ATTACHMENT (5)

TECHNICAL REQUIREMENTS REFERENCE

Prepared by Stakeholders
Date: 19-08-2003

IA = Impact Assessment Done by the Utility
Before project commitment
Assesses impact of Generation connection on the utility system (including transmission system impacts) and customers (required ULTILITY modifications)
Assumes functional requirements of gen. Design (detailed SLD and protections) to meet functional requirements and will be approved by utility during the design review.
Will include the SIA and CIA where required but can not commit to timelines/costs associated with these Assessments.
EG Embedded Generation

SIA = System Impact Assessment, done by the IMO (projects >= 10MW)

CIA = Customer Impact Assessment, done by the transmitter (projects >=10MW)

DR = Design Review Done by the utility,
After project commitment (within 1 month of CCRA)
Review detailed single line and protection philosophy, design, settings,etc.
Best if before equipment ordered to ensure acceptable to utility

ESA Plan Approval
ESA Inspection
WV Witness and Verification

Technical Requirements	In Compliance With (Reference Doc)	Notes (2003 Requirement)	Assessment Authority				Comments
			Micro	Small	Mid-Sized	Large	
1. Disconnect / Isolation Switch	Ontario Electrical Safety Code Requirement – Section 84 Sized as per – Section 14	- readily accessible by LDC - lockable - visible break	ESA	ESA	ESA WV	ESA WV	
2. Equipment rating and requirements		EG interface equipment must be compatible with LDC equipment ratings at the connection voltage (max. voltage, basic impulse level, short circuit ratings, capacity, etc.	ESA	ESA WV	ESA WV	ESA WV	WV
		Incorporation of EG must not result in any utility equipment operating beyond design rating.		IA	IA	IA SIA CIA	
3. Voltage Regulation	Ref IEEE P1547, Clause 4.1.1	• Should not cause the system voltage of the LDC to go outside the requirements of CSA CAN3-C235 Standard • Generators should not actively regulate the voltage at point of connection (also referred to as point of common coupling)		IA DR WV	IA DR WV	IA DR WV	

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	CSA CAN3-C235 –83 Standard: Clause 5	Recommended voltage variation limits for circuits up to 1000 V, at service entrance: The service entrance voltage should not fall below nominal voltage by more than: a. 5 % normal operating conditions b. 8 % for extreme operating conditions c. should not exceed more than 6 % under extreme operating conditions					Utilities generally employ 1-phase interrupting devices on 3-phase,4W systems. The EG transformer winding connections / construction of core type should not cause backfeeds on the utility distribution system when the 1-phase interrupting device operates on the feeder. EG should consider the use of 3-phase interrupting device on the utility side of his transformer that is tripped automatically when any 1-phase device operates on the utility side as a possible solution to backfeed problem.
	Clause 6	Recommended voltage variation limits at point of sale and purchase for circuits above 1000 V, but not over 50 kV: should not vary from nominal voltage by more than + - 6 %.					
		Single phase generators connected to 3ph 4 W systems shall not cause voltage unbalance at any point to exceed 3 % (check)		IA DR	IA DR	IA DR	
4. Cease to Energize: Generators shall cease to energize (automatically disconnect from LDC supply) upon:							
♦ Distribution system faults	Ontario Electrical Safety Code 84-014	Equipment and conductors that are energized from both directions shall be provided with overcurrent protection from each source of supply.		DR WV	DR WV ESA	DR WV ESA	
	IEEE P1547 Clause 4.2.1						
♦ Feeder trippings & prior to auto-reclose operation by the LDC	IEEE P1547 Clause 4.2.2			DR WV	DR WV	DR WV	
♦ System voltage changes beyond the over or under voltage range	IEEE P1547 Clause 4.2.3	The set points & clearing times for over or under voltages and over or under frequencies are given – are dependent upon the magnitude of voltage & frequency	ESA – Approved Device	DR WV	DR WV	DR WV	

