Resilience as a Service

WP 2 Internal Deliverable Report:
"Site Selection Report" (E2a.1)

Handed over by: E.ON Business Solutions GmbH

Prepared by: Robert Davies

Checked by: Christian Bucher (E.ON), Inigo Berazaluce (E.ON), Maciej Fila (SSEN), Sarah Rigby (SSEN)

Status: FINAL

Confidentiality: FOR SUBMISSION

Version: V1.0

Date: 22/02/2021

RaaS
Resilience as a Service

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1. Executive Summary

This report has been created by E.ON in collaboration with SSEN (Scottish and Southern Electricity Networks), and sets out the process used to identify the primary substation which will be the focus for the Resilience as a Service (RaaS) project. The chosen site is to be taken forward to the design stage of Phase 1 and the potential demonstration stage in Phase 2 of the project following the stage gate decision point.

The RaaS concept seeks to improve security of supply across remote or rural areas of the distribution network through the development and implementation of a new market based flexibility service. This use case represents a solution which can swiftly, automatically, restore supply to customers in the event of a fault, using services procured from a local Battery Energy Storage System together with local Distributed Energy Resources. Depending upon the type of network fault, the RaaS operational response may provide a seamless transition from grid to islanded mode, or may result in a black start of the local 11kV network from the BESS.

The site selection criteria focussed on four key considerations: potential benefits of the solution for the site, suitability for meeting project objectives practicality of delivery and operation within project timeframes and budget, and technical design and integration.

During preparation of the Full Submission Proposal for the Network Innovation Competition in 2019, SSEN identified an initial long list of primary substations on their network which may benefit from RaaS. Within the project, SSEN have extended the information considered to evaluate these sites, in addition to a number of other sites proposed by internal stakeholders, and created a shortlist of five potential trial sites for further assessment by E.ON and for site surveys to evaluate the potential system integration requirements. The five shortlisted sites were the primary substations at Drynoch, Kinloch, Kishorn Hill, Lochinver and Mallaig.

Using information on these five shortlisted sites, E.ON performed a detailed desktop-based site assessment including a sizing analysis to evaluate the required size of the RaaS system, and development of a Conceptual Engineering report for an example site. This analysis examined factors which will influence the technical design and integration of the RaaS system, and criteria relevant to the practicability of delivery and operation.

All aspects of the process supported development of a suite of considerations to be assessed during the site surveys. This preparation provided the project team with a clear plan for the time to be spent on site, ensuring that all relevant factors were considered, and supporting the requirement for social distancing in line with the presiding Covid-19 restrictions.

Following the site visits and evaluation of all data and information, each site has been assessed against the four site selection criteria, and the chosen trial site is Drynoch, on Skye.

2. List of Abbreviations

AC	Alternating Current
AVC	Automatic Voltage Control
BaU	Business as Usual
BCP	Battery Combiner Panels
BESS	Battery Energy Storage System
BMS	Battery Management System
CBA	Cost Benefit Analysis
CDM	Construction Design and Management Regulations 2015
CI	Customer Interruptions
CML	Customer Minutes Lost
DC	Direct Current
DER	Distributed Energy Resource
DG	Distributed Generation
DNO	Distribution Network Operator
DSM	Demand Side Management
DSR	Demand Side Response
EMS	Energy Management System
FEED	Front End Engineering Design
FFS	Firefighting System
FSP	Full Submission Proposal
HGV	Heavy Goods Vehicle
HVAC	Heating, Ventilation and Air Conditioning
IIS	Interruptions Incentive Scheme
LTDS	Long Term Development Statement
MVA	Mega Volt-Amps
NGESO	National Grid Electricity System Operator
NIC	Network Innovation Competition
OHL	Overhead Lines
P2/7	Engineering Recommendation P2/7 – Security of Supply
PCS	Power Conversion System
PoW	Point on Wave
RaaS	Resilience as a Service
SHEPD	Scottish Hydro Electric Power Distribution
SSEN	Scottish and Southern Electricity Networks
UPS	Uninterruptable Power Supply

3. Introduction

3.1. Overview of the RaaS use case & project plans

Resilience as a Service (RaaS) is an Ofgem Network Innovation Competition (NIC) funded project being delivered by three partners - Scottish and Southern Electricity Networks (SSEN), E.ON and Costain. SSEN are the distribution network operator (DNO) for the project evaluating the technical feasibility and financial viability from a DNO perspective; E.ON are an energy solutions provider who are leading the technical delivery of the battery system and developing the investor business case; Costain are a management consultancy acting as programme managers and providing input to the market design assessment. The project has a budget of £10.9m.

The aim of the project is to investigate the technical application and commercial opportunities associated with the provision of a new flexibility service that could be offered to DNOs to improve network resilience in remote or rural areas. This use case represents a solution which can swiftly, automatically, restore supply to customers in the event of a fault, using services procured from a local Battery Energy Storage System (BESS) together with local Distributed Energy Resources (DER). Depending upon the type of network fault, the RaaS operational response may provide a seamless transition from grid to islanded mode, or may result in a black start of the 11kV network from the BESS.

The project will determine how network resilience can be improved in a cost-effective manner for customers who experience an untypically high frequency of outages. This can be achieved by a DNO procuring RaaS from a third-party service provider who can stack revenues gained through participation in other flexibility markets. This project seeks to evaluate the financial case from a DNO perspective while giving insight to RaaS service providers on the investment case necessary and optimal flexibility markets to operate in.

In the first phase, the project focuses on site selection, system design for the chosen trial site, and refinement of the business case. This phase will validate whether the concept is technically feasible and financially viable, and will inform a decision to be made in 2021 on whether to proceed with the deployment and operation of a RaaS system at the chosen site for a trial period of up to two years.

Phase two of the project comprises the delivery, commissioning, and operation of the system in a test phase which is due to start in 2022. It will involve monitoring and evaluation of the systems performance plus examining different combinations of flexibility services.

3.2. Introduction to this report

The aim of this report is to describe the selection process used to identify the site to be taken forward to the design stage of Phase 1 and the potential demonstration stage in Phase 2 of the project.

The report describes the stages of identifying a longlist of potential sites, shortlisting them, assessing the shortlist through analysis and site surveys, and evaluating criteria to reach a decision. Selecting a site with suitable prerequisites is paramount for achieving the project goals. Accordingly, this process has considered the potential benefits of a RaaS solution at each site, together with any potential risks to project delivery. In order to support the development of a high-quality solution which can be widely applicable to other potential sites under BAU.

Descriptions of each of the shortlisted sites are provided, together with a detailed comparative analysis based on criteria determined by SSEN and E.ON.

3.3. Purpose of this report

Selection of the potential trial site is a key project decision as this will form the basis for subsequent work in designing and eventually implementing the RaaS system.

The intention of this report is to demonstrate to stakeholders that a thorough, unbiased assessment has been completed and that the selected site provides a strong basis to meet the purposes of the project.

This report is a part of Work Package 2: Front End Engineering Design (FEED) and will be a key aspect of Project Deliverable 1[1], consisting of:

- PD1.1 Report detailing the selected site for demonstration and proposed use case(s) for the RaaS demonstration
- PD1.2 External peer review of FEED

4. Alterations from initial scope of the deliverable

The scope of this deliverable has not changed over the course of the project; however, the site selection process has been adapted and refined.

The original project programme prepared for submission to the Network Innovation Competition planned site visits in April/May 2020. However, with the emergence of the COVID-19 pandemic, amendments were required. In line with national public health measures and travel restrictions, the earliest that the project team were able to arrange initial site visits was towards the end of August 2020.

The initial site surveys comprised visits to four of the five shortlisted sites and were completed by the SSEN project team together with local field teams. These surveys allowed two shortlisted sites to be discarded. A second round of site surveys to the remaining sites was then undertaken by SSEN and E.ON towards the end of September, once international travel restrictions allowed.

Whilst this introduced a delay to the project programme, the project team have continued to closely monitor progress and update the programme, communicating these changes with Ofgem and other project stakeholders. The revised project timeline reflects a shift in formal Project Deliverables from the dates set out in the Project Direction from Ofgem, however none of the revisions identified represents a 'Material Change' under Ofgem's Network Innovation Competition project governance[2].

[1] The project deliverables are set out in the Project Direction from Ofgem, and are distinct from the deliverables to be provided by project partners over the course of the project

[2] the definition of a Material Change which requires formal approval from Ofgem is provided in Appendix 1 and associated Section 8.23 of Ofgem's 'Electricity Network Innovation Competition Governance Document v.3.0', 30 June 2017 - this includes any change to the submission date of a deliverable set out within the Project Direction, or a delay to project closedown, of more than one year

5. Site selection process

The site selection process was developed to support selection of a site that will provide benefit to the network and allow the objectives of the project to be met. For example, with regard to availability of Distributed Generation (DG) which could be incorporated into the scheme, and delivery within project timeframes and budget. This process consisted of the following steps:

1) Shortlisting of potential sites by SSEN via desktop analysis
2) Desktop analysis by E.ON on battery sizing and engineering requirements
3) Identification of additional considerations and information requirements to inform the site surveys
4) A first round of site visits by SSEN to the shortlisted sites
5) A second round of site visits by SSEN and E.ON to the shortlisted sites

As the basis for this process a suite of criteria has been defined, as described in the sections below, which the shortlisted sites have been assessed against. The full list of data that has been used to assess the sites against these criteria can be found in Appendix I.

5.1. Overview of the site assessment criteria

To determine which site would be most suitable for the project trial E.ON and SSEN worked collaboratively to determine the selection criteria, utilising their technical and commercial experience. The site selection criteria address four key considerations, which are described in more detail in the sections below:

- Potential benefits of the solution for the site
- Suitability for meeting project objectives (inc. potential incorporation of local DER)
- Practicality of delivery and operation within project timeframes and budget
- Technical design and integration

5.1.1. Potential benefits of the solution for a site

The potential project benefits are clearly important as these reflect the value of a future BAU service to customers, the DNO, and the RaaS service provider. One key consideration here relates to the Interruptions Incentive Scheme (IIS) payments associated with a site, as these reflect the level of service experienced by customers with regard to security of supply and power outages. Where a site has high IIS penalties due to higher than typical outages, there is greater opportunity to realise benefits from improved levels of service.

These considerations are relevant to both the selection criteria for the RaaS trial site, and future BAU roll out.

With regard to both the DNO and investor business cases for RaaS, it is acknowledged that these must each be considered for each individual site in order to evaluate the suitability of implementing this solution. However, as the focus of the project is to develop and demonstrate the RaaS concept to pave the way for future commercial implementation, these detailed considerations do not play a key factor in the trial site selection process. Rather, the project will address these detailed, broader commercial aspects of RaaS within Work Package 5 'Business Model'.

5.1.2. Suitability for meeting project objectives

To ensure that the trial will be able to demonstrate the application of RaaS in accordance with the Full Submission Proposal (FSP), the selected site must have the potential to

- Demonstrate a real-time response to network faults which provides an improved service to customers
- Test the integration of Distributed Energy Resources (DER) and Demand Side Management (DSM) into the RaaS system.
- Have close interaction with the local community to assess the importance and value of such a solution to them and test the potential to include the local community into the concept.

These factors have informed the selection criteria incorporated into the SSEN site shortlisting process and site survey consideration set out in Section 5.2 and Section 5.3.

5.1.3. Practicability of delivery

Practicality of delivery is important as sites that would benefit from RaaS (including the trial site) are typically in remote locations which present specific challenges to system delivery, installation and operation. This is an important consideration with regard to the RaaS project to ensure successful delivery within the given timeframes and budget. Site accessibility has therefore been considered with focus on aspects such as access via restricted roads or ferries (which may require specialist licensed transportation), and availability of space and suitability of ground conditions. Figure 1 indicates the locations of the five shortlisted sites and the Port of Glasgow.

Figure 1 - Location of shortlisted sites in relation to Glasgow (marked in red): 1) Drynoch; 2) Kinloch; 3) Kishorn Hill; 4) Lochinver; 5) Mallaig

5.1.4. Technical design and integration

Consideration must also be given to the technical aspects of integrating the RaaS system into existing network infrastructure in the context of a project trial. This is of relevance to a trial system to maintain a distinction between installed for trial purposes, and existing BAU assets.

To understand the integration requirements, the criteria here relates to the type and age of existing substation assets, and evaluation of any adaptations or replacements required to accommodate the trial system.

5.2. SSEN site shortlisting

SSEN developed a shortlist of potential trial sites based on the sites identified within the FSP. This primarily considered the first two selection criteria - potential benefits for the site and suitability for meeting project objectives.

The process included a review of the business case assessment undertaken by TNEI to inform the NIC FSP.

