Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AC1-176

Timber Switch 138 kV

May 2018

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

Paulding Wind Farm V, LLC proposes to increase the generation of its previously proposed PJM queue position R49 (Timber Road II) by 58.7 MW (7.6 MW Capacity) in Paulding County, Ohio (see Figure 2). The point of interconnection is a direct connection to AEP's Timber Switch 138 kV Switching Station (see Figure 1).

The requested in service date is October 31, 2019.

Attachment Facilities

Point of Interconnection (Timber Switch 138 kV Substation)

No additional attachment facilities are required for an existing.

It is assumed that the 138 kV revenue metering installed for Timber Road II has adequate capability for the additional generation, and that it will not need to be metered separately for marketing or other purposes.

Note: The customer should review the capability of the lead from the point of ownership transition into the generating plant to ensure that it is sufficient to accommodate the increase generation output.

Interconnection Customer Requirements

It is understood that Paulding Wind Farm is responsible for all costs associated with this interconnection. The cost of Paulding Wind Farm's generating plant and the costs for the line connecting the generating plant to the Timber Switch switching station are not included in this report; these are assumed to be Paulding Wind Farm's responsibility

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Network Impacts

The Queue Project AC1-176 was evaluated as a 58.7 MW (Capacity 7.6 MW) injection into the Timber Switch 138 kV substation in the AEP area. Project AC1-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-176 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
7501_B2_TOR2516678	CONTINGENCY '7501_B2_TOR2516678' OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1 END

Table 1

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads

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

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

None

Short Circuit
(Summary of impacted circuit breakers)

None

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

No mitigations were found to be required.

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

None

Duke, Progress & TVA Impacts:

None

OVEC Impacts:

None

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.

Delivery of Energy Portion of Interconnection Request													
		Contingency	Affected	Facility	Bus				Loading		Rating		MW
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.
1	N-1	7501_B2_TOR2516678	AEP - AEP	05HAVILN-05E LIMA 138 kV line	243017	242989	1	AC	99.3	115	ER	220	35.99

Table 2

New System Reinforcements

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

None

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Light Load Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

1. (AEP - AEP) The 05HAVILN-05E LIMA 138 kV line (from bus 243017 to bus 242989 ckt 1) loads from 89.1% to 102.64% (AC power flow) of its emergency rating (220 MVA) for the tower line contingency outage of '7372'. This project contributes approximately 29.01 MW to the thermal violation.

CONTINGENCY '7372'
OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1
OPEN BRANCH FROM BUS 243242 TO BUS 247521 CKT 1 / 243242 05ALLEN 138 247521 T-131 C 138 1

OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1
OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1
END

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. (AEP - AEP) The 05HAVILN-05E LIMA 138 kV line (from bus 243017 to bus 242989 ckt 1) loads from 89.1% to 102.64% (AC power flow) of its emergency rating (220 MVA) for the line fault with failed breaker contingency outage of '7528_C2_05ALLEN 138-H'. This project contributes approximately 29.01 MW to the thermal violation.

CONTINGENCY '7528_C2_05ALLEN 138-H'
OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1
OPEN BRANCH FROM BUS 243242 TO BUS 247521 CKT 1 / 243242 05ALLEN 138 247521 T-131 C 138 1
OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1
OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1
END

Contribution to Previously Identified Overloads

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

None

System Reinforcements

Light Load Load Flow Analysis Reinforcements

New System Reinforcements

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

1. To relieve the 05HAVILN-05E LIMA 138 kV line overload

Reinforcement: Replace the East Lima (800 A) and the Haviland (800 A) wavetraps. New ratings will be, S/N 167 MVA and S/E 240 MVA. **PJM Upgrade N5474.**
Cost: $100,000
Time: 12 – 16 months

AC1-173 and AC1-176 are the drivers for this overload.

Since the cost of the upgrade is less than $5 million, any project in the AC1 queue can get cost allocation as long as it meets PJM's cost allocation criteria.

Based on PJM's cost allocation criteria, both AC1-173 and AC1-176 are responsible for the cost of this upgrade.

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Conclusion

Based upon the results of this System Impact Study, the increase of 58.7 MW (7.6 MW Capacity) wind generation of Paulding Wind Farm (PJM Project #AC1-176) will not require additional interconnection charges.

