ESB NETWORKS

Future Smart Electric Vehicle Charging

with Vehicle to Grid (V_2G) Capability

NATIONAL NETWORK, LOCAL CONNECTIONS PROGRAMME

Version	Revision (2) _RM
Date	04/08/2022

DOC-301121-HFW

CONTENTS

1 INTRODUCTION

This document provides an overview of the high-level requirements which may be required to facilitate the installation of smart EV (Electric Vehicles) charging equipment and Electric Vehicle Battery to Grid (commonly referred to as V_2G) in their home / farm / business. V_2G capabilities will enable in time EVs to store and discharge electricity to the grid with communication signals from ESB Networks and electricity suppliers / aggregators.

It is anticipated that the vehicle shall have an electric motor greater than 1 kW.

Customers should consider the overview provided here to ensure they align to the future smart grid architecture being implemented in Ireland. Aligning with this will enable their participation in future flexibility markets and system services, creating the potential for more cost-effective connections and the potential to earn money for managing their charging demand.

Currently, the communication connections from a home / farm / business Gateway to ESB Networks is in development – this architecture may not be supported for early adopters, but pilot participation will be feasible from late 2023, and importantly, this document provides the recommend future component level system design. Similarly, customers may identify that their current electrical supplier does not provide this technology or services today – this guidance is a recommendation that these suppliers prepare for the future architecture changes and development.

Finally, an electric vehicle which can feed power back into the grid is operating as a generator and must meet ESB Networks' requirements for the connection of generators in parallel with the grid. The current requirements are set out in:

MicroGeneration: Total Inverter at premises is <= 6kVA (single phase):

Conditions Governing the Connection and Operation of Micro-Generation (esbnetworks.ie)

MiniGeneration: Total Inverter Capacity at premises >6kVAand <= 17kVA (single phase):

Conditions Governing the Connection and Operation of Mini-Generation (esbnetworks.ie)

Export Limitation Schemes:

Conditions Governing the Connection and Operation of Export Limiting Schemes (esbnetworks.ie)

Note: Requirements for generators to operate when isolated from the ESB System are provided in NSAI Wiring Regulations IS EN 10101

