# *Generation Interconnection*
# *Feasibility Study Report*
# *Queue Position Y1-008*

The Interconnection Customer (IC) has proposed a 50 MWE (6.5 MWC; 50 MW MFO) wind powered generating facility to be located near Belle Haven and Painter in Accomack County, Virginia. PJM studied Y1-008 as a 50 MW injection into the Old Dominion Electric Cooperative (ODEC) system as a tap of the Kellam-Bell Haven 69kV circuit and evaluated the project for compliance with reliability criteria for summer peak conditions in 2015. The planned in-service date, as stated in the Attachment N, is December 31, 2014.

## Point of Interconnection

The Interconnection Customer requested a 69kV transmission level interconnection for the Y1-008 project. Y1-008 will interconnect with the Old Dominion Electric Cooperative transmission system at a new three (3) breaker ring bus substation to be constructed adjacent to the Tasley-Kellam 69kV circuit.

## Direct Connection Requirements

### Transmission Owner Scope of Work

The scope of work and estimated costs for the direct connection facilities is as follows:

- Construct a new three (3) breaker ring bus substation adjacent to the Tasley-Kellam 69kV substation.

  The estimated cost to perform this work is **$3,000,000** and will take **48 months** to construct after receipt of a fully executed Interconnection Services Agreement and Interconnection Construction Services Agreement.

Cost and schedule estimates are based on the assumptions stated below. These costs exclude any applicable state or federal taxes. If at a future date Federal CIAC taxes are deemed necessary by the IRS for this project, PJM, ANEC, and ODEC shall be reimbursed by the Interconnection Customer for such taxes.

Costs for extraordinary Threatened and Endangered Species, Archaeological, Cultural, or other as yet unidentified mitigation strategies are not estimated nor included in the above estimate. No environmental, real estate, or permitting issues were reviewed for the Y1-008 Feasibility Study.

### Preliminary Schedule and Notes / Assumptions

ODEC will begin the project only after the PJM Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (ICSA) are fully executed and ODEC receives a written authorization by PJM to commence activities. The estimated time to complete the direct connection work is approximately **48 months** after the execution of an ICSA. **The 2014 requested in-service date will not be attainable.** The schedule for the 69kV transmission and substation work to accommodate Y1-008 will depend on the project start date. The work to accommodate Y1-008 will

require transmission line outages. ODEC's outage windows for construction are typically available in the spring and fall of the year. Missing an outage window could result in project delays.

**Notes / Assumptions**

During construction, if extreme weather conditions or other system safety concerns arise, field construction may need to be rescheduled, which could possibly impact the schedule plan.

Excepting any operational, governmental and/or environmental regulatory delays, the use of additional resources, such as overtime, premiums for expedited material, and/or contractor labor, may enable ODEC to decrease this construction period. It is also assumed that all right-of-way and easements are secured without impact on anticipated construction start dates.

**Y1-008 Turbine generator and Existing Distribution line Carrier Communications**

An AMI/LM power line carrier system operates on ANEC's distribution system at a frequency of 9.615 kHz. Harmonic or other spurious emissions which emanate from Y1-008 and interfere with the operation of this power line carrier system shall be mitigated by Y1-008 to ANEC's satisfaction.

**Interconnection Customer Scope of Work**

Queue Y1-008 Interconnection Customer will be responsible for the construction of all generating station facilities on the Y1-008 side of the POI (Point of Interconnection) as shown on the Figure 1 one line diagram of the previous page. Y1-008 Interconnection Customer is required to design, construct, and own the 69 kV line from the POI to the Customer Facility. This line must be built in accordance RUS standards or an accepted national standard, be effectively grounded, and appropriately shielded from lightning. (Refer to RUS bulletins 1728f-810 and 1724E-200.) The customer's transformer shall be connected wye-ground on the 69 kV side and delta on the low-voltage side.

