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Cassadaga Wind Project System Reliability Impact Study - NYISO Queue #387

Prepared for

NYISO

Submitted by:
Mounika Kurra, Consultant
Larry Eng, Staff Consultant
Bernardo Fernandes, Senior Manager, Consulting

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Siemens Industry, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 USA
Tel: +1 (518) 395-5000 • Fax: +1 (518) 346-2777
www.siemens.com/power-technologies

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Contents

Legal Notice vii

Executive Summary ix

Section 1 – Introduction 1-1

Section 2 – Project Description 2-1

Section 3 – Criteria, Methodology and Assumptions 3-1

3.1 Methodology 3-1

3.2 Study Cases 3-2

3.3 Assumptions 3-3

3.4 Criteria 3-4

Section 4 – Power Flow Analysis 4-1

4.1 Impact on Base System Conditions 4-2

4.2 Impact on Contingency Conditions 4-9

4.2.1 Summer Peak Case 4-9

4.2.2 Winter Peak Case 4-16

Section 5 – Stability Analysis 5-1

5.1 Methodology 5-1

5.2 Criteria 5-1

5.3 Model Development 5-4

5.4 Stability Analysis Results 5-4

5.5 Critical Clearing Times 5-7

5.5.1 Summer Peak 5-8

5.5.2 Light Load 5-8

5.6 LVRT Test 5-8

Section 6 – Extreme Contingency Analysis 6-1

6.1 Steady-State Analysis 6-2

6.2 Stability Analysis 6-4

Section 7 – Transfer Limit Analysis 7-1

7.1 Thermal Analysis 7-1

7.1.1 Methodology 7-1

** DRAFT **

7.1.2 Criteria 7-1
7.1.3 Model Development 7-2
7.1.4 Results 7-2
7.2 Voltage Analysis 7-3
7.2.1 Methodology 7-3
7.2.2 Criteria 7-3
7.2.3 Model Development 7-4
7.2.4 Results 7-4
7.3 Stability Analysis 7-4
7.3.1 Methodology 7-4
7.3.2 Criteria 7-5
7.3.3 Model Development 7-5
7.3.4 Results 7-5
7.4 Overall Impact on Transfer Limits 7-6

Section 8 – Short Circuit Analysis 8-1
8.1 Methodology 8-1
8.2 Criteria 8-2
8.3 Model Development 8-2
8.4 Project Data 8-3
8.5 Results of the Short Circuit Calculations 8-3

Section 9 – NPCC A-10 Test 9-1
9.1 Test Methodology 9-1
9.2 Tests Performed 9-2
9.2.1 Stability Test 9-2
9.2.2 Steady-State Test 9-2
9.2.3 Test Results 9-3

Section 10 – N-1-1 Contingency Analysis 10-5
10.1 Criteria 10-5
10.2 Methodology 10-5
10.3 Results 10-6

Section 11 – Power Factor Evaluation 11-1
11.1 Methodology 11-1
11.2 Power Factor Test Results 11-1

11.2.1 Summer Peak Case 11-1
11.2.2 Winter Peak Case 11-3

Section 12 – Cost Estimates 12-1
12.1 Stand Alone System Upgrade Facilities (SA SUF) 12-1
12.2 Other Local System Upgrade Facilities (SUFs) 12-1
12.3 Connecting Transmission Owner's Attachment Facilities (CTO AFs) 12-2
12.4 Cost Estimate Summary and Time to Construct 12-2

Section 13 – Conclusions 13-1
13.1 Power Flow Analysis 13-1
13.2 Stability Analysis 13-1
13.3 Extreme Contingency Analysis 13-2
13.4 Transfer Limit Analysis 13-2
13.5 Short Circuit Analysis 13-2
13.6 NPCC A-10 Test 13-2
13.7 N-1-1 Contingency Analysis 13-3
13.8 Power Factor Test 13-3
13.9 Cost Estimate 13-3

Appendix A – SRIS Scope A-1

Appendix B – Cassadaga Wind Stability Model Parameters B-1
B.1 GSCORE Model B-1
B.2 GSVARS Model B-1
B.3 GSLVRT Model B-2
B.4 GSPWRC Model B-3
B.5 GSMEAS Model B-4
B.6 GSVPRT Model B-4
B.7 GSFPRT Model B-5
B.7 VWPOW7 Model – Power Plant Controller B-6
B.7 VWREA7 Model – Power Plant Controller B-7
B.8 PSS®E DOCU Output B-9

