NYISO Review

of the

Optional Interconnection Study-2

for

Transmission Developers, Hvdc Astoria Project

Interconnection Queue #305

Report dated March 3, 2011

DRAFT

March 9, 2011

1. Introduction

The Transmission Developers Inc. ("TDI") has proposed the development of the 1000 MW HVdc NYC Merchant Transmission Project (the "Project"). The Project will involve the construction of one nominal +/- 320 kV, 1000 MW bipolar HVdc underwater/underground merchant transmission line originating from Hydro Quebec's Hertel 315 kV Substation, at the northern terminus and terminating at the New York Power Authority's ("NYPA") proposed new Astoria 345 kV Substation replacing the NYPA Astoria 345 kV station in Queens County, New York, where two 345 kV lines Q35L & Q35M connect.

The Project has a proposed in-service date of March, 2015.

Siemens PTI (the "Consultant") has conducted a Optional Interconnection Study ("OIS") on behalf of the Developer ("TDI") to evaluate the impact of the Project on the New York State Transmission System and to ensure that the resulting power system would conform to all Applicable Reliability Standards as defined in the Attachment X[1] of the New York Independent System Operator ("NYISO") Open Access Transmission Tariff.

The NYISO Operating Committee approved the Project OIS Scope on April 8, 2010.

The original OIS report was issued on June 21, 2010. Subsequent revisions have been received to address NYISO, New York Power Authority ("NYPA"), Con Edison and LIPA comments. The report, dated July 26, 2010 was reviewed and recommended by TPAS on July 29, 2010 meeting. The report dated March 3, 2011 is the subject for this review.

[1] Standard Large Facility Interconnection Procedures, applicable to Generating Facilities that exceed 20MW and to Merchant Transmission Facilities", http://www.nyiso.com/public/webdocs/documents/tariffs/oatt/att_x.pdf.

2. Report Content

In order to properly evaluate the reliability impact of a project on the New York State Transmission System, a minimum amount of supporting data is required. At the time of writing this review, the Developer has submitted the following documentation and data:

1. Approved Scope of Work.
2. Study report
3. Appendices containing analysis results including power flow, short circuit results, stability plots, one-line diagrams, etc.

Information Needed to Complete Review

All information needed to complete this review has been received.

3. Commentary

In reviewing the contents of this SRIS report, the NYISO has the following comments and observations.

Project description and modeling

Modeling data for the Project in power flow and stability analysis was provided by the Developer to the NYISO, and included in the NYISO database provided to the Consultant.

Subsequent to OC approval (04/08/2010) of this OIS Scope for Q#305 TDI NYC Project, the Developer decided to withdraw their plan for the 1000 MW Hertel –to- Connecticut portion of the Project; as a result, the Study was performed in accordance with Scope as approved at OC on 04/08/2010, without the Hertel –to- Singer 1000 MW HVdc line modeled.

The SRIS results and conclusions are based on the studied scenarios and various assumptions related with the study methodologies, system, and project modeling; any project modeling change can result in different results and may require restudy.

It is important to note that based on the new FERC approved NYISO base case rules, NYISO Class Year 2008 ATRA cases were used for the study. The base cases included only the projects that have been cost allocated up to and including Class Year 2008. The proposed NYISO Q#266 Berrians III and Q#308 Astoria Energy II Projects were not included in the databases as they are not cost allocated as of now. Both the Q#266 Berrians III and Q#308 Astoria Energy II projects are proposing to interconnect to NYPA Astoria 345 kV Substation, more detailed analysis will be conducted during the Class Year Facilities study stage for this Project (Q#305) depending on the status of cost allocation of Q#266 and Q#308 projects.

The Project will have a maximum expected north to south summer and winter transfer level of 1000 MW into NYC. The project will mostly follow underwater and underground path between Quebec and New York. The project includes construction of approximately 362 miles of underground/underwater HVdc transmission lines, and about 0.5 mile ac cable in New York per the proposed integration one-lines shown in Appendix A. The Project will use HVdc (VSC) Voltage Source Converter technology, similar to ABB Light equipment which was modeled in the studies.

The Project was modeled using information provided by the Developer. The Project was dispatched at 100% of rated output against the Zone J generation.