TNEI used LTDS (Long Term Development Statement) data to identify sites that indicate some combination of the following conditions:

- Relatively low demand
- No redundancy in their connection to the wider network
- A long (over 5 km) 33 kV circuit connection to the wider network
- A rural setting (since urban networks are more likely to have HV network interconnection)

This assessment identified the following 31 'candidate sites' within SSEN's Scottish Hydro Electric Power Distribution (SHEPD) area:

1. Inverarity
2. Aberfoyle
3. Chaorach
4. Calvine
5. Tyndrum
6. West Parkfergus
7. Whiting Bay
8. Ballure
9. Dervaig
10. Port Askaig
11. Port Ellen
12. Colintraive
13. Strathdon
14. Balaldie
15. North Kessock
16. Helmsdale
17. Rhiconich
18. Lochinver
19. Aultbea
20. Coldbackie
21. Drynoch
22. Kishorn Hill
23. Uig
24. Gisla
25. Pollachar
26. Arisaig
27. Mallaig
28. Drumnadrochit
29. Glencoe
30. Lethen
31. Balmedie

TNEI then used the following information in a cost benefit analysis (CBA) model to evaluate the potential benefits of a RaaS solution in comparison with the conventional options of using temporary diesel generation to supply customers following a fault, or network reinforcement to improve resilience:

- Demand and forecast load growth
- Power factor

- Circuit length
- Circuit type
- Indicative per km cost of reinforcement
- Indicative fixed cost of reinforcement
- Potential RaaS set up cost
- Indicative ktCO_2e for temporary diesel generation; reinforcement; and RaaS

The results of this CBA work indicated that RaaS represents a beneficial alternative for each of the 31 candidate sites.

The SSEN RaaS project team also sought views from internal stakeholders to identify any additional sites which may benefit from RaaS. Through this engagement two further primary substations - Ullapool and Kinloch - were added to the list for detailed review.

To refine the site selection process, the project team then extended the information considered to include factors which reflect the potential for improving security of supply to customers at these sites, in addition to practical considerations relevant to achieving the project objectives within timeframes and budget.

The additional factors considered were:

- Number of customers
- Embedded generation (MVA)
- Number of faults / Customer Interruption (CI) incidents
- Average time off supply / Customer Minutes Lost (CML)
- IIS costs - CIs & CMLs
- P2/7 compliance
- Capability to restore the load via the 11 kV network
- Available headroom capacity (MVA)
- SSEN owned generation
- Space for battery within the substation compound
- Established plans for reinforcement

Analysis of this full suite of considerations allowed SSEN to create a shortlist of potential primary substations for further assessment by E.ON with regard to the potential BESS requirements, and for site surveys to evaluate the potential system integration requirements. The five shortlisted sites were:

1. Drynoch
2. Kinloch
3. Kishorn Hill
4. Lochinver
5. Mallaig

Table 1 below summarises the key advantages and disadvantages of each of these shortlisted sites.

Table 1: Summary of site shortlisting

Substation Name	Pros	Cons
Drynoch	- Space for battery within substation compound - Good level of DG (0.93 MVA)	- P2/7 compliant - Low IIS
Kinloch	- Very High IIS - Long OHL - P2/7 non-compliant - No 11 kV back feed	- No DG
Kishorn Hill	- High IIS - P2/7 non-compliant - Some DG (0.45 MVA) - Proportion of load can be restored via 11 kV	- Low number of faults - Short OHL
Lochinver	- High IIS - P2/7 non-compliant - Some DG (0.24 MVA) - no 11 kV back feed	- Possible reinforcement due
Mallaig	- High IIS - Long OHL - High number of faults - Good level of DG (0.8 MVA hydro)	- P2/7 compliant - Proportion of load can be restored via 11 kV

5.3. Preparation for site surveys

Using information provided by SSEN on the five shortlisted sites, E.ON performed a detailed desktop-based site assessment to develop a suite of considerations to be assessed during the site surveys. This focused on examining factors which would influence the technical design and integration of the RaaS system, as informed by the Conceptual Engineering Design described in subsection 5.3.2, and assessing criteria relevant to the practicability of delivery and operation.

In parallel, SSEN established the factors that they would need to consider to allow the existing substation assets to interface with a RaaS system.

The detailed site visit check lists are provided in Appendix II and Appendix III.

The factors considered were:

- Site layout
- Space availability for both construction and CDM requirements
- Underground or overhead obstacles
- Ground and drainage conditions
- Existing flora and fauna
- Transportation factors and accessibility to site (inc. road access, ferry, etc.)
- Suitability of roads for heavy goods vehicles leading to the sites
- Welfare facilities on site
- Proximity of neighbouring housing (to minimise disruption)
- Suitability of existing equipment for the integration of the BESS and the application of RaaS

This preparation provided the project team with a clear plan for the time to be spent on site, ensuring that all relevant factors were considered, and supporting the requirement for social distancing in line with the presiding Covid-19 restrictions.

5.3.1. System sizing analysis

For the RaaS concept, a key site requirement relates to the length of time that the electricity supply to an 11kV circuit can be maintained by the RaaS system in the event of a fault. To feed into the site selection process, therefore, an indication of potential battery size was required to understand the scale of the system to be built for the trial. This has a direct impact on both the physical space requirements in the vicinity of the substation and the complexity of transporting the system to site.

The subsections below describe to methodology and analysis used to develop an indicative battery sizing for this stage of the project.

5.3.1.1. Methodology

.A high-level analysis of half-hourly load profile data from the five shortlisted sites was undertaken to establish the approximate size of the system required to provide resilience at each site.

Prior to assessing the load profiles for the shortlisted sites, SSEN indicated that a ‘typical’ timeframe for dispatching a temporary diesel generation set to a remote site may be around 4 hours, however, at some sites this may be significantly more. Accordingly, this value was used as a reference target to aid the battery sizing analysis.

The sizing analysis was undertaken using load data from 2019, as this represents recent load patterns and is sufficient to allow a comparison of the sites and provide an indicative view of system requirements.

5.3.1.2. General results and site comparison

The analysis undertaken by E.ON shows a correlation between peak load and battery capacity required to cover a 4-hour outage at a site. This reflects the fact that the rural sites assessed have load profiles similar in shape, with predominantly residential load, and the main differences between sites are the levels of peak demand due to the varying number of consumers downstream.

This relationship can be seen in the following diagrams. In Figure 2, the differing levels of peak load in 2019 can be seen, and in Figure 3 the battery size required to provide 4 hours of resilience versus the peak demand is shown. This graph shows that there is a positive relationship between these variables with Mallaig having the highest demand in battery capacity. Since Mallaig requires the largest battery, the Mallaig primary substation has been used to undertake further system sizing analysis and to develop a Conceptual Engineering Design, as described below.

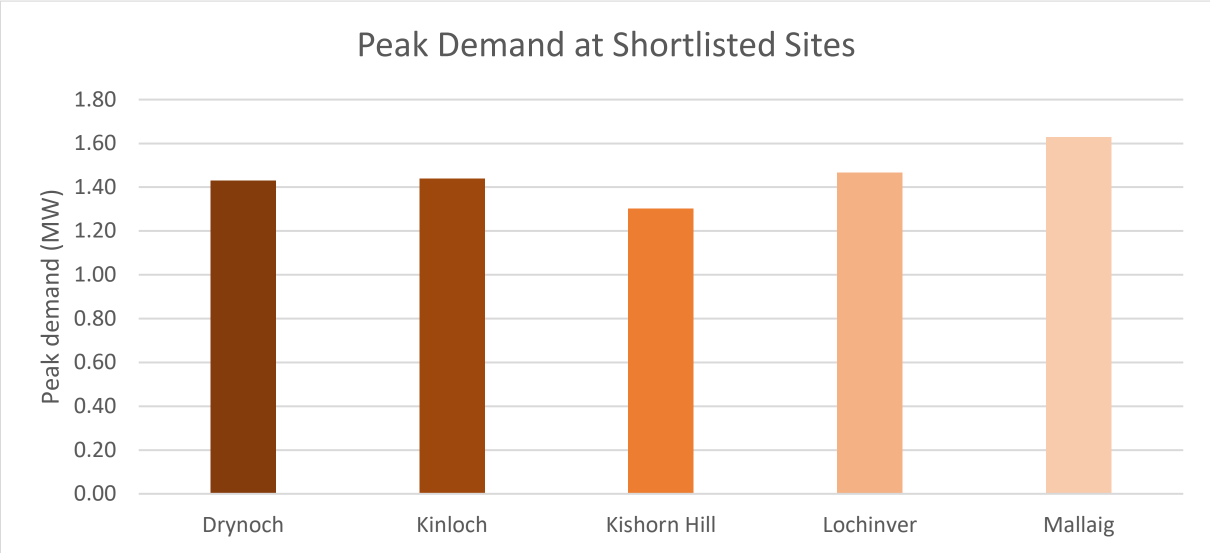


Figure 2 - Peak load demand comparison between sites

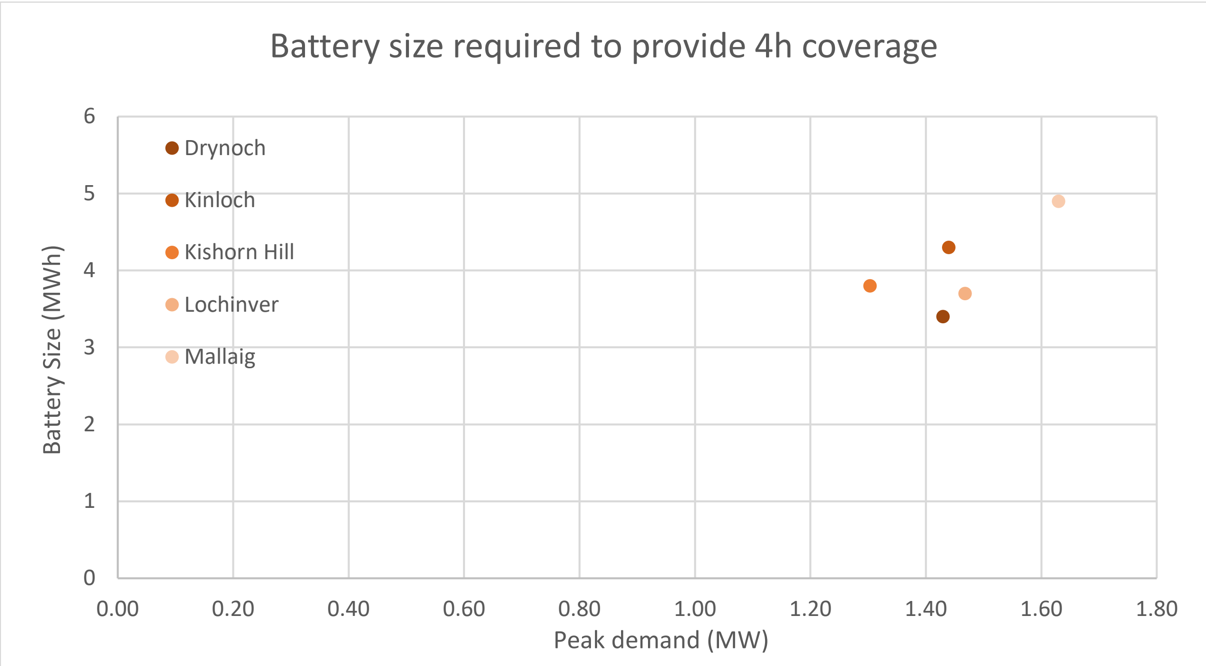


Figure 3 - Battery size required to provide 4 hour resilience at the shortlisted sites

5.3.1.3. System sizing for Mallaig

The system sizing analysis completed for Mallaig aimed to evaluate for how long a RaaS system could provide resilience to the network using different battery capacities.

Figure 4 below shows the annual electricity demand profile for Mallaig in 2019. The peak demand at this site was 1.63 MW, with an average demand of 0.9 MW. The varying seasonal demand is also visible, with a higher level of load in winter than in summer.

