

**ANALYSIS OF AFTON/LEF GENERATION LEVELS FOR THE
MARCH 2008 LUNA-DIABLO 345 kV IOS
February 26, 2008**

INTRODUCTION

El Paso Electric Company (EPEC) will be taking the Luna-Diablo 345 kV line out-of-service for about 6 days starting in late March 2008 to install a third Diablo 345/115 kV transformer. During this outage EPEC will bypass the Arroyo PST.

Public Service Company of New Mexico (PNM) ran powerflow studies to determine the maximum generation that could be dispatched at Afton and LEF to maintain acceptable system performance for a Newman-Afton 345 kV line outage with the Luna-Diablo 345 kV line initially out-of-service. This outage results in isolating the 345 kV transmission system from the west to EPEC load area where the only remaining interconnections to the east are through the 115 kV system out of Luna (see Figure 1).

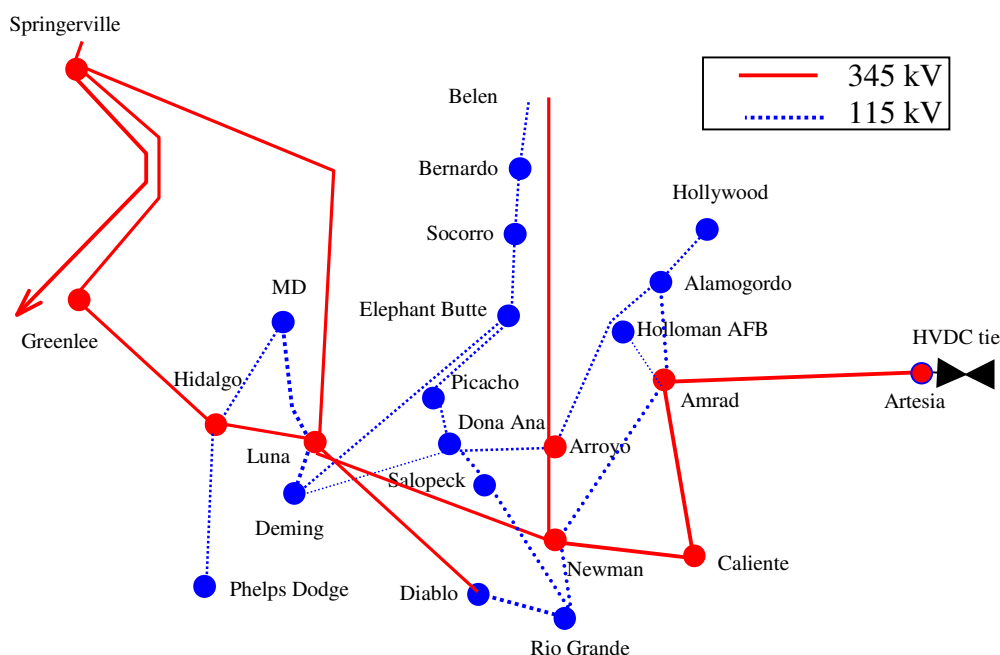


Figure 1 Southern New Mexico Transmission System

POWERFLOW BASE CASE ASSUMPTIONS

The powerflow case was supplied by EPEC. This case was based on an EPEC 2008HS3 WECC base case and adjusted to late March 2008 load conditions. PNM and TSGT's (Tri-State Generation and Transmission Association Inc.) southern New Mexico loads were scaled to 72% of the 2008 peak forecast (except for Phelps Dodge which was kept at 96.7 MW). Generation in the El Paso area was adjusted for the conditions shown in the IOS table supplied by EPEC (Attachment 1) with the exception that EPEC's SNMI rights were reduced from 509 MW to 450 MW (per Dennis Malone, based on El Paso Import Limits). For PNM to be within its import rights for this IOS the Lordsburg generation was dispatched at 72 MW. PNM, TSGT and EPE southern New Mexico load, generation and imports for this base case are shown in Tables 1 and 2.

System Engineering has determined that the Luna-Mimbres 115 kV (ML) line and station components could be loaded continuously to 224 MVA based on a 90 degree F. ambient temperature and 2 feet/second wind which would correspond to the conditions expected in March.

