becomes 8.5 cycles (i.e. 9.5 cycle with 1 cycle margin)
Intact primary													none				
Intact system double circuit fault																	
Fault under prior outage	R-304 @ K	111						K,P,F		Replace R-304 breaker at NAP	5.5/4.5						
	T10 @ H	111						P		None. 5.0 cycle is existing clearing time per ATC Protection.	6.0/8.5						
	R-304 @ K	121						K,P	G2 620	Replace R304 breaker at NAP	5.5/4.5	5.0 cycle tested clearing time to avoid G2 restriction					
	T10 @ H	121						P		None. 5.0 cycle is existing clearing time per ATC Protection.	6.0/8.5						
	R-304 @ K	151						K,P	G2 620	Replace R304 breaker at NAP	5.5/4.5	5.0/4.5 tested clearing time to avoid G2 restriction. At 5.5/4.5 tested clearing time with G2 at full output POB trips due to voltage sag (P1 1.513s for 19KV, P2 1.521s for 19KV , B1B5 1st 1.083s, B1B5 2nd 1.575s). Thus, if time delay can be readjusted, only thing needs to be done is replacing R304 breaker at NAP					
	T10 @ H	151						P		None. 5.0 cycle is existing clearing time per ATC Protection.	6.0/8.5						
	6832 @ Fox	R-304						K,P,F	G2 600		4.5/4.5	4.0/4.5 tested clearing time to avoid G2 restriction. At 4.5/4.5 with G2 620 MW gross, 345 kV 2nd criteria is violated: B1: 1.583s and B2: 1.583s. Readjusting time delay is needed for 620 MW.					
	R-304 @ K	6832	K,P,F,S	G1 560	Replace R-304 breaker at NAP	5.5/4.5		K,P,F,S	Both G1 and G2 at 540	Replace R-304 breaker at NAP	5.5/4.5	Even 4.5/4.5 tested clearing time trips gen. See also the restriction w/ new Kewaunee	K,P,F	G2 600	Replace R-304 breaker at NAP	4.5/4.5	

Type of Fault	Fault causing problems	Prior Outage	Interim Period 1 (G834/J023 - 642.96 MW gross)					Interim Period 2 (G834-3 /J022-3 - each 642.96 MW gross, with existing KEW)					Interim Period 2 (G834-3/J022-3 - each 642.96 MW gross, with New KEW)				
			System Problem	Potential Solutions: Generation Restriction (MW gross)	Potential Solutions: Other Upgrade	Potential Solutions: Tested Clearing Time with potential solutions	Comments	System Problem	Potential Solutions: Generation Restriction (MW gross)	Potential Solutions: Other Upgrade Required	Potential Solutions: Tested Clearing Time with potential solutions	Comments	System Problem	Potential Solutions: Generation Restriction (MW gross)	Potential Solutions: Other Upgrade Required	Potential Solutions: tested clearing time with potential solutions	Comments
	T10 @ H	6832	P,F		None. 5.0 cycle is existing clearing time per ATC Protection.	6.0/8.5		P,F	G2 580	5.0 cycle is existing clearing time per ATC Protection	6.0/8.5	5.0/8.5 tested clearing time to avoid G2 restriction					
	R-304 @ K	L-SEC31	K,P,F,S		*Replace R-304 breaker at* NAP	5.5/4.5		K,P,F,S	G2 580	Replace R-304 breaker at NAP	*5.5/4.5*						
	T10 @ H	L-SEC31	K,P,S,F,TH23		None. 5.0 cycle is existing clearing time per ATC Protection	6.0/8.5		K,P,F,S	G2 580	5.0 cycle is existing clearing time per ATC Protection	6.0/8.5	5.5/8.5 tested clearing time to avoid G2 restriction	none				
	R-304 @ K	POB12	none					K,P,Fs		Replace R-304 breaker at NAP	5.5/4.5						
	T10 @ H	POB12						P		None. 5.0 cycle is *existing clearing time* per ATC Protection	*6.0/8.5*						
	121 @ P	POB23	P1	G1 580		4.5/4.5	Open bus tie during G1 refueling outage	P1	G1 580		4.5/4.5	Open bus tie during G1 refueling outage	P1	G1 580		4.5/4.5	Open bus tie during G1 refueling outage
	R-304 @ K	POB45	none					K,P	G2 620	Replace R-304 breaker at NAP	5.5/4.5						
	T10 @ H	POB45						P		None. 5.0 cycle is *existing clearing time* per ATC Protection	*6.0/8.5*						
POB SLG Bus Fault with breaker failure	B2, B3BF							P2		relay setting change	4.75/12.0		none				
	AUX 1	121						K,P				CCT - 5.5/6.0					
	AUX 1	R-304						K,P				CCT - 5.5/6.0	K,P				CCT - 5.5/6.0
	AUX 1	6832						K,P,F				CCT - 5.0/6.0	K,P,F				CCT - 5.0/6.0
	AUX 1	L-CYP31						K,P,F				CCT - 5.0/6.0	K,P,F				CCT - 5.0/6.0
	AUX 1	NAPL71						K,P,F				CCT - 5.5/6.0	K,P,F				CCT - 5.5/6.0
	AUX 1	Y-311						K,P,F				CCT - 5.5/6.0	K,P,F				CCT - 5.5/6.0
Primary Aux Fault	AUX 2	111						K,P				CCT - 5.5/6.0	P				At 5.75/6.1 tested clearing time - UV trip P (19kV 1.521s, 345kV 1st 1.096s, 345kV 2nd 1.562s) CCT - 5.5/6.0
	AUX 2	121						K,P				CCT - 5.0/6.0	K,P				CCT - 5.0/6.0
	AUX 2	R-304						K,P				CCT - 5.0/6.0	K,P				CCT - 5.0/6.0
	AUX 2	L-SEC31						K,P,S				CCT - 5.0/6.0	K,P,S				CCT - 5.0/6.0
	AUX 2	B12						K,P				CCT - 5.5/6.0	K,P				CCT - 5.5/6.0
Primary Aux Fault with breaker failure								none					none				
Primary GSU fault																	
GSU breaker failure																	