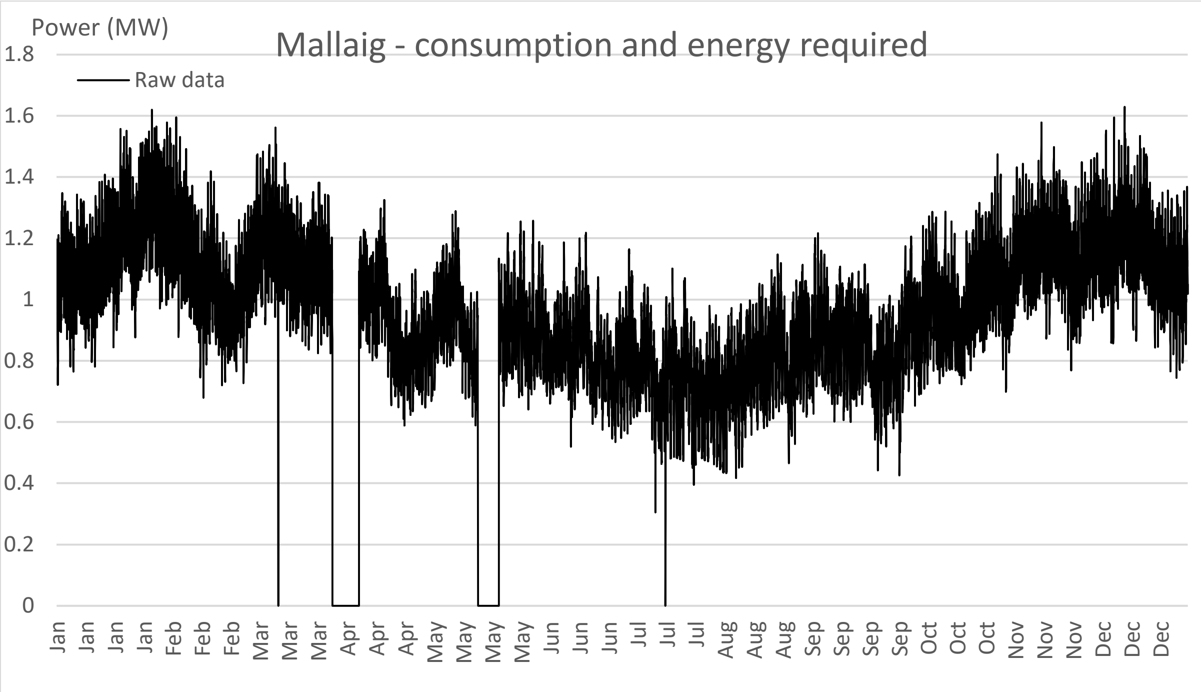


Figure 4 - 2019 Load profile for Mallaig

Electricity demand at Mallaig is measured at the substation and is provided as a half-hourly average. By summing the demand across a period of time-steps, rolling demand profiles can be created. Using this method, demand profiles representing the required energy over 1, 2, 4, 6, and 12 hours ahead can be determined for each half hourly time stamp. This is shown in Figure 5 below.

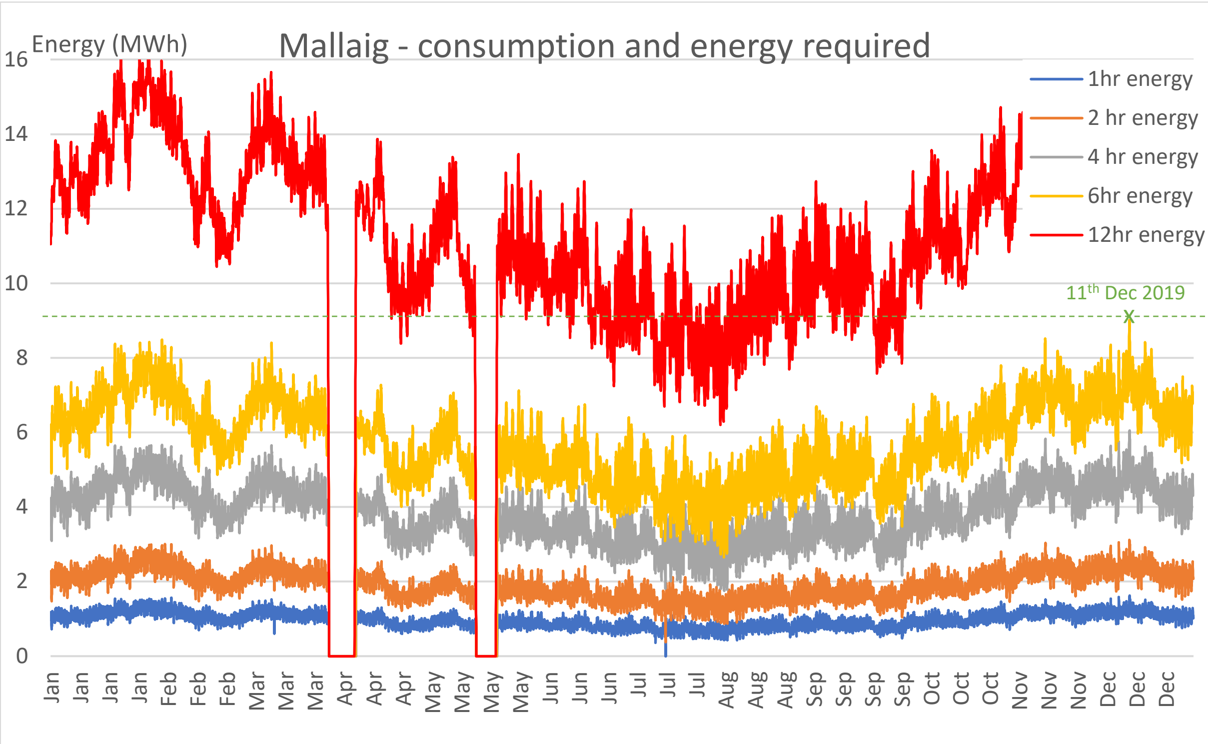


Figure 5 - Multi-hour energy demand profiles for Mallaig

This analysis can be used to determined what battery capacity would be required to maintain supply in case of a network fault for a chosen number of hours. For example, to ensure that 6 hours coverage could be provided at any point in time in 2019 without using any DER, a battery of 9.1 MWh would be required, which can be seen to occur on 11 December 2019. It is also apparent, that there is only one half-hour period in the whole year where a battery of this size would be required to provide this level of coverage, indicating that it is not likely to be practical or cost-effective to aim for this. It is therefore preferable to attempt to ensure that for the majority of the year, a given number of hours of resilience can be provided.

Figure 6 below then shows the relationship between battery size and its ability to provide coverage for potential outages in a year at Mallaig, not accounting for any DER. This graph shows how there is typically a sharp rise in a batteries' ability to provide coverage as its size increases, but that this capability tails off closer to 100% of potential outages. This is due to the nature of the demand curve at this site, where peak loads occur infrequently and load levels are typically closer to average.

This graph also demonstrates that 90% coverage for a given number of hours could be a preferable target level of resilience as up to this point the 'percentage of potential outages covered' increases approximately linearly with 'battery size' for all levels of resilience considered. Going beyond this point there is a non-linear relationship which shows there are diminishing gains from aiming beyond 90% coverage of potential outages.

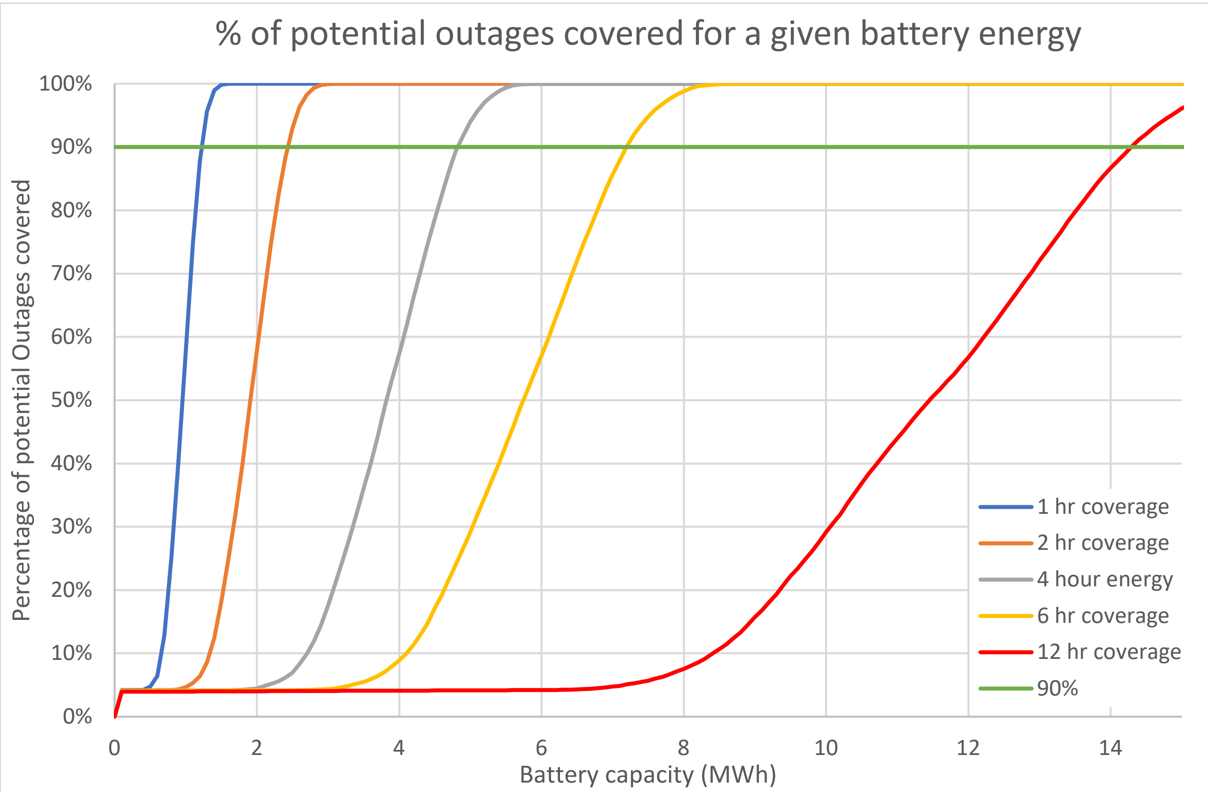


Figure 6 - Percentage of potential outages covered for a given battery energy at Mallaig

Table 2 below shows the required battery capacity to cover 90% of potential outages for 1, 2, 4, 6 and 12 hours at Mallaig in 2019, indicating the range for potential battery size that may be chosen.

Table 2 - Battery size required to cover 90% of potential outages in Mallaig

Hours coverage of 90% of potential outages	Battery size required (MWh)
1	1.3
2	2.5
4	4.9
6	7.2
12	14.3

5.3.1.4. Distributed Energy Resources and Demand Side Management

At some sites it would be possible to combine the BESS with local DER, e.g. DG or Demand Side Response (DSR) technology to support the system during outages.

If these two complementary technologies were integrated into the RaaS service, they could reduce the demand that must be met by the battery, meaning they potentially offer an additional cost-effective measure in supporting resilience.

To demonstrate their potential benefit, a simplified example can be considered. The use of these technologies would extend the duration of coverage provided by a battery equal to the proportion to the reduction of load that the DER provides. For example, if a 1 MW load has a 5 MWh battery integrated to cover 4 hours of outages in 90% of cases, operating it with 500 kW of DER or DSR would increase the coverage provided from 4 to 8 hours.

Where available, DER therefore has the potential to significantly lower the capacity requirements for the battery and thus the associated cost of the BESS system. Further analysis of the potential contribution of DER and DSR to a RaaS solution will be undertaken as part of the Front-End Engineering Design (FEED) for the selected trial site.

5.3.1.5. System sizing conclusions

To provide a working reference for system analysis to feed into the site selection, a battery capacity of 3 MWh has been used. This was judged to be reasonable by the project engineering team based on expectations of suitable sites and the available budget. The battery was designed as a 1C[3] battery system which reflects the market standard and provides the best cost benefit solution. Therefore, a 3 MVA / 3 MWh BESS was used for the Conceptual Engineering Design in the site selection process.

5.3.2. Conceptual Engineering Design

To develop an understanding of the range of factors relevant to a battery system design, a Conceptual Engineering report was created in collaboration with E.ON's engineering consultant DHybrid GmbH. This conceptual design is summarised below, with the full detail of the report being available upon request to the RaaS project team.

[3] The C-Rate indicates the ratio between energy and power of a battery system and the inverse of the time required to charge or discharge the battery at full power. 1C therefore means, that by applying the maximum rated power to a battery system it would be charged or discharged in 1 hour. 2C would indicate a possible charge or discharge with maximum power in 0.5 hours.

The Conceptual Engineering report provides an understanding of what factors should be considered at a site in terms of equipment that may be required to implement RaaS at a given primary substation. It also provides an understanding of the required system size which is of relevance to the choice of potential trial site with regards to the requirements for space to install the BESS.

Building on the sizing analysis described above, the Conceptual Engineering Design was created for Mallaig using a battery configuration of 3 MVA / 3 MWh.

5.3.2.1. BESS overview

BESS systems comprise of battery racks, power conversion systems (PCS), a step-up transformer and auxiliaries, grouped and combined into a housing.

The batteries comprise individual cells which are grouped into modules and stored in steel-racks. It is beneficial to design them in a modular fashion as this increases efficiency, reliability, and versatility.