**Protection equipment**

The Interconnection Customer is responsible for the design and implementation of all protection equipment on the Y1-008 side of the POI (Point of Interconnection) as shown on the one line diagram of the previous page and will do so in accordance with good utility practice.

Y1-008 shall provide and maintain a suitable telephone circuits for use in transfer trip relaying from Tasley substation. ODEC will provide sensing and a transfer trip relaying for all 69 kV faults on ODEC facilities. Y1-008 is required to provide ODEC with any information necessary to set ODEC line relaying and coordinate with their protective device.

**Metering Equipment**

Installation of revenue grade metering equipment will be required at the Queue Y1-008 Point of Interconnection (POI). At the customer's discretion, ODEC will design and supply the required metering equipment but all the installation cost would be borne by the customer. ODEC requires that power quality metering be installed to monitor compliance with industry standards for harmonics.

The Interconnection Customer is also required to provide revenue metering and real-time telemetry data to PJM in compliance with the requirements listed in PJM Manuals M-01 and M-14. At the

customer's discretion, ODEC will design and supply the required telemetering equipment but all the installation cost would be borne by the customer.

## Transmission Network Impacts

Potential transmission network impacts identified by *PJM* are as follows:

### Generator Deliverability

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

None

### Multiple Facility Contingency

*(Double Circuit Tower Line, Line with Failed 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)*

1. The (DPL) OIL_CITY-CHURCH 138kV line (from bus 232801 to bus 232100 ckt 1) loads from 101.23% to 104.97% (DC power flow) of its emergency rating (159 MVA) for the tower line contingency ('DBL_1NCB'). This project contributes approximately 5.96 MW to the thermal violation.

2. The (DPL) STEEL138-OIL_CITY 138kV line (from bus 232103 to bus 232801 ckt 1) loads from 108.49% to 112.23% (DC power flow) of its emergency rating (159 MVA) for the tower line contingency ('DBL_1NCB'). This project contributes approximately 5.96 MW to the thermal violation.

3. The (DPL) MILF_230-STEELE 230kV line (from bus 232004 to bus 232000 ckt 1) loads from 127.32% to 127.8% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency ('DBL_4NC'). This project contributes approximately 16.43 MW to the thermal violation.

### Short Circuit

No issues identified.

### Stability and Low Voltage Ride Through Analysis

Will be performed during the System Impact study phase of the project.

**Distribution Service Requirements**

The Interconnection Customer must submit a request for electric service through A&N Electric Cooperative (ANEC) if back up electric service at less than 69kV is desired.

**New System Reinforcements**

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

None

**Contribution to Previously Identified System Reinforcements**

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. Cost allocation for these overloads will be provided in the System Impact Study Report.*

1. To mitigate the OIL_CITY-CHURCH 138kV line (from bus 232801 to bus 232100 ckt 1) overload will require reconductoring the circuit. The estimated cost to perform this work is **$25.1M** and will take **30 months** to complete.

2. To mitigate the STEEL138-OIL_CITY 138kV line (from bus 232103 to bus 232801 ckt 1) overload will require reconductoring the circuit. The estimated cost to perform this work is **$560k** and will take **30 months** to complete.

3. To mitigate the MILF_230-STEELE 230kV line (from bus 232004 to bus 232000 ckt 1) overload will require reconductoring the circuit. The estimated cost to perform this work is **$23M** and will take **30 months** to complete.

**Transmission Owner Identifed Overloads**

The following overloads were identified by the Old Dominion Electric Cooperative (ODEC) during their evaluation of the Y1-008 project.

**New Overloads**

*Y1-008 causes the following overloads:*

1. The (ODEC) V4-064 tap to W1-008 tap 69kV circuit (6721) loads from 93% to 175% of its normal rating (59 MVA) for non-contingency under light load conditions.

2. The (ODEC) V4-064 tap to Y1-008 69kV circuit (6721) loads from 60% to 142% of its normal rating (59 MVA) for non-contingency under light load conditions.