Appendix C – One-line Power Flow Diagrams for Base Case System Conditions C-1

Appendix D – Detailed Steady State Analysis Results D-1
D.1 Subsystem File D-1

** DRAFT **

D.2 Monitor File D-2
D.3 Contingency Files D-8
D.3.1 DB2013_NY_2018_Q387_ON.CON D-8
D.3.2 Q251_CPV.con D-9
D.3.3 Q263_Stony_Creek.con D-10
D.3.4 Q387_Local_Project_On.con D-11
D.3.5 Q387_CASSADAGA_ON.con D-23
D.3.6 DB2013_NY_EXIST_MK.con D-24

Appendix E – Stability Simulation Results E-1
E.1 PSAS Files for the Local Contingencies E-1
E.2 Simulation Plots for the Local Contingencies – Summer Peak E-5
E.3 Simulation Plots for the Normal Design Contingencies – Summer Peak E-6
E.4 Simulation Plots for the Local Contingencies – Light Load E-7
E.5 Simulation Plots for the Normal Design Contingencies – Light Load E-8
E.6 CCT Plots – Summer Peak E-9
E.6.1 Falconer 115 kV E-9
E.6.2 East Dunkirk 115 kV E-11
E.6.3 Moon 115 kV E-13
E.7 CCT Plots – Light Load E-15
E.7.1 Falconer 115 kV E-15
E.7.2 East Dunkirk 115 kV E-18
E.7.3 Moon 115 kV E-20
E.8 LVRT Plots E-22

Appendix F – Extreme Contingency Analysis Results F-1

Appendix G – Detailed Thermal Transfer Limits Results G-1

Appendix H – Voltage Transfer Limit Analysis Results H-1

Appendix I – Stability Transfer Limit Analysis Results I-1

Appendix J – Short Circuit Analysis Results J-1

Appendix K – NPCC A-10 Testing Results K-1
K.1 Stability Test K-1
K.2 Steady State Test K-2

Appendix L – N-1-1 Contingency Analysis Results L-1

Appendix M – Cost Estimate for the Interconnection of the Cassadaga Wind Project M-1

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Executive Summary

Siemens Power Technologies International (Siemens PTI) has conducted a System Reliability Impact Study (SRIS) to evaluate the impact of the proposed Cassadaga Wind Q#387 (the "Project") on the reliability of the New York State Transmission System. The Project's point of interconnection ("POI") will be a new 115 kV substation located next to the Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") Moon Switching Station on the Dunkirk-Moon Switching Station 115 kV line segment of the #161/#162 lines. The Project will be located in the Townships of Charlotte and Cherry Creek in Chautauqua County, New York.

The Project consists of forty two Vestas V112 Gridstreamer 3.075 MW 60 Hz Mk0E wind turbines generating at 650 volts with individual 3.45 MVA 650 V-34.5 kV padmount transformers on four 34.5 kV feeder circuits into the collector substation. The Project is expected to have an approximate maximum summer and winter potential generating gross capacity of 129.2 MW and a net capacity of 126 MW and has a proposed in-service date of December, 2015.

Siemens PTI received from the NYISO the 2018 summer peak, winter peak and light load power flow base cases, together with the short circuit and stability databases for use in the analyses reported in this document.

Power flow steady state analyses were performed for summer peak and winter peak base case loadings, for normal (all in service) and contingency operating conditions, with and without the Project.

In base case normal operating conditions, for the summer peak and winter peak cases, no thermal violations were caused by the Project. The project had an impact from -17% up to +39% on the branch loadings and an impact of approximately 2-3% on the Hartfield and Moon 115 kV bus voltages.

Under contingency operating conditions, without the Project, the summer peak case shows some overloads on the 230 kV and 115 kV lines under several contingencies. The addition of the project reduced the overload on these lines, thus causing a positive impact on the system. The addition of the project increased the 34.5 kV post-contingency voltages by as much as 2% and exceeded its 105% limit. Post-contingency load tap changes in the 115/34.5 kV transformers reduced the 34.5 kV voltages to acceptable levels.

