#T99 – Caledonia 138kV
Generation Interconnection

Network Impacts

The T99 project was studied as a 100 MW (20 MW Capacity) injection at the TSS 890 Kelley Road substation (POI for the TSS 990 Kinnikinnik Creek Wind Farm) on the Wempletown to Belvidere 138kV line 17105 in the ComEd area. Project T99 was evaluated for compliance with reliability criteria for summer peak conditions in 2012.

The results of this study and others performed for earlier queued projects indicate that the installation of all of these projects cannot be accommodated by the ComEd transmission system without the addition of major extra high voltage (EHV) reinforcements. The T99 project contributes to several of the same violations that were initially caused by earlier projects in the R and T queues. Upgrades required by these earlier queued projects included four new 345kV lines and the addition of a 765kV "backbone" transmission system with additional ties to the transmission system east of ComEd. These large upgrade projects may have costs in the billions of dollars and the T99 may have some cost allocation to them. Subsequent studies may indicate a different set of upgrades that this project may be assessed and will depend on whether earlier queued projects withdraw.

Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

No problems were identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

No problems were identified.

Short Circuit

(Summary of impacted circuit breakers)

To be determined in the System Impact Study.

Contribution to Previously Identified Overloads

(T99 contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

Table 1 - Contribution to Previously Identified Overloads

Item	Project	Contribution MW	Overloaded Element	Overload %		Rating		Contingency
				From	To	Type	MVA	
1a	T99	22.2	Silver Lake to Libertyville Red 345kV line #13821	102.5%	103.6%	Applicable Load Dump	2024	Wayne to Silver Lake Red 345kV line #14401 & Tollway to Libertyville Blue 345kV line #18502
1b	T99	18.4	Byron to Lee County Blue 345kV line #0627	175.5%	176.3%	Applicable Load Dump	2277	Byron to Cherry Valley Red 345kV line #0622 & Byron to Cherry Valley Blue 345kV line #0621
1c	T99	33.5	Byron to Lee County Blue 345 kV line #0627	167.6%	169.1%	Applicable Load Dump	2277	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1d	T99	4.5	Nelson to Lee County 345kV line #15501	116.4%	116.8%	Normal	1234	No Contingency
1e	T99	33.1	Nelson to Lee County 345kV line #15501	229.1%	230.8%	Applicable Load Dump	2024	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1f	T99	14.2	Nelson to P20 345kV line #15502	185.7%	186.6%	Applicable Load Dump	1572	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1g	T99	14.2	P20 to Electric Junction 345kV line #18402	190.6%	191.5%	Applicable Load Dump	1572	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1h	T99	5.4	Libertyville 345/138kV transformer #81	135.3%	136.2%	Applicable Load Dump	610	Libertyville to Prospect Heights Red 345kV line #11723 & Libertyville to Prospect Heights Blue 345kV line #15424
1i	T99	44.4	Kelley Rd (TSS 890) to Belvidere Blue 138kV line #12206	145.6%	164.4%	Applicable Load Dump	236	Cherry Valley - Stillman Valley - O68/R54 138kV line #15621 & Cherry Valley – Daimler Chrysler – Belvidere Blue 138kV line #15624
1j	T99	17.2	Marengo Red Tap to Pleasant Valley portion of Belvidere – Marengo – Pleasant Valley Red 138kV line #12204	294.3%	298.7%	Applicable Load Dump	388	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1k	T99	8.3	Pleasant Valley to Crystal Lake Red 138kV line #13809	131.2%	133.6%	Applicable Load Dump	345	Silver Lake to Pleasant Valley 345kV line #13817 & Cherry Valley to Silver Lake 345kV line #15616
1l	T99	29.6	Belvidere to Marengo Tap Blue portion of Belvidere – Marengo - Woodstock 138kV line #12205	215.2%	221.4%	Applicable Load Dump	473	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1m	T99	13.7	Marengo Tap to Marengo Blue portion of Belvidere – Marengo - Woodstock 138kV line #12205	118.2%	122.1%	Applicable Load Dump	345	Cherry Valley – E Rockford – Alpine – Belvidere 138kV line #15623 & Cherry Valley - Alpine - E Rockford - Sand Park - Harlem - Roscoe Bert -Wempletown 138kV line #15625
1n	T99	14.6	Marengo Tap to Woodstock Blue portion of Belvidere – Marengo - Woodstock 138kV line #12205	250.2%	255.1%	Applicable Load Dump	300	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1o	T99	14.6	Woodstock to Pleasant Valley Blue 138kV line #14106	190.6%	194.8%	Applicable Load Dump	345	Cherry Valley to Silver Lake 345kV line #15616 & Cherry Valley – W DeKalb – Glidden 138kV line #15627
1p	T99	8.2	Pleasant Valley to Crystal Lake Blue portion of the Pleasant Valley - Crystal Lake - Silver Lake 138kV line #13809	126.6%	128.9%	Applicable Load Dump	345	Silver Lake to Pleasant Valley 345kV line #13817 & Cherry Valley to Silver Lake 345kV line #15616

Steady-State Voltage Requirements
(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined in the System Impact Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through
(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the System Impact Study.