Type of Fault	Fault causing problems	Prior Outage	Interim Period 1 (G834/J023 - 642.96 MW gross)					Interim Period 2 (G834-3 /J022-3 - each 642.96 MW gross, with existing KEW)					Interim Period 2 (G834-3/J022-3 - each 642.96 MW gross, with New KEW)				
			System Problem	Potential Solutions				System Problem	Potential Solutions				System Problem	Potential Solutions			
				Generation Restriction (MW gross)	Other Upgrade	Tested Clearing Time with potential solutions	Comments		Generation Restriction (MW gross)	Other Upgrade Required	Tested Clearing Time with potential solutions	Comments		Generation Restriction (MW gross)	Other Upgrade Required	tested clearing time with potential solutions	Comments
Unit Trip																	

Nomenclature

K: Kewaunee
P: Point Beach (P1, P2)
S: Sheboygan Energy
F: Fox Energy
TH: Thilmany

L111: Point Beach-Sheboygan Energy Center 345 kV line
L121: Point Beach-Forest Junction 345 kV line
Q303: Point Beach-Kewaunee 345 kV line
L151: Point Beach-Fox Energy 345 kV line
R304: Kewaunee-North Appleton 345 kV line

NAPL71: North Appleton-Werner West 345 kV line
CYP31: Cypress-Arcadian 345 kV line
6832: North Appleton-Fox Energy Center 345 kV line
T10: Kewaunee T10 345/138 kV transformer
SEC31: Sheboygan Energy Center-Granville 345 kV line

H: *High side*
POBxy: Point Beach bus tie xy
CCT: Critical clearing time (see note below)

Note: Tested clearing times noted in the table includes 1.0 cycle margin. The Planning margin is added to the local primary clearing time for primary clearing simulations and the local breaker failure time for breaker failure simulations.

