APPENDIX F

Process and Technical Requirements for Connecting Embedded Generation Facilities

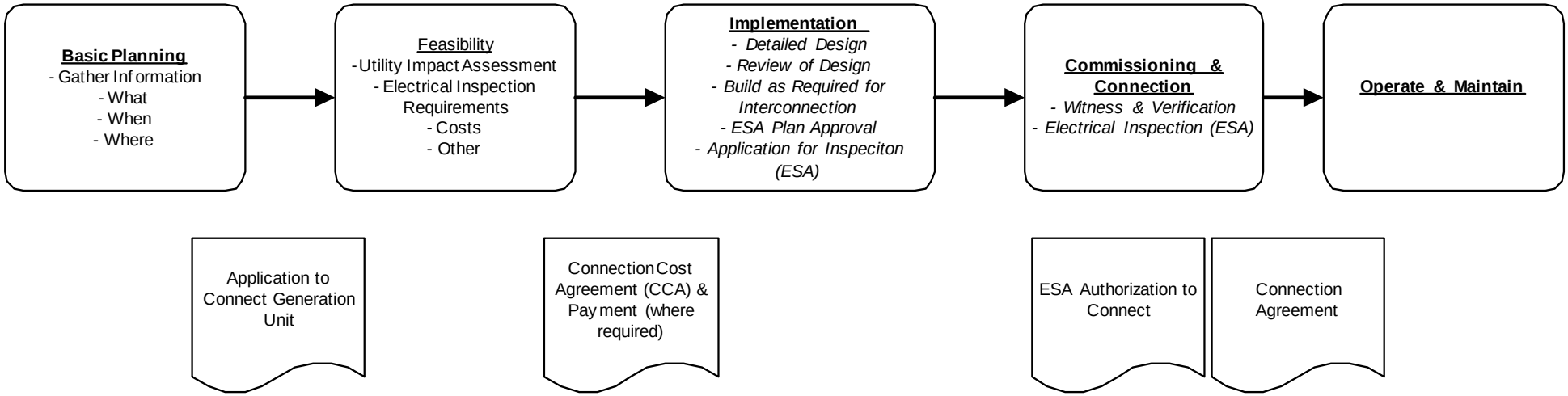
F. 1 CONNECTION PROCESS

INTRODUCTION

This Code provides for the standardization of connection processes, size categories and the time frames for connecting embedded generation facilities to the distribution system. These categories are as described below.

Generator Classification	Rating
Micro	≤ 10 kW
Small	(a) ≤ 500 kW connected on distribution system voltage < 15 kV (b) ≤ 1 MW connected on distribution system voltage ≥ 15 kV
Mid-Sized	(a) ≤10 MW but > 500 kW connected on distribution system voltage < 15 kV (b) > 1 MW but ≤ 10 MW connected on distribution system voltage ≥ 15 kV
Large	> 10 MW

GENERATION CONNECTION
PROCESS SUMMARY



F.1.1 CONNECTION PROCESS FOR MICRO-EMBEDDED LOAD DISPLACEMENT GENERATION FACILITY

Micro-Embedded Load Displacement Generation Facility Connection Process
10 kW or less

Step 1. – Request for Information

Customer proposing the installation of a micro-embedded load displacement generation facility contacts the distributor (or LDC) and the ESA for information.

Step 2. – Provision of Information

The distributor makes the information available to the proponent in a timely manner. Information Package includes:

- Description of the connection process (basis is in DSC - this incorporates the distributor's specifics; timing; contact numbers etc. and reiterates/stresses the need for ESA authorization to connect);
- approvals needed by the distributor for connection;
- technical requirements including metering;
- contractual requirements (Micro-Embedded Generation Facility Connection Agreement); and
- application forms.

ESA provides information on Electrical Safety Requirements

Step 3. – Generator Develops Plan

Generator reviews relevant information from distributor, ESA, on project, and puts together an installation plan:

- size/type of generation facility;
- load displacement/net metering/isolated from distribution system/grid connection;
- project plan - who needs to be included/when.

Step 4. – Application Process

Generator submits application to the distributor. Information required includes:

- the name-plate rated capacity of each unit of the proposed generation facility and the total name-plate rated capacity of the proposed generation facility at the connection point;
- the fuel type of the proposed generation facility;
- the type of technology to be used; and
- the location of the proposed generation facility including address and account number with the distributor where available.

Step 5. ESA Electrical Inspection Application
Note: runs in parallel with Step 6.

- Generator to submit plans and specific information to ESA for inspection.

Step 6. Distributor Review of Application

For generator at existing customer connection:

- distributor must respond to the generator's application and make an offer to connect approved generation or refusal to connect with reasons within 15 calendar days;
- typical requirement is new meter only;
- check for service upgrade requirement;
- check for significant amount of other generation on feeder;
- inform generator of requirements specific to the connection (typically requirements for metering) and costs, timing to implement, etc.; and
- Offer to connect good for 30 days - generator to indicate intent within this timeframe

Steps 7 & 8 Decision to Proceed and Install

If the generator decides to proceed the generator will:

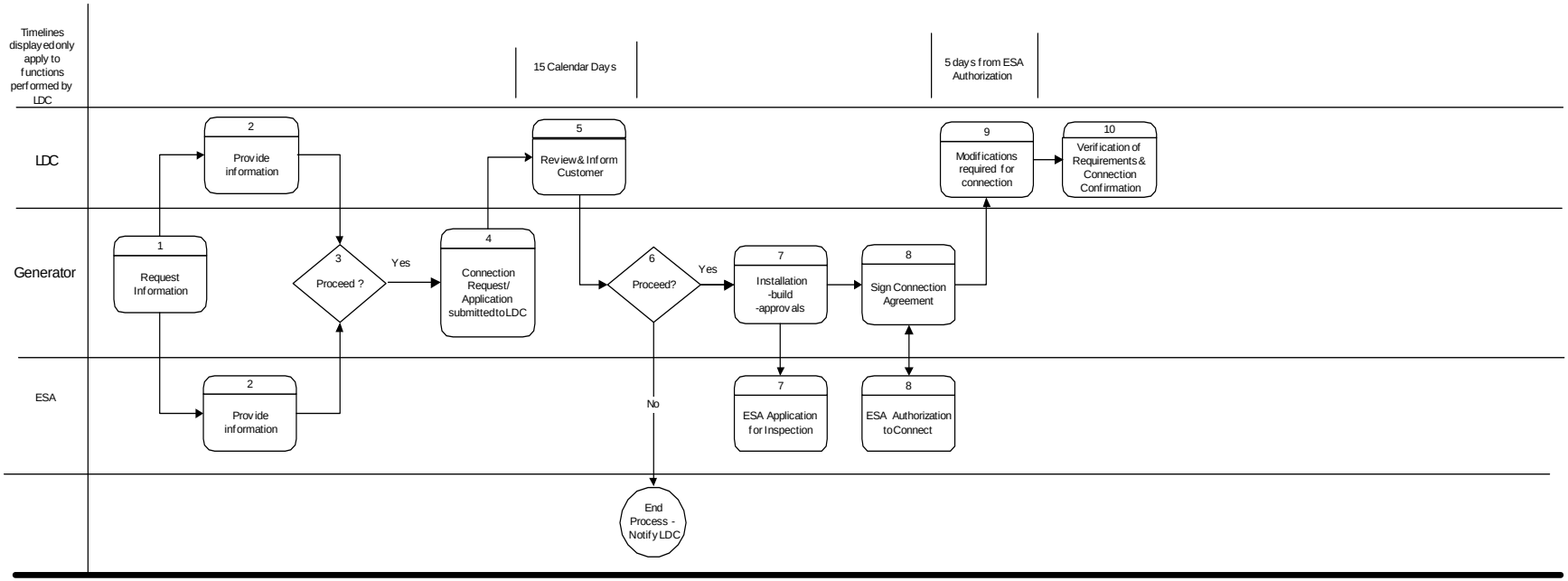
- commit to paying the distributor for upgrades (metering);
- begin to install;
- the generator must work closely with the distributor, the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays;
- activities will be planned in coordination with project milestones and it is up to the generator to initiate actions at the required times; and
- generator applies for Electrical Inspection.

Steps 9 & 10

The generator will contact the distributor after completing the ESA inspection process and receiving an Authorization to Connect.

- The distributor will respond within 5 days to change the meter (if necessary).
- The distributor will check to ensure generator commitments have been satisfied. These include:
    - ESA Authorization to Connect; and
    - Signed Agreement.

GENERATION CONNECTIONS
MICRO ≤10 KW



F.1.2. CONNECTION OF SMALL EMBEDDED GENERATION FACILITIES

Small Embedded Generation Facility Connection Process
500 kW or less Connected to <15kV
1MW or less Connected to ≥ 15kV

Small Embedded Generation Facilities have been split into two categories (a) and (b).
The process followed for connection of both (a) and (b) is identical, only the timelines will differ.

- Small (a) - No distribution system reinforcement or expansion required to facilitate generator connection.

- Small (b) - Distribution system reinforcement or expansion is required to facilitate connection.

Step 1. – Initial Contact

Customer proposing the installation of a generation facility contacts the distributor and ESA for information.

Step 2. – Provision of Information

The distributor makes the information available to the proponent in a timely manner. Information Package includes:

- description of the connection process (basis is in DSC - this incorporates the distributor's specifics; timing; contact numbers etc. and reiterates/stresses the need for ESA authorization to connect) and the information required by section 6.2.3(e) of the Code ;
- approvals needed by the distributor for connection (ESA);
- technical requirements including metering;
- contractual requirements (connection cost agreement and Connection Agreement);
- application forms;
- generator is informed of potential need to contact OEB; and
- notification of the potential involvement of the transmitter.

ESA provides information on Electrical Safety Requirements and their Plan Approval process.

Step 3. – Generator Develops Plan

Generator reviews relevant information from distributor, ESA, on technologies, and puts together an installation plan:

- size/type of generation facility;
- load displacement/net metering/isolated from the distribution system/grid connection; and
- project plan - who needs to be included/when.

Step 4. – Initial Consultation (no charge except as permitted by section 6.2.9.3 of the Code)

Generator requests preliminary meeting and submits basic information. Information required includes:

- the name-plate rated capacity of each unit of the proposed generation facility and the total name-plate rated capacity of the proposed generation facility at the connection point;
- the fuel type of the proposed generation facility;
- the type of technology to be used; and
- alternative locations of the proposed generation facility including addresses and account numbers with the distributor where available.

Within the time required by the Code, the distributor meets with the generator to review plans at a basic level, including:

- location of existing distribution facilities in reference to proposed alternative generation facility locations;

- the information required by sections 6.2.9.1 and 6.2.9.3 of the Code, if this has been requested;

- rough estimate on time and costs which could be associated with project for each alternative location sufficiently to evaluate the relative merits of the alternative location; and

- basic feasibility of project for each alternative location.

Step 5. – Application for Impact Assessment

The generator applies for an impact assessment by the distributor for the chosen location and makes payment with application.

Information required includes:

- size of generation facility (each unit and total at connection point);
- type of generation facility;
- type and details of technology;
- fuel type;
- single line diagram;

- location (address, account number); and
- preliminary generator/consultant design of proposed interface protection.

Generator wants to know:

- connection feasibility and cost;
- metering requirements; and
- ESA requirements.

Step 6. Offer to Connect (Impact Assessment and ESA Approval Process)

The distributor performs an impact assessment of proposed generation facility on the distribution system and customers, including:

- voltage impacts;
- current loading;
- fault currents; and
- connection feasibility and identification of line/equipment upgrades required, distribution or transmission system protection modifications/requirements, metering requirements, detailed cost estimate and offer to connect.

Timing

Time to review and inform from receipt of payment and application:

- Small (a) - up to 60 days; and
- Small (b) - up to 90 days.

Steps 7 & 8 Decision to Proceed and Install

If the generator decides to revise the original plans based on results of impact assessment, the plans must be re-submitted for another review by going back to step 5. Any change in design, equipment or plans requires notification to the ESA.

If the generator feels that the offer to connect is not fair and reasonable, the generator should request distributor review using the dispute resolution process as defined in the distributor's Conditions of Service.