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♦ System frequency changes beyond the over or under frequency range	IEEE P1547 Clause 4.2.4	variations and generator size. For details see relevant clauses of IEEE P1547.	ESA – Approved Device	DR WV	DR WV	DR WV	
♦ Loss of LDC supply, resulting in the formation of island	Ontario Electrical Safety Code 84-008	Upon loss of voltage in one or more phases of the supply authority system, the Generator shall: a. Be automatically disconnected from all ungrounded conductors of the LDC. b. Not be reconnected until normal voltage is restored unless the LDC has approved an alternative procedure.	ESA – approved device	IA DR WV	IA DR WV	IA DR WV	The standard lists some examples (as given below) by which the islanding protection can be achieved: 1. The generator aggregate capacity is less than one-third of the minimum load of the local EPS. 2. The generator is certified to pass an applicable non-islanding test. 3. The generator installation contains reverse or minimum power flow protection, sensed between the point of generator connection and the point of connection, which will disconnect or isolate the generator if power flow from the Area EPS (LDC) to the Local EPS (generator facility) reverses or falls below a set threshold. 4. The generator contains other non-islanding means such as a) forced frequency or voltage shifting, b) transfer trip, or c) governor and excitation controls that maintain constant power and constant power factor.
	Ref. IEEE P1547 Clause 4.4.1	For unintentional islanding condition, the generator interconnection system shall detect the island and cease to energize the LDC system within 2 seconds of the formation of the island. (or less - 0.6 seconds if feeder breaker equipped with auro-reclose)					
5. Inadvertent energization of LDC distribution system	Ref IEEE P1547 / D10, Clause 4.1.5	The generator shall not energize the LDC distribution system when the distribution system is de-energized	ESA – approved device	DR WV	DR WV	DR WV	

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6. Reconnect to LDC system	IEEE P1547 Clause 4.2.6	• After a disturbance on the LDC system, no reconnection shall take place until the LDC system voltages are within the limits of CSA CAN3-C235 Standard, and frequency range of 59.3Hz to 60.5 Hz. • The generator interconnection system shall include an adjustable delay (or a fixed delay of 5 minutes) that may delay reconnection for up to 5 minutes after the LDC steady state voltage and frequency are restored to the ranges identified above.	ESA – approved device	DR WV	DR WV	DR WV	
7. Power quality:	Generator is required to not negatively impact the power quality of the system. Generally no up front assessment, where there are specific concerns during the IA or DR, clarification/information may be requested. If there are negative impacts once the generator is in service, they will be required to disconnect until they take corrective action.						
♦ Limitation of DC injection	IEEE P1547 Clause 4.3.1	The max. DC injection value is limited to 0.5% of the full rated output current at the point of generator connection.	ESA – approved device	As required	As required	As required	
♦ Limitation of flicker	IEEE P1547 Clause 4.3.2 IEC 61000-3-7	The generator shall not create objectionable flicker for other customers on the Area EPS. IEEE Std 519 and other standards are referred. Loss of synchronism protection may be required to be incorporated by the EG, if necessary, to limit flicker. The flicker limits shall be as per IEC 61000-3-7 Standard.	ESA – approved device	As required	As required IA	As required IA	The IEC Standards are recommended for adoption by CSA. PQ monitored after installation. Agreement to Retrofit solution.
♦ Limitation of harmonics	IEEE P1547 Clause 4.3.3 IEC 61000-3-6	Harmonic current limitations are given in Table 3 of IEEE P1547/D10. To be as per IEC 61000-3-6	ESA – approved device	As required	As required	As required	The IEC Standards are recommended for adoption by CSA.
8. Synchronization:	IEEE P1547 Clause 4.1.3	The generator shall parallel with the LDC without causing a voltage fluctuation at the point of connection greater than + - 5 % of the prevailing voltage level of the LDC at the point of connection and meet flicker requirements of item 7 above.	ESA – approved device	IA WV In-Service check	IA WV In-Service check	IA WV In-Service check	Synchronizing parameters and settings would depend on the size of the synchronous/inverter units. Soft start would normally be employed for induction units.

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9. Monitoring	IEEE P1547 Clause 4.1.6	Each generator unit of 250 kVA or more, or generator aggregate of 250 kVA at a single point of connection shall have provisions for monitoring: • Connection status • Real power output • Reactive power output • Voltage at point of generator connection	N/A	IA – As required for specific installations	IA - As required for specific installations	IA WV	
10. Metering All metering must meet the requirements of Measurement Canada and the Ontario Market Rules							
Net Metering							
		2 register meter –or- 2 détente meters is current Measurement Canada minimum requirement. Metering must also satisfy requirements for customer account/load type, applicable net-metering settlement provisions, and any other applicable statutory provisions.	Utility design/install	Utility design/install			Bidirectional meter – may cost up to $600-700 (250 meter, balance to pay for installation operation) Interval Meter (700-800) and install
Load Displacement (no injection)		Meter gross load and net consumption					
Sale of Energy							
♦ Sale of Power to LDC (<1MW)	Distribution System Code	4 quadrant interval meter			MSP design/install DR	MSP design/install DR	Interval meter up to $2500. Customer to provide phone line.
♦ Sale of Power (all >1MW, & all Market Participants)	DSC, IMO Market Rules				MSP design/install DR	MSP design/install DR	