Figure 1: Point of Interconnection (Timber Switch 138 kV Substation)

Single-Line Diagram

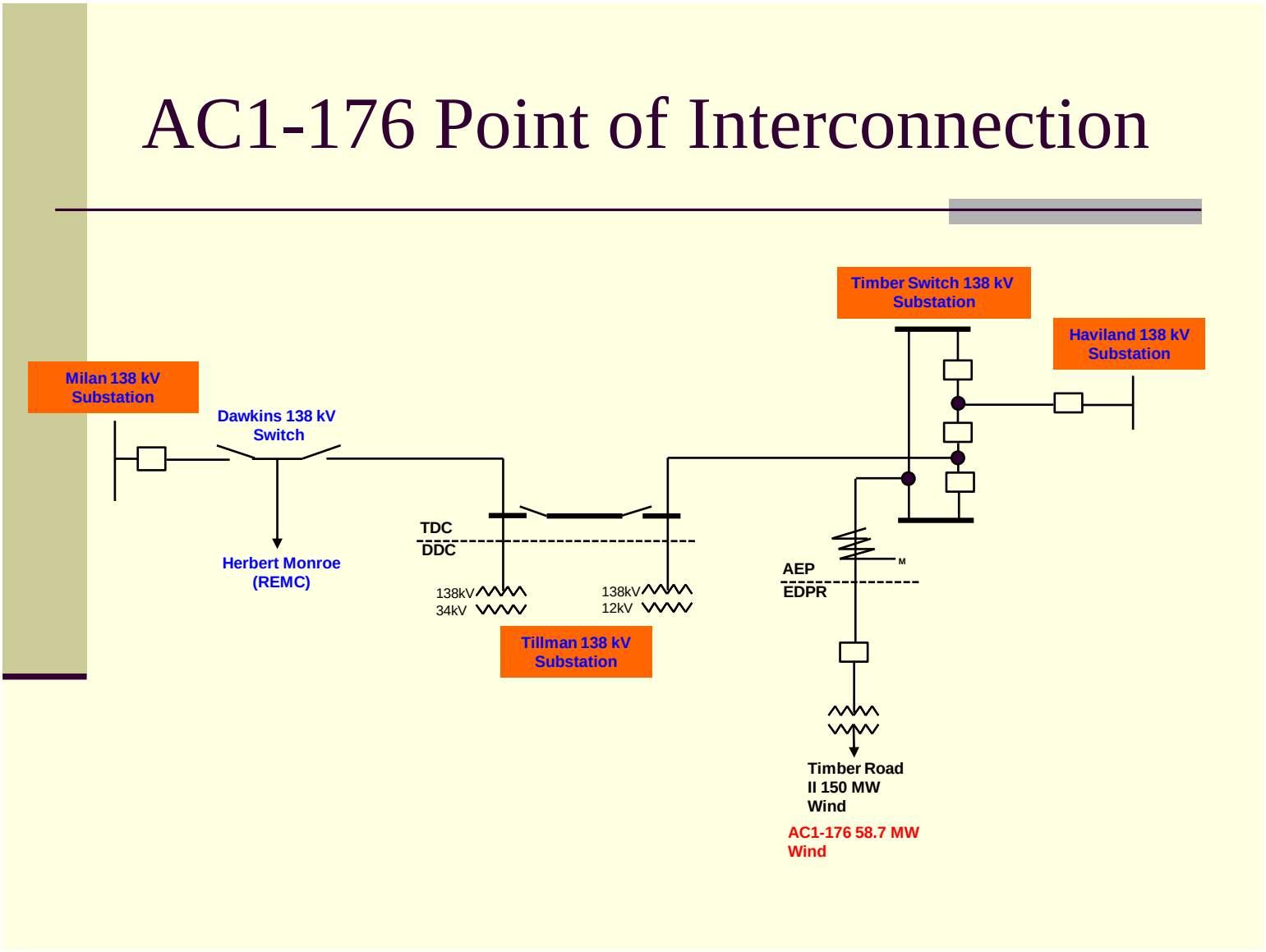
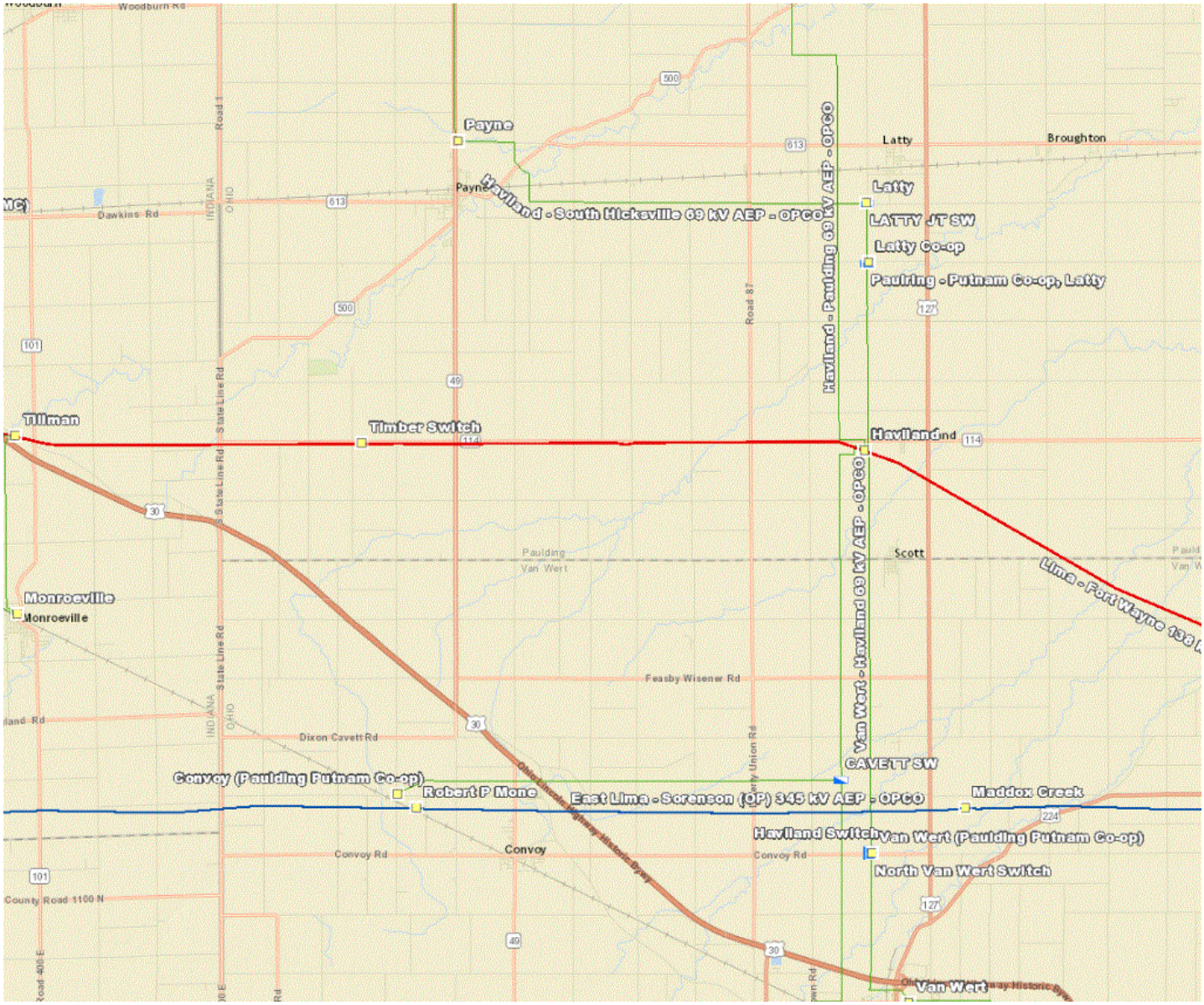


