NEPOOL Operating Procedure No. 12

VOLTAGE AND REACTIVE CONTROL

Approved: October 3, 2003 by the NEPOOL Participants Committee

References:

1. ISO New England Transmission Operating Guides - All Voltage/Reactive Guides
2. NEPOOL Operating Procedure No. 4 - Action During a Capacity Deficiency (OP 4)
3. NEPOOL Operating Procedure No. 7 - Action in an Emergency (OP 7)
4. NEPOOL Operating Procedure No. 14 - Technical Requirements for Generation, Dispatchable and Interruptible Load (OP 14)
5. NEPOOL Operating Procedure No. 16 - Transmission System Data (OP 16)
6. NEPOOL Operating Procedure No.19 - Transmission Operations (OP 19)
7. Master/Satellite Procedure No. 9 - Operation of the Chester Static VAR Compensator (M/S 9)
8. NERC Planning Standard III.C.S2.M3 and III.C.S2.M4

TABLE OF CONTENTS

APPENDIX

I. INTRODUCTION

This procedure provides broad criteria, operating practices and responsibilities to help ensure that desired/reliable voltage and reactive conditions are maintained on the power system. It also includes general actions to control voltage/reactive conditions when deviations from normal occur or are needed to minimize adverse effects during abnormal conditions.

More specific criteria and actions may be required when the measures described in this procedure do not correct the abnormal voltage/reactive conditions. This information is contained in detailed voltage/reactive documents issued as part of the ISO New England Transmission Operating Guides. Whereas these guides are referenced several times throughout this procedure, Appendix A lists the documents and indicates the types of information they contain. To facilitate references to Appendix A, its column numbering and headings are consistent with the format and order of this procedure.

II. CRITERIA

A. VOLTAGE SCHEDULES AND LIMITS FOR GENERATORS AND KEY TRANSMISSION STATIONS

Major generating stations throughout New England have specified voltage schedules, which should be maintained as closely as possible in system operations. They should also be used by operators and planners in off-line studies of the power system. During certain conditions at a generating station or on the power system, sustained deviations from voltage schedules may be required/unavoidable and minimum and maximum voltages have been established that can be sustained at generating stations during these infrequent conditions.

In addition to voltage schedules, minimum and maximum voltage limits at several key generating or transmission stations have been established to promote system reliability during adverse voltage/reactive conditions. These reliability concerns can be based on the security of the transmission system or station service supplies to nuclear generators. The key stations and associated voltage limits are detailed in the area Voltage Guides issued as part of the ISO New England Transmission Operating Guides (refer to Appendix A, column 1).

B. GENERATOR REACTIVE CAPABILITIES, COMMITMENTS AND REQUIRED REACTIVE RESERVES

Generator reactive capabilities available to regulate voltages should be employed in system operations and analyses. Data collection methods (see OP 14) have been designed such that these reactive capabilities should be fully available except for occasional times when unique temporary problems occur at a particular generating station.

To promote security of the transmission system during adverse voltage/reactive conditions, required unit commitments and levels of required reactive reserve for generators within certain areas of New England and for the Chester SVC have been established. System conditions that warrant the prescribed unit commitments or reactive reserves have also been identified. Details are provided in the ISO New England Transmission Operating Guides (see Appendix A columns 2 and 3).

III. VOLTAGE/REACTIVE OPERATING PRACTICES

A. TRADITIONAL VOLTAGE/REACTIVE CONTROL

Besides the use of generator reactive capabilities, the proper dispatch of shunt capacitors/reactors combined with effective transformer voltage schedules or fixed tap settings are the most traditional means of achieving desired voltages and reactive conditions. Listings of switchable shunt devices

installed to support the New England transmission system (115 kV and above) and guides for switching them can be found in the area Voltage Guides (see Appendix A, column 4).

B. TRANSMISSION INTERFACE TRANSFER LIMITS TO AVOID LOW VOLTAGE

In some cases, custom software tools have been developed to calculate voltage based transfer limits for transmission interfaces. These limits ensure acceptable voltage response to contingencies. Appendix A column 5 notes the transmission operating guides that contain voltage based transfer limits for transmission interfaces.