3. The (ODEC) Hallwood-Parksley 69kV circuit (6790) loads from 77% to 101% of its emergency rating (113 MVA) for the loss of the Oak Hall–Perdue 69kV circuit under light load conditions.

4. The (ODEC) Parksley-Tasley 69kV circuit (6790) loads from 91% to 151% of its emergency rating (113 MVA) for the loss of the Oak Hall–Perdue 69kV circuit under light load conditions.

5. The (ODEC) Tasley-Perdue 69kV circuit (6778) loads from 83% to 122% of its emergency rating (113 MVA) for the loss of the Oak Hall–Perdue 69kV circuit under light load conditions.

**New System Reinforcements**

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

1. To mitigate the overloads in items #1 and 2 above will require rebuilding the Tasley-Kellam 69kV (6721) circuit between W1-008 tap and Y1-008. The estimated cost to perform this work is **$11M** and will take **48 months** to complete.

2. To mitigate the overloads in items #3 and 4 above will require rebuilding the Oak Hall-Tasley 69kV (6790) circuit between Hallwood and Tasley. The estimated cost to perform this work is **$11M** and will take **48 months** to complete.

3. To mitigate the overload in item #5 will require rebuilding the Oak Hall-Tasley 69kV (6778) circuit between Perdue and Tasley. The estimated cost to perform this work is **$2M** and will take **24 months** to complete.

**Contribution to Existing Overloads**

*Y1-008 further contributes to the overloading of the following circuits:*

1. The (ODEC) Oak Hall-W3-054A tap 69kV (6790) circuit loads from 134% to 161% of its normal rating (86 MVA) for non-contingency under light conditions.

2. The (ODEC) Tasley-W1-008 tap 69kV circuit (6721) loads from 126% to 208% of its normal rating (59 MVA) for non-contingency under light load conditions.

3. The (ODEC) Oak Hall-Perdue 69kV circuit (6778) loads from 124% to 159% of its normal rating (121 MVA) for the loss of the Oak Hall-W3-054A tap 69kV circuit under light load conditions.

4. The (ODEC) Tasley-Perdue 69kV circuit (6778) loads from 166% to 211% of its normal rating (93 MVA) for the loss of the Oak Hall-W3-054A tap 69kV circuit under light load conditions.

5. The (ODEC) Oak Hall-W3-054A tap 69kV circuit (6790) loads from 138% to 181% of its normal rating (113 MVA) for the loss of the Oak Hall-Perdue 69kV circuit under light load conditions.

**Contribution to Previously Identified System Reinforcements**

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. Cost allocation for these overloads will be provided in the System Impact Study Report.*

1. To mitigate the overloads in items #1, 3, 4, and 5 above will require building a second Oak Hall-W3-054A 69kV circuit, a distance of approximately 2 miles. The estimated cost to perform this work is **$6M** and will take **48 months** to complete.

2. To mitigate the overload in item #2 above will require rebuilding the Tasley-Kellam 69kV (6721) circuit between Tasley and W1-008. The estimated cost to perform this work is **$1M** and will take **24 months** to complete.

The above violations are summarized in the following table:

## ODEC SYSTEM NETWORK IMPACTS

| Light load conditions - all facilities are 69 kV | | | | |
|---|---|---|---|---|
| Contingency | Facility | Rating MVA | w/o Y1-008 | w/Y1-008 |
| All Lines in | Oak Hall to W3-054A | 86 | 134% | 161% |
| All Lines in | Tasley to W1-008 tap | 59 | 126% | 208% |
| All Lines in | V4-064 tap to W1-008 tap | 59 | 93% | 175% |
| All Lines in | Y1-008 to V4-064 tap | 59 | 60% | 142% |
| l/o Oak Hall to W3-054 | Oak Hall to Perdue | 121 | 124% | 159% |
| l/o Oak Hall to W3-054 | Tasley to Perdue | 93 | 166% | 211% |
| l/o Hallwood to W3-054 | Tasley to Perdue | 93 | 83% | 122% |
| l/o Tasley to Perdue | Oak Hall to W3-054 | 113 | 138% | 181% |
| l/o Tasley to Perdue | Tasley to Parksley | 79 | 91% | 151% |
| l/o Tasley to Perdue | Hallwood to Parksley | 113 | 77% | 101% |

**Potential Congestion due to Local Energy Deliverability**

*(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:*

These are ***not*** required reliability upgrades.