If the generator decides to proceed:

- both parties sign Connection Cost Agreement;
- generator commits to payments;
- both parties commit to schedules, information exchange, scope of work of the generator and of the distributor;
- distributor initiates the work to be done to facilitate the connection;
- generator initiates the required activities; and
- generator must work closely with the distributor, the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays.

Steps 9 & 10 Implementation

Both parties commit to obtain required approvals:

- generator prepares detailed engineering drawings;
- generator submits all detailed plans to ESA for Plan Approval process (includes detailed single line diagram, interface protection); and
- submits information to distributor for design review (includes detailed single line diagram, interface protection and metering details). It is recommended that generators provide this information to the distributor within 30 days of signing to allow for a timely design review.

The distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- interface protection design review;
- distributor reviews detailed single line diagram and interface protection to ensure acceptability; and
- recommend that this review be complete before equipment purchase by generator.

- Generator receives interface protection design review from the distributor:
  - generator tenders and awards contracts for equipment;
  - build - including ESA and other approvals;
  - connection work; and
  - line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

Step 11 Authorization to Connect

The generator arranges for and receives Authorization to Connect from ESA.

Step 12 Connection Agreement

The generator and the distributor agree to, and sign, Connection Agreement.

Note: A temporary connection agreement for the purpose of connection for Commissioning and Verification may be signed at this point while negotiating final Connection Agreement.

Step 13 & 14 Commissioning & Verification

Generation facility commissioning and testing:

- generator arranges for commissioning and testing of the generation facility; and
- distributor witnesses and verifies the commissioning process related to the

connection facilities.

Timing

Time from completion of step 9 to final connection:

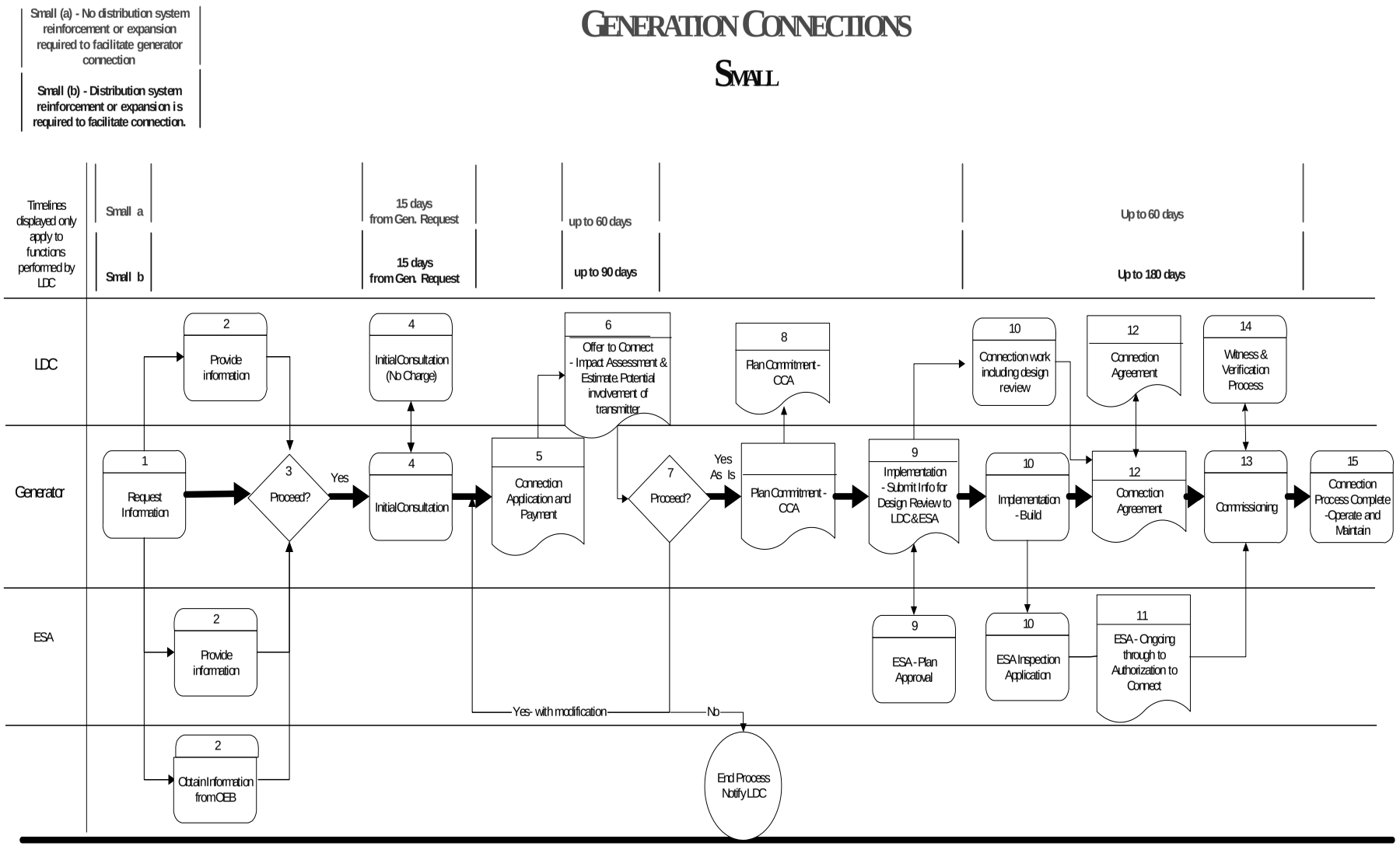
- Small (a) – up to 60 days; and
- Small (b) – up to 180 days.

Step 15 Completion

Process Complete – generation facility fully connected and operational.

GENERATION CONNECTIONS

SMALL



F.1.3 CONNECTION OF MID-SIZED EMBEDDED GENERATION FACILITY

Mid-Sized Embedded Generation Facility Connection Process
Greater than 500 kW Connected to <15kV
Greater than 1MW and 10 MW or less Connected to ≥ 15kV

Step 1. – Initial Contact

Customer proposing the installation of a generation facility contacts the distributor and ESA for information. The distributor may also guide the generator to contact the transmitter for additional connection information. Since it is likely that the generator may be planning on selling power to the grid, the generator may also need contact the OEB regarding licence applications.