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

No new system reinforcements were identified.

Contribution to Previously Identified System Reinforcements
(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Previous projects in the PJM Queue have established the need for two 345 kV lines from Byron to Wayne and a second Byron to Nelson 345 kV line to satisfy ComEd's transient stability criteria.

Summary of Required Upgrades to Satisfy Stability Criteria

1. First 345kV transmission line between Byron and Wayne (56 miles). This line is required to mitigate transient stability criteria violations initially caused by the R16 project. The cost estimate for this upgrade is $**250,000,000**. (PJM Network Upgrade# N**1606**). The T99 project may have a cost allocation to this upgrade.

2. Second 345kV transmission line between Byron and Wayne (56 miles). This line is required to mitigate transient stability criteria violations initially caused by the R33 project. The cost estimate for this upgrade is $**50,000,000** (PJM Network Upgrade# N**1638**). The T99 project may have a cost allocation to this upgrade.

3. A new 345kV transmission line between Byron and Nelson (33 miles). This line is required to mitigate transient stability criteria violations initially caused by the R33 project. The cost estimate for this upgrade is $**125,000,000** (PJM Network Upgrade# N**1639**). The T99 project may have a cost allocation to this upgrade.

In addition, a new 31-mile 345 kV Cherry Valley to Pleasant Valley line is proposed. One 345kV breaker at Cherry Valley substation and a three-breaker 345kV ring bus at Pleasant Valley will be required to terminate the proposed line. This line will provide a second 345 kV path between Cherry Valley and Silver Lake. The estimated costs for these facilities are $**97,000,000**. The T99 project may have a cost allocation to this upgrade.

The projects mentioned above mitigate the thermal violations described below:
These 345 kV additions address the 345 kV overloads resulting from T32 and prior PJM queue projects listed in Table 1 (Items 1a, 1b, 1c, 1d, 1e, 1f, and 1g). The 345 kV additions also reduce the base flows on the 138 kV facilities in the Belvidere – Marengo – Woodstock – Pleasant Valley – Crystal Lake corridor. A preliminary investigation shows that these reductions in flows appear to eliminate the 138 kV overloads listed in Table 1 (Items 1i, 1j, 1k, 1l, 1m, 1n, 1o, and 1p).

T99 also contributes to the overload of the Libertyville 345/138kV transformer #81 (Item 1h). To address this overload, a 345 kV line breaker and associated facilities on the 345 kV Red bus at Prospect Heights is required.

Other projects in the T-Queue prior to T99 demonstrate the need for long-lead time facilities including a 765 kV "backbone" transmission system tying the Byron area to the transmission system east of ComEd. While project T99 may have some contributions to the need for this 765 kV "backbone", it may be possible to place T99 in service prior to construction of the 765kV "backbone". With the addition of the four 345 kV lines listed above and the Libertyville transformer relief, sufficient 138 kV capacity may be available to add project T99.

The cost of all of the upgrades mentioned above could be in the range of billions of dollars. Additional studies will be performed during the System Impact and Facilities Studies to determine the ability to add project T99 after the four 345 kV lines are installed and prior to the installation of the 765 kV "backbone". These studies will also develop the optimum plan to address these issues. Studies will also be performed regarding cost allocation among the various projects.

Potential Issues

During summer rating conditions (usually May through September), there are two single contingencies that may cause curtailment of the generation connected to TSS 890 Kelley Road due to the lack of generation outlets. If both the Kinnikinnik Creek Wind Farm (100MW) and the T99 (100MW) wind farm are operating near full output, PJM Operations may require a reduction in output of both wind farms so that the sum of the two does not exceed approximately 178MW. The outage of either transmission line 17105 or 12206 (refer to Figure #1) causes the total output of the wind farms to flow on the remaining line which has a summer emergency rating of 178MVA (See Items #2v and #2w in Table 2).

Approximately 13-miles of line 17105 between the Sand Park Tap to Kelley Rd and line 12206 between Kelley Rd to Belvidere would have to be reconductored/rebuilt in order to mitigate these potential overloads. The restrictions discussed above are detailed in Table 2 for the summer peak conditions using summer ratings.

