Generation Interconnection

System Impact Study Report

for

Queue Project AF2-391

CENTRAL HARDIN 69 KV

72.0 MW Capacity / 120 MW Energy

January 2022

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is EKPC.

2 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: 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 an Interconnection Customer 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 possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer 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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Hardin County, Kentucky. The installed facilities will have a total capability of 120 MW with 72.0 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this project is June 15, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-391
Project Name	CENTRAL HARDIN 69 KV
State	Kentucky
County	Hardin
Transmission Owner	EKPC
MFO	120
MWE	120
MWC	72.0
Fuel	Solar
Basecase Study Year	2023

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AF2-391 will interconnect with the EKPC transmission system at the Central Hardin 69kV substation.

5 Cost Summary

The AF2-391 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$910,000
Allocation towards System Network Upgrade Costs*	$5,914,346**
Total Costs	**$6,824,346****

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

** Final LG&E Impacts and necessary LG&E system upgrade(s) will be determined once the LG&E affected system study is completed by LG&E.

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Note 1: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

6.1 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Install necessary equipment (a 69 kV isolation switch structure and associated switch, plus interconnection metering, fiber-optic connection and telecommunications equipment, circuit breaker and associated switches, and relay panels) at Central Hardin substation, to accept the IC generator lead line/bus (Estimated time to implement is 12 months)	$780,000
Total Attachment Facility Costs	**$780,000**

6.2 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
None	$
Total Direct Connection Facility Costs	**$0**

6.3 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Install necessary microwave infrastructure at Central Hardin for telecommunications/telemetry needs.	$130,000
Total Non-Direct Connection Facility Costs	**$130,000**

7 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner 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.

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.

8 Revenue Metering and SCADA Requirements

8.1 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 Section 8 of Attachment O.

8.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

8.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

9 Summer Peak Analysis

The Queue Project AF2-391 was evaluated as a 120.0 MW (Capacity 72.0 MW) injection at the Central Hardin 69 kV substation in the EKPC area. Project AF2-391 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-391 was studied with a commercial probability of 100%. Potential network impacts were as follows:

9.1 Generation Deliverability

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

1.(EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 89.21% to 122.49% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 30.53 MW to the thermal violation.

2.(EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 99.68% to 145.09% (AC power flow) of its normal rating (66 MVA) for non-contingency condition. This project contributes approximately 30.53 MW to the thermal violation.

3.(EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 97.54% to 110.13% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 11.77 MW to the thermal violation.

9.2 Multiple Facility Contingency

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

1.(LGEE - EKPC) The 2ETOWN KU-2KARGLE 69 kV line (from bus 324519 to bus 341713 ckt 1) loads from 71.69% to 194.09% (AC power flow) of its emergency rating (76 MVA) for the bus fault outage of 'EKPC_P2-2_CENT HARD 138'. This project contributes approximately 90.03 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P2-2_CENT HARD 138'                    /* CENTRAL HARDIN
138 BUS
 OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1          /* 341287 2CENT
HARDIN69.000 342568 4CENT HARDIN138.00
 END
```

2.(LGEE - EKPC) The 2ETOWN KU-2KARGLE 69 kV line (from bus 324519 to bus 341713 ckt 1) loads from 68.18% to 190.4% (AC power flow) of its emergency rating (76 MVA) for the bus fault outage of 'EKPC_P2-3_CHARD W124-804'. This project contributes approximately 89.45 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P2-3_CHARD W124-804'                   /* CENTRAL HARDIN
 OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1          /* 341287 2CENT
```

HARDIN69.000 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 342568 CKT 1 /* 324047
4BLACKBRNCH 138.00 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 324260 CKT 1 /* 324047
4BLACKBRNCH 138.00 324260 4HARDBG 138.00
  END

3.(EKPC - EKPC) The 2KARGLE-2CENT HARDIN 69 kV line (from bus 341713 to bus 341287 ckt 1) loads from 41.4% to 132.88% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-3_CHARD W124-804'. This project contributes approximately 89.45 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-3_CHARD W124-804' /* CENTRAL HARDIN
  OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1 /* 341287 2CENT
HARDIN69.000 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 342568 CKT 1 /* 324047
4BLACKBRNCH 138.00 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 324260 CKT 1 /* 324047
4BLACKBRNCH 138.00 324260 4HARDBG 138.00
  END

4.(EKPC - EKPC) The 2KARGLE-2CENT HARDIN 69 kV line (from bus 341713 to bus 341287 ckt 1) loads from 40.16% to 131.94% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-2_CENT HARD 138'. This project contributes approximately 90.03 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-2_CENT HARD 138' /* CENTRAL HARDIN
138 BUS
  OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1 /* 341287 2CENT
HARDIN69.000 342568 4CENT HARDIN138.00
  END