Step 2. – Provision of Information

The distributor to make the information available to the proponent in a timely manner. Information Package includes:

- description of the connection process (basis is in DSC - this incorporates the distributor's specifics - contact numbers etc. and reiterates/stresses the need for ESA Plan Approval and authorization to connect) and the information required by section 6.2.3(e) of the Code ;
- approvals needed by the distributor for connection (ESA);
- technical requirements including metering;
- contractual requirements (connection cost agreement and Connection Agreement);
- application forms; and
- generator is informed of the potential need to contact transmitter and OEB.

ESA provides information on Electrical Safety Requirements and their Plan Approval process.

Step 3. – Generator Develops Plan

Generator reviews relevant information from distributor, ESA, transmitter, and OEB, and puts together a development plan:

- size/type of generation facility;
- load displacement/isolated from distribution system/grid connection; and
- project plan - who needs to be included/when.

Step 4. – Initial Consultation (no charge except as permitted by section 6.2.9.3 of the Code)

Generator requests preliminary meeting and submits basic information. Information required includes:

- the name-plate rated capacity of each unit of the proposed generation facility and the total name-plate rated capacity of the proposed generation facility at the connection point;
- the fuel type of the proposed generation facility;
- the type of technology to be used; and
- alternative locations of the proposed generation facility including addresses and account numbers with the distributor where available.

Within the time required by the Code, the distributor meets with the generator to review plans at a basic level, including:

- location of existing distribution facilities in reference to proposed alternative generation facility locations;
- the information required by sections 6.2.9.1 and 6.2.9.3 of the Code, if this has been requested;
- rough estimate on time and costs which could be associated with project for each alternative location sufficiently to evaluate the relative merits of the alternative location; and
- basic feasibility of project for each alternative location.

Step 5. – Application for Impact Assessment

Generator applies for an impact assessment by the distributor for the chosen location and makes payment with application. Impact assessment may also be required from transmitter or host distribution system. The distributor will forward applicable information on behalf of generator.

In addition to the information provided in step 4, the following information is also required:

- a single line diagram of the proposed connection; and
- a preliminary design of the proposed interface protection.

Step 6. Impact Assessment

The distributor performs an impact assessment of proposed generation facility on the distribution system and customers:

- voltage impacts;
- current loading;
- fault currents; and
- connection feasibility and identification of line/equipment upgrades required, distribution or transmission system protection modifications, metering requirements, and an overview of cost implications.

Timing

Time to review and inform from receipt of application:

- up to 60 days.

The distributor requests and receives an impact assessment of proposed generation facility on transmitter/host distribution system and customers. Transmitter/host distributor will prepare impact assessment as required. The geographic distributor; and is only responsible for timely delivery of information specific to their distribution system. Generator wants to know:

- connection feasibility and cost; and
- metering requirements.

Assumes generator/consultant will design generation facility, including interface protection to achieve the required functionality. The distributor will review this design within 1 month of signing CCA.

Generator also provides information to ESA for inspection to begin Plan Approval process.

Steps 7 & 8 Decision to Proceed and Establish Scope of Project

If the generator decides to revise the original plans based on results of the impact assessment, the generator must re-submit the revised plans for another review by going back to step 5. Any change in design, equipment, or plans requires notification to the ESA.

If the generator feels that the results of the impact assessment are manageable, the generator will request a meeting to develop a scope so that the distributor can prepare an estimate and an Offer to Connect.

If the generator decides to proceed:

- both parties agree to, and sign, scope of project; and
- generator pays for preparation of estimate by the distributor, host distribution system and transmitter as required.

Steps 9, 10, 11 Prepare Estimate and Present Offer to Connect

The distributor must notify the transmitter and/or host distribution system (as required) within 10 days of receiving payment and notification that the generator has decided to proceed and an estimate is to be prepared.

The distributor shall prepare a detailed estimate of the project based on the scope defined in step 8.

The distributor must prepare their portion of the Offer to Connect within 90 days of receipt of payment from the generator. In any event, the distributor has up to 30 days from date of receipt to incorporate the estimate of the transmitter or host distribution system.

If the generator decides to proceed after reviewing the Offer to Connect:

- all parties agree to, and sign, Connection Cost Agreement (CCA);
- generator agrees to payment schedule for work required by the distributor and/or transmitter/host distribution system;
- all parties commit to schedules, information exchange, scope of work; and
- the generator must work closely with the distributor, the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays.

Steps 11, 12, 13, 14 – Implementation

Timing:

- time from commitment to proceed to final connection to be negotiated in Connection Cost Agreement;
- distributor initiates the work to be done to facilitate the connection;
- generator initiates the activities identified as it's responsibility; and
- transmitter and/or host distributor initiates the work to be done to facilitate connection.

Both parties committed to project and generator commits to obtain required approvals:

- generator prepares detailed engineering drawings;
- generator submits all detailed plans to ESA for Plan Approval process (including detailed single line diagram, interface protection); and
- generator submits information to distributor for design review (including detailed single line diagram, interface protection and metering details) (Recommend that generator provide this information to distributor within 30 days of signing CCA so that design review can be done in a timely manner).

Distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- interface protection design review;
- distributor reviews detailed single line diagram and interface protection to ensure acceptability; and
- recommend that this review be complete before equipment purchase.

Generator receives interface protection design review from distributor:

- generator tenders and awards contracts for equipment;
- build - including ESA and other approvals;
- connection work; and
- line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

Step 15 - Connection Agreement

The generator and the distributor agree to, and sign, Connection Agreement.
The distributor and transmitter/host distribution system review existing agreements for required revisions.

Note: A temporary connection agreement for the purpose of connection for commissioning and verification may be signed at this point while negotiating final Connection Agreement.