Appendix I: Minimum Excitation Limits at Point Beach and Kewaunee during Interim Periods

Minimum Excitation Limits at Point Beach and Kewaunee during Interim Periods

As noted in this G833/J022-G834/J023 Interim Operations Re-Study Report, Point Beach and Kewaunee units need to maintain certain reactive power output in anticipation of critical contingency conditions. Reactive power output from a synchronous machine has an impact on the transient stability of the unit. Typically, when a unit produces relatively small reactive power output or absorbs reactive power from transmission system (under-excitation), the unit tends to be less stable under a fault condition. The results of the interim operation study indicate that a certain level of reactive power output (over-excitation) needs to be maintained to ensure generation stability in anticipation of critical fault conditions. This is primarily due to too many generators with few outlets out of Fox Valley area.

The minimum excitation limiter, which may also be referred to as the under-excited reactive ampere limit or under-excitation limiter, settings are an effective mechanism to ensure a minimum level of unit excitation. However, limiting the amount of under-excited operation can negatively affect the ability to control system and plant voltages under lighter system load conditions where transmission line charging may result in higher system voltages. Therefore, any minimum excitation limits need to be coordinated with voltage control requirements.

The "interim" solutions described in the Interim Operations Re-Study Report would be followed by the completion of the necessary Network Upgrades identified in the G833/J022-G834/J023 System Impact Re-Study Report, which has yet to be posted. The Network Upgrades would be the long-term solutions which ensure a wider operating envelope for the local transmission system and the interconnected generators by permitting generating unit operation at near unity or leading power factor, or at least provide a foundation to achieve the wider operating envelop through additional transmission reinforcement in the area that may be needed in the future.

Transient Stability Studies

To estimate minimum excitation limits (MVAR output levels), it is assumed that the stability upgrades identified for each interim period are in-service (see G833/J022-G834/J023 Interim Operation Re-Study Report). Various MVAR output levels at Point Beach and Kewaunee 345 kV buses were evaluated using two different generation dispatch scenarios during the three interim periods. Critical faults under system intact condition identified in the interim operation study were applied, which are:

- Fault on L111 with breaker failure at Point Beach
- Fault on L151 with breaker failure at Point Beach
- Fault on Q-303 with breaker failure at Point Beach (post-May 2010 until May 2011 only since a series breaker is proposed to be installed by May 2011)
- Fault on R-304 with breaker failure at Kewaunee (post Kewaunee bus reconfiguration project period only)

With stability upgrades for each interim period in-service and based on the study results shown in Table I.1 through I.4, the Point Beach and Kewaunee units would need to maintain the following minimum excitation levels to ensure synchronism of these and nearby generators:

- For May 2010 – May 2011 (With Point Beach Unit #1 upgraded and with the existing Kewaunee bus configuration)
  - Point Beach G1 and G2: 48 MVAR or higher per unit
  - Kewaunee G1: 41 MVAR or higher
- For May 2011 until completion of the Kewaunee bus reconfiguration project (With both Point Beach Units #1 and #2 upgraded),
  - Point Beach G1 and G2: 70 MVAR or higher per unit
  - Kewaunee G1: 58 MVAR or higher
- Post completion of the Kewaunee bus reconfiguration project (With both Point Beach Units #1 and #2 upgraded)
  - Point Beach G1 and G2: 68 MVAR or higher per unit
  - Kewaunee G1: 49 MVAR or higher

These minimum excitation limits were estimated by testing the critical system faults. Additional study for all other relevant system faults was not performed because of the following reasons:

- For Interim 1 period (see Table I.1), the critical faults under system intact conditions are more severe at the low generation scenario, and the estimated minimum excitation limits of Kewaunee and Point Beach units are either same or higher than their MVAR outputs at the 352 kV voltage schedule where all other faults under system intact conditions were proven to be stable in the interim operation study. Therefore, additional study for all other relevant system faults under system intact conditions was not performed. For prior outage conditions, it is recommended to maintain at least 354 kV at the Point Beach and Kewaunee 345 kV buses (note: 354 kV is high-end of the preferred voltage range at Point Beach) in anticipation of critical faults. This is to ensure stable system even with faults under prior outage conditions which appear to be more severe at high generation scenario and were proven to be stable at the 352 kV voltage level with interim upgrades and operating restrictions implemented.
- As mentioned above, the critical faults under system intact conditions appear to be more severe at the low generation scenario according to the results of the interim operation study, and the estimated minimum excitation limits of Kewaunee and Point Beach units are higher than their MVAR outputs at the 352 kV voltage schedule of low generation scenario (see Table 2.4.1) where all other faults under system intact conditions were proven to be stable in the interim operation report. Therefore, additional study for all other relevant system faults under system intact conditions was not performed. For prior outage conditions, it is also recommended to maintain at least 354 kV (high-end of the preferred voltage range at Point Beach) in anticipation of critical faults. This is to ensure stable system even with faults under prior outage condition which appear to be more severe at high generation scenario and were proven to be stable at 352 kV.