5.(EKPC - EKPC) The 2STEPHENSBRG-2UPTON T 69 kV line (from bus 342307 to bus 342403 ckt 1) loads from 90.44% to 107.36% (AC power flow) of its emergency rating (39 MVA) for the bus fault outage of 'EKPC_P2-2_KU HODG 69'. This project contributes approximately 8.36 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-2_KU HODG 69' /* KU HODGENVILLE 69
TIE

```
 OPEN BUS 341632                    /* 2HODGENVILLE
 END
```

6.(EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 98.58% to 134.07% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-4_CHARD W124-91T'. This project contributes approximately 30.55 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P2-4_CHARD W124-91T'          /* CENTRAL HARDIN
 OPEN BRANCH FROM BUS 324047 TO BUS 342568 CKT 1        /* 324047
4BLACKBRNCH 138.00 342568 4CENT HARDIN138.00
 OPEN BRANCH FROM BUS 324047 TO BUS 324260 CKT 1        /* 324047
4BLACKBRNCH 138.00 324260 4HARDBG 138.00
 OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1        /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
 END
```

7.(EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 98.57% to 134.07% (AC power flow) of its emergency rating (98 MVA) for the line fault with failed breaker contingency outage of 'EKPC_P4-2_CHARD W124-814'. This project contributes approximately 30.55 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P4-2_CHARD W124-814'          /* CENTRAL HARDIN
 OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1        /* 341287 2CENT
HARDIN69.000 342568 4CENT HARDIN138.00
 OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1        /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
 END
```

9.3 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)

1.(LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 130.05% to 131.12% (DC power flow) of its emergency rating (1451 MVA) for the single line contingency outage of 'AEP_P1-2_#363'. This project contributes approximately 15.62 MW to the thermal violation.

```
CONTINGENCY 'AEP_P1-2_#363'
 OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1        / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
```

END

2. (LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 115.35% to 116.75% (AC power flow) of its normal rating (1134 MVA) for non-contingency condition. This project contributes approximately 15.4 MW to the thermal violation.

3.(EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 156.5% to 198.4% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 40.88 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL
HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

4.(EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 184.06% to 238.31% (AC power flow) of its emergency rating (76 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 40.88 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL
HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

5.(EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 106.81% to 125.45% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 19.31 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                   /* CENTRAL HARDIN - KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1          /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1          /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

6.(EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 125.33% to 144.96% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-2_KU HODG 69'. This project contributes approximately 16.59 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-2_KU HODG 69' /* KU HODGENVILLE 69
TIE
OPEN BUS 341632 /* 2HODGENVILLE
END

9.4 Steady-State Voltage Requirements

To be determined.

9.5 Potential Congestion due to Local Energy Deliverability

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.

1. (LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 136.33% to 138.17% (AC power flow) of its emergency rating (1451 MVA) for the single line contingency outage of 'AEP_P1-2_#363'. This project contributes approximately 26.03 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#363'
OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1
END

2. (LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 122.66% to 124.97% (AC power flow) of its normal rating (1134 MVA) for non-contingency condition. This project contributes approximately 25.67 MW to the thermal violation.

3. (LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 122.66% to 124.97% (AC power flow) of its normal rating (1134 MVA) for non-contingency condition. This project contributes approximately 25.67 MW to the thermal violation.

4. (EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 196.85% to 266.7% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 68.13 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL
HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

5. (EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 108.67% to 164.31% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 50.88 MW to the thermal violation.

6. (EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 108.67% to 164.31% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 50.88 MW to the thermal violation.

7. (EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 236.06% to 326.36% (AC power flow) of its emergency rating (76 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 68.13 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL
HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

8. (EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 125.93% to 201.6% (AC power flow) of its normal rating (66 MVA) for non-contingency condition. This project contributes approximately 50.88 MW to the thermal violation.

9. (EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 125.93% to 201.6% (AC power flow) of its normal rating (66 MVA) for non-contingency condition. This project contributes approximately 50.88 MW to the thermal violation.

10. (EKPC - EKPC) The 2STEPHENSBRG-2UPTON T 69 kV line (from bus 342307 to bus 342403 ckt 1) loads from 83.91% to 104.96% (AC power flow) of its emergency rating (39 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 10.44 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                  /* CENTRAL HARDIN - KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1          /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1          /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

11. (EKPC - LGEE) The 4CENT HARDIN-4HARDIN CO 138 kV line (from bus 342568 to bus 324261 ckt 1) loads from 95.6% to 123.08% (AC power flow) of its emergency rating (265 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 71.65 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                  /* CENTRAL HARDIN - KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1          /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1          /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

12. (EKPC - LGEE) The 4CENT HARDIN-4HARDIN CO 138 kV line (from bus 342568 to bus 324261 ckt 1) loads from 87.02% to 104.22% (AC power flow) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 34.57 MW to the thermal violation.