System Upgrade Facilities (“SUFs”) and Attachment facilities are required to physically interconnect the Project to New York State Transmission System. A non-binding good faith cost estimate was provided by the Developer (TDI) based on the project proposed interconnection. The cost estimates for two new breaker positions, including GIS cable terminations is

approximately $18 Million. More detailed cost estimates will be provided during the Facilities Study stage upon consolidation with the CTO NYPA.

The Schedule to construct this Project for Astoria interconnection option is summarized below:

Design/Tendering phase: 1st quarter 2012 to 4th quarter 2012

Manufacture and delivery: 4th quarter 2012 to 4th quarter 2013

Installation and commissioning: 1st quarter 2014 to 1st quarter 2015

Power Flow Analysis

Power flow analysis was conducted for Class Year 2008 ATRA summer peak load and winter peak load conditions per the SRIS study scope. In the summer and winter cases, the Project was dispatched against generation within Zone J, New York.

The Project has an impact on thermal loading of the Q35L & Q35M Circuits, but the Project did not create any new overloads, nor did it exacerbate any existing ones (both pre-contingency and post-contingency). The Project has an insignificant impact on phase angle regulators ("PARs") in Zone J; all PARs were able to hold scheduled flow within angle limits in pre-Project and post-Project cases.

Subsequent to the 7/29/10 TPAS review and recommendation for OC approval of the Astoria OIS#2 study report for TDI's HVDC Transmission Project #305, the NYISO informed TDI that LTE rather than STE ratings should have been used in the study for the two Astoria-E13th Street Q35L & Q35M cable circuits owned by NYPA. If LTE ratings were used in the OIS#2 study for the two Astoria-E13th Street Q35L & Q35M cable circuits, loss of one of the two cables would have caused the remaining cable circuit to exceed its LTE rating of 621 MVA but there would have been no significant adverse impact on the reliability of the New York State Transmission System. To avoid the overload beyond LTE, some form of mitigation would be required, which could include automatically tripping the entire 1000 MW output of the Project upon the loss of either cable circuit, automatically running back (virtually instantaneously) the Project to 621 MW upon the loss of either cable circuit, or requesting an exception to exceed the LTE rating up to the STE rating and reducing the Project output to 621 MW within 15 minutes following the loss of either cable circuit. A determination will be made in the future as to which option to pursue to prevent an overload of either of these cable circuits.

The Project did not cause any significant incremental impact on the ABCJK PAR Schedules. The Project did not have any impact on HQ-NY import capability.

The Project does not cause any new voltage violations, nor does it significantly impact the voltage profile in either summer or winter conditions.

Stability Analysis

Stability analysis was performed for Class Year 2008 ATRA summer peak and light load conditions per the SRIS study scope. Standard New York stability contingencies associated with the UPNY-ConEd interface as well as other local three-phase and single line to ground faults were simulated on both peak and light load base cases without and with the Project.

The system remained stable and positively damped for all system faults and all local faults under normal and delayed clearing conditions. For some contingencies the VSC blocked during the fault but regained control immediately after fault clearing. The Project does not have a significant adverse impact on system stability for all the contingencies studied.

A critical clearing time assessment was performed using the summer peak and light load base cases with and without the Project. It was concluded that the Project does not affect existing allowable normal clearing times for any of the simulated disturbances.

NYISO concurs with the conclusions

Extreme Contingency Analysis

Steady-state analysis of the extreme contingencies was conducted on the Class Year 2008 ATRA summer peak load base cases without and with the Project. It was found that the Project does not cause any significant overload along lines or incremental impacts on the voltages of the buses in the Study Area under the extreme contingencies tested.

Selected stability extreme contingencies were evaluated, all of which exhibited an acceptably stable response.

NPCC A-10 BPS Testing

NPCC A-10 Bulk Power System testing was performed according with the latest approved A-10 criteria. The test was performed for TDI converter station 345 kV and E.13st 138 kV Substation. The results indicate that there is no need to change the classification of those Substations as a result of Project interconnection.