Steady State Voltage Control Studies at Minimum System Load Conditions

Using a minimum load case with 40% of 2010 summer peak load condition, three scenarios were built and studied to confirm if any high voltages occur at Point Beach 345 kV and Kewaunee 345/138 kV buses under various conditions. The scenarios are:

- Scenario 1: Minimum load case with G834-J023 added
- Scenario 2: Minimum load case with G834/J023_G833/J022 added
- Scenario 3: Minimum load case with Scenario 2 and with Point Beach G2 and Kewaunee G1 offline.

The minimum reactive power outputs of Point Beach and Kewaunee units in each case were adjusted to match with the estimated minimum excitation limits as follows:

- For Scenario 1:
  - Point Beach G1 and G2: 48 MVAR
  - Kewaunee G1: 41 MVAR
- For Scenario 2:
  - Point Beach G1 and G2: 70 MVAR
  - Kewaunee G1: 58 MVAR

No study was performed using the minimum excitation limits of Interim 2B period since no significant impact is expected due to the Kewaunee bus reconfiguration project.

For the study, the following critical contingencies were tested.

- System Intact
- Open Line-end
  i. Open North Appleton end of R-304
  ii. Open Granville end of L-SEC31
  iii. Open Arcadian end of L-CYP31
  iv. Open Forest Junction end of L121
  v. Open Fox River end of L151
- N-1 or multiple contingency analyses are not performed since these conditions will lower voltages due to increased system impedances.

Monitored elements are Point Beach 19 kV and 345 kV, and Kewaunee 345 kV and 138 kV bus voltages. The following criteria are assumed for the monitored elements.

- Point Beach 19 kV bus voltage: 95 percent to 105 percent of nominal voltage
- Point Beach 345 kV bus voltage: Not exceed 358 kV (high end of normal voltage range) under system intact condition. Not exceed 360 kV (slightly lower than high end of absolute voltage range) under a line end open
- Kewaunee 345 kV bus voltage: 95 percent to 105 percent of nominal voltage
- Kewaunee 138 kV bus voltage: 140 kV and 143 kV under system intact and contingency conditions

In conclusion, no high voltage conditions were found as shown in Table I.4. Sensitivity analysis was performed by turning on some of the capacitor banks in the area such as New Holstein, Glenview, Howard and Shoto. As a result, high voltage at Kewaunee 138 kV bus is identified with the Granville end of L-SEC31 open. However, the voltage issue

can be addressed by remedial actions such as turning off some of the capacitor banks in the area as described in Table I.5.

Table I.1. Minimum Excitation Limit Study Results for Interim 1 (May 2010 – May 2011)

Interim 1 (KV and MVAR level at POB and KEW for stable system under critical faults)			
Critical Fault under Intact (tested clearing times)	High Gen Scenario[1]	Low Gen Scenario[1]	Comment
L111 BF @ POB **(3.5/10.0/4.5)**	350 kV or higher (POB G1: 43.4 POB G2: 43.4 KEW G1: 40.9)	351 kV or higher (POB G1: 42.7 POB G2: 42.7 KEW G1: 26.1)	Thus, minimum excitation limits are: POB G1: 47.4 POB G2: 47.4 KEW G1: 40.9
L151 BF @ POB **(3.5/10.0/4.5)**	348 kV or higher (POB G1: 12.0 POB G2: 12.0 KEW G1: 20.1)	349 kV or higher (POB G1: 33.3 POB G2: 33.3 KEW G1: 17.5)	
Q303 BF @ POB **(3.5/10.0/6.5)**	350 kV or higher (POB G1: 43.4 POB G2: 43.4 KEW G1: 40.9)	352 kV or higher (POB G1: 47.4 POB G2: 47.4 KEW G1: 30.4)	
R304 BF @ KEW	N/A		