The power conversion system (PCS), typically referred to as an inverter, is the device which has direct control of battery charging and discharging. These come in two major types: Grid-Following and Grid-Forming. Grid Forming inverters are capable of operating as a voltage source, whereas Grid-Following inverters act purely as a current source. The application of RaaS requires Grid-Forming inverters as these can operate without a voltage reference from the mains network to operate in island-mode. A step-up transformer on the output side of the PCS then transforms the 0.4kV nominal voltage output to the required 11 kV and can provide earthing and a neutral conductor.

BESS systems can typically be constructed in one of two ways: as an in-building solution or a containerised solution. Given the fixed term application of the demonstration project, a containerised solution was considered for the site evaluation.

5.3.2.2. System Layout

The concept design proposes a system consisting of the following major components:

- Battery storage racks (1C) with BMS
- Battery Combiner Panels (BCP)
- Power Conversion System (PCS) modules
- Battery distribution board for LV-AC protection of the PCS modules
- Transformer station
- Energy Management System

The battery storage racks for a 3 MWh system (reflecting the conclusions from the Mallaig analysis) can be installed within one climatised 40-foot container plus a 20-foot PCS container and a 4-winding transformer in an outdoor transformer station. The system can also be installed in multiple 20-foot containers to simplify transportation and increase flexibility during set up if desired.

Auxiliaries such as firefighting systems, monitoring and fault detection systems (e.g. DC ground fault), protection equipment as well as cables (AC & DC) are to be incorporated into the design for safe and stable system operation.

Indicative dimensions for the physical system components are shown in Figure 7, indicating the space requirements but acknowledging that the layout will be site specific. The total space requirement is approximately 16m x 10m, with a total area of 160 m^2 for the indicated system size. During the installation process, a larger area of land would be required to allow for construction equipment and to have sufficient space for a Construction Design and Management compliant site setup (CDM site).

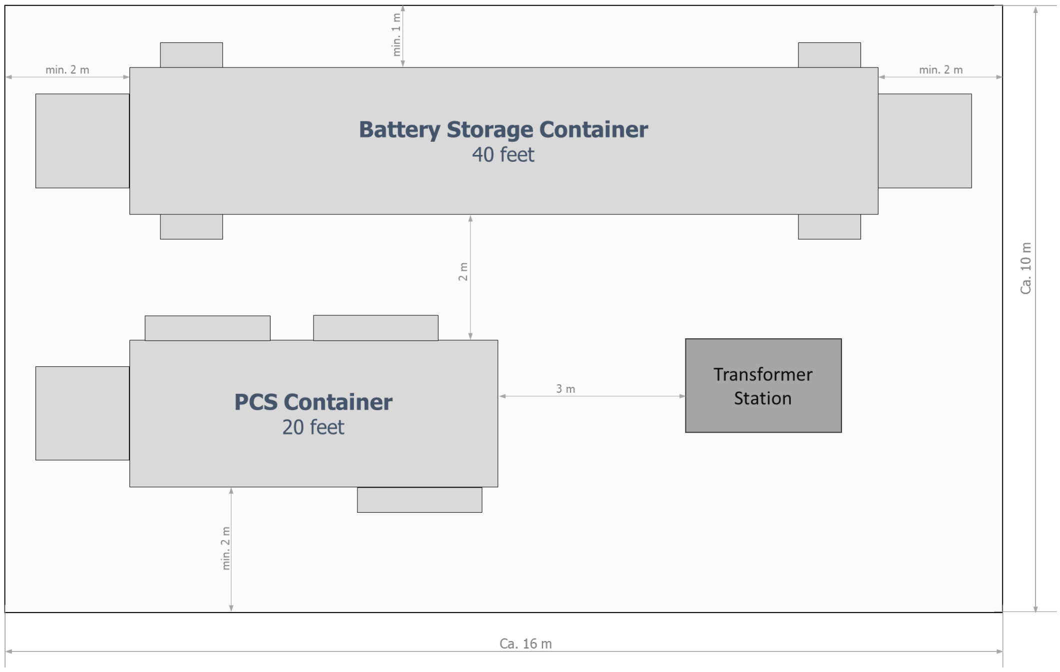


Figure 7 - Indicative dimensions for example site Battery Storage System extension

5.3.3. Electrical integration requirements

As the RaaS system will integrate with the 11kV switchboard, sufficient space is required to allow the additional connection with a new circuit breaker, together with integration of a synchronisation controller[4]. Where space allows, it is possible to extend an existing switchboard to enable more connections. However, this should be done using the same manufacturer and model to ensure a high level of reliability. If the same manufacturer and model is unavailable, the switchboard may require replacing and this would need to be factored into plans for installation.

5.4. Evaluation of shortlisted sites

The evaluation of shortlisted sites is based on a combination of desktop reviews of information available from SSEN data systems (full list provided in Appendix I), together with site visits to survey the shortlisted substations.

The site surveys were completed over two trips. The initial visits were undertaken between the 18th August 2020 and 21st August 2020 by the SSEN project engineer together with local site managers. In addition to engaging with the local field teams to learn more about the sites, photographs were taken to complement the assessments completed at each site, and where phone signals allowed, video calls were held with members of the E.ON project team. Two of the five shortlisted sites, Kishorn Hill and

[4] Further detail on the synchronization controller is provided in the Conceptual Engineering Report, which can be made available upon request.

Mallaig, could be discarded after the first round of site visits based on information collected during these surveys.

The second round of site surveys to the remaining sites were completed between 23rd September 2020 and 25th September 2020, with representatives from both E.ON and SSEN.

The detailed site assessment checklists can be found in Appendix II and III.

5.4.1. Drynoch

Drynoch is a village located on the Isle of Skye with 1047 customers connected to the electrical grid. The substation is connected on 33 kV with a single 12.15 km radial line. The peak demand was 1.34 MW and there is 0.93 MVA of embedded DER on the 11 kV network. Over the last five years, a total of 17 interruption incidents were recorded, of which 6 were with high Customer Interruptions (> 500 customers). The average time off supply was 34.8 minutes.

5.4.1.1. Alignment to project goals

Drynoch has had the second lowest number of network faults in the past five years of all shortlisted sites. But there has been a sufficient number of faults to be confident that more than one unplanned fault event is likely to occur during the two years test period. Additionally, the embedded generation on the 11 kV circuit enables integration of local renewables which can increase the resilience providing capacity of the system. An existing relationship between E.ON and the local Talisker distillery as one of the main businesses connected to this substation will enable an additional route to local stakeholder engagement.

5.4.1.2. Potential benefits of the solution

Drynoch had the lowest IIS costs across the five shortlisted over the last five years, however, the IIS impact is still substantial. An additional potential benefit to the application of RaaS at this site is the potential to support neighbouring 11 kV networks via an existing 11 kV back-feed, thus increasing the area that can be supported from the RaaS asset. This option would need to be further evaluated within the FEED.

5.4.1.3. Practicability of delivery and operation

The Drynoch substation lies 212 miles from Glasgow and would take c. 5 hours to reach in a standard sized car and respectively longer in a heavy goods vehicle (HGV) as shown in Figure 8 below.

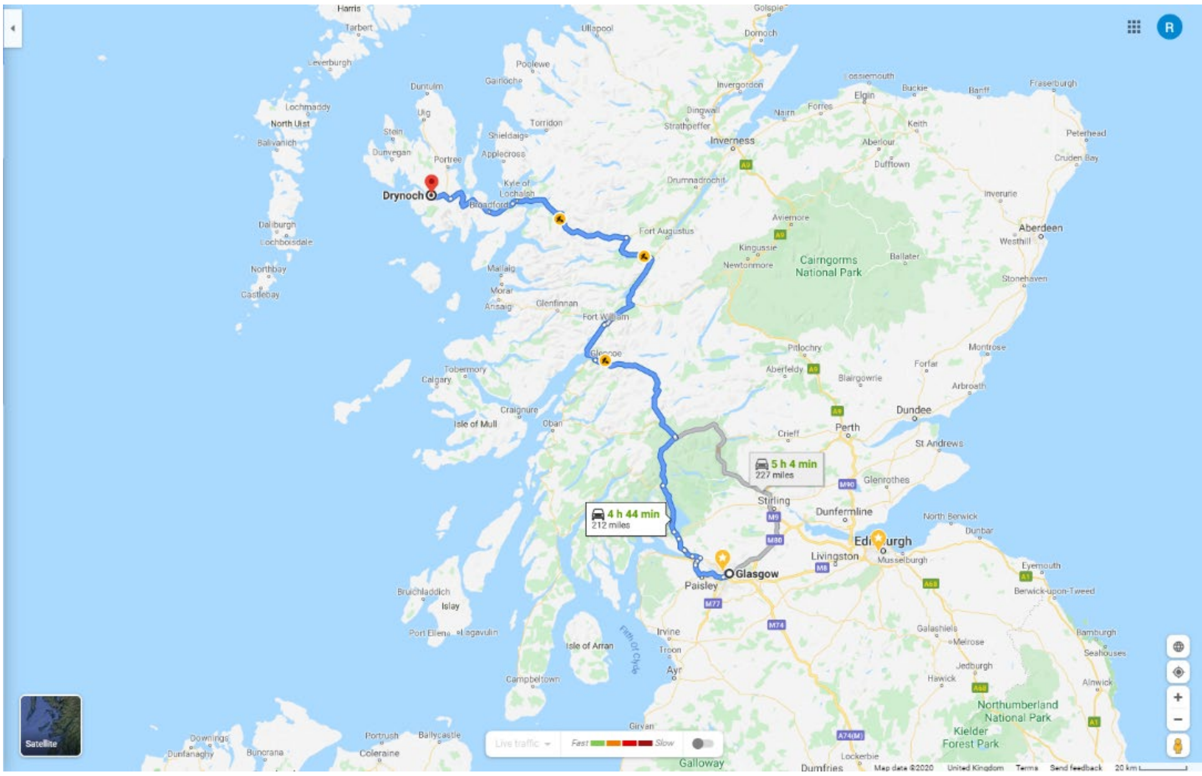


Figure 8 - Potential route from Glasgow to Drynoch

Drynoch has good accessibility via the bridge that connects Skye to the mainland, meaning the entire journey can be completed on double-track A-roads. The bridge crosses the sea at Kyle of Lochalsh and is suitable for a flat-bed truck. Space availability for parking and turning of vehicles is assessed to be good. Sufficient space for cranes and storage containers is available inside the substation compound. The transportation risk is therefore deemed to be low.

In Figure 9 below, the Drynoch site layout diagram can be seen. A picture of the substation is shown below in Figure 10.

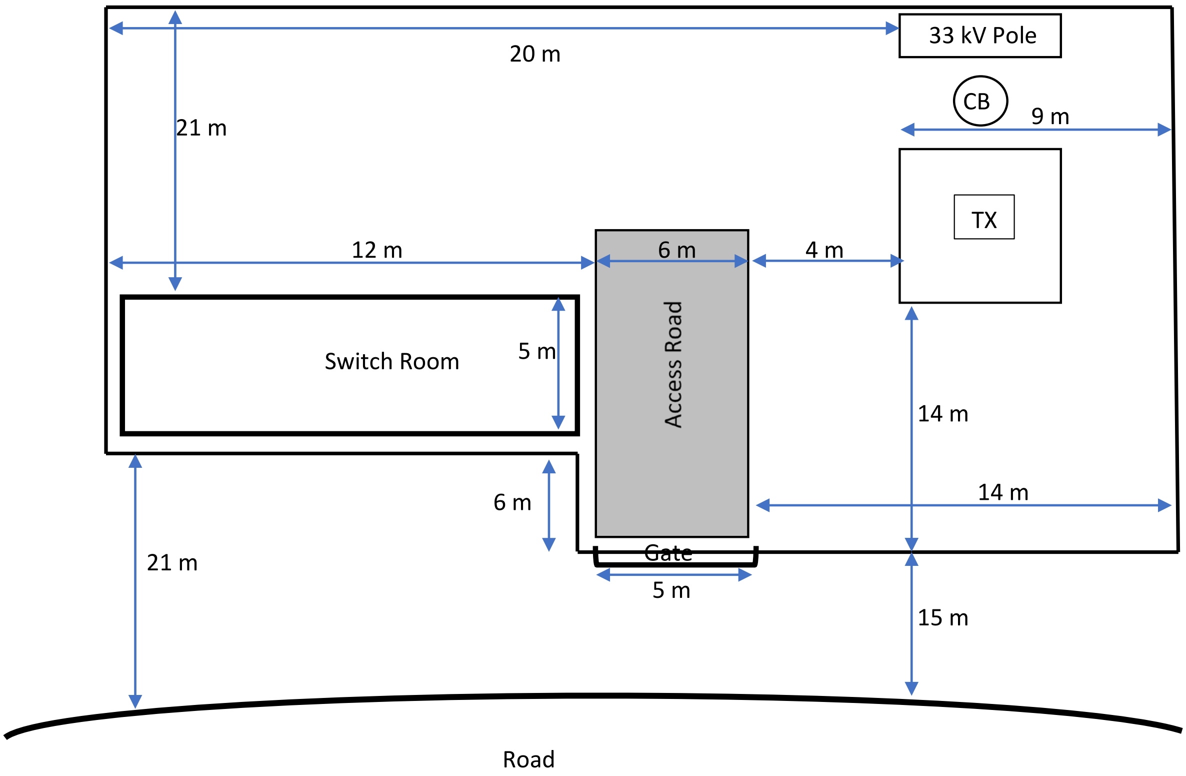


Figure 9 - Site layout diagram of Drynoch

Figure 10 - Google street view image of Drynoch

According to site layout diagrams provided, approximately 500 m^2 of space is available at Drynoch, that is owned by SSEN and is available for the trial project. In the site visit it was confirmed that there was plenty of space for the system within the perimeter of the site boundary, which is shown in Figure 11.