13. (EKPC - LGEE) The 4CENT HARDIN-4HARDIN CO 138 kV line (from bus 342568 to bus 324261 ckt 1) loads from 87.02% to 104.22% (AC power flow) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 34.57 MW to the thermal violation.

14. (EKPC - EKPC) The 4CENT HARDIN 138/69 kV transformer (from bus 342568 to bus 341287 ckt 1) loads from 95.19% to 111.66% (AC power flow) of its emergency rating (175 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 28.72 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

15. (EKPC - EKPC) The AF2-111 TAP-7SPURLOCK 345 kV line (from bus 958170 to bus 342838 ckt 1) loads from 105.54% to 106.48% (AC power flow) of its emergency rating (1151 MVA) for the single line contingency outage of 'AEP_P1-2_#1027'. This project contributes approximately 13.18 MW to the thermal violation.

```
CONTINGENCY 'AEP_P1-2_#1027'
  OPEN BRANCH FROM BUS 248000 TO BUS 324010 CKT 1          / 248000 06CLIFTY
345 324010 7TRIMBL REAC 345 1
  OPEN BRANCH FROM BUS 324010 TO BUS 324114 CKT 1          / 324010 7TRIMBL
REAC 345 324114 7TRIMBLE CO 345 1
  END
```

16. (EKPC - EKPC) The AF2-111 TAP-7SPURLOCK 345 kV line (from bus 958170 to bus 342838 ckt 1) loads from 103.46% to 104.3% (AC power flow) of its normal rating (1056 MVA) for non-contingency condition. This project contributes approximately 10.74 MW to the thermal violation.

17. (EKPC - EKPC) The AF2-111 TAP-7SPURLOCK 345 kV line (from bus 958170 to bus 342838 ckt 1) loads from 103.46% to 104.3% (AC power flow) of its normal rating (1056 MVA) for non-contingency condition. This project contributes approximately 10.74 MW to the thermal violation.

18. (EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 133.99% to 165.16% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 32.18 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                    /* CENTRAL HARDIN - KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1          /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1          /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

19. (EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 122.63% to 143.67% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

20. (EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 122.63% to 143.67% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

21. (EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 106.21% to 131.09% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

22. (EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 106.21% to 131.09% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

