Taiban Mesa II - 50 MW Wind Farm

OASIS # IA-PNM-2003-05

Material Modification Determination Report

September 2016

Prepared by:
Public Service Company of New Mexico
Foreword

This technical report is prepared for IA-PNM-2003-05 (“Interconnecting Customer”) that has a Large Generator Interconnection Agreement with Public Service Company of New Mexico (PNM). This study was performed by PNM Transmission/Distribution Planning and Contracts Department to determine if a modification to the Interconnecting Customers facilities is deemed a material modification.

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Table of Contents

1. Executive Summary ................................................................. 4
2. Introduction ................................................................................ 5
3. Criteria ......................................................................................... 5
   3.1. Generator Reactive Power Range Criterion ............................... 5
   3.2. Transient Stability Criteria ......................................................... 6
4. Approach ...................................................................................... 6
5. Results .......................................................................................... 8
   5.1. Powerflow ............................................................................... 8
   7.2. Transient Stability ................................................................. 8
6. Conclusions .................................................................................. 9
Appendix A – Reactive Powerflow Diagrams ..................................... 10
Appendix B – Stability Plots ............................................................. 13
1. Executive Summary

On March 15, 2016 the interconnection customer proposed a new wind turbine model for the Taiban Mesa II Wind farm ("Project") and requested that PNM make a determination whether the proposed modification represented a Material Modification under the Large Generator Interconnection Procedures (LGIP). The customer proposes to change from the current wind turbine technology of 34 – GE 1.5 MW turbines to 26 – GE 2.0 MW turbines. This report contains the results of the evaluation.

In the original interconnection studies there were no network upgrades to interconnect the project as a Network Resource.

The findings of this report are as follows:

- The interconnection customer did not request any changes that constitute a material impact or timing of any Interconnection Request with a later queue priority date. Therefore the interconnection customer satisfies the requirement of not presenting a material impact.
- Reactive power analysis indicates the reactive power capability of the Taiban II project will meet the +/- .95 power factor requirement at the point of interconnection as proposed by the Interconnection Customer.
- Transient Stability simulation indicates that the new models are stable and meet performance criteria. The interconnection customer provided WECC accepted standard models for modeling of the project.
2. Introduction

Taiban Mesa II is a wind farm consisting of 34 – GE 1.5 MW wind turbines that requested interconnection to the BA- Blackwater Transmission line on October 29, 2003. This request was an expansion of an existing wind Taiban I wind farm. Taiban Mesa II completed a System Impact Study, Facilities Study and executed a Large Generator Interconnection agreement on February 23, 2007.

On March 15, 2016 the interconnection customer proposed a new wind turbine model for the project and requested that PNM make a determination whether the proposed modification represented a Material Modification under the Large Generator Interconnection Procedures (LGIP).

The proposed wind turbine technology change is 26 – GE 2.0 MW turbines for delivering 50 MW to the point of interconnection at Taiban Mesa Switching Station.

3. Criteria

The LGIP states that a proposed change in the application is considered a Material Modification if such change would cause one of the following outcomes for interconnection requests that are junior in the interconnection queue with respect to the Project:

- A material impact (increase) of interconnection cost
- A material delay of commercial date due to proposed changes

The study described in this report was conducted to evaluate whether the change in Technology results in a material modification.

3.1. Generator Reactive Power Range Criterion

All generators that seek to interconnect to the PNM transmission system must comply with certain reactive power requirements. The required power factor range is determined by the power factor test summarized below:

- Base cases are constructed with the Central Cluster Project generation in-service. The reactive power range at full output and control capability described in the interconnection application are represented in the case with generation enabled.
A power flow simulation is conducted to determine whether each generating unit can provide a ± 0.95 power factor range at the POI. If a unit cannot provide the ± 0.95 power factor at the POI, then supplemental reactive power support to achieve a ± 0.95 power factor range at the POI shall be required.