C. CIRCUIT SWITCHING TO CONTROL HIGH VOLTAGE

In some areas, transmission circuit switching is a viable option for controlling high voltage/excessive charging conditions. Appendix A column 6 identifies the ISO New England Transmission Operating Guides that provide information for switching circuits in the Boston area to control high voltage.

D. LOAD MANAGEMENT FOR VOLTAGE/REACTIVE RELIABILITY

In severe cases of low voltage and/or inadequate reactive reserves, load management actions can be taken. Details on conditions when these actions can/should be used and how they should be implemented are provided in the Voltage Guides (as identified in Appendix A, column 7) and NEPOOL Operating Procedures No. 4 and 7.

IV. RESPONSIBILITIES

This procedure is based on the principle that voltage control is best achieved when action is taken as close as possible to the affected area. Voltage schedules and other reactive conditions will be supervised by Station, Satellite and the ISO operators, each being responsible for an ever expanding area of responsibility. Regardless of who's requesting or directing corrective measures, action must ultimately be taken by Station or Satellite operators depending on who has "hands on" control of the reactive resources.

A. GENERATING AND TRANSMISSION STATIONS

Generating and transmission station operators are responsible for maintaining station service and other local voltage requirements and scheduled voltages at levels designated by individual Participants. Generating stations are also responsible for maintaining voltage schedules set for the high side of the generator step-up transformers by the appropriate NEPOOL committee. Normally, automatic voltage regulation works off the low side of the step-up transformer (generator terminals). Thus, in order to maintain a high side voltage schedule, manual intervention can be required to offset varying power flows through and voltage drops across the step-up transformer.

When unable to maintain scheduled station and local voltages with the means under their control, the generating or transmission station operators must notify their respective Satellite operator (and local dispatch authority if appropriate).

B. SATELLITES

Satellites are responsible for monitoring and supervising the following conditions within their territories:

- voltage schedules and limits,
- unit MVAR loadings, capabilities and reserves,
- shunt capacitor and reactor dispatches,
- transformer voltage schedules or fixed tap settings,

- synchronous condenser operation (requested via ISO New England by the Satellite unless in emergency conditions),
- MVAR flows between the AC system and HVDC facilities,
- Static VAR Compensator operation (must be coordinated with the ISO),
- line switching for voltage/reactive control (must be coordinated with the ISO and, if warranted, with other Satellites),
- the Satellites will notify/ coordinate the need for MW re-dispatch for MVAR requirements with the ISO. The Satellites will not directly re-dispatch MW with generators unless it is an emergency,
- other predefined indicators of voltage/reactive security (e.g. a particular circuit flow, the status of specific units, area load level, etc.).

Satellites are responsible for: 1) detecting and correcting deviations from normal scheduled voltage/reactive operations, 2) responding to notifications by generating or transmission station operators of difficulty in maintaining station or other local voltage or reactive schedules and, 3) responding to ISO requests to assist with inter-Satellite or inter-Area problems.

Satellites are authorized to exercise the following actions to correct voltage/reactive difficulties within their territories:

- direct voltage schedules and levels of reactive output and reserve on generators, synchronous condensers and Static VAR Compensators,
- direct the use of shunt capacitors and reactors,
- direct the operation of LTC transformers.

When a Satellite is unable to correct a voltage/reactive problem using the above actions or the Satellite believes that the problem should be handled on a multi-Satellite or inter-Area basis, the Satellite will notify the ISO and request assistance.

Before exercising any of the following voltage/reactive control actions, Satellites must notify the ISO and coordinate their implementations:

- line switching,
- load management.

C. ISO NEW ENGLAND

The ISO is responsible for the general monitoring and supervision of voltage/reactive conditions on the New England bulk power system (115 KV and above). If in monitoring the system a problem is detected within a Satellite, the ISO will contact the Satellite and request action.

When a Satellite reports to the ISO that it is not possible to correct a problem at a station or Satellite level, the ISO will assume direct responsibility for alleviating the problem. The ISO is authorized to direct, through the appropriate Satellite(s), all actions listed in the above Satellite section B and in addition any MW re-dispatching.