23. (EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 100.98% to 125.14% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HRDBG138'. This project contributes approximately 20.76 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HRDBG138'                  /* CENTRAL HARDIN - HARDINSBURG
  OPEN BRANCH FROM BUS 324047 TO BUS 342568 CKT 1       /* 324047
4BLACKBRNCH 138.00 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 324260 CKT 1       /* 324047
4BLACKBRNCH 138.00 324260 4HARDBG 138.00
  END
```

24. (EKPC - EKPC) The AF2-308 TAP-AF2-260 TAP 69 kV line (from bus 960170 to bus 959690 ckt 1) loads from 91.92% to 122.91% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 32.18 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                  /* CENTRAL HARDIN - KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1       /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1       /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

25. (EKPC - EKPC) The AF2-308 TAP-AF2-260 TAP 69 kV line (from bus 960170 to bus 959690 ckt 1) loads from 82.89% to 103.73% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

26. (EKPC - EKPC) The AF2-308 TAP-AF2-260 TAP 69 kV line (from bus 960170 to bus 959690 ckt 1) loads from 82.89% to 103.73% (AC power flow) of its normal rating (89 MVA) for non-contingency condition. This project contributes approximately 19.62 MW to the thermal violation.

9.6 System Reinforcements

Facility	Upgrade Description	Cost	Cost Allocated to AF2-090	Upgrade Number
2STEPHENSBRG -2UPTON T 69 kV line (from bus 342307 to bus 342403 ckt 1)	**EKPC Reinforcement**: **Project ID:** n6238 Increase the maximum operating temperature of the 4/0 ACSR conductor in the Stephensburg-Upton Tap 69 kV line section to 212 degrees F (10.75 miles) $750K. 18 months. 49/54 MVA SN/SE. **Type:** FAC **Cost:** $750,000 **Time Estimate:** 18 Months **Ratings:** 49/54 MVA SN/SE **Notes:** AF2-391 is the driver for this upgrade.	$750,000	$750,000	N8009
7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1)	**LG&E:** Trimble-Clifty 345 kV line is a tie line between LG&E and OVEC. The line is owned by LG&E. The potential upgrade on the Trimble-Clifty 345 kV line, if determined to be a constraint by LG&E, is to reconductor the line with a high temperature conductor and upgrade necessary terminal equipment to achieve ratings of 2610/2610 MVA SN/SE. Cost estimate is $17.4M with a time estimate of 18 months. **LG&E will determine if there are any LG&E system impacts, including on Trimble- Clifty line. Final LG&E Impacts and necessary LG&E system upgrade(s) will be determined once the LG&E affected system study is completed by LG&E. **OVEC:** No upgrades required	$17,400,000	TBD**	N/A

2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1))

EKPC Reinforcement:
Project ID: n6238
Increase the operating temperature of the 556.5 MCM ACSR/TW conductor from 212F to 302F. EKPC's new rating would be Normal 103 MVA/Emergency 129 MVA. Cost of upgrade: $40,000. Time to complete 6 months.
Type: FAC
Cost: $40,000
Time Estimate: 6 Months
Ratings: 103/129 MVA SN/SE

The cost allocation table is as follows:

Queue	MW contribution	% Allocation	Cost $40 K
AF2-260	23.5	24.8%	9.916
AF2-308	12.2	12.9%	5.148
AF2-309	18.2	19.2%	7.679
AF2-391	40.9	43.1%	17.257

EKPC Reinforcement:
Project ID: n6238.1
Replace the 556 MCM ACSR jumpers at the Central Hardin substation using bundled 500 MCM copper or equivalent. EKPC's new rating would be Normal 103 MVA/Emergency 132 MVA. Cost of upgrade: $15,000. Time to complete 6 months.
Type: FAC
Cost: $15,000
Time Estimate: 6 Months
Ratings: 103/132 MVA SN/SE

The cost allocation table is as follows:

Queue	MW contribution	% Allocation	Cost $15 K
AF2-309	18.2	30.8%	4.619
AF2-391	40.9	69.2%	10.381

EKPC Reinforcement:
Project ID: n6238.2
Rebuild the Central Hardin-Kargle 69 kV line section using 954 MCM ACSS conductor at 392 degrees F (0.6 miles). EKPC's new rating would be Normal 114 MVA/Emergency 146 MVA. Cost of upgrade: $450,000. Time to complete 12 months.
Type: FAC
Cost: $450,000
Time Estimate: 12 Months
Ratings: 114/146 MVA SN/SE

The cost allocation table is as follows:

Queue	MW contribution	% Allocation	Cost $450 K
AF2-309	18.2	30.8%	138.579
AF2-391	40.9	69.2%	311.421

$40,000 + $15,000 + $450,000 + $0

$17,257 + $10,381 + $311,421 + $0

N6238
N6238.1
N6238.2
N6238.3

Facility	Upgrade Description	Cost	Cost Allocated to AF2-090	Upgrade Number
	EKPC Reinforcement: **Project ID:** n6238.3 Change the Zone 3 relay setting at Central Hardin associated with the line protection to at least 228 MVA LTE rating. EKPC's new rating would be Normal 147 MVA/Emergency 228 MVA. Cost of upgrade: $0. Time to complete 6 months. **Type:** FAC **Cost:** $0 **Time Estimate:** 6 Months **Ratings:** 147/228 MVA SN/SE			

<table>
<tr><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF2-090</th><th>Upgrade Number</th></tr>
<tr><td>2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1)</td><td>
<u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7035.1
Increase the maximum operating temperature of the 556 MCM ACSR conductor in the Kargle-KU Elizabethtown 69 kV line section to 302 degrees F (1.45 miles). Cost estimate: $100 K. Time Estimate: 9 months. New expected SE rating after the upgrade will be 132 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $100,000
<u>Time Estimate:</u> 9 Months
<u>Ratings:</u> 132 MVA SE

The cost allocation table is as follows:
<table>
<tr><th>Queue</th><th>MW contribution</th><th>% Allocation</th><th>Cost $100 K</th></tr>
<tr><td>AF2-090</td><td>29.8</td><td>23.9%</td><td>23.917</td></tr>
<tr><td>AF2-260</td><td>23.5</td><td>18.9%</td><td>18.860</td></tr>
<tr><td>AF2-308</td><td>12.2</td><td>9.8%</td><td>9.791</td></tr>
<tr><td>AF2-309</td><td>18.2</td><td>14.6%</td><td>14.607</td></tr>