### 3.2. Transient Stability Criteria

The NERC/WECC transient stability performance requirements for transmission contingencies are as follows:

- All machines will remain in synchronism.
- All voltage swings are well damped.
- Following fault clearing for single contingencies, voltage on load buses may not dip more than 25% of the pre-fault voltage or dip more than 20% of the pre-fault voltage for more than 20 cycles. For N-2 and breaker failure contingencies, voltage on load buses may not dip more than 30% of the pre-fault voltage or dip more than 20% of the pre-fault voltage for more than 40 cycles.
- All frequency dips are well damped.
- Following fault clearing for single contingencies, frequency on load buses may not dip below 59.6 Hz for more than 6 cycles. For N-2 and breaker failure contingencies, frequency on load buses may not dip below 59.0 Hz for more than 6 cycles. Fault clearing times used in this DISIS are shown in Table 1.

#### Table 1 — PNM Fault Clearing Times

<table>
<thead>
<tr>
<th>Categories</th>
<th>Fault Type</th>
<th>Voltage (kV)</th>
<th>Clearing Time (near-far end breakers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1,P3,P6</td>
<td>3 Phase Normally Cleared</td>
<td>345</td>
<td>4–4 Cycles</td>
</tr>
<tr>
<td></td>
<td>230</td>
<td>4–4 Cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>115</td>
<td>4–4 Cycles</td>
<td></td>
</tr>
<tr>
<td>P2,P4,P5,P7</td>
<td>1 Phase Stuck Breaker</td>
<td>345</td>
<td>4-12 Cycles</td>
</tr>
<tr>
<td></td>
<td>230</td>
<td>4-12 Cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>115</td>
<td>4-15 Cycles</td>
<td></td>
</tr>
</tbody>
</table>

#### 4. Approach

The approach for this study is to evaluate the project in two parts.
Part 1: Determine material impacts:

1. Determine if the request materially increases interconnection cost.
2. Determine if the request materially increases delay due to proposed changes.

Part 2: Technical evaluation:

1. Determine if Powerflow analysis needs to be reevaluated for this project.
2. Determine if Short Circuit Analysis needs to be reevaluated for this project.
3. Evaluate if the technology allows for the customer to meet the Generator Reactive Power Range Criterion at the point of Interconnection.
4. Evaluate if dynamic models supplied properly initialize in the current GE PSLF model establishing a successful “flat” run.
5. Evaluate dynamic performance of the project during a system disturbance.

A WECC 2018HS2 powerflow case was used to evaluate the proposed technology change. The project proposed changes are as follows:

**Generator:**
- Wind Turbine: 26 – GE 2.0 Wind turbines
- Reactive: +/- .90 pf at the terminal of the wind turbines assumed.
- Terminal voltage: .69 kV

**Wind Turbine Pad mount .69/34.5 kV Transformer:**
- Rating: 2.3 MVA (26 total transformers)
- Voltage: .69 kV / 34.5 kV
- Impedance: 5.75 % - X/R ratio 7.5 on 2.3 MVA rating

**Equivalent 34.5 kV Wind Collector impedance**
- Impedance: 0.008370 +j0.009170 p.u. B= 0.066530 on 100 MVA base

**345/34.5 kV Step-Up Transformer**
- Rating: 33/44/55 MVA
- Voltage ratio: 345/34.5 kV
- Impedance: 0.002249 + j 0.089972 on a 33 MVA base
5. Results

Part 1: Determination of Material impacts.

The interconnection customer did not request any changes that constitute a material impact or timing of any Interconnection Request with a later queue priority date. Therefore the interconnection customer satisfies the requirement of not presenting a material impact.

Part 2: Technical evaluation

Short Circuit Analysis: Based upon previous analysis with resources in these areas, existing short circuit capacity is more than adequate to accommodate the project. Further analysis is not required.

5.1 Powerflow

Powerflow analysis was limited to the evaluation of Reactive Power Criterion because the customer is not changing the size of the wind farm rather changing the technology of the wind turbine. Previous studies have evaluated the project’s performance on the transmission system, so further analysis is not required.

Reactive power analysis indicates the reactive power capability of the Taiban II project will meet the +/- .95 power factor requirement at the point of interconnection as proposed by the Interconnection Customer.

See Appendix A for Power Flow one-line diagrams.