The ISO is also responsible for monitoring and supervising voltage/reactive operations of inter-Area ties. Problems may be noticed by the ISO or appear in the form of requests from neighboring pools or companies for assistance. The ISO will inform the appropriate Satellite(s) of the nature of the problem specifying; the pool or company involved, the location of the undesirable voltage/reactive condition and, general conditions aggravating the difficulty. The ISO is authorized to work with/through the Satellites and use all section B actions and MWh re-dispatching to eliminate the problem.

When abnormal voltage/reactive operating conditions materialize, the ISO may initiate a survey of key system parameters to better assess the nature and expanse of the conditions. Appendix B contains the survey forms that the ISO will use. The forms are broken down based on Satellite territories.

Document History

OP 12.rtf	08/18/1998
Updated Appendix A, B	05/27/2003

Voltage/Reactive Documents in the ISO New England Transmission Operating Guides

Voltage/Reactive Document	1 Voltage Limits	2 Units Critical To Voltage Control	3 Req'd. Reactive Reserves	4 Shunt Information	5 Interf. Voltage Xfer Lims.	6 Line Switching For High Voltage	7 Load Management Actions
Eastern REMVEC Low Voltage Guide	✓		✓	✓			✓
Northern New England Transmission Corridor-Low Voltage Guide	✓	✓		✓			✓
Northern New England Transmission Corridor - High Voltage Guide	✓	✓		✓			
Orrington Capacitors	✓			✓			
Boston Area Planning and Operations Guide	✓			✓		✓	✓
Northwest Vermont Interchange Procedure		✓			✓		
Sandy Pond Reactive Switching	✓						
M/S-9 Operation of the Chester SVC	✓	✓	✓	✓			
M/S 1 Nuclear Plant Operation	✓						
ME V/R Guide and Calculator	✓				✓		
SWCT V/R Guide and Calculator	✓				✓		
CT V/R Guide and Calculator	✓				✓		

Appendix B-1
Generators

REMVEC

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC [3]		Survey Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period [1]			Light Load Period [2]					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading			
AES GRANITE RIDGE CT 1	238	241	219	225	241	219	161	-75			
AES GRANITE RIDGE CT 1	238	241	219	225	241	219	161	-75			
ANP BELLINGHAM 1	356	362	335	350	362	335	95	-100			
ANP BELLINGHAM 2	356	362	335	350	362	335	95	-100			
ANP BLACKSTONE 1	356	362	335	350	362	335	95	-100			
ANP BLACKSTONE 2	356	362	335	350	362	335	95	-100			
BEAR SWAMP 1	240	241	219	225	241	219	150	-75			
BEAR SWAMP 2	240	241	219	225	241	219	150	-75			
BRAYTON 1	118	121	110	116	121	110	126	-42			
BRAYTON 2	118	121	110	116	121	110	126	-42			
BRAYTON 3	358	362	335	352	362	335	290	-230			
BRAYTON 4	358	362	328	352	362	328	250	-150			
CANAL 1	358	362	335	355	362	335	250	-50			
CANAL 2	358	362	335	355	362	335	190	-50			
CLEARY CC	118	121	110	116	121	110	88	-54.5			
COMERFORD	240	241	219	225	241	219	78	-48.8			
DARMOUTH POWER	115	121	109	115	121	109	39.2	-12.5			
DIGHTON POWER 1	118	121	110	116	121	110	30	0			

NOTE: Units not listed will follow local voltage schedules in accordance with Satellite requirements or Interconnection Agreements.
(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table/ curve.