Step 16 Commissioning and Verification

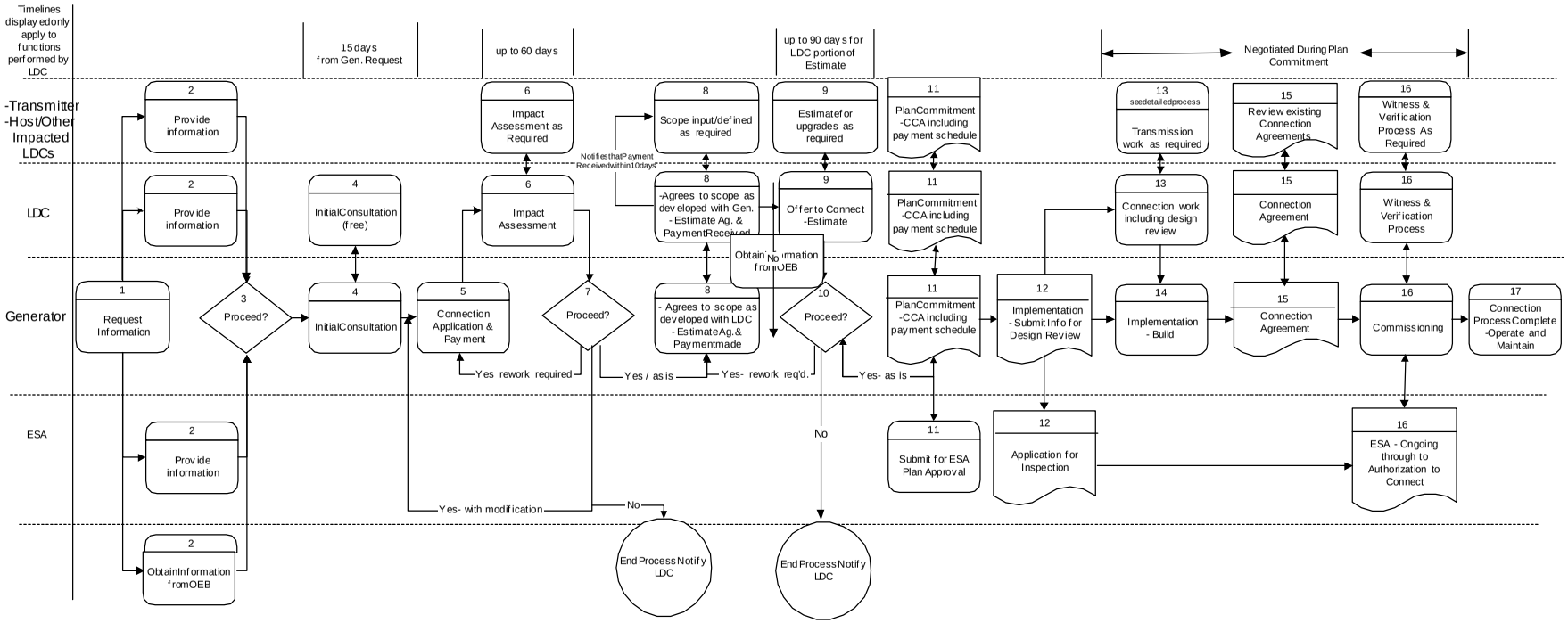
Generation facility commissioning and testing:

- generator arranges for commissioning and testing of the generation facility;
- distributor witnesses and verifies the commissioning process related to the connection facilities; and
- transmitter/host distributor witness and verify the commissioning process as required.

Step 17 Completion

Process Complete – generation facility fully connected and operational.

GENERATION CONNECTIONS
MID-SIZED



F.1.4 CONNECTION OF A LARGE EMBEDDED GENERATION FACILITY

Large Embedded Generation Facility Connection Process
Greater than 10 MW

Step 1. – Initial Contact

Customer proposing the installation of a generation facility contacts the distributor and ESA for information. The distributor may also guide the generator to contact the transmitter for additional connection information. The distributor should inform the generator that IMO involvement is required for all projects over 10 MW. Since it is likely that the generator may be planning on selling power to the grid, the generator may also need contact the OEB regarding licence applications.

Step 2. – Provision of Information

Distributor to make the information available to the proponent in a timely manner. Information Package includes:

- description of the connection process (basis is in DSC - this incorporates the distributor's specifics - contact numbers etc. and reiterates/stresses the need for ESA authorization to connect) and the information required by section 6.2.3(e) of the Code ;
- approvals needed by the distributor for connection (ESA);
- technical requirements including metering;
- contractual requirements (connection cost agreement and Connection Agreement);
- application forms; and
- informs generator of need to contact transmitter, IMO, and OEB.

ESA provides information on Electrical Safety Requirements and their Plan Approval process.

Step 3. – Generator Develops Plan

Generator reviews relevant information from distributor, ESA, transmitter, IMO, and OEB, and puts together an installation plan:

- size/type of generation facility;
- load displacement/isolated from distribution system/grid connection; and
- project plan - who needs to be included/when.

Step 4. – Initial Consultation (no charge except as permitted by section 6.2.9.3 of the Code)

Generator requests preliminary meeting and submits basic information. Information required includes:

- the name-plate rated capacity of each unit of the proposed generation facility and the total name-plate rated capacity of the proposed generation facility at the connection point;
- the fuel type of the proposed generation facility;
- the type of technology to be used; and
- alternative locations of the proposed generation facility including addresses and account numbers with the distributor where available.

Within the time required by the Code, the distributor meets with the generator to review plans at a basic level, including:

- location of existing distribution facilities in reference to proposed alternative generation facility locations;
- the information required by sections 6.2.9.1 and 6.2.9.3 of the Code, if this has been requested;
- rough estimate on time and costs which could be associated with project for each alternative location sufficiently to evaluate the relative merits of the alternative location; and
- basic feasibility of project for each alternative location.

Step 5. – Application for Impact Assessment

Generator applies for an impact assessment from the distributor and makes payment with application. Impact assessment may also be required from transmitter and/or host distribution system. Projects greater than 10MW will also require a System Impact Assessment by the IMO. The distributor will collect payment from generator and forward both payments and applicable information on behalf of generator to transmitter, host distribution system, and IMO as required.

In addition to the information provided in step 4, the following information is also required:

- a single line diagram of the proposed connection; and
- a preliminary design of the proposed interface protection.

Step 6. Impact Assessment

The distributor performs an impact assessment of proposed generation on the distribution system and customers:

- voltage impacts;
- current loading;
- fault currents; and
- connection feasibility and identification of line/equipment upgrades required, distribution or transmission system protection modifications, etc.

Timing

Time to review and inform from receipt of application:

- up to 90 days.