Table I.2. Minimum Excitation Limit Study Results for Interim 2A (May 2011 until Kewaunee Reconfiguration Complete)

Interim 2A (KV level at POB and KEW for stable system under critical faults)			
Critical Fault under Intact (tested clearing times)	High Gen Scenario[1]	Low Gen Scenario[1]	Comment
L111 BF @ POB (3.5/**9.0**/4.5)	351 kV or higher (POB G1: 69.6 POB G2: 69.6 KEW G1: 57.5)	352 kV or higher (POB G1: 60.1 POB G2: 60.1 KEW G1: 35.8)	Thus, minimum excitation limits are: POB G1: 69.6 POB G2: 69.6 KEW G1: 57.5
L151 BF @ POB (3.5/**9.5**/4.5)	350 kV or higher (POB G1: 53.7 POB G2: 53.7 KEW G1: 46.9)	352 kV or higher (POB G1: 60.1 POB G2: 60.1 KEW G1: 35.8)	
Q303 BF @POB	N/A		
R304 BF @ KEW	N/A		

Table I.3. Minimum Excitation Limit Study Results for Interim 2B (Post Kewaunee Reconfiguration)

Interim 2B (KV level at POB and KEW for stable system under critical faults)			
Critical Fault under Intact (tested clearing times)	High Gen Scenario[1]	Low Gen Scenario[1]	Comment
L111 BF @ POB (3.5/**9.0**/4.5)	351 kV or higher (POB G1: 67.2 POB G2: 67.2 KEW G1: 48.9)	352 kV or higher (POB G1: 58.6 POB G2: 58.6 KEW G1: 27.3)	Thus, minimum excitation limits are: POB G1: 67.2 POB G2: 67.2 KEW G1: 48.9
L151 BF @ POB (3.5/9.5/4.5)	349 kV or higher (POB G1: 35.6 POB G2: 35.6 KEW G1: 27.1)	352 kV or higher (POB G1: 58.6 POB G2: 58.6 KEW G1: 27.3)	
Q303 BF @ POB	N/A		
R304 BF @ KEW (3.5/9.5/4.5)	348 kV or higher (POB G1: 20.1 POB G2: 20.1 KEW G1: 16.4)	351 kV or higher (POB G1: 53.4 POB G2: 53.4 KEW G1: 22.9)	

1. Approximate MVAR change at Point Beach and Kewaunee:
   - High generation scenario:
     - 1kV change at Point Beach for every 16 MVAR change
     - 1kV change at Kewaunee for every 11 MVAR change
   - Low generation scenario:
     - 1kV change at Point Beach for every 5 MVAR change
     - 1kV change at Kewaunee for every 4.5 MVAR change

Table I.4. Voltages at Point Beach and Kewaunee Under System Intact and Contingencies

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 1 - Minimum Load Case With G834 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition))															
Monitored Bus		Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1	345.00	699433	1.0203 PU	352.02 KV	1.0203 PU	352.01 KV	1.0205 PU	352.08 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV
PT BCH2	345.00	698898	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH3	345.00	699211	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH4	345.00	698900	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH5	345.00	698901	1.0203 PU	351.99 KV	1.0202 PU	351.96 KV	1.0202 PU	351.98 KV	1.0203 PU	351.99 KV	1.0202 PU	351.96 KV	1.0204 PU	352.03 KV
PT BHG1	19.000	699434	1.0008 PU	19.01 KV	1.0060 PU	19.11 KV	0.9971 PU	18.95 KV	0.9999 PU	19.00 KV	0.9987 PU	18.98 KV	0.9988 PU	18.98 KV
PT BHG2	19.000	699435	1.0018 PU	19.03 KV	1.0071 PU	19.13 KV	0.9982 PU	18.97 KV	1.0010 PU	19.02 KV	0.9998 PU	19.00 KV	0.9999 PU	19.00 KV
KEWAUNEE	345.00	699630	1.0203 PU	352.00 KV	1.0214 PU	352.37 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
KEWAUNEE	138.00	699620	1.0256 PU	141.54 KV	1.0257 PU	141.54 KV	1.0254 PU	141.50 KV	1.0259 PU	141.57 KV	1.0247 PU	141.41 KV	1.0251 PU	141.46 KV