REMVEC	Appendix B-2
Voltage & Reactive Schedules and Surveys	Generators

Units	Voltage Schedule						MVAr Capability @ SCC (3)		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period (1)			Light Load Period (2)					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading			
FORE RIVER GT 1	118	121	110	116	121	110	256	-90			
FORE RIVER GT 2	118	121	110	116	121	110	256	-90			
FORE RIVER ST 1	118	121	110	116	121	110	200	-120			
FPL RISE GT 1	119	121	110	117	121	110	110	-90			
FPL RISE GT2	119	121	110	117	121	110	110	-90			
FPL RISE ST 1	119	121	110	117	121	110	110	-90			
KENDALL REPOW G1	119	121	110	117	121	110	N/a	N/a			
KENDAL REPOW G2	119	121	110	117	121	110	N/a	N/a			
KENDAL REPOW G3	119	121	110	117	121	110	N/a	N/a			
KENDAL REPOW G4	119	121	110	117	121	110	N/a	N/a			
MANCHESTER ST 9 /9A	119	121	110	117	121	110	105	-96			
MANCHESTER ST 10/10A	119	121	110	117	121	110	105	-96			
MANCHESTER ST 11/11A	119	121	110	117	121	110	105	-96			
MEDWAY J1	238	241	219	235	241	219	20	-10			
MEDWAY J2	238	241	219	235	241	219	20	-10			
MEDWAY J3	115	121	109	115	121	109	20	-20			
MILFORD POWER (1-2)	117	121	110	115	121	110	80	-57			
MILLENIUM GT	117	121	112	115	121	110	125	-90			
MILLENIUM ST	117	121	112	115	121	110	62	-44			
MOORE (1-4)	240	241	219	225	241	219	64	-40			
MYSTIC 4	119	121	109	117	121	109	104	-75			

NOTE: Units not listed will follow local voltage schedules in accordance with Satellite requirements or Interconnection Agreements.
(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table NA: Not available

REMVEC — **Appendix B-3**

Voltage & Reactive Schedules and Surveys — **Generators**

Units	Voltage Schedule						MVAr Capability @ SCC [3]		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period [1]			Light Load Period [2]							
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading	Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
MYSTIC 5	119	121	109	117	121	109	104	-75			
MYSTIC 6	119	121	109	117	121	109	104	-75			
MYSTIC 7	360	362	335	352	362	335	316	-150			
MYSTIC 8	360	362	335	352	362	335	N/a	N/a			
MYSTIC 9	360	362	335	352	362	335	N/a	N/a			
NEA BELLINGHAM (1-3)	358	362	328	352	362	328	75	-45			
NEW BOSTON 1	119	121	109	117	121	109	220	-46			
OCEAN STATE 1 (1-3)	356	362	335	350	362	335	213	-90			
OCEAN STATE 2 (4-6)	356	362	335	350	362	335	213	-90			
PILGRIM	358	362	342	355	362	342	335	-100			
POTTER 2	117	126	115	117	126	115	53	-22			
SALEM HARBOR 1	119	121	109	117	121	109	28	-36			
SALEM HARBOR 2	119	121	109	117	121	109	37.5	-12.5			
SALEM HARBOR 3	119	121	109	117	121	109	67	-45			
SALEM HARBOR 4	119	121	109	117	121	109	275	-165			
SEMASS G1	116	121	109	116	121	109	15	-5			
SEMASS G2	116	121	109	116	121	109	10	-2			
SOMERSET 6	116	121	110	115	121	110	86	0			
TIVERTON (GT, ST)	115	121	109	115	121	109	180	-50			
VERMONT YANKEE	360	362	342	354	362	342	150	-100			

NOTE: Units not listed will follow local voltage schedules in accordance with Satellite requirements or Interconnection Agreements.

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table /curve . N/A : Not available

REMVEC	**Appendix B-4**
Voltage & Reactive Schedules and Surveys for Autotransformers with LTCs	**Generators**

		Tap-Changer Control						Survey	
								Date:	
								Time:	
								Load period:	Heavy/Light
				Available LTC Taps		Voltage Control Bandwidth			
Substation	High Side kV/ Low Side kV	LTC Operation (Automatic/Manual)	Scheduled Voltage	Max	Min	High Limit (kV)	Low Limit (kV)	Actual Voltage (kV)	LTC Operation (Automatic/Manual)
COOLIDGE XF	345/115	A	117	33	1	138	92		
GRANITE XF	230/115	A	116	16	-16	138	92		
KINGSTON XF									

Appendix B-5
REMVEC Transmission Capacitors & Reactors

Voltage & Reactive Schedules and Surveys for Transmission Capacitors & Reactors

Transmission Capacitor Information		Survey	
		Date:	
		Time:	
		Load period:	Heavy/Light
Location	Available MVAR	Actual Voltage (kV)	Closed/ Open
HYANNIS-GE2	1 @ 40		
KENT COUNTY	1 @ 63		
MANCHESTER ST.	1 @ 63		
K-STREET-1	1 @ 53.6		
K-STREET-2	1 @ 53.6		
MYSTIC	1 @ 53.6		
LEXINGTON	1 @ 53.6		
BAKER STREET #1	1 @ 53.6		
BAKER STREET #2	1 @ 53.6		
NEEDHAM	1 @ 53.6		
FRAMINGHAM	1 @ 53.6		
HIGHGATE	6 @ 20 2 @ 10		
COOLIDGE	2 @ 25		