The distributor requests and receives an impact assessment of proposed generation on transmitter, host distribution system, and customers. Transmitter/host distributor will prepare impact assessment as required. The geographic distributor is only responsible for timely delivery of information specific to their distribution system.

Generator wants to know:

- connection feasibility and cost;
- metering requirements; and
- ESA requirements.

Assumes generator/consultant will design generation facility, including interface protection to achieve the required functionality. Distributor will review this design within one month of CCA signing.

Steps 7 & 8 Decision to Proceed and Establish Scope of Project

If the generator decides to revise the original plans based on results of impact assessment, the generator must re-submit the revised plans for another review by going back to step 5. Any change in design, equipment, or plans requires notification to the ESA.

If the generator feels that the results of the impact assessment are manageable, the generator will request a meeting to develop a scope so that the distributor can prepare an estimate and an Offer to Connect.

If the generator decides to proceed:

- both parties agree to, and sign, scope of project; and
- generator pays for preparation of estimate by the distributor, host distributor, transmitter and IMO as required.

Steps 9, 10, 11 Prepare Estimate and Present Offer to Connect

The distributor must notify the transmitter and/or host distribution system (as required) within 10 days of receiving payment that the generator has decided to proceed and an estimate is to be prepared.

The distributor shall prepare a detailed estimate of the project based on the scope defined in step 8.

The distributor must prepare their portion of the Offer to Connect within 90 days of receipt of payment from generator. In any event, the distributor has up to 30 days from date of receipt to incorporate the estimate of the transmitter or host distributor.

If the generator decides to proceed after reviewing the Offer to Connect:

- all parties agree to and sign, Connection Cost Agreement (CCA);
- generator agrees to payment schedule for work required by distributor and/or transmitter/host distribution system or IMO;
- all parties commit to schedules, information exchange, scope of work; and
- the generator must work closely with the ESA and any other organizations from which work, inspections, approvals or licenses are required to prevent delays.

Steps 12, 13, 14 - Implementation

Timing

- time from commitment to proceed to final connection to be negotiated in Connection Cost Agreement;
- distributor initiates the work to be done to facilitate the connection;
- generator initiates the activities identified as its' responsibility; and
- transmitter/host distributor/IMO initiates the work to be done to facilitate connection.

Both parties committed to project and generator commits to obtain required approvals:

- generator prepares detailed engineering drawings;
- generator submits all detailed plans to ESA for Plan Approval process (including detailed single line diagram, interface protection); and
- generator submits information to distributor for design review (including detailed single line diagram, interface protection and metering details) (Recommend that generator provide this information to the distributor within 30 days of signing CCA so that design review can be done in a timely manner).

Distributor performs design review to ensure detailed engineering is acceptable and informs generator:

- interface protection design review;
- distributor reviews detailed single line diagram and interface protection to ensure acceptability: and
- recommend that this review be complete before equipment purchase.

Generator receives interface protection design review from distributor:

- generator tenders and awards contracts for equipment;
- build - including ESA and other approvals;
- connection work; and
- line/equipment upgrades are completed.

Generator constructs facility and applies for ESA Electrical Inspection to receive Authorization to Connect.

Step 15 - Connection Agreement

The generator and the distributor agree to, and sign, Connection Agreement.
The distributor and transmitter/host distributor review existing agreements for required revisions.

Note: A temporary connection agreement for the purpose of connection for commissioning and verification may be signed at this point while negotiating final Connection Agreement.

Step 16 Commissioning and Verification

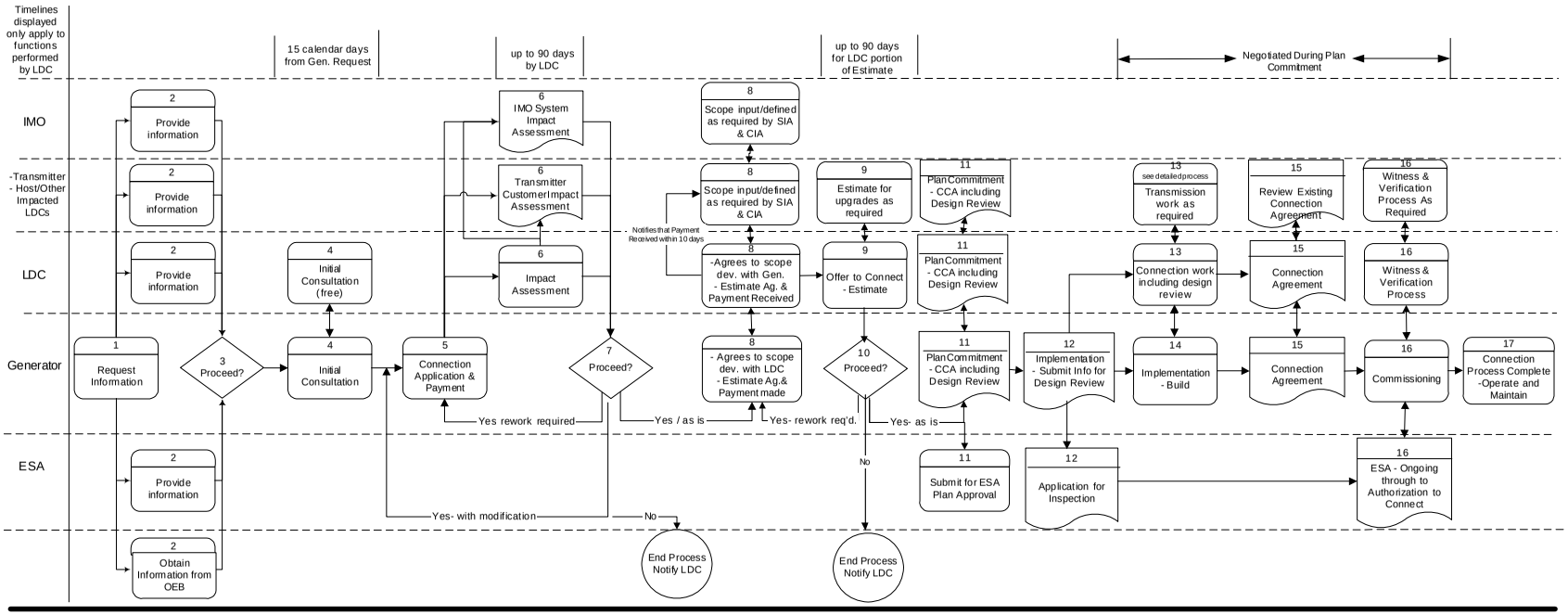
Generation facility commissioning and testing:

- generator arranges for commissioning and testing of the facility;
- distributor witnesses and verifies the commissioning process related to the connection facilities; and
- transmitter/host distributor/IMO witness and verify the commissioning process as required.