**Table 1
Generation (MW)**

NAME	PGEN PMAX	
NEWMANG1	77	77
NEWMANG2	80	80
NEWMANG3	89.6	101
NEWMN4G1	73	73
NEWMN4G2	off-line	74
NEWMN4S1	38	38/75*
RIOGD_G6	48	48
RIOGD_G7	45	45
RIOGD_G8	off-line	150
COPPER_G	50	69
EPEC Total Generation	500.6	531
LRDSBGG1	36	40
LRDSBRG2	36	40
PNM Total SNM Generation	72	80
PYRMDG1	off-line	40
PYRMDG1	off-line	40
PYRMDG2	off-line	40
PYRMDG2	off-line	40
TSGT Total SNM Generation	0	160

* requires Newman4G1 and Newman4G2 to be at maximum output

Table 2 Loads and Losses, Generation and SNMI Rights

Company	Total Load + Losses (MW)	Total Generation (MW)	Eddy County (MW)	SNMI Rights (MW)*	Load - Generation -SNMI Rights
EPEC	1085	501	134	450	0
PNM	PNM 118/PD 97	72	0	146	-3
TSGT	83	0	0	87	-4

* See Attachment 1

STUDY METHODOLOGY AND CRITERIA

This analysis was performed assuming an extended Newman-Afton 345 kV line outage since this condition represents the most severe system limitations for line loadings and

voltage. For these studies, the system was allowed to readjust (e.g., transformer taps, phase shifters, etc.).

This study adhered to the NERC/WECC reliability criteria and additions/exceptions as listed below.

The applicable NERC/WECC reliability criteria is listed below:

- Changes in bus voltages from pre- to post-contingency must be less than 5% and 10% for single and double contingencies, respectively.
- All equipment loadings must be below their normal ratings under normal conditions.
- All line loadings must be below their emergency ratings for both single and double contingencies. All transformers and equipment with emergency rating should be below their emergency rating.

Additions and exceptions to the NERC/WECC criteria are stated below in Table 3.

Table 3

Area	Conditions	Loading Limits	Voltage (p.u.)	Voltage Drop	Application
EPEC	Normal	< Normal Rating	0.95 - 1.05		69kV and above
			0.95 - 1.10		Artesia 345 kV
			0.95 - 1.08		Arroyo 345 kV PST source side
			0.90 - 1.05		Alamo, Sierra Blanca and Van Horn 69kV
	Contingency	< Emergency Rating	0.925 - 1.05	7%	60 kV to 115 kV
			0.95 - 1.10	7%	Artesia 345kV
			0.95 - 1.08	7%	Arroyo 345kV PST source side
			0.90 - 1.05		Alamo, Sierra Blanca and Van Horn 69kV
			0.95 - 1.05	7%	Hidalgo, Luna, or other 345 kV buses
PNM	Normal ALIS	< Normal Rating	0.95-1.05		46 kV and above*
	Contingency N-1	< Emergency Rating	0.925-1.05	6 %	
	Contingency N-2	< Emergency Rating	0.90-1.05	10 %	
Tri- State	Normal ALIS	< Normal Rating	0.95-1.05		All buses
	Contingency N-1	< Emergency Rating	0.90-1.1	6 %	Tri-State buses served from the PNM System
				8 %	Tri-State buses served from the Tri-State system
Contingency N-2	< Emergency Rating	0.90-1.1	10%	All buses	

STUDY SCENARIO

The maximum pre-outage Afton/LEF generation level in order to maintain acceptable system performance for the worst case N-1 contingency was determined.

The Newman-Afton 345 kV line outage was run under the following conditions:

- LEF and Afton total generation at 0 MW
- LEF and Afton total generation at 50 MW
- Afton generation at maximum MW (235 MW)
- LEF generation at maximum MW (570 MW)
- Afton and LEF generation both at maximum MW (805 MW)

POWERFLOW RESULTS

The powerflow results for equipment overloads are shown below. There were no voltage violations for these analyses.

Table 1 shows that the maximum Afton/Luna total generation that can be dispatched without overloading the Luna 345/115 kV transformer is 50 MW. This generation dispatch level could be increased to higher level (i.e., 235 MW) if the Luna transformer had an emergency overload rating where the Afton/LEF generation could be ramped down after the outage.

Table 4 Luna-Diablo 345 kV line IOS with Arroyo PST bypassed--no mitigation measures
Afton/Luna
Total MW generation

Contingency	Monitored Element	MVA Rating	Total MW generation				
			0	50	235	570	805
			p.u. loading				
NEWMAN-AFTON 345 kV	AIRPOR_T-PICACHO 115 kV	133				1.06	1.19
NEWMAN-AFTON 345 kV	CABALLOT-HOT_SPRG 115 kV	60				1.02	1.16
NEWMAN-AFTON 345 kV	CABALLOT-MIMBRES 115 kV	60				1.04	1.18
NEWMAN-AFTON 345 kV	DONA_ANA-PICACHO 115 kV	159				1.07	1.20
NEWMAN-AFTON 345 kV	EL_BUTTE-CUCHILLO 115 kV	52				1.04	1.21
NEWMAN-AFTON 345 kV	EL_BUTTE-PICACHO 115 kV	40				1.07	1.13
NEWMAN-AFTON 345 kV	HOT_SPRG-CUCHILLO 115 kV	52				1.08	1.26
NEWMAN-AFTON 345 kV	LUNA-MIMBRES 115 kV	224*				1.12	1.23
NEWMAN-AFTON 345 kV	LUNA 345.00-LUNA 115 kV	224	0.97	1.00	1.11	1.32	1.46
NEWMAN-AFTON 345 kV	MIMBRES-AIRPOR_T 115 kV	133				1.15	1.28