1. In Item #2v, the overload of the Sand Park Tap to Kelley Rd TSS 890 portion of the Wempletown to TSS 890 138kV line #17105 is caused by the outage of the Kelley Rd TSS 890 to Belvidere Blue 138kV line #12206. (See Table 2 below). Reconductoring of approximately 5 miles of 138kV line 17105 will achieve a summer emergency rating

greater than 300 MVA. Replacing, reinforcing and/or adding new structures to some of the existing single circuit H-frame structures also may be required. An order-of-magnitude cost estimate for the reconductor is $**5,000,000**. This is not a required upgrade for this project at this time, but will be reevaluated in the System Impact Study. To correct this issue, the customer would have to put in a Merchant Transmission project and follow the appropriate process.

2. In Item #2w, the overload of the Kelley Rd TSS 890 to Belvidere Blue 138kV line #12206 is caused by the outage of the Wempletown - Roscoe Bert - Harlem - Sand Park - Kelley Rd TSS 890 138kV line #17105. (See Table 2 below). Reconductoring of approximately 7.5 miles of 138kV line 12206 will achieve a summer emergency rating greater than 300 MVA. Replacing, reinforcing and/or adding new structures to some of the existing single circuit H-frame structures also may be required. An order-of-magnitude cost estimate for the reconductor is $**7,500,000**. This is not a required upgrade for this project at this time, but will be reevaluated in the System Impact Study. To correct this issue, the customer would have to put in a Merchant Transmission project and follow the appropriate process.

The impacts on the AEP system due to the expansion of the 765kV system in ComEd and the new 765kV tie lines to AEP have not been studied. Additional system reinforcements may be required due to Project T99 and these line additions.

Impacts on the MISO member transmission systems are not included in this analysis, but they will be included in the Impact Study, which may reveal upgrades needed in the MISO system not identified in this Feasibility Study.

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

As a result of the aggregate energy resources in the area, the following violations were identified:

Table 2 - Delivery of Energy Portion of Interconnection Request

Item	Project	Contribution MW	Overloaded Element	Overload %		Rating		Contingency
				From	To	Type	MVA	
2a	T99	29.9	Cherry Valley to Silver Lake 345kV line #15616	282.9%	284.9%	Emergency	1530	Nelson to Lee County 345kV line #15501
2b	T99	30.8	Byron to Lee County Blue 345kV line #0627	203.4%	205.1%	Emergency	1739	Cherry Valley to Silver Lake 345kV line #15616
2c	T99	18.4	Silver Lake to Libertyville Red 345kV line #13821	134.2%	135.4%	Emergency	1530	Nelson to Lee County 345kV line #15501
2d	T99	16.0	Wempletown to T92T93 Blue 345kV line #17101	159.3%	160.3%	Emergency	1214	Wempletown to T92T93 Red 345kV line #17102
2e	T99	13.5	T92T93 to Rockdale Blue 345kV line #17101	166.9%	168.0%	Emergency	1214	T92T93 to Paddock Red 345kV line #17102
2f	T99	15.9	Wempletown to T92T93 Red 345kV line #17102	181.4%	182.6%	Emergency	1341	Wempletown to T92T93 Blue 345kV line #17101
2g	T99	15.6	T92T93 to Paddock Red 345kV line #17102	176.9%	178.1%	Emergency	1341	T92T93 to Rockdale Blue 345kV line #17101
2h	T99	30.4	Nelson to Lee County 345kV line #15501	284.8%	286.8%	Emergency	1530	Cherry Valley to Silver Lake 345kV line #15616