<tr><td>AF2-391</td><td>40.9</td><td>32.8%</td><td>32.825</td></tr>
</table>
<u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7035.2
Rebuild the 556 MCM ACSR conductor section of the Kargle-KU Elizabethtown 69 kV line section using 954 MCM ACSR conductor (1.45 miles). Cost estimate: $2.01 M. Time Estimate: 15 months. New expected SE rating after the upgrade will be 182 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $2,010,000
<u>Time Estimate:</u> 15 Months
<u>Ratings:</u> 182 MVA SE

The cost allocation table is as follows:
<table>
<tr><th>Queue</th><th>MW contribution</th><th>% Allocation</th><th>Cost $2.01 M</th></tr>
<tr><td>AF2-309</td><td>18.2</td><td>30.8%</td><td>0.619</td></tr>
<tr><td>AF2-391</td><td>40.9</td><td>69.2%</td><td>1.391</td></tr>
</table>
<u>LG&E:</u>
LG&E impacts to be determined during the LG&E affected system study.
</td><td>$100,000
+
$2,010,000</td><td>$32,825
+
$1,391,000</td><td>N7035.1
N7035.2</td></tr>
</table>

<table>
<tr><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF2-090</th><th>Upgrade Number</th></tr>
<tr><td>AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1)</td><td><u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7149
Increase the maximum operating temperature of the 556 MCM ACSR conductor in the AF2-260 Tap-Stephensburg 69 kV line section to 302 degrees F (2.1 miles). Cost Estimate: 150 K. Time Estimate: 9 months. New expected SE rating after the upgrade will be 125 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $150,000
<u>Time Estimate:</u> 9 Months
<u>Ratings:</u> 125 MVA SE

The cost allocation table is as follows:
<table>
<tr><th>Queue</th><th>MW contribution</th><th>% Allocation</th><th>Cost $150 K</th></tr>
<tr><td>AF2-309</td><td>7.1</td><td>14.8%</td><td>22.188</td></tr>
<tr><td>AF2-391</td><td>40.9</td><td>85.2%</td><td>127.813</td></tr>
</table>
</td><td>$150,000</td><td>$127,813</td><td>N7149</td></tr>
</table>

<table>
<tr><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF2-090</th><th>Upgrade Number</th></tr>
<tr><td>AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1)</td><td>
<u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7036.1
Increase the maximum operating temperature of the 556 MCM ACSR conductor in the AF2-308 Tap-Central Hardin 69 kV line section to 302 degrees F (4.15 miles). Cost estimate: 280 K $1,730,000. Time Estimate: 9 months. New expected SE rating after the upgrade will be 129 MVA 103.0/129.0/135.0 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $280,000
<u>Time Estimate:</u> 9 Months
<u>Ratings:</u> 103/129 MVA SN/SE

The cost allocation table is as follows:
<table>
<tr><th>Queue</th><th>MW contribution</th><th>% Allocation</th><th>Cost $280 K</th></tr>
<tr><td>AF2-308</td><td>28.0</td><td>23.3%</td><td>65.230</td></tr>
<tr><td>AF2-309</td><td>70.0</td><td>58.2%</td><td>163.075</td></tr>
<tr><td>AF2-365</td><td>5.6</td><td>4.7%</td><td>13.046</td></tr>
<tr><td>AF2-391</td><td>16.6</td><td>13.8%</td><td>38.649</td></tr>
</table>
<u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7036.2
Replace the 556 MCM ACSR jumpers at the Central Hardin substation using bundled 500 MCM copper or equivalent. Cost Estimate: $25 K. Time Estimate: 6 months. New expected SE rating after the upgrade will be 132 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $25,000
<u>Time Estimate:</u> 6 Months
<u>Ratings:</u> 132 MVA SE

<u>Notes:</u>
AF2-391 is the driver for this upgrade.

<u>EKPC Reinforcement:</u>
<u>Project ID:</u> n7036.3
Rebuild the AF2-308 Tap-Central Hardin 69 kV line section using 954 MCM ACSS conductor at 392 degrees F (4.15 miles). Cost Estimate: $3.21 M. Time Estimate: 16 months. New expected SE rating after the upgrade will be 143 MVA.
<u>Type:</u> FAC
<u>Cost:</u> $3,210,000
<u>Time Estimate:</u> 16 Months
<u>Ratings:</u> 143 MVA SE

<u>Notes:</u>
AF2-391 is the driver for this upgrade.
</td><td>$280,000
+
$25,000
+
$3,210,000</td><td>$38,649
+
$25,000
+
$3,210,000</td><td>N7036.1
N7036.2
N7036.3</td></tr>
<tr><td></td><td>Total Cost</td><td>$24,430,000</td><td>$5,914,346**</td><td></td></tr>
</table>

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

9.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

(LGEE - EKPC) The 2ETOWN KU-2KARGLE 69 kV line (from bus 324519 to bus 341713 ckt 1) loads from 71.69% to 194.09% (AC power flow) of its emergency rating (76 MVA) for the bus fault outage of 'EKPC_P2-2_CENT HARD 138'. This project contributes approximately 90.03 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-2_CENT HARD 138' /* CENTRAL HARDIN 138 BUS
OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1 /* 341287 2CENT HARDIN69.000 342568 4CENT HARDIN138.00
END

Bus Number	*Bus Name*	*Full Contribution*
957961	*AF2-090 C*	*3.00*
957962	*AF2-090 E*	*1.48*
960172	*AF2-308 BAT*	*16.31*
961003	*AF2-391 BAT*	*90.03*
LTF	*CALDERWOOD*	*0.13*
LTF	*CATAWBA*	*0.05*
LTF	*CHEOAH*	*0.13*
LTF	*COFFEEN*	*< 0.01*
LTF	*EDWARDS*	*< 0.01*
LTF	*FARMERCITY*	*< 0.01*
LTF	*G-007*	*0.01*
LTF	*LGEE*	*0.19*
LTF	*NEWTON*	*0.03*
LTF	*NY*	*< 0.01*
LTF	*O-066*	*0.07*
LTF	*PRAIRIE*	*0.36*

(EKPC - EKPC) The 2KARGLE-2CENT HARDIN 69 kV line (from bus 341713 to bus 341287 ckt 1) loads from 41.4% to 132.88% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-3_CHARD W124-804'. This project contributes approximately 89.45 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P2-3_CHARD W124-804'                  /* CENTRAL HARDIN
  OPEN BRANCH FROM BUS 341287 TO BUS 342568 CKT 1       /* 341287 2CENT
HARDIN69.000 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 342568 CKT 1       /* 324047
4BLACKBRNCH 138.00 342568 4CENT HARDIN138.00
  OPEN BRANCH FROM BUS 324047 TO BUS 324260 CKT 1       /* 324047
4BLACKBRNCH 138.00 324260 4HARDBG 138.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