Figure 2: Point of Interconnection (Timber Switch 138 kV Substation)



Appendices for Light Load Contingency Violation

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AEP - AEP) The 05HAVILN-05E LIMA 138 kV line (from bus 243017 to bus 242989 ckt 1) loads from 87.67% to 100.73% (AC power flow) of its emergency rating (220 MVA) for the tower line contingency outage of '7372'. This project contributes approximately 29.01 MW to the thermal violation.

CONTINGENCY '7372'
OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1
OPEN BRANCH FROM BUS 243242 TO BUS 247521 CKT 1 / 243242 05ALLEN 138 247521 T-131 C 138 1
OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1
OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1
OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1
END

Bus Number	*Bus Name*	*Full Contribution*
246953	*05TIMB G C*	*2.04*
247911	*05TIMB G E*	*8.22*
247534	*R-048 C*	*0.33*
247928	*R-048 E*	*1.31*
247521	*T-131 C*	*1.27*
247925	*T-131 E*	*5.1*
247607	*V1-011 C*	*6.42*
247959	*V1-011 E*	*42.99*
247608	*V1-012 C*	*9.64*
247960	*V1-012 E*	*64.49*
926521	*AC1-173 C*	*0.42*
926522	*AC1-173 E*	*2.8*
926531	*AC1-176 C*	*3.76*
926532	*AC1-176 E*	*25.25*