Step 17 Completion

Process Complete – generation facility fully connected and operational.

GENERATION CONNECTIONS
LARGE



F.2 Technical Requirements

LIST OF ACRONYMS

CSA	Canadian Standards Association
ESA	Electrical Safety Authority
IEC	International Electrical Code
IEEE	Institute of Electrical and Electronic Engineers
OESC	Ontario Electrical Safety Code

Technical Requirements for Generator Connection

Point of Connection

The point of connection (also may be referred to as point of common coupling) will be identified in the design and on the single line diagram. The distributor will co-ordinate design, construction, maintenance and operation of the facilities on its side of the point of connection. The applicant is responsible for the design, construction, maintenance and operation of the facilities on its side of the point of connection unless described otherwise in an interconnection agreement.

Note: On the generator's side of the point of connection the equipment shall be approved in accordance with rule 2-004 of the Ontario Electrical Safety Code (OESC).

1. Isolation at the Point of Connection

A means of isolation must be provided by the generator and must be in compliance with the OESC. The distributor's practice may require its own additional means of disconnection on the distributor's side of the point of connection.

2. Interconnection Grounding

Generation facilities and the associated interconnection systems must be grounded as per manufacturer's recommendations and the OESC, as well as taking into account the normal practices of the distributor.

Interconnection of three phase transformers, and transformer grounding systems on three phase distribution systems shall be co-coordinated with the distributor and shall not cause voltage disturbances or disrupt co-ordination of distribution system ground fault protection.

3. Voltage Regulation, IEEE 1547, CSA Standard CAN3-C235-83

CSA Standard CAN3-C235-83 provides general guidance as to appropriate distribution system steady state service voltage levels. The generation facility must operate satisfactorily within the extreme voltage level variation limits shown in these standards. Voltage regulation is the responsibility of the distributor.

3.1 Steady-State Voltage, CSA Standard CAN3-C235

Customers connected to the feeder must be supplied with adequate voltage levels, as per CSA Standard CAN3-C235 for the following situations: with and without the generation facility generating power for minimum and maximum feeder loading conditions.

3.2 Voltage Fluctuation, CSA CAN3-325-83, IMO Requirements for Facilities of Larger than 10 MW

Adequate voltage regulation shall be maintained under a variety of operating conditions. During normal operation, and whenever possible, the generation facility shall be loaded and unloaded gradually to allow adequate time for regulating devices to respond.

3.2 Synchronization, IEEE 1547 and/or IMO Requirements for Facilities of Larger than 10 MW

The generator shall parallel with the distribution system without causing a voltage fluctuation or flicker greater than those specified by the above standards at the point of connection.
Note: OESC rule 84-006 covers the synchronization of parallel generators.

3.2 Voltage Unbalance

Where the distribution system supplies single-phase loads, some unbalances are inevitable. The generation facility should be capable of operating under these conditions and shall not cause further deterioration of existing unbalance conditions.

4. Power Factor, IEEE 1547, CSA C107.1

The generator's system is not required to be capable of adjusting the power factor but shall operate in the preferred range of 0.9 lag to 0.95 lead. If the generation facility disturbs the distribution system voltage levels at the point of connection then the generator may be required to operate its facility within a smaller range or take other compensatory measures. Field settable fixed and dynamic power factor correction techniques may be used if consultation with the distributor reveals no adverse affect on the distribution system. For generators that are IMO inactive, the reactive power compensation at the generating units should be sufficient so as not to cause any material increase in the reactive power requirements at the transmission system transformer station due to operation of the units, at any distribution feeder load conditions.

For inverter based generator facilities power factor limits will be as given in the MicroPower Connect guidelines.

5. Equipment Ratings and Requirements

The generation facility interface equipment must be compatible with LDC equipment ratings at the connection voltage (maximum voltage, basic impulse limit, short circuit ratings, capacity etc.) and the incorporation of the added generation facility must not result in any distribution system equipment operating beyond the distribution system's operational rating. A distributor shall review the equipment ratings for the purpose of assessing integration of the generation facility with the distribution system. The equipment ratings that shall be reviewed include, but are not limited to, the following.

5.1 Equipment Thermal Loading

All existing distributor's equipment in distribution and transmission stations shall not be overloaded beyond acceptable limits under all operating conditions of the generation facility. This equipment includes feeder conductor, line voltage regulators, regulating stations, reclosers, circuit breakers and transformers.

Assuming that under existing operating conditions there is no overloaded equipment, the study will be conducted for minimum load conditions and maximum generation, including all existing generation facilities already existing on the feeder. The load flow study will identify the potential overload of the existing equipment.

5.2 Impact of Generation Facility Fault Contribution on Equipment Rating

The generation facility will contribute to the total fault current. The distribution system's interrupting devices shall be able to interrupt the maximum fault current that will flow through the devices. All the distribution system's electrical equipment has to be able to withstand the fault current passing through it for the required time for the protection to clear the fault.

The fault interrupting rating of the existing interrupting devices and the fault withstanding rating of the electrical equipment shall be higher than maximum fault current possible to flow through the equipment.

Where the generator causes these limits to be exceeded, distribution system equipment replacement or fault current limiting devices may be required.

5.3 Voltage Regulating and Metering Devices

The distributor's system has been designed for unidirectional flow of power, from source (i.e., station) to the customer. Therefore, the voltage regulating and metering devices are designed to correctly operate in these conditions. The connection of generating facilities to the distribution feeder could cause the power to flow to be reversed through the power equipment, which will create difficulties to properly regulate the voltage or to measure the energy, respectively.

Where it is possible for power to flow in reverse through the existing voltage regulating devices and/or the metering points, the regulating devices and metering devices shall be suitable for such bi-directional flow.