1. The T-144 TAP-COSTEN 138 kV line (from bus 886230 to bus 232807 ckt 1) loads from 90.91% to 100.2% (DC power flow) of its normal rating (211 MVA) for non-contingency condition. This project contributes approximately 19.61 MW to the thermal violation.

2. The HALLWOOD-W3-054A TAP 69 kV line (from bus 232844 to bus 903690 ckt 1) loads from 59.01% to 103.25% (DC power flow) of its emergency rating (113 MVA) for the single line contingency ('CKT 6778'). This project contributes approximately 49.99 MW to the thermal violation.

3. The PERDUE-OAKHL_69 69 kV line (from bus 232846 to bus 232280 ckt 1) loads from 64.94% to 106.26% (DC power flow) of its emergency rating (121 MVA) for the single line contingency ('CKT 6790'). This project contributes approximately 49.99 MW to the thermal violation.

4. The CLAY_230-LINWOOD 230 kV line (from bus 231000 to bus 213750 ckt 1) loads from 106.3% to 106.48% (DC power flow) of its emergency rating (805 MVA) for the single line contingency ('220-85'). This project contributes approximately 8.72 MW to the thermal violation.

5. The PARKSLEY-HALLWOOD 69 kV line (from bus 232845 to bus 232844 ckt 1) loads from 63.93% to 108.17% (DC power flow) of its emergency rating (113 MVA) for the single line contingency ('CKT 6778'). This project contributes approximately 49.99 MW to the thermal violation.

6. The OAK HALL-POCOMOKE 138 kV line (from bus 232132 to bus 232130 ckt 1) loads from 97.37% to 109.13% (DC power flow) of its emergency rating (289 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 33.99 MW to the thermal violation.

7. The STOCKTON-KENNEY 69 kV line (from bus 232278 to bus 232277 ckt 1) loads from 101.09% to 111.03% (DC power flow) of its emergency rating (58 MVA) for the single line contingency ('CKT 13713'). This project contributes approximately 5.76 MW to the thermal violation.

8. The WATTSVIL-STOCKTON 69 kV line (from bus 232281 to bus 232278 ckt 1) loads from 101.27% to 111.2% (DC power flow) of its emergency rating (58 MVA) for the single line contingency ('CKT 13713'). This project contributes approximately 5.76 MW to the thermal violation.

9. The N_CHURCH-PINEY138 138 kV line (from bus 232131 to bus 232128 ckt 1) loads from 110.85% to 119.25% (DC power flow) of its normal rating (172 MVA) for non-contingency condition. This project contributes approximately 14.46 MW to the thermal violation.

10. The POCOMOKE-T-144 TAP 138 kV line (from bus 232130 to bus 886230 ckt 1) loads from 107.24% to 121% (DC power flow) of its emergency rating (247 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 33.99 MW to the thermal violation.

11. The T-144 TAP-COSTEN 138 kV line (from bus 886230 to bus 232807 ckt 1) loads from 113.51% to 127.27% (DC power flow) of its emergency rating (247 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 33.99 MW to the thermal violation.

12. The M HERMON-NSALSBRY 69 kV line (from bus 232272 to bus 232271 ckt 1) loads from 115.57% to 126.93% (DC power flow) of its emergency rating (140 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 15.92 MW to the thermal violation.

13. The OAKHL_69-WATTSVIL 69 kV line (from bus 232280 to bus 232281 ckt 1) loads from 105.78% to 128.94% (DC power flow) of its normal rating (68 MVA) for non-contingency condition. This project contributes approximately 15.75 MW to the thermal violation.