957961	*AF2-090 C*	*3.66*
957962	*AF2-090 E*	*1.81*
960172	*AF2-308 BAT*	*16.19*
961003	*AF2-391 BAT*	*89.45*
LTF	*CALDERWOOD*	*0.13*
LTF	*CATAWBA*	*0.05*
LTF	*CHEOAH*	*0.13*
LTF	*COFFEEN*	*0.01*
LTF	*EDWARDS*	*< 0.01*
LTF	*FARMERCITY*	*< 0.01*
LTF	*G-007*	*< 0.01*
LTF	*LGEE*	*0.21*
LTF	*NEWTON*	*0.06*
LTF	*NY*	*< 0.01*
LTF	*O-066*	*0.06*
LTF	*PRAIRIE*	*0.44*

(EKPC - EKPC) The 2STEPHENSBRG-2UPTON T 69 kV line (from bus 342307 to bus 342403 ckt 1) loads from 90.44% to 107.36% (AC power flow) of its emergency rating (39 MVA) for the bus fault outage of 'EKPC_P2-2_KU HODG 69'. This project contributes approximately 8.36 MW to the thermal violation.

CONTINGENCY 'EKPC_P2-2_KU HODG 69' /* KU HODGENVILLE 69
TIE
OPEN BUS 341632 /* 2HODGENVILLE
END

Bus Number	*Bus Name*	*Full Contribution*
959691	*AF2-260 C*	*9.6*
959692	*AF2-260 E*	*4.8*
960171	*AF2-308*	*3.87*
960181	*AF2-309 C*	*5.8*
960182	*AF2-309 E*	*3.87*
961001	*AF2-391 C O1*	*5.02*
961002	*AF2-391 E O1*	*3.35*
LTF	*CALDERWOOD*	*0.1*
LTF	*CATAWBA*	*0.04*
LTF	*CBM-W1*	*0.18*
LTF	*CHEOAH*	*0.1*
LTF	*FARMERCITY*	*< 0.01*
LTF	*G-007*	*0.01*
LTF	*LGEE*	*0.11*
LTF	*NY*	*< 0.01*
LTF	*O-066*	*0.07*
LTF	*PRAIRIE*	*0.1*
LTF	*WEC*	*< 0.01*

(LGEE - OVEC) The 7TRIMBL REAC-06CLIFTY 345 kV line (from bus 324010 to bus 248000 ckt 1) loads from 130.05% to 131.12% (DC power flow) of its emergency rating (1451 MVA) for the single line contingency outage of 'AEP_P1-2_#363'. This project contributes approximately 15.62 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#363'
OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1
END

Bus Number	*Bus Name*	*Full Contribution*
243442	*05RKG1*	*14.7*
243443	*05RKG2*	*14.48*
342900	*1COOPER1 G*	*2.45*
342903	*1COOPER2 G*	*4.75*
342918	*1JKCT 1G*	*1.91*
342921	*1JKCT 2G*	*1.4*
342924	*1JKCT 3G*	*1.91*
342927	*1JKCT 4G*	*1.27*
342930	*1JKCT 5G*	*1.26*
342933	*1JKCT 6G*	*1.27*
342936	*1JKCT 7G*	*1.27*
342939	*1JKCT 9G*	*1.31*
342942	*1JKCT 10G*	*1.31*
342945	*1LAUREL 1G*	*1.38*
932551	*AC2-075 C*	*0.95*
933441	*AC2-157 C*	*4.85*
936381	*AD2-048 C*	*3.43*
936571	*AD2-072 C O1*	*10.12*
939131	*AE1-143 C*	*9.58*
940041	*AE1-246 C O1*	*11.96*
940831	*AE2-071 C*	*3.03*
941341	*AE2-130 C*	*30.62*
941411	*AE2-138 C*	*15.16*
941981	*AE2-210 C O1*	*5.22*
942411	*AE2-254 C O1*	*4.03*
942591	*AE2-275 C O1*	*6.82*
942601	*AE2-276*	*3.19*
942891	*AE2-308 C O1*	*11.52*
943111	*AE2-339 C*	*2.56*
943701	*AF1-038 C*	*4.66*
943821	*AF1-050 C*	*5.42*
944151	*AF1-083 C O1*	*4.98*
944201	*AF1-088 FTIR*	*63.85*
944511	*AF1-116 C*	*10.74*
944621	*AF1-127 C O1*	*4.44*
945381	*AF1-203 C*	*1.73*
945861	*AF1-251 C*	*10.73*

957141	*AF2-008 FTIR*	*31.93*
957961	*AF2-090 C*	*16.47*
959691	*AF2-260 C*	*12.28*
960151	*AF2-306*	*1.68*
960161	*AF2-307 C*	*2.55*
960171	*AF2-308*	*5.81*
960181	*AF2-309 C*	*8.72*
960641	*AF2-355 C O1*	*15.13*
960741	*AF2-365 C O1*	*4.74*
961001	*AF2-391 C O1*	*15.62*
LTF	*CBM-S1*	*97.41*
LTF	*CBM-S2*	*14.8*
LTF	*CBM-W1*	*20.42*
LTF	*CBM-W2*	*56.26*
LTF	*CPLE*	*1.2*
955451	*J1027*	*13.72*
955461	*J1028*	*15.21*
955891	*J1074*	*22.99*
956911	*J1189*	*0.45*
952811	*J759*	*9.7*
952821	*J762*	*29.93*
952861	*J783 C*	*9.3*
953611	*J800*	*14.01*
953931	*J856*	*9.41*
LTF	*LGEE*	*18.14*
LTF	*MADISON*	*12.34*
LTF	*MEC*	*6.1*
LTF	*NY*	*0.27*
LTF	*TVA*	*9.52*
LTF	*WEC*	*0.67*
930461	*AB1-087*	*35.12*
930471	*AB1-088*	*35.12*
925981	*AC1-074 C O1*	*3.99*

(EKPC - EKPC) The 2CENT HARDIN-2KARGLE 69 kV line (from bus 341287 to bus 341713 ckt 1) loads from 156.5% to 198.4% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 40.88 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_CHARD-HARD138'                    /* CENTRAL
HARDIN - KU HARDIN
  OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1          /* 324261 4HARDN
138.00 342568 4CENT HARDIN138.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
957961	*AF2-090 C*	*29.76*
959691	*AF2-260 C*	*23.49*
960171	*AF2-308*	*12.16*
960181	*AF2-309 C*	*18.24*
960741	*AF2-365 C O1*	*1.62*
961001	*AF2-391 C O1*	*40.88*
LTF	*BLUEG*	*1.1*
LTF	*CBM-S1*	*2.85*
LTF	*CBM-S2*	*0.98*
LTF	*CBM-W1*	*1.59*
LTF	*CBM-W2*	*3.58*
LTF	*CPLE*	*0.08*
952821	*J762*	*13.45*
LTF	*MADISON*	*0.86*
LTF	*MEC*	*0.42*
LTF	*NY*	*< 0.01*
LTF	*TRIMBLE*	*0.31*
LTF	*TVA*	*0.79*
LTF	*WEC*	*0.04*

(EKPC - LGEE) The 2KARGLE-2ETOWN KU 69 kV line (from bus 341713 to bus 324519 ckt 1) loads from 184.06% to 238.31% (AC power flow) of its emergency rating (76 MVA) for the single line contingency outage of 'EKPC_P1-2_CHARD-HARD138'. This project contributes approximately 40.88 MW to the thermal violation.

CONTINGENCY 'EKPC_P1-2_CHARD-HARD138' /* CENTRAL HARDIN - KU HARDIN
OPEN BRANCH FROM BUS 324261 TO BUS 342568 CKT 1 /* 324261 4HARDN 138.00 342568 4CENT HARDIN138.00
END

Bus Number	*Bus Name*	*Full Contribution*
957961	*AF2-090 C*	*29.76*
959691	*AF2-260 C*	*23.49*
960171	*AF2-308*	*12.16*
960181	*AF2-309 C*	*18.24*
960741	*AF2-365 C O1*	*1.62*
961001	*AF2-391 C O1*	*40.88*
LTF	*BLUEG*	*1.1*
LTF	*CBM-S1*	*2.85*
LTF	*CBM-S2*	*0.98*
LTF	*CBM-W1*	*1.59*
LTF	*CBM-W2*	*3.58*
LTF	*CPLE*	*0.08*
952821	*J762*	*13.45*
LTF	*MADISON*	*0.86*
LTF	*MEC*	*0.42*
LTF	*NY*	*< 0.01*
LTF	*TRIMBLE*	*0.31*
LTF	*TVA*	*0.79*
LTF	*WEC*	*0.04*

(EKPC - EKPC) The AF2-260 TAP-2STEPHENSBRG 69 kV line (from bus 959690 to bus 342307 ckt 1) loads from 106.81% to 125.45% (AC power flow) of its emergency rating (98 MVA) for the single line contingency outage of 'EKPC_P1-2_C HAR-KU ETN69'. This project contributes approximately 19.31 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P1-2_C HAR-KU ETN69'                    /* CENTRAL HARDIN
- KU ETOWN
  OPEN BRANCH FROM BUS 341287 TO BUS 341713 CKT 1          /* 341287 2CENT
HARDIN69.000 341713 2KARGLE 69.000
  OPEN BRANCH FROM BUS 324519 TO BUS 341713 CKT 1          /* 324519 2ETOWN
KU 69.000 341713 2KARGLE 69.000
  END
```