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11. Fault protection to protect the generation	ESA requirements / Distribution System Code Requirements	• The generator must provide suitable protection for all electrical equipment in its facility, including generators, transformers etc. • Gen & transformer protections must co ordinate with interface protection. • Interface protection must coordinate with relevant LDC feeder protection / protective device.	ESA	ESA DR WV	ESA DR WV	ESA DR WV	
12. Grounding scheme for generator interconnection	Ontario Electrical Safety Code		ESA		ESA	ESA	Bonding to neutral of utility system not usually permitted for wind generators.
	IEEE P1547 Clause 4.1.2	• Shall not cause over voltages that exceed the rating of equipment connected to the LDC system. • Shall not disrupt the coordination of ground fault protection of the LDC system.	DR	DR WV	DR WV	DR WV	Generator submission must demonstrate that protections coordinate with LDC protection coordination.
13. Protection from Electro magnetic Interference (EMI)	Ref. IEEE P1547 Clause 4.1.8.1	▪ The interconnection system shall have the capability to withstand EMI environments in accordance with ANSI/IEEE C37.90.2. The influence of EMI shall not result in a change in state or mis-operation of the interconnection system.					
14. Surge withstand performance	IEEE P1547Clause 4.1.8.2 Electrical Safety Code 84-014	The interconnection system shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE/ANSI C62.41.2 or IEEE C37.90.1.	ESA – approved device	DR	DR	DR	
15. Paralleling device	IEEE P1547 *Clause* 4.1.8.3	The interconnection system paralleling device shall be capable of withstanding 220 % of the interconnection system rated voltage.	ESA – approved device	DR WV	DR WV	DR WV	WV - check nameplate rating

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16. Generators connected to Distribution Secondary Spot Networks	IEEE P1547 Clause 4.1.4.2	• Any generator connected to a spot network shall not cause operation or prevent reclosing of any network protectors installed on the spot network. • Generator output shall not cause any cycling of network protectors. • The network equipment loading and fault interrupting capacity shall not be exceeded with the addition of generator. • For other details see Clause 4.1.4.2.	ESA – approved device		DR	DR	
17. Power Factor	Utility voltage regulation & system operational requirements.	For induction & inverter units – better than 0.9 lead For synchronous units – from 0.9 lag to 0.95 lead	ESA – approved device				
18. Frequency Control	Utility requirements where intentional islanding is permitted.	Intentional islanding is presently not normally considered for EGs.	N/a		IA where intentional islanding to be allowed.	IA where intentional islanding to be allowed.	Normally the size and type of generating units used for DX connections can not control the frequency. Frequency measurement provided at the POINT OF CONNECTION (or elsewhere) should trip the unit(s) if the system frequency deviates from the set points.
D. Design Review and document submission							
Technical submissions: Drawings, protection details	Required by ESA .		ESA Plan Approval	ESA IA /DR / WV / As Built	ESA IA /DR / WV / As Built	ESA IA /DR / WV / As Built	Required by Utility & ESA Utility – Detailed SLD, Interface Protection ESA
1. Equipment rating and requirements	Manufacturers' data sheet – data readily available			WV	WV	WV	Manufacturers' data sheet – data readily available
E. Commissioning	To be developed	Plans required well ahead of actual commissioning					To be developed
ESA							
Utility	WV, Connection Agreement, etc.						

Notes:

1. The minimum technical and functional requirements (given in Part A) are mandatory & are required to be met by the generator in the design of their facilities. Additional site specific requirements may also be needed for certain generators [viz: 1-phase units, those connected to LDC secondary feeders (at utilization voltages) or to spot networks etc], which would be determined on a case by case basis by the LDCs.
2. The requirements are universally needed for connection of generators to distribution systems, including synchronous machines, induction machines or power inverters/converters and will be sufficient for most installations.
3. The requirements shall be met at the point of common coupling (point of connection), although the devices used to meet these requirements can be located elsewhere.
4. The generation facility design must comply with the latest edition of Ontario Electrical Safety Code and meet the requirements of other applicable standards, viz.: CSA, IEEE, ANSI/IEEE, UL, etc.
5. The requirements specified in this document are designed to protect the distribution system facilities of the LDCs, avoid electrical interference problems, ensure the safety of LDC customers & generator employees & the general public, and maintain overall system reliability & power quality.
6. The responsibility of protecting the generation facilities is the generators' sole responsibility (checked by ESA) and should be accomplished through the proper application, installation, operation, and maintenance of the required protective devices.