*ML line rating increased for conditions expected in March (see Powerflow Base Case Assumptions Section)

CONCLUSIONS

Based on the study results above, 50 MW is the maximum total Afton/LEF generation that can be online for the upcoming Luna-Diablo 345 kV line IOS before the worst N-1 contingency of the Newman-Afton 345 kV line without causing equipment overloads or voltage violations.

RECOMMENDATIONS

In the future for a Luna-Diablo 345 kV line IOS or other conditions that restrict LEF/Afton generation levels it would be prudent to implement a generator dropping scheme for LEF and Afton for these type of IOS outages (see attachment 2). This would allow for the full dispatch of LEF and Afton generation. This type of remedial action scheme would require WECC approval.

Attachment 1

**INITIALLY OUT OF SERVICE (IOS) TRANSMISSION ELEMENT
AND ASSOCIATED SNMIC (PATH 47) CURTAILMENTS**

Table 5: PST In-Service Before IOS Condition and PST Removed After IOS

(Rio Grande #8 Out-of-Service)		Southern New Mexico Entities							
IOS Condition	IOS Maximum SNMIC Limit	Transmission Rights			Curtailment Responsibility of Rights			EPI Limits	
		EPE	TSGT	PNM	EPE	TSGT	PNM	Reactive	Thermal
Phase Shifting Transformer	800	505	110	185	140	0	0	646	677
Springerville-Luna 345	500	343	59	98	302	51	87	347	628
Greenlee-Hidalgo 345	511	351	60	101	294	50	84	352	627
WestMesa-Arroyo 345	694	476	81	137	169	29	48	436	500
Hidalgo-Luna 345	667	458	78	131	187	32	54	431	680
Luna-Afton 345	736	505	86	145	140	24	40	401	436
Afton-Newman 345	736	505	86	145	140	24	40	401	436
Luna-Diablo 345	742	509	87	146	136	23	39	---	404
Arroyo Auto-Transformer	703	408	110	185	237	0	0	---	402
(1) Caliente Auto-Transformer	737	442	110	185	203	0	0	---	461
(1) Diablo Auto-Transformer	772	477	110	185	168	0	0	---	489
Newman Auto-Transformer	749	454	110	185	191	0	0	---	473

- Notes:**
- El Paso Import (EPI) is the sum of the flows over the following lines:
WestMesa-Arroyo 345 metered at WestMesa
Afton-Newman 345 metered at Afton
Luna-Diablo 345 metered at Luna
 - All values are in MW unless noted differently
 - EPE = El Paso Electric Company; TSGT = Tri-State G&T;
PNM = Public Service Company of New Mexico

13-Feb-08
Updated Format
Removed TNMP

	PST In-Service	
	ALIS	Percentage
EPE:	645	68.62%
TSGT:	110	11.70%
PNM:	185	19.68%
Total	940	100.00%

When PST is In-Service before IOS condition and the PST is by-passed, EPE starts curtailing it's portion of SNMI from 645 MW.

Attachment #2

**Maximum Luna Energy Facility (LEF) and Afton Generation
Under Line Initially Out of Service (IOS) Conditions**

Transmission Element Under IOS Condition	Overloaded Element	Maximum LEF + Afton Generation Output
Springerville-Luna 345 kV line	None	No Curtailment Needed
Greenlee-Hidalgo 345 kV line	None	No Curtailment Needed
WestMesa-Arroyo 345 kV line	None	No Curtailment Needed
Hidalgo-Luna 345 kV line	Luna 345/115 kV Transformer	750 MW
Luna-Afton 345 kV line	Luna 345/115 kV Transformer	100 MW (Curtailment of only LEF required)
Afton-Newman 345 kV line	Luna 345/115 kV Transformer	100 MW
Luna-Diablo 345 kV line	Luna 345/115 kV Transformer	90 MW
Arroyo 345/115 autotransformer	None	No Curtailment Needed

Note: Maximum LEF Output assumed to be 570 MW and Afton is 235 MW

Analysis Performed by El Paso Electric Company

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