2 OVERVIEW ARCHITECTURE

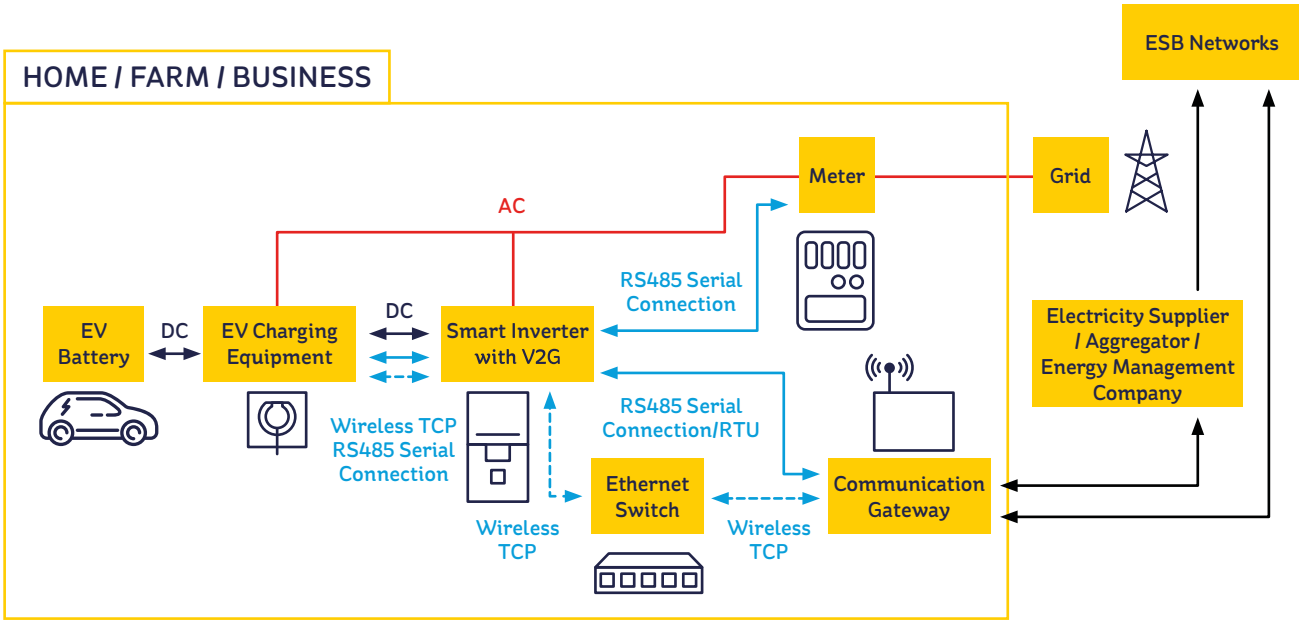

Figure 1 Overview Architecture

Each component of Figure 1 – moving left to right – is addressed in sequence. The document provides details of the specifications and standards for each component in the architecture.

Note: Where the potential export from the system would exceed certain limits, a 'fail safe' system, is required to ensure that the system can operate safely. In the immediate term, an "export limiting scheme" achieves this objective and is thus required in cases where limits are breached. Customers should review carefully the Conditions Governing the Connection and Operation of Export Limiting Schemes to clearly identify the export limits. Alternative solutions achieving this objective, in line with the architecture described in this document, are in development.

3 COMPONENT REQUIREMENTS AND STANDARDS

3.1 TYPICAL EV (ELECTRIC VEHICLE) BATTERY (FOR ILLUSTRATIVE PURPOSES ONLY)

Table 1 EV (Electric Vehicle) Battery

REQUIREMENT	STANDARD
Lithium Battery	- EN 62133-2 OR EN 62619 - EN 62109 for AC connected Battery
Nickel based or Lead Acid Battery	- EN 62133-1 OR EN 62485 - EN 62109 for AC connected Battery

3.2 GENERAL EV CHARGING (NOT AN EXHAUSTIVE LIST)

Table 2 EV Charging Equipment

REQUIREMENT	STANDARD
Installation	- Shall fully comply with Wiring Regulations I.S. 10101 and in accordance with industry best practice (*) - All systems shall be installed to manufacturer's guidelines. - Installed by a competent Safe Electric contractor. - The Customer should ensure that the proposed export does not exceed the available capability of the network, by making application to ESBN for the proposed generator connection as per the MicroGeneration or MiniGeneration standards before finally deciding on the EV and home charger combination prior to purchase and installation.
Typical EV Charging Equipment	- Shall comply with 93/465/EEC – The affixing and use of the CE conformity marking. - Shall comply with IEC 61851 – Electric vehicle conductive charging system. - Shall comply with IEC 62196 – Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles. - Shall comply with 89/336/EEC – Electromagnetic Compatibility Directive - Shall comply with IS EN 50549-1 – Requirements for generating plants to be connected in parallel with distribution network: Part 1: Connection to an LV Distribution Network. - Shall comply with WEEE (2002/96/EC) – Waste Electrical and Electronic Equipment Directive. - Shall comply with I.S. EN IEC 61439 – Low-voltage switchgear and control gear assemblies.
Typical EV Charging Equipment Communications (**)	- Shall meet the requirements of DD CLC/TS 50457-2 a communication protocol between the off-board charger and EV in conductive charging situations. - Shall meet the requirements of IEC TS 61980-2 for communication between vehicle and Wireless Power Transfer (WPT) systems connected to the supply network.

(*) Installations should obviously conform with IS EN 10101 as this is a necessary condition but may not be sufficient. Technologies such as Electric Vehicles develop rapidly and may outpace the requirements in other Regulations, yet the installer still has a responsibility to ensure safety. This is more likely to be observed when best industry practice is observed, taking learnings from other jurisdictions where applicable.

(**) Communications standards change rapidly but at present these are the standards that are most likely to be required by ESB Networks.

3.3 DC ELECTRICAL SYSTEM (NOT AN EXHAUSTIVE LIST)

The DC system provided in CE systems will conform to the required specifications, but where the customer is installing DC components within the premises then an awareness of the standards to which such systems is required, and typical requirements would include the following – although again this is not an exhaustive list and a competent Contractor will ensure that required installation and equipment standards are met.