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 2A - Minimum Load Case with G834 (J023) and G833 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition))															
Monitored Bus		Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1	345.00	699433	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV	1.0206 PU	352.11 KV	1.0203 PU	352.01 KV	1.0203 PU	352.00 KV	1.0203 PU	352.01 KV
PT BCH2	345.00	698898	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH3	345.00	699211	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH4	345.00	698900	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH5	345.00	698901	1.0202 PU	351.99 KV	1.0202 PU	351.96 KV	1.0203 PU	352.00 KV	1.0203 PU	351.99 KV	1.0201 PU	351.95 KV	1.0204 PU	352.03 KV
PT BHG1	19.000	699434	1.0026 PU	19.05 KV	1.0074 PU	19.14 KV	0.9995 PU	18.99 KV	1.0019 PU	19.04 KV	1.0007 PU	19.01 KV	1.0008 PU	19.02 KV
PT BHG2	19.000	699435	1.0026 PU	19.05 KV	1.0074 PU	19.14 KV	0.9995 PU	18.99 KV	1.0019 PU	19.04 KV	1.0007 PU	19.01 KV	1.0008 PU	19.02 KV
KEWAUNEE	345.00	699630	1.0203 PU	352.00 KV	1.0218 PU	352.51 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
KEWAUNEE	138.00	699620	1.0256 PU	141.53 KV	1.0257 PU	141.55 KV	1.0253 PU	141.49 KV	1.0258 PU	141.56 KV	1.0246 PU	141.39 KV	1.0249 PU	141.44 KV

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 2A with Point Beach G2 and Kewaunee G1 offline - Minimum Load Case with G834 (J023) and G833 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition)													
Monitored Bus	Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1 345.00	699433	1.0203 PU	352.01 KV	1.0203 PU	352.02 KV	1.0242 PU	353.35 KV	1.0203 PU	352.01 KV	1.0203 PU	352.02 KV	1.0203 PU	352.02 KV
PT BCH2 345.00	698898	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0240 PU	353.27 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH3 345.00	699211	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0240 PU	353.27 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH4 345.00	698900	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0240 PU	353.27 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH5 345.00	698901	1.0203 PU	352.00 KV	1.0203 PU	351.99 KV	1.0239 PU	353.26 KV	1.0203 PU	352.00 KV	1.0202 PU	351.98 KV	1.0204 PU	352.03 KV
PT BHG1 19.000	699434	1.0046 PU	19.09 KV	1.0018 PU	19.03 KV	1.0030 PU	19.06 KV	1.0026 PU	19.05 KV	1.0011 PU	19.02 KV	1.0021 PU	19.04 KV
PT BHG2 19.000	699435	0.9911 PU	18.83 KV	0.9911 PU	18.83 KV	0.9947 PU	18.90 KV	0.9911 PU	18.83 KV	0.9911 PU	18.83 KV	0.9911 PU	18.83 KV
KEWAUNEE 345.00	699630	1.0196 PU	351.75 KV	1.0208 PU	352.17 KV	1.0230 PU	352.92 KV	1.0196 PU	351.77 KV	1.0192 PU	351.62 KV	1.0192 PU	351.62 KV
KEWAUNEE 138.00	699620	1.0239 PU	141.30 KV	1.0247 PU	141.41 KV	1.0260 PU	141.59 KV	1.0241 PU	141.32 KV	1.0231 PU	141.19 KV	1.0234 PU	141.23 KV

Table I.5. Voltages at Point Beach and Kewaunee Under System Intact and Contingencies (With Capacitor Banks at New Holstein, Glenview, Howard and Shoto online)