The ground at the site is also level and sufficiently prepared for a system to be installed with only minor civil works required.

The entire substation compound is fenced. Toilet facilities and water connection are available and sufficient space for further CDM setup is available in front of the substation building. No overhead lines obstruct the proposed construction site; however, crane operation needs to be carefully planned to account for the nearby 33 kV incoming feeder. The proposed construction site has some underground drainage which needs to be considered during construction. Cell phone connection is available.

Figure 11 - Photograph of Drynoch Substation from site visit

5.4.1.4. Technical design and integration

The 33kV / 11kV transformer is old and has aged protection equipment that is fully electro-mechanical and unsuitable to ensure the project goals are met. Additionally, the automatic voltage control (AVC) at this substation is not suitable for BESS implementation and the substation controller needs to be upgraded from C10 to C10e to be suitable for a RaaS application.

For this site to be chosen, the protection equipment as well as the 11 kV switchboard requires replacement and extension.

5.4.1.5. Conclusion

Drynoch substation provides a good option for the implementation and testing of the RaaS solution. Although it provides the lowest direct benefits and requires replacement of the protection equipment and the 11 kV switchboard. The site enables a wide range of demonstrations in line with the project goals and lowest risk and cost for delivery, installation and operation of the assets.

5.4.2. Kinloch

Kinloch is a village located on the Isle of Mull with 783 customers connected to the electrical grid. The substation is connected on 33 kV with a single 34.1 km radial line. The peak demand at the site was 1.4 MW in 2019 and the network has no embedded generation on the 11 kV network. Over the last five years, a total of 98 interruption incidents were recorded of which 12 were with high Customer Interruptions (> 500 customers). The average time off supply was 106.5 minutes.

Due to the increased effort to get to Kinloch, this substation was only visited in the second round of site visits.

5.4.2.1. Alignment to project goals

Kinloch matches the project goals well given the high number of interruptions and time of supply. This would enable sufficient opportunity to undertake live testing of the solution. However, the lack of embedded generation on the 11 kV circuit to be integrated in the RaaS concept would prevent the project from testing integration of local DER.

5.4.2.2. Potential benefits of the solution

Kinloch had the highest IIS cost of all shortlisted sites, therefore indicating the greatest direct benefits from the RaaS project. It was also highlighted during the site visits that a RaaS solution in Kinloch would be highly beneficial to the local community and network.

5.4.2.3. Practicability of delivery and operation

Kinloch is located 126 miles north-west of Glasgow on the Isle of Mull. This journey would take approximately 4 hours including ferry transfer to the island as shown in Figure 12.

A regular ferry, suitable for a 17m length truck (>40ft truck), operates between Craignure and Oban. On the island, single-track roads with passing spaces are common, meaning there is a high probability that certain sections of the route must be closed for the public during delivery of the main BESS components. Access to the construction ground is good with sufficient space for turning. Regular touristic traffic needs to be considered. The transportation to Kinloch poses a high risk for this site and would need to be planned and considered carefully during system design.

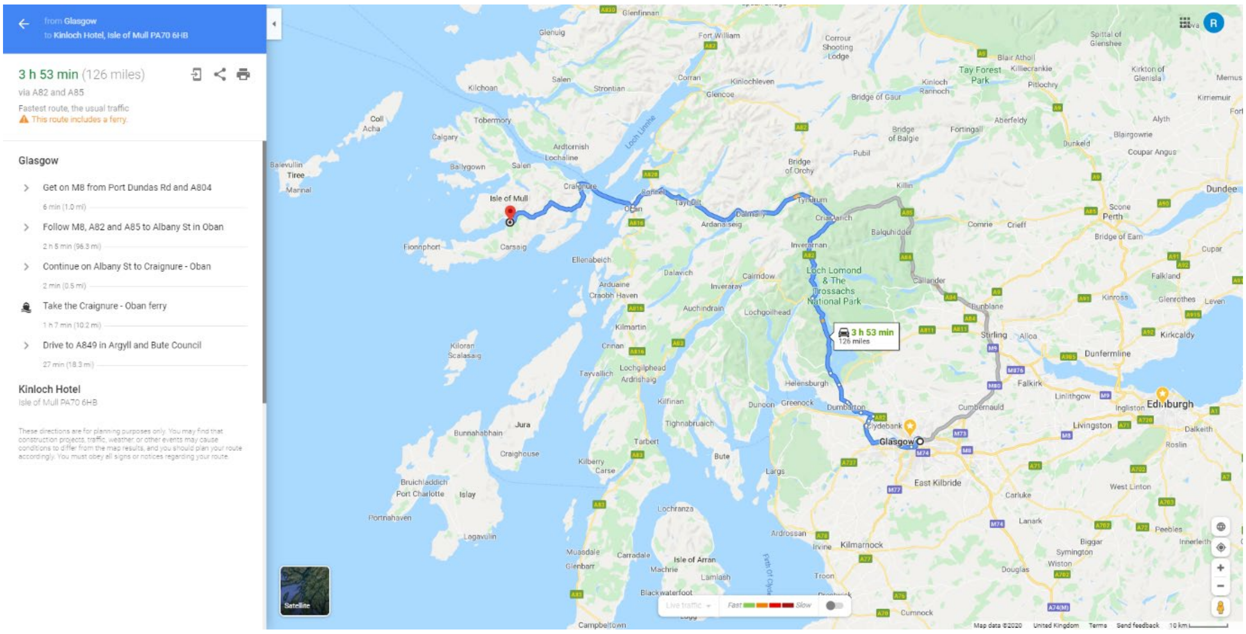


Figure 12 - Potential route from Glasgow to Kinloch

In Figure 13 below, the site layout of Kinloch substation can be seen.

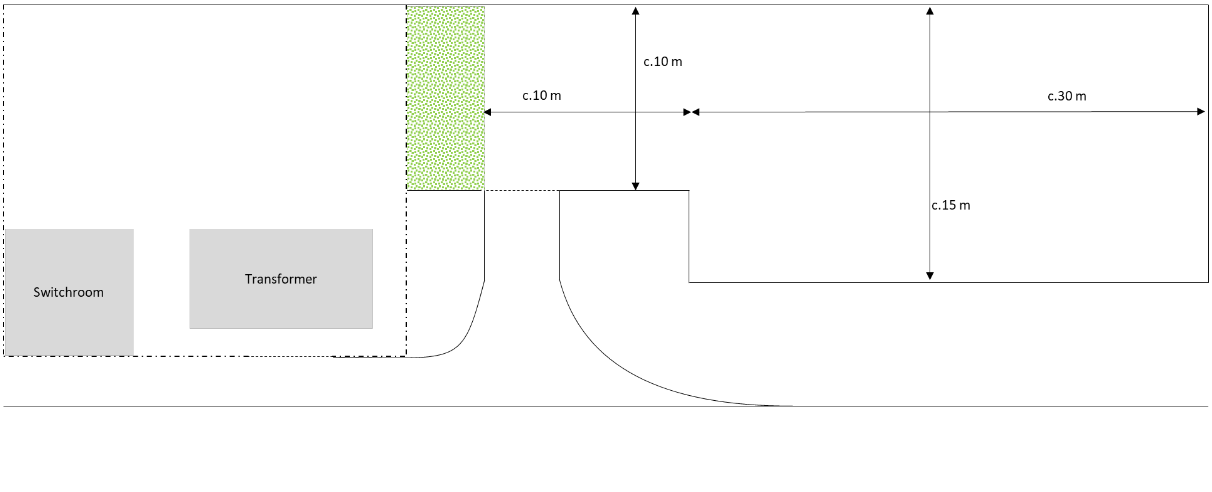


Figure 13 - Sketch of Kinloch substation including potential construction site

As shown in Figure 13, there is sufficient space available at the Kinloch substation due to the large potential construction ground available to the right-hand side of the substation compound with dimensions of c. 30m x 15 m plus 10 m x 10 m (see Figure 14). This is equivalent to approximately 550 m^2 and is sufficient for the permanent system as well as during construction. There is no existing water or welfare facilities, so these would need to be provided. However, there is sufficient space for CDM to be set up. Space and accessibility must be reserved for diesel gensets that are deployed in case of an outage. The site's location close by the sea means that there is an increased risk from rough weather as well as high salt content in the air.

Figure 14 - Photograph of the potential construction site at Kinloch substation

The ground is flat, gravelled and has a slight slope, but no major civil works are expected. The construction ground is gated with some CCTV available as well. Minor vegetation requires removal for cabling routes to the switchroom. No overhead lines are obstructing the construction site; however, crane operation needs to be carefully planned to account for the nearby outgoing 11 kV feeder. The planned construction site has no underground infrastructure to be considered and cell phone coverage is available. Overall, this site has medium level of risk associated with the regards to installation.

5.4.2.4. Technical design and integration

The Kinloch substation currently does not have an 11 kV switchboard meaning it requires a new installation. 33 kV protection equipment and a transformer considered suitable for RaaS application are available and have no need for replacements.

The technical design needs to consider the additional challenges imposed by the necessary transportation routes. This might include specific designs to only use smaller containers or similar measures.

5.4.2.5. Conclusion

Kinloch is considered a suitable site for a RaaS trial as it will benefit significantly from the solution plus electrical implementation is also considered beneficial for the demonstration project. However, lack of embedded generation limits the match to project goals whilst the increased challenges involved with delivery to the site imposes additional risks and costs in delivering and operating the RaaS solution.

5.4.3. Kishorn Hill

Kishorn Hill is an area in the Scottish Highlands next to Loch Kishorn with 846 customers connected to the electrical grid. The substation is connected on 33 kV with a single 5.3 km radial line. The peak demand at the site was 1.38 MW in 2019 and the network has 0.45 MVA of embedded generation on the 11 kV network. Over the last five years, a total of 15 interruption incidents were recorded of which 13 were with high Customer Interruptions (> 500 customers). The average time off supply was 39.3 minutes.

Kishorn Hill has not been visited in the second round of the site visits as it was discarded as potential trial site after the first round of site visits for the reasons given below. The information gathered for Kishorn Hill is therefore less complete, compared to the other sites.

5.4.3.1. Alignment to project goals

Kishorn Hill has had the lowest number of network faults in the past five years of all shortlisted sites. However, with 15 interruptions it is still likely that an interruption will occur during the trial phase. The embedded generation on the 11 kV circuit enables integration of local renewables which can increase the resilience providing capacity of the system.

5.4.3.2. Potential benefits of the solution

Kishorn Hill had average IIS cost compared to the other shortlisted sites, indicating a good potential benefit from RaaS. The benefits are slightly reduced, however, as the site has some capability to be restored via an 11 kV connection which means that the RaaS system may have less opportunity to provide resilience.

5.4.3.3. Practicability of delivery and operation

Kishorn Hill substation lies 195 miles from Glasgow, with the majority of the route using A-roads, with some segments being single-track roads potentially requiring temporary closure. The substation itself lies off the A-road on a small road as shown below in Figure 15. The accessibility at this site is deemed to be of medium risk.