Transfer Limit Analysis

Thermal, voltage, and stability constrained transfer limit analyses were performed under summer peak load conditions to determine the incremental impact of the Project on the normal and emergency transfer limits of the Central East, Total East, UPNY – SENY, UPNY – ConEd,

Dunwoodie South and ConEd-Cable interfaces (open and closed definitions as applicable). Thermal transfer limit analysis was also performed for the NYISO-ISO-NE, PJM-NYISO and LIPA Import interface.

The Project degrades about 100 MW the Voltage transfer limits of UPNY-ConEd interface, but relative to the 1000 MW size of the Project and due to the chosen base case dispatch it is not considered a significant adverse impact. The Project has virtually no impact on all other studied interfaces.

The Project does not have significant adverse impact on the ABCJK PAR imbalance interface and on the HQ-NY import capability.

Short Circuit Analysis

NYISO Guideline for Fault Current Assessment has been used for bus fault calculation. The highest of the three faults applied (i.e.: three phase, double-line to ground, and single-line to ground faults) was compared against the respective station lowest circuit breaker rating to determine whether or not the circuit breaker is over-duty.

The Short Circuit model for the Project was prepared based on the information provided by the developer and ABB. The ABB model uses Generators to represent the simulation of the HVdc line with high value reactance's (X=X'd=X''d=9999) which makes the fault contribution from the Project equal to zero. The only fault contribution analyzed in the study was from the Project converter transformers. The developer agreed to provide more information during the Class Year Facilities study for the project that will account for current levels at nearby stations for fault locations/conditions where the VSC does not block.

The results of the analysis as performed indicate that the Project increases fault duties in the substations in proximity to the POI, but does not cause fault current at any substation in the Study Area to exceed the lowest interrupting rating.

Sensitivity Analysis

A sensitivity Power Flow and Short Circuit analysis was conducted to evaluate the impact of moving the converter station for the project 14 miles away from the Astoria 345 kV Substation. The results for the sensitivity analysis were similar to the previous results with converter station less than 1 mile from the Astoria 345 kV Substation. Moving the converter station does not have a significant impact on the results.

NYISO concurs with the conclusions as presented in the OIS report.

4. Conclusions

The results presented in the report under the system conditions evaluated and using the existent models, methodologies and applicable rules, indicate that the proposed Project with the SUFs identified in the SRIS would not adversely impact the reliability of the New York State Transmission System. This conclusion is based on the following understandings and assumptions:

- The Project will be operated in accordance with all NYISO requirements, including all applicable NYISO and Transmission Owner day ahead and real time operational procedures and limits. The NYISO will operate the project in a manner that does not negatively impact the New York State Transmission System; this may include dispatching patterns that eliminate potential reliability issues that may exist during certain system conditions.

- The Project and associated interconnection facilities will be designed in accordance with all the Applicable Reliability Standards.

- The SRIS results and conclusions are based on the studied scenarios and various assumptions related with the study methodologies, system, and project modeling information provided by the Developer; any project modeling change can result in different results and possible re-study.

- Additionally, it is understood that any potential overduty conditions will be re-evaluated, identified and mitigated during the Facilities Study.

- The SRIS did not include any evaluation of a deliverability standard or test.

Subsequent to the 7/29/10 TPAS review and recommendation for OC approval of the Astoria OIS#2 study report for TDI's HVDC Transmission Project #305, the NYISO informed TDI that LTE rather than STE ratings should have been used in the study for the two Astoria-E13th Street Q35L & Q35M cable circuits owned by NYPA. If LTE ratings were used in the OIS#2 study for the two Astoria-E13th Street Q35L & Q35M cable circuits, loss of one of the two cables would have caused the remaining cable circuit to exceed its LTE rating of 621 MVA but there would have been no significant adverse impact on the reliability of the New York State Transmission System. To avoid the overload beyond LTE, some form of mitigation would be required, which could include automatically tripping the entire 1000 MW output of the Project upon the loss of either cable circuit, automatically running back (virtually instantaneously) the Project to 621 MW upon the loss of either cable circuit, or requesting an exception to exceed the LTE rating up to the STE rating and reducing the Project output to 621 MW within 15 minutes following the loss of either cable circuit. A determination will be made in the future as to which option to pursue to prevent an overload of either of these cable circuits.