Table 3 DC Electrical System (not an exhaustive list)

REQUIREMENT	STANDARD
DC System / Components	- Shall fully comply with NSAI I.S. 10101 and be labelled to identify as such.
DC Isolator as per NSAI I.S. 10101	- A DC isolator switch (2 pole) shall be provided at the connection point to the Inverter, and accessible from the inverter location. - Shall be labelled “DANGER Contains Live Parts” or an equivalent statement.
DC Cables as per NSAI I.S. 10101	- Shall be segregated from AC cables. - Shall be designed to minimise resistive losses, and voltage drop, to <3%. - Positive and Negative DC cables must be identified at either end of each circuit. - Shall be double insulated.
DC Connectors as per NSAI I.S. 10101	- Shall be rated to IP21, class II, shrouded, and shall be labelled positive and negative. - Shall comply with EN 62852, and EN 50521.

3.4 SMART INVERTER

Inverters are the systems to convert DC power generated by the EV Battery module into AC power for connection to the consumer load and grid for Vehicle to Grid capability.

Table 4 Smart Inverter (not an exhaustive list)

REQUIREMENT	STANDARD
Smart Inverter *(The standards provided here shall be clearly identified within the smart inverter datasheet and if available preferably clearly labelled on the device nameplate / housing).* Some typical features which may be expected form such a system include:	- Shall fully comply with EN50549 (With Irish Protection Settings). - Shall fully comply with NSAI I.S. 10101 - Meet the requirements of EN 62109 - Recommend a rated efficiency of >95% to maximise generation.
Smart Inverter (externally installed) as per NSAI I.S. 10101	- Shall have an ingress rating of IP65 or greater.

Smart Inverter Labelling as per NSAI I.S. 10101	- Shall be installed with clearly labelled, accessible (from the inverter location), DC and AC isolator switches. - Shall carry a warning label, prominently located – "Inverter - Isolate AC and DC before carrying out work" or an equivalent statement.
Smart Inverter Communications	- Meet the requirements Modbus TCP SunSpec - Meet the requirements Modbus RTU SunSpec (RS 485) - Meet the interface requirements of IEEE 2030.5 - Meet the requirements of IEEE 1547
Vehicle to Grid (V2G) Communications	- Shall meet the requirements of EN ISO 15118-3 for a physical vehicle-to-grid communication interface, including data link requirements for signalling. - Shall meet the requirements of EN ISO 15118-8 for wireless communication interfaces.
Cybersecurity	- Meet the requirements of EN 303645

3.5 COMMUNICATION GATEWAY

The communication gateway is the in-home hub for the aggregator and ESB Networks to communicate with the smart inverter. The Communication Gateway device will be at a minimum ESB Networks specified for technical design and operation.

Table 5 Communication Gateway

REQUIREMENT	STANDARD
Communication Gateway Device	- For Future Connection with ESB Networks and your Supplier or Aggregator: - Meet the requirements of IEEE2030.5/ DNP3/IEC 61850/ IEC 104/ IEEE 1815/ SunSpec Modbus - Meet the requirements of NIS Cybersecurity Directives

3.6 AC ELECTRICAL SYSTEM (NOT AN EXHAUSTIVE LIST)

Table 6 AC Electrical System

REQUIREMENT	STANDARD
AC System	- Shall fully comply with I.S. 10101 and be labelled to identify as such. - The AC system must be tested and certified by a Registered Electrical Contractor and a Safe Electric certificate must be provided.
AC Isolator as per NSAI I.S. 10101	- An AC isolator (2 pole, switching live and neutral) shall be installed between the inverter and the consumer unit, and accessible from the inverter location. - AC isolator shall be labelled – "Electric Vehicle System MAIN AC Isolator" or an equivalent statement.
Meter Box as per NSAI I.S. 10101	- The main incoming point of the dwelling (typically the meter box) must contain a warning label indicating the presence of a separate source of electrical supply to the building.

3.7 EMERGENCY ISOLATION / BACKUP OPERATION

Table 7 Emergency Isolation / Backup Operation

REQUIREMENT	STANDARD
Emergency Isolation	- Shall fully comply with I.S. 10101
Backup Operation	- Shall fully comply with I.S. 10101

Note: Customers should note that small generation systems operating in parallel with ESB Networks cannot work independently unless specially designed to be 'grid forming'. When operating independently special arrangements apply for Safety and these involve, amongst other requirements, a complete electrical separation of the customers premises from ESB Networks by means of a Change Over switch. A contractor experienced in this should be employed if such arrangements are required.

Details of requirements for the installation and operation of such generators are provided in NSAI Wiring Regulations IS EN 10101.