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 1 - Minimum Load Case With G834 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition)) - with New Holstein (16.8 mvar), Glenview (16.2 mvar), Howard (32 mvar), Shoto (16.2 mvar) back online															
Monitored Bus		Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1	345.00	699433	1.0203 PU	352.02 KV	1.0203 PU	352.01 KV	1.0206 PU	352.10 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV
PT BCH2	345.00	698898	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH3	345.00	699211	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH4	345.00	698900	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH5	345.00	698901	1.0203 PU	352.00 KV	1.0202 PU	351.97 KV	1.0203 PU	352.01 KV	1.0203 PU	352.00 KV	1.0202 PU	351.96 KV	1.0204 PU	352.03 KV
PT BHG1	19.000	699434	0.9992 PU	18.98 KV	1.0038 PU	19.07 KV	0.9960 PU	18.92 KV	0.9983 PU	18.97 KV	0.9980 PU	18.96 KV	0.9979 PU	18.96 KV
PT BHG2	19.000	699435	1.0003 PU	19.00 KV	1.0048 PU	19.09 KV	0.9971 PU	18.95 KV	0.9994 PU	18.99 KV	0.9991 PU	18.98 KV	0.9989 PU	18.98 KV
KEWAUNEE	345.00	699630	1.0203 PU	352.00 KV	1.0216 PU	352.46 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
KEWAUNEE	138.00	699620	1.0301 PU	142.16 KV	1.0297 PU	142.10 KV	1.0295 PU	142.08 KV	1.0305 PU	142.21 KV	1.0286 PU	141.94 KV	1.0290 PU	142.01 KV

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 2A - Minimum Load Case with G834 (J023) and G833 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition)) - with New Holstein (16.8 mvar), Glenview (16.2 mvar), Howard (32 mvar), Shoto (16.2 mvar) back online															
Monitored Bus		Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1	345.00	699433	1.0203 PU	352.02 KV	1.0203 PU	352.01 KV	1.0210 PU	352.24 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV	1.0203 PU	352.01 KV
PT BCH2	345.00	698898	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0208 PU	352.17 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH3	345.00	699211	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0208 PU	352.17 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH4	345.00	698900	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0208 PU	352.17 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
PT BCH5	345.00	698901	1.0203 PU	351.99 KV	1.0202 PU	351.96 KV	1.0207 PU	352.14 KV	1.0203 PU	352.00 KV	1.0202 PU	351.96 KV	1.0204 PU	352.03 KV
PT BHG1	19.000	699434	1.0011 PU	19.02 KV	1.0053 PU	19.10 KV	0.9999 PU	19.00 KV	1.0001 PU	19.00 KV	1.0000 PU	19.00 KV	0.9999 PU	19.00 KV
PT BHG2	19.000	699435	1.0011 PU	19.02 KV	1.0053 PU	19.10 KV	0.9999 PU	19.00 KV	1.0001 PU	19.00 KV	1.0000 PU	19.00 KV	0.9999 PU	19.00 KV
KEWAUNEE	345.00	699630	1.0203 PU	352.00 KV	1.0220 PU	352.59 KV	1.0203 PU	352.00 KV	1.0204 PU	352.03 KV	1.0203 PU	352.00 KV	1.0203 PU	352.00 KV
KEWAUNEE	138.00	699620	1.0300 PU	142.14 KV	1.0297 PU	142.10 KV	1.0293 PU	142.05 KV	1.0305 PU	142.20 KV	1.0283 PU	141.91 KV	1.0288 PU	141.97 KV