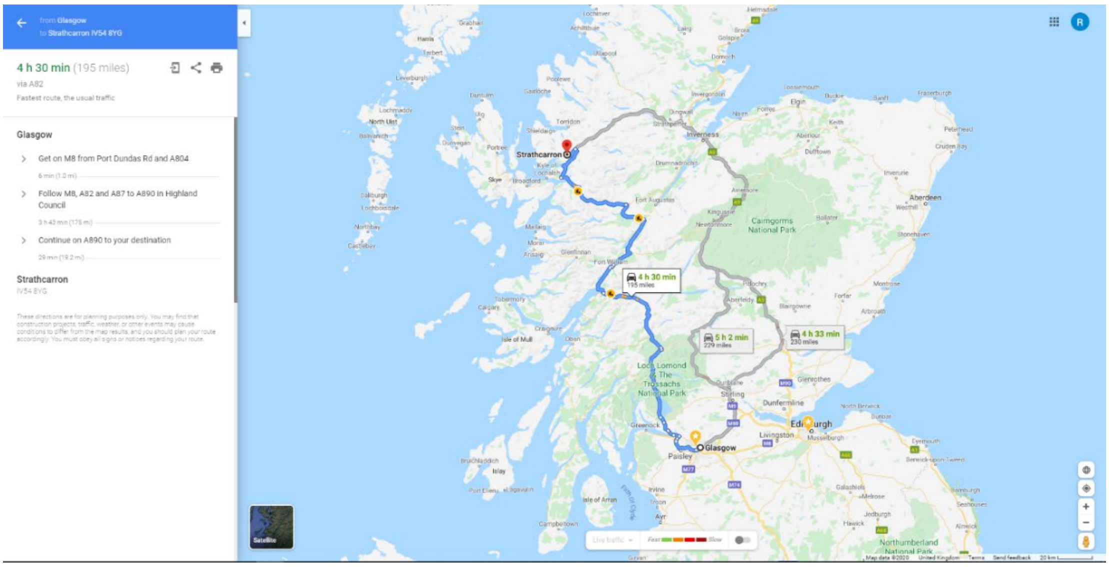


Figure 15 - Potential route to Kishorn Hill from Glasgow

The site layout diagram in Figure 16 below shows that there is a space of only c.18m x 5.6m available to the edge of SSEN's available land. This is insufficient for the planned project installation therefore land would need to be leased to from a third party. The potential time and cost for negotiating a leasing agreement is considered to represent a risk for timely delivery of the project.

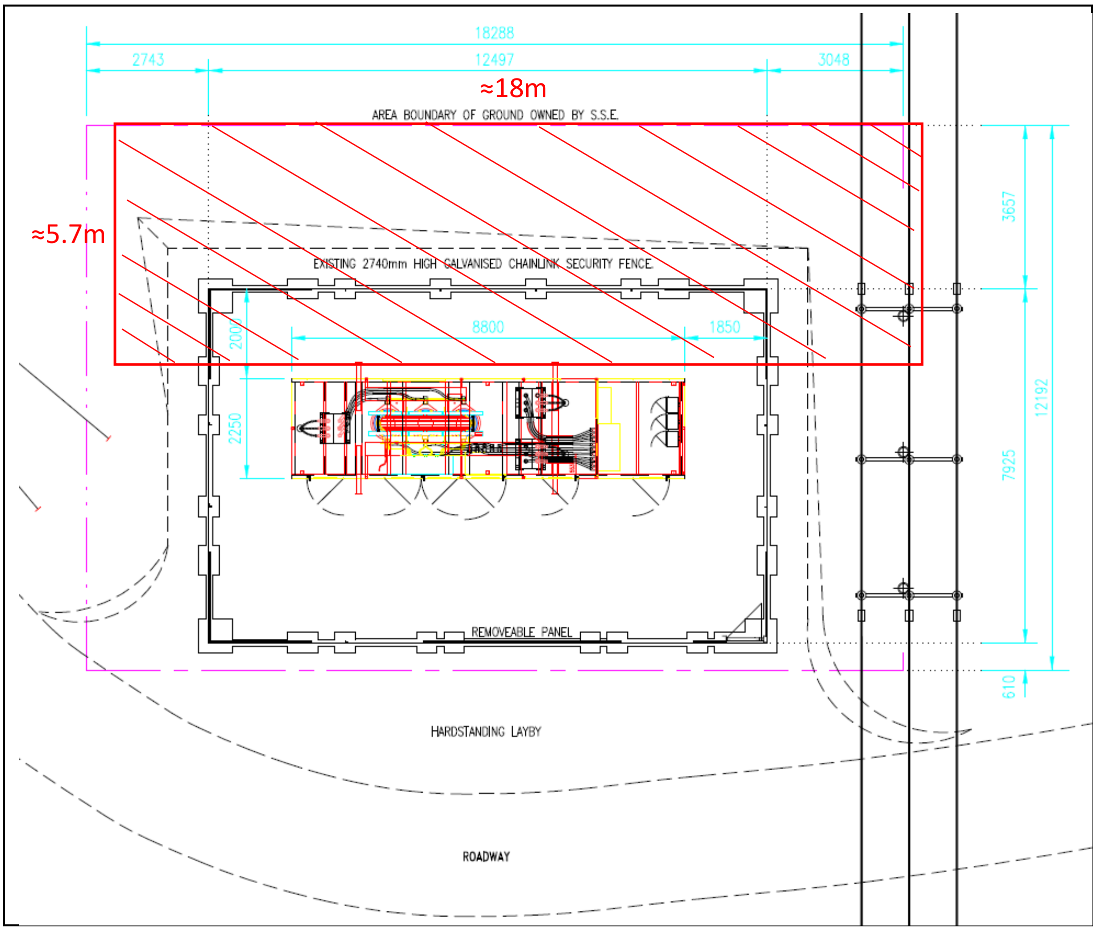


Figure 16 - Site layout diagram of Kishorn Hill

5.4.3.4. Technical design and integration

As can be seen from Figure 17, the site uses a containerised substation with no space to implement additional systems. It would therefore be required to completely replace the substation in order to integrate the RaaS system. This would add significant cost, complexity and risk to the project.

Figure 17 - Google Street View image of Kishorn Hill substation

5.4.3.5. Conclusion

There are significant risks associated with this site due to a lack of space at the site, and the requirement to replace the containerised substation. On the other hand, the alignment to project goals is only regarded to be medium. Therefore, this site was deemed to be unsuitable for the demonstration project.

5.4.4. Lochinver

Lochinver is a village that lies on Loch Inver and is the most northernly site being considered. It has 846 customers connected to the electrical grid. The substation is connected to 33 kV with a single 31.5 km radial line. The peak demand was 1.5 MW and there is 0.24 MVA of embedded generation on the 11 kV network. Over the last five years, a total of 56 interruption incidents were recorded, of which 12 were with high Customer Interruptions (> 500 customers). The average time off supply was 73.3 minutes.

5.4.4.1. Alignment to project goals

Lochinver has had an average number of network faults in the past five years of all shortlisted sites, which is sufficient to be confident that more than one unplanned fault event is likely to occur during the two years test period. Additionally, the embedded generation on the 11 kV circuit enables integration of local renewables which can increase the resilience providing capacity of the system.

5.4.4.2. Potential benefits of the solution

Lochinver had the second highest IIS cost of the shortlisted sites, which indicates a high potential benefit for this site. In addition, a RaaS solution might provide an alternative to comply with P2/7 requirements in Lochinver.

5.4.4.3. Practicability of delivery and operation

Lochinver substation lies on the coast 253 miles north of Glasgow as shown in Figure 18. The substation lies off a small road within the town (Figure 19), meaning A-roads can be followed for most of the route, with some segments comprising single-track roads which may require temporary closure for the public. Additionally, the last segment on the target road is deemed to add complexity, given the narrow road, overhead vegetation and lack of space for turning of trucks. Overall, accessibility is deemed to be of high risk.

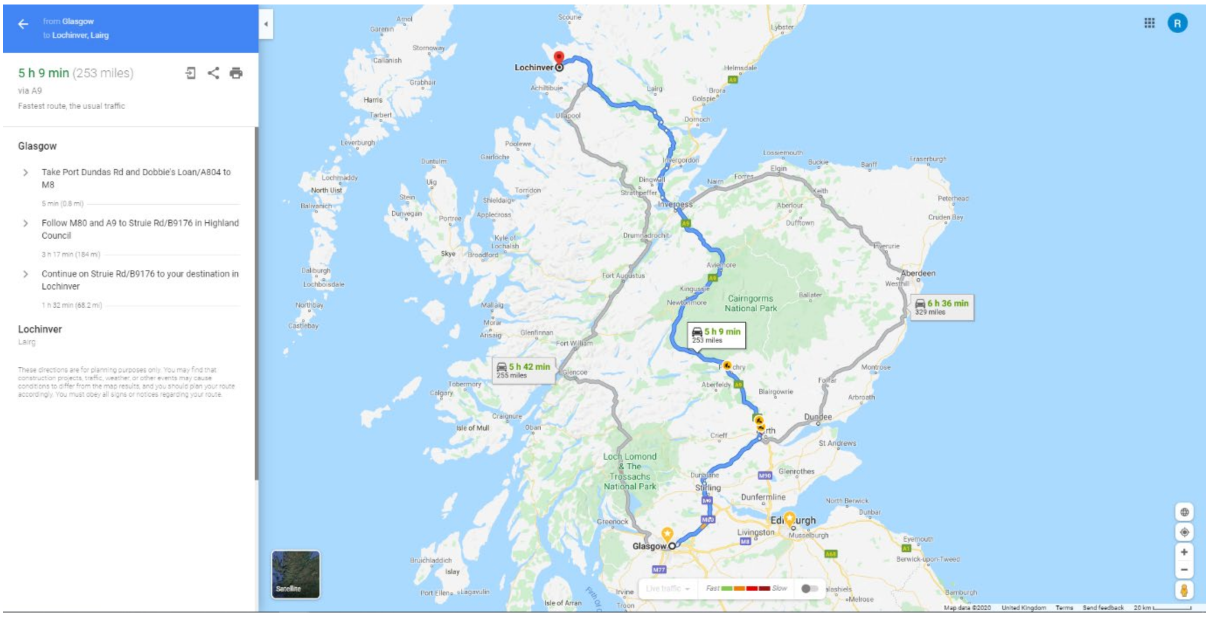


Figure 18 - Potential route to Lochinver from Glasgow

Figure 19 - Road access to Lochinver substation

There is space available between the substation and the boundary of SSEN land. With approximately 450m^2 being available, which is sufficient for the system, installation and CDM as shown in Figure 20. The site however requires extensive ground and civil works to remove existing vegetation and provide levelled ground with suitable foundations which would add significant cost and risk. The substation lies completely within a corrugated-iron building as can be seen in Figure 21 below.

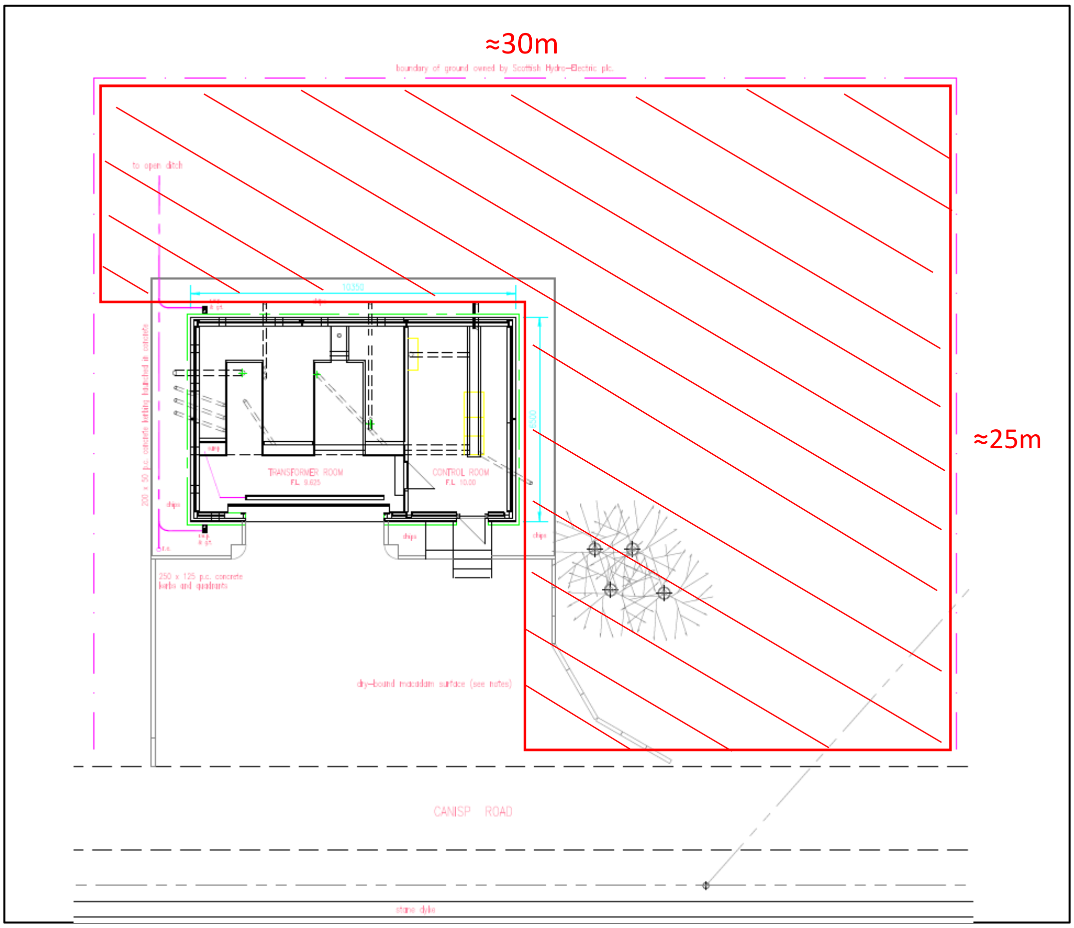


Figure 20 - Site layout diagram of Lochinver

Figure 21 - Google Street View of Lochinver Substation

Furthermore, this site has residential homes in close proximity of the substation which poses a high risk of noise pollution from the BESS which could negatively impact public opinion on the project and might require high costs to mitigate.