	Available MVAR	Actual Voltage (kV)	Closed/ O
SANDBAR	1 @ 24.8		
ESSEX #1	1 @ 24.8		
ESSEX #2	1 @ 24.8		
ESSEX #3	1 @ 24.8		
ESSEX #4	1 @ 24.8		
WILLISTON	1 @ 24.8		
MIDDLEBURY	1 @ 22.9		
NORTH RUTLAND	1 @ 24.8		
BERLIN	1 @ 24.8		
GEORGIA	1 @ 24.8		
MILLBURRY	1 @ 63		
NORTHBORO RD.	1 @ 54		
PRATTS JCT.	1 @ 63		
TEWKSBURY #1	1 @ 63		
TEWKSBURY #2	1 @ 63		

Transmission Reactor Information		Survey	
		Date:	
		Time:	
		Load period:	Heavy/Light
Location	Available MVAR	Actual Voltage (kV)	Closed/ Open
K-STREET	1@ - 80		
WOBURN REACT	3 @ -80		
MYSTIC	1 @ -80		
NORTH CAMBRIDGE	2 @ -80		

Appendix B-6
Generators

CONVEX

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC [3]		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period [1]			Light Load Period [2]					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading			
AES THAMES	117	121	110	117	121	110	80	0			
ALTRESCO	119	121	109	119	121	109	105	-44			
BERKSHIRE POWER	117	121	108	117	121	105	163	-50			
BRIDGEPORT ENERGY	118	121	116	117	121	116	260	-50			
BRIDGEPORT HBR 2	118	121	116	117	121	116	115	0			
BRIDGEPORT HBR 3	118	121	116	117	121	116	260	-160			
BRIDGEPORT RESCO	118	121	116	117	121	116	30	-36			
CROSS SOUND CABLE	357	362	340	357	362	340	N/a	N/a			
DEVON 7	118	121	116	117	121	116	47	-19			
DEVON 8	118	121	116	117	121	116	47	-19			
LAKE ROAD 1	357	362	340	357	362	340	174	-90			
LAKE ROAD 2	357	362	340	357	362	340	174	-90			
LAKE ROAD 3	357	362	340	357	362	340	174	-90			
MASS POWER	119	121	111	119	121	111	135	-81			
MIDDLETOWN 2	118	121	112	116	121	112	54	-20			
MIDDLETOWN 3	118	121	112	116	121	112	87	-37			
MIDDLETOWN 4	357	362	340	357	362	340	200	-90			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table /curve.

Appendix B-7
Generators

CONVEX

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC (3)		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period (1)			Light Load Period (2)					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading			
MILFORD 1	118	121	116	117	121	116	150	-40			
MILFORD 2	118	121	116	117	121	116	150	-40			
MILLSTONE 2	357	362	345	357	362	345	420	0			
MILLSTONE 3	357	362	345	357	362	345	565	0			
MONTVILLE 5	117	121	110	117	121	110	86	-35			
MONTVILLE 6	117	121	110	117	121	110	200	-60			
MOUNT TOM	117	121	111	117	121	109	55	0			
NEW HAVEN HBR	119	121	116	117	121	116	143.5	0			
NORTHFIELD G1	359	362	344	351	362	344	80	-40			
NORTHFIELD G2	359	362	344	351	362	344	80	-40			
NORTHFIELD G3	359	362	344	351	362	344	80	-40			
NORTHFIELD G4	359	362	344	351	362	344	80	-40			
NORTHFIELD P1	359	362	344	351	362	344	80	-45			
NORTHFIELD P2	359	362	344	351	362	344	80	-45			
NORTHFIELD P3	359	362	344	351	362	344	80	-45			
NORTHFIELD P4	359	362	344	351	362	344	80	-45			
NORWALK HBR 1	119	121	114	119	121	113	62	-40			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table/ curve.