For the winter peak case, the project caused an adverse impact of about 11% on the Hartfield 115/34.5 kV transformer following the double circuit contingency of the circuits 153 and 154. However, the overload on the Hartfield 115/34.5 kV transformer can be mitigated by the construction of a new sub -T station 'West Ashville', located at the junction of Dunkirk-Falconer Line 160 and Sherman-Ashville Line 863, which is a reliability project approved by National Grid. Voltage violations were noticed at some buses near the POI under several contingencies, with the addition Project. Load tap changes in the 115/34.5 kV transformers reduced most of the 34.5 kV voltage to acceptable levels.

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Stability analysis was performed for the system summer peak and light load conditions, with and without the Project. The stability results show that the Project does not adversely impact the stability performance of the system. The Project did not trip by low voltage or overvoltage protections, as well as frequency protection in any of the local or normal design contingencies tested.

The project meets the Post-Transition Period LVRT Standard, according to the tests performed for the summer peak and light load cases.

Critical Clearing Time (CCT) analysis was performed with and without the project. In summary, all cases without the project in summer peak and light load cases showed CCT > 600 cycles. The addition of the project reduces the CCTs of the Falconer, the East Dunkirk and the Moon 115 kV substations, as shown in Table 5-8 and Table 5-9, for the summer peak and light load cases, respectively. It is important to note that despite the reduction, the CCTs are still much larger than the clearing times of the substations tested.

Extreme contingency analysis was performed for the summer peak condition, with and without the Project. The Project did not cause any significant thermal impact on the NY transmission system under extreme contingency condition. However, the Project did cause significant voltage violations in the Study Area under extreme contingencies. The project caused an impact of up to 1.35 % on the buses near the POI for both the summer peak conditions. With regards to the system dynamic performance, the Project does not have an adverse impact on the stability performance of the system under the extreme contingencies tested.

Transfer limit analysis was performed for the summer peak condition, with and without the Project and the results show that:

1. The Project did not cause large impact on the Dysinger East interface for both normal and emergency thermal transfer limits. The Project increases the voltage transfer limit of this interface by 74 MW in normal conditions and by 60 MW in emergency conditions.

2. The Project decreases both the PJM-NY normal and emergency thermal transfer limits by 48 MW.

Short circuit analysis was performed for the cases with and without the Project. The short-circuit results show the Project does not cause any substation to exceed their lowest breaker rating.

NPCC A-10 Bulk Power System (BPS) classification stability and steady-state tests were performed on three buses: Falconer 115 kV, East Dunkirk 115 kV and Moon/Q387 Cassadaga 115 kV Substations. The results show that the Project does not change the current NPCC classification of these substations as non BPS elements.

The N-1-1 contingency analysis indicates that the addition of the Project reduced the N-1-1 post-contingency overloads before system adjustments in most cases. For the other cases, there was no adverse impact on the N-1-1 contingencies which could not be mitigated by reducing the Project generation dispatch for the N-1 contingencies.

The power factor test results show that the Project meets the requirements at the point of interconnection.

The total non-binding cost estimate of System Upgrade Facilities (SUFs), Connecting Transmission Owner's Attachment Facilities (CTO AFs) and Stand Alone System Upgrade Facilities (SA SUF) necessary to accommodate the Project, totals $9.43 Million ±50%. The estimated time to construct these facilities is 24 months.

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Section 1

Introduction

Siemens Power Technologies International (Siemens PTI) has conducted a System Reliability Impact Study (SRIS) to evaluate the impact of the proposed Cassadaga Wind Q#387 (the "Project") on the reliability of the New York State Transmission System. The Project's point of interconnection ("POI") will be a new 115 kV substation located next to the Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") Moon Switching Station on the Dunkirk-Moon Switching Station 115 kV line segment of the #161/#162 lines. The Project will be located in the Townships of Charlotte and Cherry Creek in Chautauqua County, New York. The Project is expected to have an approximate maximum summer and winter potential generating gross capacity of 129.2 MW and a net capacity of 126 MW and has a proposed in-service date of December, 2015.