5.4.4.4. Technical design and integration

There is a high risk associated with the existing electrical infrastructure. There is no switchboard at the site and all 11kV switches are pole-mounted, leading to increased difficulty to connect the RaaS system. The 11kV transformer circuit breaker is also not appropriate for the intended RaaS application and would require an upgrade. The transformer at the site is in reasonable condition.

5.4.4.5. Conclusion

Although there are good benefits and alignment to project goals, this site has a high level of risk associated with delivery and operation as well as technical integration. This is due to site access issues, complexity in the civil works required, and difficulty with connecting the RaaS system to the 11 kV circuit. Additionally, there are customer properties in close vicinity to the substation resulting in a high risk of complaints due to noise exposure.

5.4.5. Mallaig

Mallaig is a port in Lochaber on the west coast of the Scottish Highlands. It has 802 customers connected to its electrical grid. The substation is connected on 33 kV with a single 20.3 km radial line. The peak demand was 1.9 MW and there is 0.8 MVA of embedded generation on the 11 kV network. Over the last five years, a total of 87 interruption incidents were recorded, of which 12 were with high Customer Interruptions (> 500 customers). The average time off supply was 42 minutes.

Mallaig has not been visited in the second round of the site visits as it was discarded as potential trial site after the first round of site visits for the reasons given below. The information gathered for Mallaig is therefore less complete, compared to the other sites.

5.4.5.1. Alignment to project goals

Mallaig has had an average number of network faults in the past five years compared to all shortlisted sites, which is sufficient to be confident that more than one unplanned fault event is likely to occur during the two years test period. Additionally, the embedded generation on the 11 kV circuit enables integration of local renewables which can increase the resilience providing capacity of the system.

5.4.5.2. Potential benefits of the solution

Mallaig had approximately average IIS cost among the shortlisted sites, which would offer a good level of potential commercial benefits for this site. However, during the site visit to Mallaig, the project team learned from engagement with the local site manager that the Mallaig 11 kV network can be back-fed from the neighbouring Arisaig primary substation within three minutes. This means that this site has considerably lower outage times caused by faults on the 33 kV line than initially expected.

5.4.5.3. Practicability of delivery and operation

Mallaig lies 148 miles north-west of Glasgow, with the substation lying directly off the A830 meaning the entire journey can be done on A-roads as shown in Figure 22. The journey would take approximately 3.5 hours to drive and imposes height restrictions of 4.1 m to pass under bridges. Risk from accessibility is deemed to be medium.

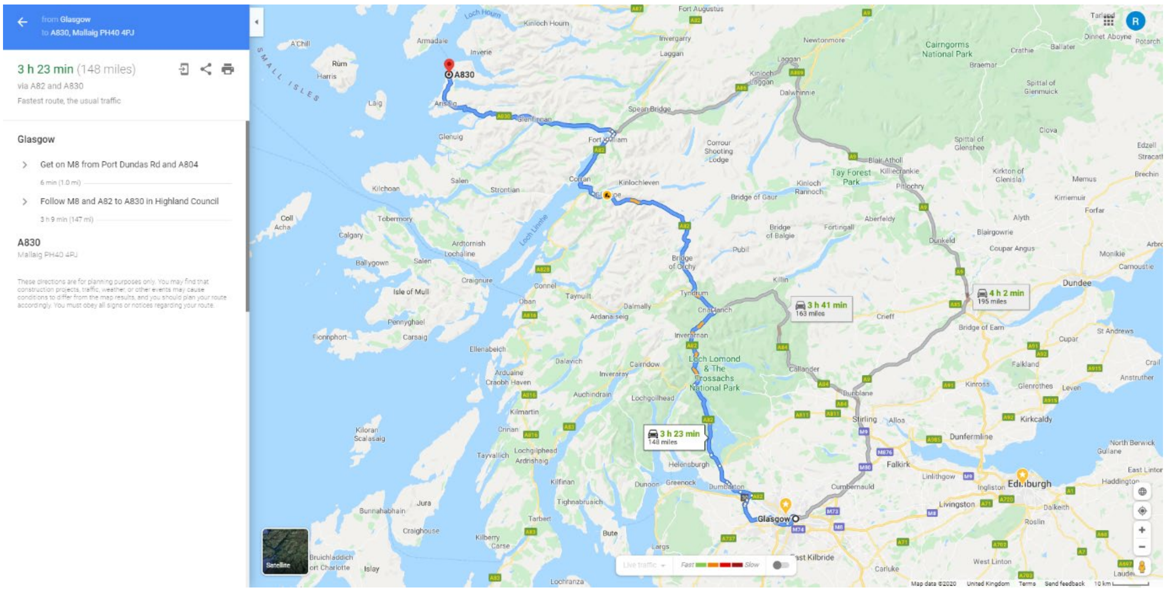


Figure 22 - Potential route to Mallaig from Glasgow

In Figure 23, the site layout diagram for Mallaig can be seen, with pictures of the substation compound shown in Figure 24 and Figure 25. These show there is a space available of approximately 9m x 20m within the substation compound, which is just sufficient for the permanent system's location. The site lies in a relatively open area of land just off an A-road, however, there is some heavier vegetation that would require removing. Height of the system must be considered at this site as the system would have to sit below the 11 kV lines where there is a clearance of approximately 2.8m required. Ground conditions are deemed to be good with little civil works expected. Challenges arise from additional space requirements during construction for logistics, storage and CDM site setup. In total, the risk for delivery is deemed to be high.

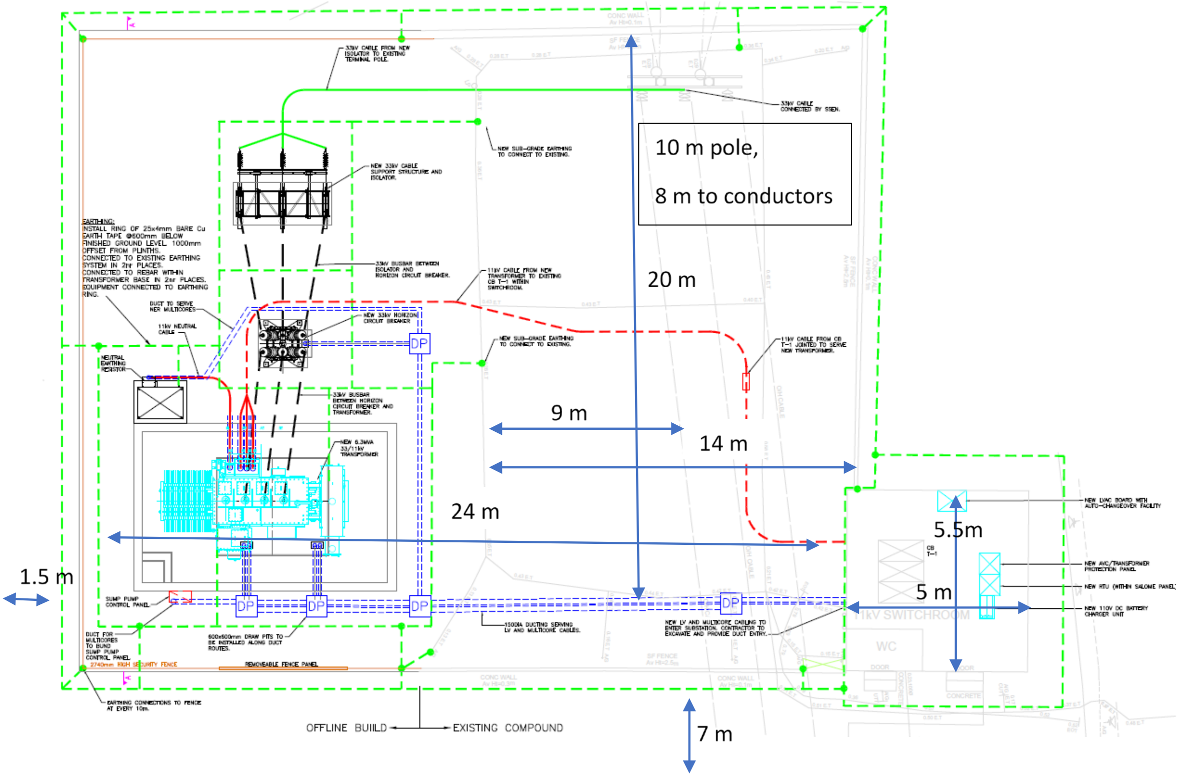


Figure 23 - Site layout diagram of Mallaig

Figure 24 - Photograph of Mallaig substation taken during site visit

Figure 25 - Photograph of access road to Mallaig substation and surrounding land

5.4.5.4. Technical design and integration

In 2018 the former 8 MVA, 33/11kV transformer of Mallaig substation was replaced with a 6.3 MVA, 33/11kV transformer. This means that the transformer, protection and controls are all modern and suitable for implementation of the RaaS system. The 11kV switchboard however is approximately 60 years old, meaning it may be unsuitable for the RaaS application and difficult to find a suitable extension. In addition, there is little space within the existing switchroom for an extension, potentially requiring an extension of the switchroom.

5.4.5.5. Conclusion

The Mallaig substation could be suitable for the RaaS trial considering alignment to project goals and the modern transformer at the substation. However, due to the 11kV back-feed connection to Arisaig, which is fed by a separate 33 kV line, there are only minor benefits to be gained from this site. Also, delivery and implementation of the system would be challenging given the space constraints inside the substation compound and the necessity to increase the switchroom to extend or replace the switchboard.

5.5. Conclusions and selected site

Following completion of the desktop analysis and site surveys, the primary substation selected for the RaaS project is Drynoch on the Isle of Skye. Drynoch provides the opportunity to test all key aspects of the RaaS concept, achieve the project goals, and deliver the full range of benefits from the solution. This site will now be taken forward to the design stage with an initial FEED developed for peer review. This will then inform development of the detailed design and potential implementation of RaaS in Phase 2 of the project, following the Stage Gate decision point.

Kinloch substation has been identified as the site to be considered during Phase 2 within the BAU preparation for a second site which will be developed for PD8.

All locations considered are expected to benefit from RaaS, and therefore the successful trial of the system at Drynoch would support the future intended roll out of RaaS to other suitable sites across SSEN's area, and adoption by other DNOs. The findings and conclusions are summarized in Table 3 below.

Table 3: Summary of site selection

Substation Name	Pros	Cons	Conclusion
Drynoch	- Space for battery within substation compound - Good level of DG (0.93 MVA) - Low risk for delivery and operation - Regular outages to be expected for live testing - E.ON relationship to local businesses	- P2/7 compliant - Low IIS - Need to replace existing 11 kV switch board and protection	Selected as potential Trial Site
Kinloch	- Very High IIS - Long OHL - P2/7 non-compliant - No 11 kV back feed - Good space availability - No 11 kV switchboard existing - Regular outages to be expected for live testing	- No embedded generation - High risk accessibility on Island for Delivery and Operations	Selected as potential follow-up site for PD8 regarding BAU preparation for a second site
Kishorn Hill	- High IIS - P2/7 non-compliant - Some DG (0.45 MVA) - Proportion of load can be restored via 11 kV	- Low number of faults - Short OHL - No space for system - Replacement of complete substation required	Not selected for the project trial
Lochinver	- High IIS - P2/7 non-compliant - Some DG (0.24 MVA) - no 11 kV back feed - Good space availability - Regular outages to be expected for live testing	- Possible reinforcement due - Extensive ground and civil works required - Difficult accessibility on site - Difficult connection to 11 kV - Housing in close vicinity with potential noise issues	Not selected for the project trial

Mallaig	- High IIS - Long OHL - High number of faults - Good level of DG (0.8 MVA hydro) - Good space availability - Good accessibility - Regular outages to be expected for live testing	- P2/7 compliant - Back-feed possible via Arisaig 11 kV circuit - Proportion of load can be restored via 11 kV	Not selected for the project trial

6. Feedback from Stakeholder Engagement

The SSEN project team engaged with a wide range of internal colleagues from asset management and field engineering teams to obtain data and local expert knowledge to inform the site selection process. This has been invaluable for both the site selection process and for further shaping plans for the RaaS system design.