Subject to the above, NYISO Staff is satisfied that all existent Applicable Reliability Standards have been addressed in the SRIS for the Project. Therefore, NYISO Staff recommends approval of this SRIS.

Appendix A

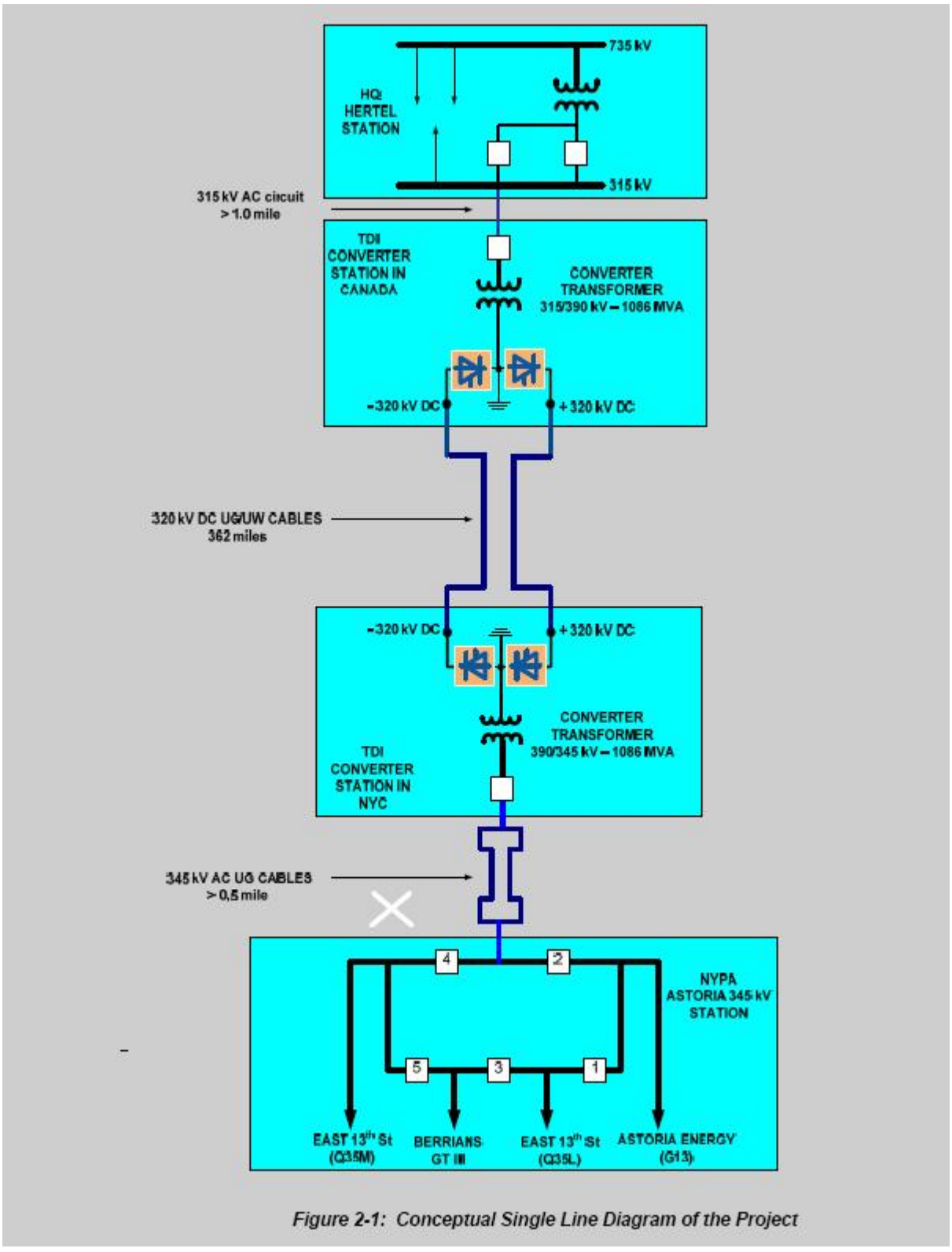

Figure 2-1: Conceptual Single Line Diagram of the Project