

<b><i>Non-Synchronous Generation / HVDC / FACTS Interconnection Projects -- Power System Studies for Considerations</i></b>	
<b>Name of Study</b>	<b>Study Description</b>
Development of TO Technical Performance Requirements, including itemization of required technical studies	that will typically consider accurate models of <b>developer's proprietary controls</b> (control systems) and full plant design.
LIPA System Synchronous Generation Displacement Study	The purpose of this study is to identify any adverse system impacts due to possible displacement of local generation, and its reserve requirement, by a Non-Synchronous Generation Interconnection project. Topics to consider: Transient voltage recovery, System Frequency, dynamic reactive power, minimum short circuit levels for reliable Non-Synchronous Generation Interconnection operation, impact on LIPA system protective relay systems.
AC System Reactive Power Requirements Study	The purpose of this study is to determine the amount of reactive power support required to maintain AC system bus voltages within criteria, over the full range of Non-Synchronous Generation Interconnection import/export capability.
Main Circuit Design Study	This study contains the design calculations in order to define the main circuit equipment parameters and the steady state operating characteristics of the Non-Synchronous Generation Interconnection project. Ratings of all equipment shall be specified.
Reactive Power Study	The purpose of this study is to dimension the reactive power supply and absorption equipment at the Point of Interconnection, and to establish a reactive power compensation concept to satisfy the AC system requirements. Study shall verify that project meets reactive power performance requirements.
Dynamic Performance Study and accompanying AC System Equivalent Study - including switching studies, TRV studies	The purpose of this study is to define an equivalent representation of the remaining AC system (not including the explicit representation of the Non-Synchronous Generation Interconnection project and adjacent substations) for use in dynamic performance studies. The purpose of this study is to verify that the response to disturbances does not cause instability in the integrated HVDC/AC system, and to verify the proper dynamic and steady state performance of the overall Non-Synchronous Generation Interconnection system with all controls and important equipment modeled together. This study will require accurate models of developer's proprietary controls (control systems) and full plant design.
AC System Harmonic Impedance Sectors - for Harmonics Study	The purpose of this study is to develop impedance sectors for the Non-Synchronous Generation Interconnection project terminal, and to define the AC system impedance seen at the interconnecting substation for various harmonic frequencies. This data will be utilized to design converter station AC harmonic filters.
Harmonic and IT Product Study and accompanying AC Harmonic Filter Performance and Rating Study	The purpose of this study is to design an AC filtering scheme which will satisfy harmonic performance requirements, and at the same time satisfy reactive compensation requirements. Demonstration of filter performance (harmonic voltage distortion, IT product, etc...) and verification of filter ratings are required.
Telephone Interference Study	Based on AC harmonic performance results, a detailed telephone circuit interference study may be required to assess the potential for phone circuit noise.
Sub synchronous Torsional Interaction (SSTI) Study	Torsional interaction between an Non-Synchronous Generation Interconnection system and a turbine generator is a phenomenon whereby the DC control system influences the damping of rotor torsional modes of oscillation of nearby turbine generators. The purpose of this study is to assess the level of potential SSTI and to
Control System / Power Electronics Devices Interaction Study	The purpose of this study is to determine if any adverse control system interactions will exist with nearby HVDC or power electronic system facilities, and to
Insulation Coordination Study	The purpose of this study is to develop and specify insulation and over voltage protection requirements for the Non-Synchronous Generation Interconnection system and interconnecting AC system facilities, and to demonstrate adequate levels of insulation coordination.
Temporary Over voltage (TOV) Study	The purpose of this study is to evaluate potential for over voltages and to develop and describe over voltage control strategies for different fault scenarios and system conditions for rectifier and inverter operation with or without recovery of the Non-Synchronous Generation Interconnection.
Interconnection Facility Circuit Breaker Requirements Study	The purpose of this study is to define specific technical requirements for AC circuit breakers associated with the project and at the Interconnection substation, and to determine the specific switching requirements of the Interconnection Facility circuit breakers. The study shall evaluate voltage and transient recovery voltage
Power Line Carrier (PLC) Performance Verification Study	Conducted electromagnetic noise on the power lines interconnected to the LIPA substation could potentially interfere with PLC communication systems. The purpose of this study is to describe the levels of electromagnetic interference associated with the operation of the project.  At the present time, LIPA does not have any power line carrier systems on its transmission system.
Electrical Interference / Radio/TV Interference Study	The purpose of this study is to give a quantitative description of the levels of high frequency electromagnetic interference associated with the operation of the project, and to verify conformance with related technical performance requirements.
Efficiency / Loss Evaluation Study	The purpose of this study is to calculate Non-Synchronous Generation Interconnection system losses.
Site Service Supply System Study	The purpose of this study is to define interconnection project AC power supply requirements, summarize the design and interconnection of independent station service AC supplies from the LIPA system and verify that the supplies shall not be subjected to a single contingency or to a common mode failure.
AC Protection System Study	The purpose of this study is to develop an overall protection strategy for the Non-Synchronous Generation Interconnection system and interconnecting AC system
Remote Operator Control Study	The purpose of this study is to develop a functional layout for the remote operator control system. Control block diagrams, SCADA data summaries, remote AC voltage control schemes, remote reactive power control schemes, remote DC power control schemes, etc... will be developed.
Functional Performance Study	The purpose of this study is to functionally test Control and Protection (C&P) equipment and to verify proper operation of the individual C&P cubicles and correct interaction and functionality of the interfaces between the cubicles.
Real Time Digital Simulation (RTDS) Study	The purpose of the study is to verify the dynamic behavior of the LIPA system in real time using a digital simulator and actual converter station control hardware. The study shall apply various dynamic events to the LIPA system and analyze the behavior of the project controls.
System Restoration Study	The purpose of this study is to determine the impact of the Non-Synchronous Generation Interconnection project and associated blackstart capabilities (if any) on
Load Flow and Stability Model Study	The purpose of this study is to design and provide modeling information that can be used to represent the Non-Synchronous Generation Interconnection system and all associated equipment in load flow, short circuit and stability databases / studies.
Project Testing & Commissioning Phase	To be determined based upon Interconnection Agreement

**Notes:**

- A listing of relevant studies relevant to the integration of significant incremental levels of off-shore wind generation is provided. This list has been developed based on prior experience, and may not be all inclusive.
- The listing of studies considers an entire project life cycle, from early stages of planning to testing/commissioning.