Voltages at Point Beach and Kewaunee under Key line-end open- (Interim 2A with Point Beach G2 and Kewaunee G1 offline - Minimum Load Case with G834 (J023) and G833 (J023) in-service, load level at 6462 MW (40% of 2010 peak load condition) - with New Holstein (16.8 mvar), Glenview (16.2 mvar), Howard (32 mvar), Shoto (16.2 mvar) back online															
Monitored Bus	Bus Number	System Intact		Open North Appleton end of Kewaunee-North Appleton (R304)		Open Granville end of Granville-Sheboygan Energy Center (SEC31)		Open Arcadian end of Arcadian-Cypress (CYP31)		Open Forest Junction end of Point Beach-Forest Junction (L121)		Open Fox River end of Point Beach-Fox River (L151)	
PT BCH1 345.00	699433	1.0212 PU	352.30 KV	1.0237 PU	353.18 KV	1.0324 PU	356.18 KV	1.0233 PU	353.05 KV	1.0236 PU	353.16 KV	1.0230 PU	352.93 KV
PT BCH2 345.00	698898	1.0211 PU	352.29 KV	1.0237 PU	353.17 KV	1.0322 PU	356.10 KV	1.0233 PU	353.05 KV	1.0236 PU	353.15 KV	1.0230 PU	352.92 KV
PT BCH3 345.00	699211	1.0211 PU	352.29 KV	1.0237 PU	353.17 KV	1.0322 PU	356.10 KV	1.0233 PU	353.05 KV	1.0236 PU	353.15 KV	1.0230 PU	352.92 KV
PT BCH4 345.00	698900	1.0211 PU	352.29 KV	1.0237 PU	353.17 KV	1.0322 PU	356.10 KV	1.0233 PU	353.05 KV	1.0236 PU	353.15 KV	1.0230 PU	352.92 KV
PT BCH5 345.00	698901	1.0211 PU	352.29 KV	1.0236 PU	353.16 KV	1.0321 PU	356.08 KV	1.0233 PU	353.05 KV	1.0236 PU	353.13 KV	1.0230 PU	352.94 KV
PT BHG1 19.000	699434	1.0002 PU	19.00 KV	1.0027 PU	19.05 KV	1.0110 PU	19.21 KV	1.0024 PU	19.05 KV	1.0027 PU	19.05 KV	1.0020 PU	19.04 KV
PT BHG2 19.000	699435	0.9919 PU	18.85 KV	0.9944 PU	18.89 KV	1.0027 PU	19.05 KV	0.9940 PU	18.89 KV	0.9943 PU	18.89 KV	0.9937 PU	18.88 KV
KEWAUNEE 345.00	699630	1.0208 PU	352.17 KV	1.0244 PU	353.42 KV	1.0312 PU	355.77 KV	1.0229 PU	352.91 KV	1.0227 PU	352.85 KV	1.0221 PU	352.64 KV
KEWAUNEE 138.00	699620	1.0293 PU	142.05 KV	1.0318 PU	142.39 KV	1.0377 PU	143.20 KV	1.0313 PU	142.33 KV	1.0302 PU	142.17 KV	1.0301 PU	142.15 KV

Appendix J: Unit Restriction Due to Stability under Prior Outage Conditions in Table ES-3 during One of Point Beach Units offline

				Scenario 1: With POB G1 off-line, with POB G2 at full output		Scenario 2: With POB G1 at full output, With POB G2 off-line	
Interim Periods	Fault	Prior Outage	Simulated Clearing Time	High Gen	Low Gen	High Gen	Low Gen
Interim 1 (With G834/J023, With existing Kewaunee)	R304 at KEW	6832	5.5/4.5	OK	OK	OK	OK
	L121 at POB	POB Bus tie 2-3	4.5/4.5	OK	OK	P1*	P1*
Interim 2A (With G833/4-J022/3, With existing Kewaunee)	R304 at KEW	L121	5.5/4.5	OK	OK	OK	OK
	R304 at KEW	L151	5.5/4.5	OK	OK	OK	OK
	6832 at FOX	R-304	4.5/4.5	OK	OK	OK	OK
	R-304 at KEW	6832	5.5/4.5	OK	OK	OK	OK
	R-304 at KEW	L-SEC31	5.5/4.5	OK	OK	OK	OK
	L121 at POB	POB Bus tie 2-3	4.5/4.5	OK	OK	P1*	P1*
	R-304 at KEW	POB Bus tie 4-5	5.5/4.5	OK	OK	OK	OK
Interim 2B (With G833/4-J022/3, With new Kewaunee)	R-304 at KEW	6832	4.5/4.5	OK	OK	OK	OK
	L121 at POB	POB Bus tie 2-3	4.5/4.5	OK	OK	P1*	P1*

* POB G1 tripped. The outage of Point Beach Bus tie 2-3 followed by L121 fault isolates Point Beach G1 to the remaining line L111. Therefore, taking the Point Beach Bus tie 2-3 out of service during Point Beach G2 refueling outage window does not eliminate the POB G1 stability issue for L121 fault under Point Beach Bus tie 2-3 out of service. Thus, follow the operating restriction for the fault condition described in the G833/4-J022/3 Interim Operation Re-study Report.