The study will be conducted for minimum load and maximum generation condition. The direction of the power flow through voltage regulating devices connected between the generation facility and the transformer station will be verified including line voltage regulators, regulating stations and transformers' under load tap changer, at the distribution station and transformer station. Also all metering devices, either for billing purpose or monitoring reasons, will be verified.

6. Cease to Energize

The distributor will review the generator's design to ensure that the facility will cease to energize automatically from the distribution system's supply under the conditions identified in this section.

Important considerations in this design review:

As per IEEE 1547
To maintain the reliability of the distribution system, the distributor may use automatic re-closing. The applicant needs to be aware of line re-closing when designing the system protection schemes to ensure that it deenergizes the distribution system prior to automatic re-close of the distribution system's breakers or line reclosers. The distributor must review to ensure that the generator's design will deenergize the generation facility prior to auto-reclose operation of feeder tripping devices.

As per IEEE 1547 and OESC 84-008(b)
After a disturbance on the distribution system, no reconnection shall take place until the distribution system voltages and frequency are within the limits specified in CSA CAN3-C235 standard.

The generator's 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 distribution system's steady state voltage and frequency are restored to the ranges identified above.

6.1 Loss of LDC Supply Resulting in the Formation of an Island, IEEE 1547 CSA C22.2 No. 107.1, OESC 84-008 (Loss of Supply Authority Voltage)

6.1.2 Unplanned islanding

The applicants system shall cease to energize the distribution system following the formation of an unintentional island.

6.1.3 Planned islanding

Where planned islanding is allowed, the generator and the distributor will jointly agree to all requirements.

6.4 Over-Current Protection Coordination Due to Generation Facilities Fault Contribution IEEE 1547 and OESC 84-014 (System Protection Devices)

Any element of the interconnection system external to the generation facility, but ahead of the point of connection, should be installed in a fail-safe manner with self-checking features or redundant protection functions for large generators.

Equipment and conductors shall be provided with overcurrent protection from each source of supply. The generation facilities protection system shall be capable of

automatically isolating the generator from the distribution system for the following:

- internal faults within the facility; and/or
- external faults within the distribution system.

The protective device selectivity and sensitivity have to be maintained over the range of minimum to maximum fault currents with infeed from the generator.

Where the primary connection of the generation facility transformer is Wye- (Y) grounded, the sensitivity of the ground fault protections could become deficient, as zero sequence current will have an additional ground path through the transformer to the distribution system. The ground fault occurring within the protected zone has to be “seen” by the ground fault protections with and without the transformer connected.

6.5 System Voltage Changes Beyond the Over or Under Voltage Range, IEEE 1547

Over and under voltage and over and under frequency protection is required at the generation facilities interconnection point.

The set points and clearing times for over or under voltages and over or under frequencies are dependent upon the magnitude of voltage and frequency variations and generator size. For details see relevant clauses of IEEE 1547. Generator equipment should be approved to CSA 107.1 or other acceptable standard.

Note: OESC rule 84-014 states that each parallel power generation facility installation shall be provided with such additional devices that are required for system stability and equipment protection.

7. Revenue Metering

Revenue Metering shall be in accordance with *Canada’s Electricity and Gas Inspection Act, R.S. 1985, C.E-4*.

8. Feeder Relay Directioning

The existing over-current protections in distribution system are typically designed to clear line and ground faults occurring downstream from their location, as the source feeding the fault is only the transformer station. Connecting a generating facility provides another source supplying the fault, and the fault contribution from the facility might cause protection to operate non-selectively for reverse faults, out of the protected zone.

If the maximum reverse fault current through a non-directional fault-interrupting device exceeds the setting of the device, the fault-interrupting device shall be provided with a directional feature to prevent tripping for reverse fault current flow. The phase protection could be replaced with an impedance relay (21) if required.

The main concern is the infeed from the generation facility with Wye- (Y) grounded connection on the HV of the interface transformer for faults on the adjacent feeders.

The generator may consider adding a reactor <5 ohm in the neutral of the generator's transformer, within the constraints of the overvoltages.

9. Monitoring, IEEE 1547, OESC and/or IMO & Transmitter Requirements for Facilities of Higher than 10 MW,

A generation facility connected to the point of connection, rated at greater than 250 kVA, shall have provision for monitoring connection status, real power output, reactive power output, and voltage either at the point of connection or aggregate connection, as required by the distributor. The monitoring equipment shall either be installed, or there shall be adequate provision in the design, to allow future installation of such equipment if not required at time of interconnection. When implementation of data telemetry is required, the distributor and the generator will mutually agree upon communication media options.

Note: At the generator's side of the point of connection the equipment shall be approved as per rule 2-022 of the OESC. The installation shall be inspected as per rule 2-004 of the OESC.

10. Power Quality

The generator shall not significantly impact the power quality of the system. If there are negative impacts once the generation facility is in service, they will be required to disconnect until appropriate measures have been taken to prevent negative impacts to the distribution system and the customers it serves.

10.1 Flicker, IEEE1547, IEC 61000-3-7

The generation facility shall not cause objectionable flicker on the distribution system. It is recognized that flicker is a site dependent condition. Loss of synchronism protection may be required to be incorporated by the generator, if necessary, to limit flicker.

10.2 Harmonics, IEEE1547, IEC 61000-3-6

Inverter connected generation facilities are expected to comply with CSA 22.2 No. 107.1 current distortion limits.

For inverters only capable of operating in voltage follower mode, voltage harmonic distortion limits are not specified, but may be addressed by the distributor. Inverters certified to CSA 107.1 are considered to meet these requirements. The CSA standard excludes current harmonics due to voltage distortions in the distribution system.

10.3 Limitation of DC Injection, IEEE1547

The generation facility shall not inject a d.c. current greater than 0.5% of the unit rated output current after a period of six cycles following energizing of the distribution system.

10.4 Protection from Electromagnetic Interference (EMI), IEEE 1547, C37.90

The influence of EMI should not interfere with operation of the generation facility's interconnection system.

10.5 Surge Withstand Performance, IEEE 1547, C62.41.2 or C37.9.90, OESC 84-014

The interconnection system shall have the capability to withstand voltage and current surges.

10.6 Paralleling Device, IEEE 1547

The interconnection system paralleling-device shall be capable of withstanding 220% of the interconnection system rated voltage.