Appendix B-8
Generators

CONVEX

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC [3]		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period [1]			Light Load Period [2]					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	Schedule	Maximum	Minimum	Schedule	Maximum	Minimum	Lagging	Leading			
NORWALK HBR 2	119	121	114	119	121	113	54	-36			
ROCKY RIVER	117	121	105	116	121	105	15	0			
SHEPAUG	117	121	109	116	121	109	8	-8			
SOUTH MEADOW 5	116	121	106	116	121	105	30	-20			
SOUTH MEADOW 6	116	121	106	116	121	105	30	-20			
STEVENSON 1	117	121	112	117	121	112	3.75	0			
STEVENSON 2	117	121	112	117	121	112	3.75	0			
STEVENSON 3	117	121	112	117	121	112	3.75	0			
STEVENSON 4	117	121	112	117	121	112	3.75	0			
STONY BROOK	359	362	335	351	362	335	150	-40			
WALLINGFORD ENERGY (1-5)	117	121	108	117	121	105	125	-125			
WEST SPRINGFIELD 1	117	121	108	117	121	105	35	-23			
WEST SPRINGFIELD 2	117	121	108	117	121	105	74	-52			
WEST SPRINGFIELD 3	117	121	108	117	121	105	40	-34			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table/ curve.

Appendix B-9
Autotransformers w/LTCs

CONVEX Voltage & Reactive Schedules and Surveys for Autotransformers with LTCs

		Tap-Changer Control						Survey	
								Date:	
								Time:	
								Load period:	Heavy/Light
				Available LTC Taps		Voltage Control Bandwidth			
Substation	High Side kV/ Low Side kV	LTC Operation (Automatic/Manual)	Scheduled Voltage	Max	Min	High Limit (kV)	Low Limit (kV)	Actual Voltage (kV)	LTC Operation (Automatic/Manual)
BERKSHIRE	345/115	A	119			120	118		
CARD	345/115	A	115			116	114		
EAST SHORE	345/115	M	119			n/a	n/a		
FROST BRIDGE	345/115	A	118			119	117		
LUDLOW	345/115	A	119			120	118		
MANCHESTER	345/115	A	116			117	115		
MONTVILLE	345/115	A	117			118	116		
NORTH BLOOMFIELD	345/115	A	116			117	115		
PLUMTREE	345/115	A	116			117	115		
SOUTHINGTON BUS #1	345/115	A	118			119	117		
SOUTHINGTON BUS #2	345/115	A	118			119	117		

Appendix B-10
CONVEX Transmission Capacitors & Reactors

Voltage & Reactive Schedules and Surveys for Transmission Capacitors & Reactors

Transmission Capacitor Information		Survey	
		Date:	
		Time:	
		Load period:	Heavy/Light
Location	Available MVAR	Actual Voltage (kV)	Closed/ Open
AGAWAM 11K	50.4		
AGAWAM 12K	50.4		
BERLIN #1	37.8		
BERLIN #2	37.8		
BERLIN #3	50.4		
CANTON #1	25.2		
CANTON #2	26.2		
DARIEN	37.8		
EAST SHORE #1	42.0		
EAST SHORE #2	42.0		
FRANKLIN DRIVE	37.8		
FROST BRIDGE #1	50.4		
FROST BRIDGE #2	50.4		
FROST BRIDGE #3	50.4		
GLENBROOK #1	36.0		
GLENBROOK #2	36.0		
GLENBROOK #3	36.0		
GLENBROOK #4	36.0		
Location	Available	Actual Voltage (kV)	Closed/
	MVAR		Open
GLENBROOK #5	37.8		
MANCHESTER #1	50.4		
MANCHESTER #2	50.4		
MANCHESTER #3	50.4		
MANCHESTER #4	50.4		
MANCHESTER #5	50.4		
MANCHESTER #6	50.4		
MONTVILLE #1	50.4		
MONTVILLE #2	50.4		
MYSTIC #1	25.2		
MYSTIC #2	25.2		
NORTH BLOOMFIELD #1	50.4		
NORTH BLOOMFIELD #2	50.4		
NORTH BLOOMFIELD #3	50.4		
NORTH HAVEN	42.0		
NORWALK #1	37.8		
NORWALK #2	37.8		
PLUMTREE #1	50.4		
PLUMTREE #2	37.8		
ROCKY RIVER	25.2		
SACKETT	42.0		
SOUTHINGTON #1	50.4		
SOUTHINGTON #2	50.4		
SOUTHINGTON #3	50.4		
STONY HILL	25.2		
WATERSIDE	37.8		