Bus Number	*Bus Name*	*Full Contribution*
957961	*AF2-090 C*	*5.05*
959691	*AF2-260 C*	*28.76*
960171	*AF2-308*	*11.98*
960181	*AF2-309 C*	*17.98*
961001	*AF2-391 C 01*	*19.31*
LTF	*CALDERWOOD*	*0.13*
LTF	*CATAWBA*	*0.05*
LTF	*CHEOAH*	*0.13*
LTF	*COFFEEN*	*< 0.01*
LTF	*FARMERCITY*	*< 0.01*
LTF	*LGEE*	*0.18*
LTF	*NEWTON*	*< 0.01*
LTF	*NY*	*< 0.01*
LTF	*PRAIRIE*	*0.31*
LTF	*WEC*	*< 0.01*

(EKPC - EKPC) The AF2-308 TAP-2CENT HARDIN 69 kV line (from bus 960170 to bus 341287 ckt 1) loads from 125.33% to 144.96% (AC power flow) of its emergency rating (98 MVA) for the bus fault outage of 'EKPC_P2-2_KU HODG 69'. This project contributes approximately 16.59 MW to the thermal violation.

```
CONTINGENCY 'EKPC_P2-2_KU HODG 69'                    /* KU HODGENVILLE 69
TIE
  OPEN BUS 341632                                     /* 2HODGENVILLE
  END
```