7.2 Transient Stability

Transient stability simulations were conducted to determine whether the Project exhibits a stable response to transmission system contingencies. The simulations were also conducted to determine whether changing the Project Technology had the potential to negatively impact system performance in the vicinity of the Project, as compared to system performance with the Project as originally proposed.
Table 2 — List of Contingencies for Stability Analysis

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Category</th>
<th>Fault Location</th>
<th>Fault Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>P0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td>P1</td>
<td>Rio Puerco 345</td>
<td>3 Phase</td>
</tr>
</tbody>
</table>

The simulation shows that the Project would be stable and well damped for the contingencies tested. See Appendix B for stability plots of the original project and with the proposed technology change.

6. Conclusions

The result of this analysis indicates that the Taiban Mesa II project as redesigned by the interconnection customer does not constitute a material modification and is acceptable to PNM for meeting requirements to interconnect to the transmission system.
Appendix A – Reactive Powerflow Diagrams

- Over excited generation
- Under excited generation
2018 HS Case

Post Modification for Taiban II PMA request
San Juan Units 2&3 retired. Replaced w/ PNM-2014-02-0515-4C gen

General Electric International, Inc.  PSLF Program   Wed Aug 17 21:45:45 2016   D:\D\adhoc\taibII-mma\TaibanII_POST_PF_LOW.sav

P mis = -0.0001 MW  Q mis =  0.0002 MVAR

1.000<

197.7 47.0
198.3 12.5
41.6
50.0 16.7
50.1 9.8

269.6 22.1
693.5 13.8
299.8 22.7

Appendix B – Stability Plots

- Pre-material modification no disturbance simulation
- Pre-material modification Rio Puerco – West Mesa 345 kV Line fault simulation
- Post-material modification no disturbance simulation
- Post-material modification Rio Puerco – West Mesa 345 kV Line fault simulation
2018 HS Case
Pre Matrrial Modification for Taiban II MMA request
San Juan Units 2&3 retired. Replaced w/ PNM-2014-02-DSIS-4C gen
W ESTERN ELECTRICITY COORDINATING COUNCIL
2018 HS2 BASE CASE
JULY 19, 2012
ALL COMMENTS FROM TSS REVIEW ARE INCLUDED
No Fault - No disurbance run
GRN - Taiban II PP MMA ANALYSIS
2018 HS Case
Pre Material Modification for Taiban II MMA request
San Juan Units 2&3 retired. Replaced w/ PNM-2014-02-DSIS-4C gen
WESTERN ELECTRICITY COORDINATING COUNCIL
2018 HS2 BASE CASE
JULY 19, 2012
ALL COMMENTS FROM TSS REVIEW ARE INCLUDED
Rio Puerco - West Mesa 345 CKT 3 3 phase fault Normal Clearing
GRN - Taiban MMA

PNM Taiban II MMA
Transient Stability Plots

Local Bus Voltages

Local Bus Frequencies

Project Bus Voltage

Project Bus Frequency

Project Real Power (MW)

Project Reactive Power (Mvar)
PNM Taiban II MMA
Transient Stability Plots

Local Bus Voltages

Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0

1.00 1.01 1.02 1.03 1.04 1.05 1.06 1.07 1.08 1.09 1.10

Project Bus Voltage

Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0

1.00 1.01 1.02 1.03 1.04 1.05 1.06 1.07 1.08 1.09 1.10

Project Real Power (MW)

Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0

45.00 45.83 46.67 47.50 48.33 49.17 50.00 50.83 51.67 52.50 53.33 54.17 55.00

Project Reactive Power (Mvar)

Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0

-20.00 -16.00 -12.00 -8.00 -4.00 0.00 4.00 8.00 12.00 16.00 20.00

2018 HS Case
Post Modification for Taiban II MMA request
San Juan Units 2&3 retired. Replaced w/ PNM-2014-02-DSIS-4C gen
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PNM Taiban II MMA
Transient Stability Plots

Local Bus Voltages

Local Bus Frequencies

Project Bus Voltage

Project Bus Frequency

Project Real Power (MW)

Project Reactive Power (Mvar)