The objectives of the SRIS are to:

1) Assess the impact of the Project on the reliability of the New York State Transmission System (115 kV and above) at, and in proximity to the POI in the West Region (Zone A), and the Genesee Region (Zone B) that are most likely to be affected by the project (the "Study Area"). For the lower voltage systems, the study will focus on the underlying 34.5 kV and 23 kV network elements in proximity to the POI.
2) Confirm that facilities associated with the Project comply with applicable NERC, NPCC, NYSRC, National Grid (the Connecting Transmission Owner or "CTO"), and Affected System(s) reliability and design standards.
3) Evaluate alternatives to eliminate adverse reliability impacts, if any, resulting from the proposed Interconnection of the Project.
4) Assess the impact of the proposed Project on transmission transfer limits.
5) Assess the impact of the proposed Project on substation fault duties.
6) Assess the impact of the proposed Project on Extreme Contingencies.
7) Perform NPCC A-10 testing on the impact of the Project on the BPS classification of existing and new proposed stations near the POI.
8) Assess the impact of the proposed Project on N-1-1 Contingencies.
9) Estimate the cost of CTO's Attachment Facilities and System Upgrade Facilities, if any.

The scope of the SRIS was approved by the NYISO Operating Committee on January 17, 2014, and is included in Appendix A of this report. This SRIS study was performed in accordance with this scope, applicable reliability criteria and related NYISO's interconnection

procedures, practices, and methodologies and the requirements specified in NYISO OATT Attachment X.

Siemens PTI received from the NYISO the 2018 summer peak, winter peak and light load power flow base cases, together with the short circuit and stability databases for this study. This report documents the project description, the study methodology, assumptions, criteria and the study results and conclusions.

Section 2

Project Description

The proposed Cassadaga Wind Project will be installed at a new 115 kV substation located next to the National Grid Moon Switching Station on the Dunkirk-Moon Switching Station 115 kV line segment of the #161/#162 lines. The Project will be located in the Townships of Charlotte and Cherry Creek in Chautauqua County, New York. The Project is expected to have an approximate maximum summer and winter potential generating gross capacity of 129.2 MW and a net capacity of 126 MW and has a proposed in-service date of December, 2015.

The Project consists of forty two Vestas V112 Gridstreamer 3.075 MW 60 Hz Mk0E wind turbines generating at 650 volts with individual 3.45 MVA 650 V-34.5 kV padmount transformers on four 34.5 kV feeder circuits into the collector substation. The project is connected to the POI through a main 84/112/140 MVA 34.5 kV - 115 kV transformer. 5.4 miles of 954 ACSR 115 kV transmission line on single wood poles from the collector substation to the new POI switching station which is the newly re-constructed National Grid 115 kV Moon Switching Station. Both circuits #161 and #162 will be looped into the new switching station into a six breaker ring bus configuration. The Project electrical one-line diagram and its connection to the POI are shown in Figure 2-1.

The Project was modeled in the study using information provided by the NYISO. In the power flow model, the Project is represented by four 34.5 kV feeders. Feeders 1 and 2 contain 11 WTGs each and Feeder 3 and 4 Contain 10 WTGs each. A total of 3.15 MW of equivalent load was modeled across the 4 feeders to account for the project's net injection of 126 MW at the POI. Generators and the loads on each of the feeders are aggregated in a single equivalent generator and load. The four generators and loads were dispatched at 100% of rated output.

The dynamic simulation database associated with the power flow cases were provided by the NYISO. The dynamic simulation model for the Project was obtained from the form "Appendix 1 to LFIP, Interconnection Data Request_R11" submitted to the NYISO by the developer. Based on this information the Project's generators were modeled using the Vestas V112 Gridstreamer 3.075 MW 60 Hz Mk0E wind turbine model equipped with the Vestas Power Plant Controller, operating in voltage droop control mode. The dynamic model parameters for the Project generating units are included in Appendix B.

This document contain(s) critical infrastructure information, confidential commercial information, trade secrets, and/or proprietary information and as such is entitled to confidential treatment under Section 87(2) of the New York State Public Officers Law and the Commission's regulations (16 NYCRR 6-1). An unredacted version of this document has been submitted under separate cover pursuant to 16 NYCRR 6-1.4.