Bus Number	*Bus Name*	*Full Contribution*
959691	*AF2-260 C*	*41.13*
959692	*AF2-260 E*	*20.57*
960171	*AF2-308*	*20.39*
960181	*AF2-309 C*	*30.59*
960182	*AF2-309 E*	*20.39*
960741	*AF2-365 C O1*	*3.37*
960742	*AF2-365 E O1*	*2.25*
961003	*AF2-391 BAT*	*16.59*
LTF	*BLUEG*	*0.88*
LTF	*CBM-S1*	*2.48*
LTF	*CBM-S2*	*1.01*
LTF	*CBM-W1*	*0.38*
LTF	*CBM-W2*	*1.81*
LTF	*CPLE*	*0.09*
LTF	*G-007A*	*0.03*
LTF	*GIBSON*	*0.05*
LTF	*MADISON*	*0.48*
LTF	*MEC*	*0.19*
LTF	*TILTON*	*0.02*
LTF	*TRIMBLE*	*0.25*
LTF	*TVA*	*0.63*
LTF	*VFT*	*0.07*
LTF	*WEC*	*< 0.01*

10 Light Load Analysis

The Queue Project AF2-391 was evaluated as a 120.0 MW (Capacity 120.0 MW) injection at the Central Hardin 69 kV substation in the EKPC area. Project AF2-391 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-391 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

None

10.2 Multiple Facility Contingency

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

None

10.3 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

10.4 Steady-State Voltage Requirements

To be determined

10.5 Potential Congestion due to Local Energy Deliverability

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.

None

11 Short Circuit Analysis

The following Breakers are overdutied:

None

12 Stability and Reactive Power

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the Facilities Study Phase.

13 Affected Systems

13.1 TVA

None

13.2 MISO

Preliminary MISO impacts have been identified. Please refer to the MISO Affected System report for details. Final MISO impacts to be determined by MISO during the Facilities Study phase.

13.3 LG&E

An LG&E affected system study is required. An LG&E affected system study agreement will need to be signed.

14 Attachment 1: One Line Diagram

AF2-391 Conceptual Single-Line Diagram of Interconnection Facilities