Appendix B-11
Generators

MAINE

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC [3]		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period [1]			Light Load Period [2]							
	scheduled	minimum	Maximum	Scheduled	Minimum	Maximum	Lagging	Leading	Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
ANDROSCOGGIN E C #1	120	113	121	120	113	121	16	15			
ANDROSCOGGIN E C #2	120	113	121	120	113	121	16	15			
ANDROSCOGGIN E C #3	120	113	121	120	113	121	16	15			
BUCKSPORT G4	120	113	121	120	113	121	115	75			
HARRIS HYDRO G1	120	113	121	120	113	121	12	0			
HARRIS HYDRO G2	120	113	121	120	113	121	12	0			
HARRIS HYDRO G3	120	113	121	120	113	121	12	0			
M. INDEPENDENCE GT1	121	114	123	121	114	123	110	65			
M. INDEPENDENCE GT2	121	114	123	121	114	123	110	65			
M. INDEPENDENCE ST	121	114	123	121	114	123	118	80			
RUMFORD POWER GT	120	113	121	120	113	121	110	25			
RUMFORD POWER ST	120	113	121	120	113	121	59	25			
WESTBROOK 1	120	113	121	120	113	121	110	36			
WESTBROOK 2	120	113	121	120	113	121	110	36			
WESTBROOK 3	120	113	121	120	113	121	127	87			
YARMOUTH 1	120	113	121	120	113	121	14	0			
YARMOUTH 2	120	113	121	120	113	121	14	0			
YARMOUTH 3	120	113	121	120	113	121	55	0			
YARMOUTH 4	355	349	362	355	349	362	242	209			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table /curve.

Appendix B-12
Generators

MAINE

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC (3)		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period (1)			Light Load Period (2)					Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
	scheduled	minimum	Maximum	Scheduled	Minimum	Maximum	Lagging	Leading			
WYMAN HYDRO 1	120	113	121	120	113	121	12	0			
WYMAN HYDRO 2	120	113	121	120	113	121	12	0			
WYMAN HYDRO 3	120	113	121	120	113	121	12	0			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table / curve.

Appendix B-13
Autotransformers w/LTCs

MAINE Voltage & Reactive Schedules and Surveys for Autotransformers with LTCs

		Tap-Changer Control						Survey	
								Date:	
								Time:	
								Load period:	Heavy/Light
		LTC Operation (Automatic/Manual)	Scheduled Voltage	Available LTC Taps		Voltage Control Bandwidth			
Substation	High Side kV/ Low Side kV			Max	Min	Low Limit (kV)	High Limit (kV)	Actual Voltage (kV)	LTC Operation (Automatic/Manual)
SOUTH GORHAM T1	345/115	A-note 1	119	16	-16	118	120		
SUROWIEC T1	345/115	A	119	16	-16	118	120		
MASON T9	345/115	A	119	16	-16	118	120		
MAXCY'S T3	345/115	A	119	16	-16	118	120		
ORRINGTON T1	345/115	A-note 2	121-note 3	16	-16	120	122		
ORRINGTON T2	345/115	A-note 2	121-note 3	16	-16	120	122		

note 1- This transformer LTC run in manual when WEC is online.

note 2- These transformer LTC's run in manual when MIS is online.

note 3- When being operated in manual the Orrington scheduled voltage is ~1kV less than Graham bus voltage.

APPENDIX B-14
MAINE Transmission Capacitors & Reactors

Voltage & Reactive Schedules and Surveys for Transmission Capacitors & Reactors

Transmission Capacitor Information			Survey	
			Date:	
			Time:	
			Load period:	Heavy/Light
Location		Available MVAR	Actual Voltage (kV)	Closed/ Open
CHESTER SVC CAP	345 kV	1 @ 442		
ORRINGTON KC1	115kV	1 @ 67		
ORRINGTON KC2	115kV	1 @ 67		
ORRINGTON KC3	115kV	1 @ 67		
MAXCY'S KC1	115kV	1 @ 50		
MAXCY'S KC2	115kV	1 @ 50		
MASON KC2	115kV	1 @ 50		
MASON KC3	115kV	1 @ 50		
SUROWIEC KC1	115kV	1 @ 50		
SUROWIEC KC2	115kV	1 @ 50		
SUROWIEC KC3	115kV	1 @ 50		
SOUTH GORHAM KC1	115kV	1 @ 50		
SOUTH GORHAM KC2	115kV	1 @ 50		
SANFORD 115 KC1	115kV	1@30.6		