Table 2 - Delivery of Energy Portion of Interconnection Request (Continued)								
2i	T99	13.2	Nelson to P20 345kV line #15502	227.5%	228.6%	Emergency	1234	Cherry Valley to Silver Lake 345kV line #15616
2j	T99	13.2	P20 to Electric Junction 345kV line #18402	233.7%	234.8%	Emergency	1234	Cherry Valley to Silver Lake 345kV line #15616
2k	T99	8.3	Zion to Pleasant Prairie Red 345kV line #2221	135.1%	135.9%	Emergency	1096	Cherry Valley to Silver Lake 345kV line #15616
2l	T99	44.4	Kelley Rd (TSS 890) to Belvidere Blue 138kV line #12206	192.7%	217.6%	Emergency	178	Cherry Valley – Daimler Chrysler – Belvidere Blue 138kV line #15624
2m	T99	29.1	Belvidere to Marengo Tap Blue portion of Belvidere – Marengo - Woodstock 138kV line #12205	218.8%	225.5%	Emergency	430	Cherry Valley to Silver Lake 345kV line #15616
2n	T99	23.0	Marengo Tap to Marengo portion of the Belvidere-Marengo-Woodstock Blue 138kV line #12205	138.3%	147.1%	Emergency	261	Woodstock to Pleasant Valley Blue 138kV line #14106
2o	T99	13.9	Marengo Tap to Woodstock Blue portion of Belvidere to Woodstock 138kV line #12205	259.7%	265.0%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2p	T99	13.9	Woodstock to Pleasant Valley Blue 138kV line #14106	224.0%	229.4%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2q	T99	23.0	Marengo Blue to Marengo Red 138kV Bus Tie	149.5%	161.9%	Emergency	185	Woodstock to Pleasant Valley Blue 138kV line #14106
2r	T99	16.3	Marengo Red Tap to Pleasant Valley portion of Belvidere – Marengo – Pleasant Valley Red 138kV line #12204	314.4%	319.9%	Emergency	293	Cherry Valley to Silver Lake 345kV line #15616
2s	T99	5.3	Pleasant Valley to Crystal Lake Blue portion of the Pleasant Valley - Crystal Lake - Silver Lake 138kV line #13809	114.3%	116.4%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2t	T99	5.8	Cherry Valley to W DeKalb tap portion of Cherry Valley – W DeKalb – Glidden 138kV line #15627	178.4%	180.1%	Emergency	338	Nelson to Lee County 345kV line #15501
2u	T99	5.8	W DeKalb tap to Glidden portion of Cherry Valley – W DeKalb – Glidden 138kV line #15627	239.7%	242.1%	Emergency	235	Nelson to Lee County 345kV line #15501
2v	T99	100.0	Sand Park Tap to Kelley Rd (TSS 890) portion of Wempletown - Roscoe Bert - Harlem - Sand Park - TSS 890 138kV line #17105	56.2%	112.4%	Emergency	178	Kelley Rd (TSS 890) to Belvidere Blue 138kV line #12206
2w	T99	100.0	Kelley Rd (TSS 890) to Belvidere Blue 138kV line #12206	56.2%	112.4%	Emergency	178	Wempletown - Roscoe Bert - Harlem - Sand Park - Kelley Rd (TSS 890) 138kV line #17105

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2d	T99	16.0	Wempletown to T92T93 Blue 345kV line #17101	159.3%	160.3%	Emergency	1214	Wempletown to T92T93 Red 345kV line #17102
2e	T99	13.5	T92T93 to Rockdale Blue 345kV line #17101	166.9%	168.0%	Emergency	1214	T92T93 to Paddock Red 345kV line #17102
2f	T99	15.9	Wempletown to T92T93 Red 345kV line #17102	181.4%	182.6%	Emergency	1341	Wempletown to T92T93 Blue 345kV line #17101
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2h	T99	30.4	Nelson to Lee County 345kV line #15501	284.8%	286.8%	Emergency	1530	Cherry Valley to Silver Lake 345kV line #15616

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2m	T99	29.1	Belvidere to Marengo Tap Blue portion of Belvidere – Marengo - Woodstock 138kV line #12205	218.8%	225.5%	Emergency	430	Cherry Valley to Silver Lake 345kV line #15616
2n	T99	23.0	Marengo Tap to Marengo portion of the Belvidere-Marengo-Woodstock Blue 138kV line #12205	138.3%	147.1%	Emergency	261	Woodstock to Pleasant Valley Blue 138kV line #14106
2o	T99	13.9	Marengo Tap to Woodstock Blue portion of Belvidere to Woodstock 138kV line #12205	259.7%	265.0%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2p	T99	13.9	Woodstock to Pleasant Valley Blue 138kV line #14106	224.0%	229.4%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2q	T99	23.0	Marengo Blue to Marengo Red 138kV Bus Tie	149.5%	161.9%	Emergency	185	Woodstock to Pleasant Valley Blue 138kV line #14106
2r	T99	16.3	Marengo Red Tap to Pleasant Valley portion of Belvidere – Marengo – Pleasant Valley Red 138kV line #12204	314.4%	319.9%	Emergency	293	Cherry Valley to Silver Lake 345kV line #15616
2s	T99	5.3	Pleasant Valley to Crystal Lake Blue portion of the Pleasant Valley - Crystal Lake - Silver Lake 138kV line #13809	114.3%	116.4%	Emergency	261	Cherry Valley to Silver Lake 345kV line #15616
2t	T99	5.8	Cherry Valley to W DeKalb tap portion of Cherry Valley – W DeKalb – Glidden 138kV line #15627	178.4%	180.1%	Emergency	338	Nelson to Lee County 345kV line #15501
2u	T99	5.8	W DeKalb tap to Glidden portion of Cherry Valley – W DeKalb – Glidden 138kV line #15627	239.7%	242.1%	Emergency	235	Nelson to Lee County 345kV line #15501
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2w	T99	100.0	Kelley Rd (TSS 890) to Belvidere Blue 138kV line #12206	56.2%	112.4%	Emergency	178	Wempletown - Roscoe Bert - Harlem - Sand Park - Kelley Rd (TSS 890) 138kV line #17105