14. The PINEY GR 230/138 kV transformer (from bus 232128 to bus 232007 ckt 1) loads from 117.96% to 127.82% (DC power flow) of its emergency rating (424 MVA) for the single line contingency ('CKT 13713'). This project contributes approximately 41.82 MW to the thermal violation.

15. The KINGS CK-LORETTO 138 kV line (from bus 232129 to bus 232127 ckt 1) loads from 123.96% to 131.09% (DC power flow) of its normal rating (275 MVA) for non-contingency condition. This project contributes approximately 19.6 MW to the thermal violation.

16. The KINGS CK-LORETTO 138 kV line (from bus 232129 to bus 232127 ckt 1) loads from 128.96% to 138.65% (DC power flow) of its emergency rating (351 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 33.99 MW to the thermal violation.

17. The BELLHAVN-V4-064 TAP 69 kV line (from bus 232903 to bus 900450 ckt 1) loads from 57.79% to 142.53% (DC power flow) of its normal rating (59 MVA) for non-contingency condition. This project contributes approximately 50 MW to the thermal violation.

18. The Y1-008 TAP-BELLHAVN 69 kV line (from bus 913040 to bus 232903 ckt 1) loads from 65.37% to 143.49% (DC power flow) of its normal rating (64 MVA) for non-contingency condition. This project contributes approximately 50 MW to the thermal violation.

19. The TASLEY-PERDUE 69 kV line (from bus 232284 to bus 232846 ckt 1) loads from 100.59% to 154.35% (DC power flow) of its emergency rating (93 MVA) for the single line contingency ('CKT 6790'). This project contributes approximately 49.99 MW to the thermal violation.

20. The W3-054A TAP-OAKHL_69 69 kV line (from bus 903690 to bus 232280 ckt 1) loads from 130.73% to 159.76% (DC power flow) of its normal rating (86 MVA) for non-contingency condition. This project contributes approximately 24.97 MW to the thermal violation.

21. The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 158.96% to 170.09% (DC power flow) of its emergency rating (143 MVA) for the single line contingency ('CKT 23002'). This project contributes approximately 15.92 MW to the thermal violation.

22. The OAKHL_69-WATTSVIL 69 kV line (from bus 232280 to bus 232281 ckt 1) loads from 156.23% to 173.98% (DC power flow) of its emergency rating (89 MVA) for the single line contingency ('CKT 137AC'). This project contributes approximately 15.8 MW to the thermal violation.

23. The V4-064 TAP-W1-008 TAP 69 kV line (from bus 900450 to bus 901040 ckt 1) loads from 91.09% to 175.84% (DC power flow) of its normal rating (59 MVA) for non-contingency condition. This project contributes approximately 50 MW to the thermal violation.

24. The N_CHURCH-PINEY138 138 kV line (from bus 232131 to bus 232128 ckt 1) loads from 163.66% to 174.61% (DC power flow) of its emergency rating (226 MVA) for the single line contingency ('CKT 13713'). This project contributes approximately 24.76 MW to the thermal violation.

25. The TASLEY-PARKSLEY 69 kV line (from bus 232284 to bus 232845 ckt 1) loads from 118.42% to 181.7% (DC power flow) of its emergency rating (79 MVA) for the single line contingency ('CKT 6778'). This project contributes approximately 49.99 MW to the thermal violation.

26. The W3-054A TAP-OAKHL_69 69 kV line (from bus 903690 to bus 232280 ckt 1) loads from 142.94% to 187.18% (DC power flow) of its emergency rating (113 MVA) for the single line contingency ('CKT 6778'). This project contributes approximately 49.99 MW to the thermal violation.

27. The W1-008 TAP-TASLEY 69 kV line (from bus 901040 to bus 232284 ckt 1) loads from 124.79% to 209.53% (DC power flow) of its normal rating (59 MVA) for non-contingency condition. This project contributes approximately 50 MW to the thermal violation.