Transmission Reactor Information			Survey	
			Date:	
			Time:	
			Load period:	Heavy/Light
Location		Available MVAR	Actual Voltage (kV)	Closed/ Open
CHESTER SVC REACTIVE	345 kV	1@ - 125		
ORRINGTON KR1	115kV	1@ - 40		
ORRINGTON KR2	115kV	1 @ -40		
SUROWIEC KR1	115 kV	1 @ -40		
SUROWIEC KR2	115 kV	1 @ -40		

Appendix B-15
Generators

PSNH

Voltage & Reactive Schedules and Surveys

Units	Voltage Schedule						MVAr Capability @ SCC (3)		Survey		
									Date:		
									Time:		
									Load period:	Heavy/Light	
	Heavy Load Period (1)			Light Load Period (2)							
	scheduled	minimum	Maximum	Scheduled	Minimum	Maximum	Lagging	Leading	Actual Voltage (kV)	MVARs	AVR Status (ON/OFF)
AES GRANITE RIDGE ST 1	119	109	121	119	109	121	161	-75			
MERRIMACK 1	119	109	121	119	109	121	45	-30			
MERRIMACK 2	119	109	121	119	109	121	165	-100			
NEWINGTON	357	339	362	357	339	362	137	-70			
CONED NEWINGTON ENERGY 1	357	339	362	357	339	362	105	0			
CONED NEWINGTON ENERGY 2	357	339	362	357	339	362	105	0			
CONED NEWINGTON ENERGY 3	357	339	362	357	339	362	120	0			
SCHILLER 4	119	109	121	119	109	121	30	-12.5			
SCHILLER 5	119	109	121	119	109	121	30	-12.5			
SCHILLER 6	119	109	121	119	109	121	30	-12.5			
SEABROOK	357	345	362	357	345	362	580	-120			

(1) Heavy 07:00-22:00 hours Monday Through Saturday except Holidays
(2) Light all others
(3) Data from NX-12D, pt. 13 (MVar lagging), pt. 18 (MVar leading) of the Normal Reactive Capability portion of the table /curve.

Appendix B-16
PSNH Transmission Shunt Capacitors & Shunt Reactors

Voltage & Reactive Schedules and Surveys for Transmission Shunt Capacitors & Shunt Reactors

Transmission Capacitor Information		Survey	
		Date:	
		Time:	
		Load period:	Heavy/Light
Location	Available MVAR	Actual Voltage (kV)	Closed/ Open
BEEBE	20		
OCEAN RD. #1	25.2		
OCEAN RD. #2	25.2		
CHESTNUT HILL #1	12.6		
CHESTNUT HILL #2	12.6		
CHESTNUT HILL #3	25.2		
MERRIMACK #1	36.1		
MERRIMACK #2	36.1		

Transmission Reactor Information		Survey	
		Date:	
		Time:	
		Load period:	Heavy/Light
Location	Available MVAR	Actual Voltage (kV)	Closed/ Open
Scobie Pond #1	40.0		
Scobie Pond #2	40.0		

Appendix B-17
PSNH Autotransformers w/LTCs

Voltage & Reactive Schedules and Surveys for Autotransformers with LTCs

		Tap-Changer Control						Survey		
								Date:		
								Time:	Heavy/Light	
				Available LTC Taps		Voltage Control Bandwidth		Load period:	Heavy/Light	
Substation	High Side kV/ Low Side kV	LTC Operation (Automatic/Manual)	Scheduled Voltage	Max	Min	High Limit (kV)	Low Limit (kV)	Actual Voltage (kV)	LTC Tap	LTC Operation (Automatic/Manual)
DEERFIELD TB14	345/115	A	119.6	33	1	120.8	118.5			
SCOBIE TB30	345/115	A	119.6	33	1	120.8	118.5			