Engagement has also been undertaken with local community organisations (such as Community Councils and the Highland Council), and this will be taken forward over the course of the project to build relationships and ensure the views of SSENs customers are understood and appropriately addressed. Engagement with local DER owners/operators will also be commenced to explore how the local community and local businesses can be included in the RaaS concept.

7. Learning and recommendations relevant to other project activities

RaaS is intended to cost-effectively improve service to customers in areas where traditional reinforcement to provide network resilience would be prohibitively costly. The choice of Drynoch as the project trial site will present challenges and allow solutions to be developed to provide learning on the integration of RaaS with existing substation assets and participation of local DER, thereby supporting potential future BAU roll-out of the concept.

Implications regarding the costs and operational risks from this learning will be also considered in the ongoing business case work for RaaS providers and DNOs within Work Package 5 'Business Model'. In addition, Work Package 4 'Planning for Operational Commercial Optimisation' will consider the potential to stack the RaaS service with other flexibility products on a location specific basis.

Appendices

I. Summary of data sources used

Description of data	Use of data	BAU / Trial related data	General or site specific data
Demand and forecast load growth	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	Site specific data
Power factor	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	Site specific data
Circuit length	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	Site specific data
Circuit type	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	Site specific data
Indicative per km cost of reinforcement	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	General data
Indicative fixed cost of reinforcement	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	General data
Potential RaaS set up cost	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	Site specific data
Indicative ktCO_2e for temporary diesel generation; reinforcement; and RaaS	Cost Benefit Analysis to evaluate the potential benefits of a RaaS solution	Data has BaU-relevance	General data
Number of customers	Analysis of potential for improving security of supply to customers at these sites	Trial related data	Site specific data
Embedded generation (MVA)	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data Data has BaU-relevance	Site specific data

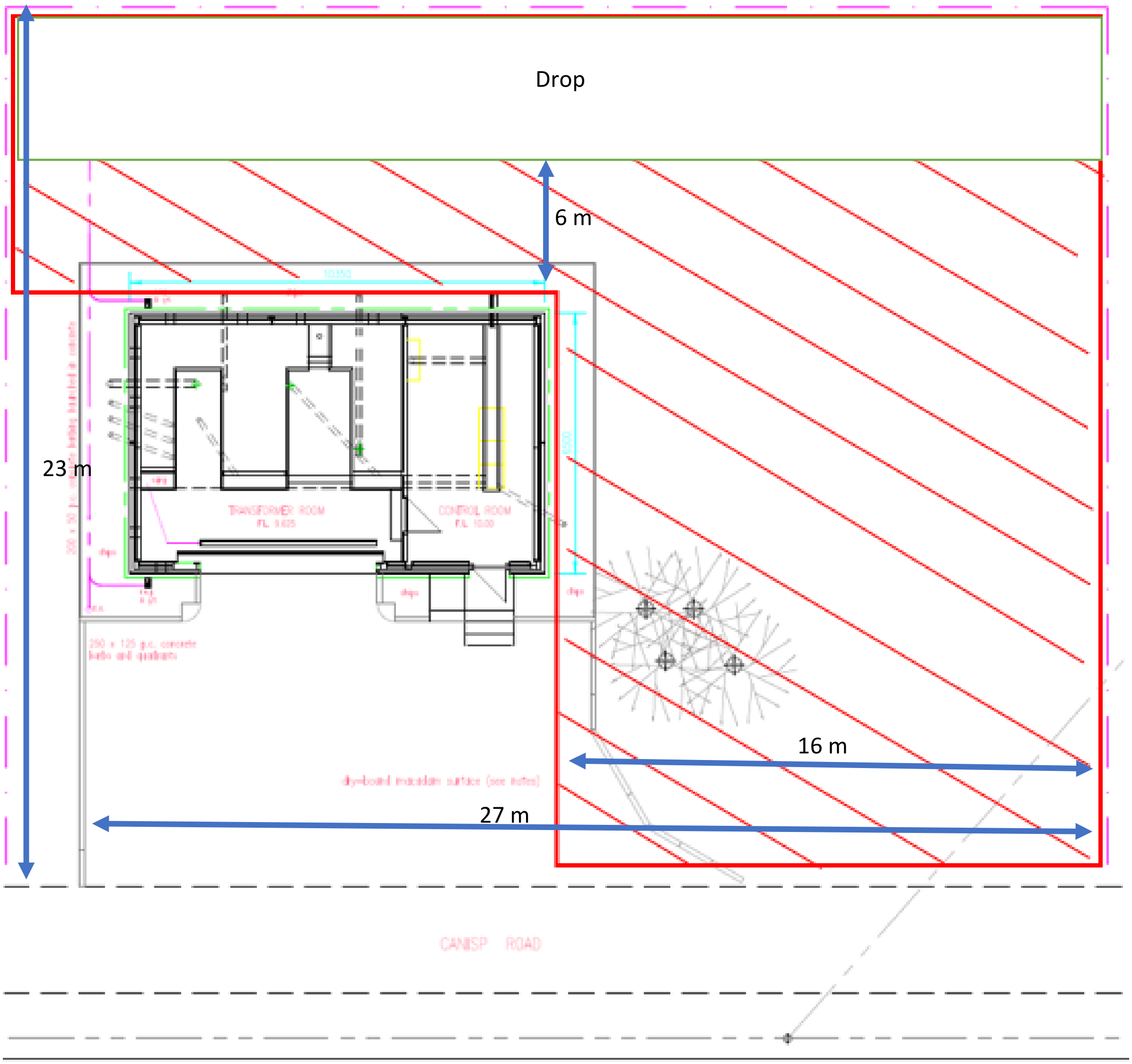
Number of faults / Customer Interruption (CI) incidents	Analysis of potential for improving security of supply to customers at these sites	Trial related data Data has BaU-relevance	Site specific data
Average time off supply / Customer Minutes Lost (CML)	Analysis of potential for improving security of supply to customers at these sites	Trial related data Data has BaU-relevance	Site specific data
IIS costs - CIs & CMLs	Analysis of potential for improving security of supply to customers at these sites	Trial related data Data has BaU-relevance	Site specific data
P2/7 compliance	Analysis of potential for improving security of supply to customers at these sites	Trial related data Data has BaU-relevance	Site specific data
Capability to restore the load via the 11 kV network	Analysis of potential for improving security of supply to customers at these sites	Trial related data Data has BaU-relevance	Site specific data
Available headroom capacity (MVA)	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data Data has BaU-relevance	Site specific data
SSEN owned generation	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data Data has BaU-relevance	Site specific data
Space for battery within the substation compound	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Established plans for reinforcement	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data Data has BaU-relevance	Site specific data
Load profiles of each site	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data

Existing site layout	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Suitability of roads for heavy goods vehicles leading to the sites	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Existing welfare facilities on site	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Accessibility to site	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Space availability for construction period and CDM requirements	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Ground conditions and required civil works	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Existing flora and fauna	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Proximity of neighbouring housing	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Underground or overhead obstacles	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data
Suitability of existing equipment for the integration of the BESS and the application of RaaS	considerations relevant to achieving the project objectives within timeframes & budget	Trial related data	Site specific data

II. First site survey reports - Lochinver, Mallaig, Drynoch, Kishorn Hill

Lochinver

Survey carried out on 19th August 2020 by Maciej Fila with John Ross

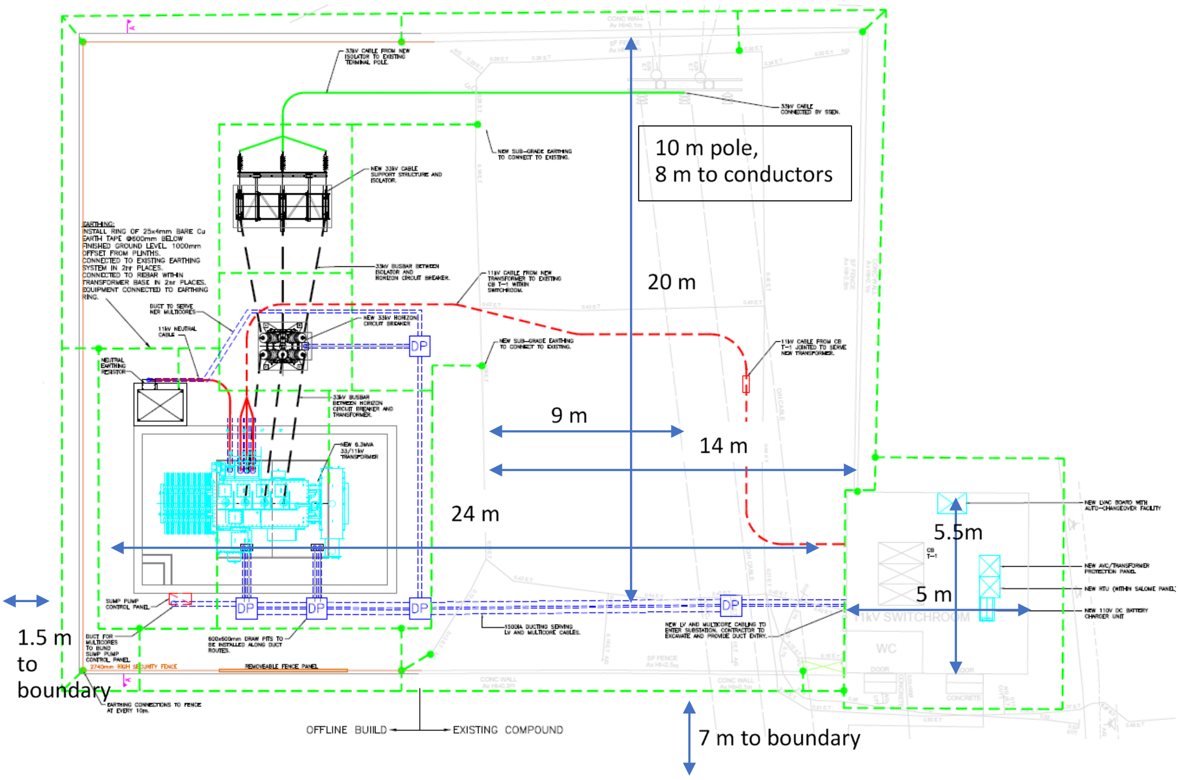


Survey Item	Comments
Space within the substation for BESS 16x10m	27x23 meters plot with 17 meters free to the righthand side of the substation. Uneven ground (1-2 meters drops) with trees and bushes but ok to level out.
Space around substation to deliver BESS. Access and roads to substation to transport BESS. (Trailer (carrying 40 feet container) and lorry, incl. space for a crane to unload the containers.	Narrow entrance to the road to the substation and narrow road. One single track road but normal road via Ullapool. No weight or height restrictions observed.

Generic discussion about construction challenges on the sites based on SSEN experience.	None highlighted.
Ground quality - The amount of civil works required to installed BESS containerized solution	Uneven ground around the substation. 1 meter drop to the right of the substation and 1.5 – 2 meters drop behind the substation.
Existing 11kV circuit breakers (type, age, condition etc)	No 11 kV switchboard. 11 kV feeders with GVR and NuLec. Air breaker for 11 kV transformer
Existing 33 kV circuit breakers (type, age, condition etc)	New vacuum CB
Existing protection systems (transformer 33 and 11 kV, 11 kV feeders) and AVC, LVAC, tripping, changeover	MCGG and MVAJ TX protection – old. FMAR (EF and OC) feeder protection. SuperTAPP AVC
Space within Switch Room for additional CBs (1 or 2) – extension of existing 11 kV busbar	New 11 kV switchgear will be required with building (containerised 11 kV board). Could be placed on the left-hand side of the substation but better on right – possible between battery and existing enclosure.
Earthing arrangements and space to add earthing transformers	Solid earth. Space for additional Tx.
Space within substation to install RaaS controller	Yes, possibly above location of the table.
Existing RTU	Modern C10e
11 kV tele-controlled switches availability/functionally	3 on feeder going up 1 on feeder going down. In good order – working
Back-Up for power supply of EMS ca. 2 kW and BMS and PCS auxiliary supply ca. 3x 6 kW	No
Existing grounding in place to share with BESS	Should be OK. Check earthing resistance in detail if selected.
Communication and internet access GSM, 3G, 4G availability? Broadband Line?	Vodafone very poor. EE seems to be OK
Black-start procedure. Review possibility to connected 11kV switches to battery EMS (via ANM?)	Not specific. Standard start up with diesel generators
Other	Commercial customer identified – ice plant

Mallaig

Survey carried out on 20th August 2020 by Maciej Fila with Lachie Innes



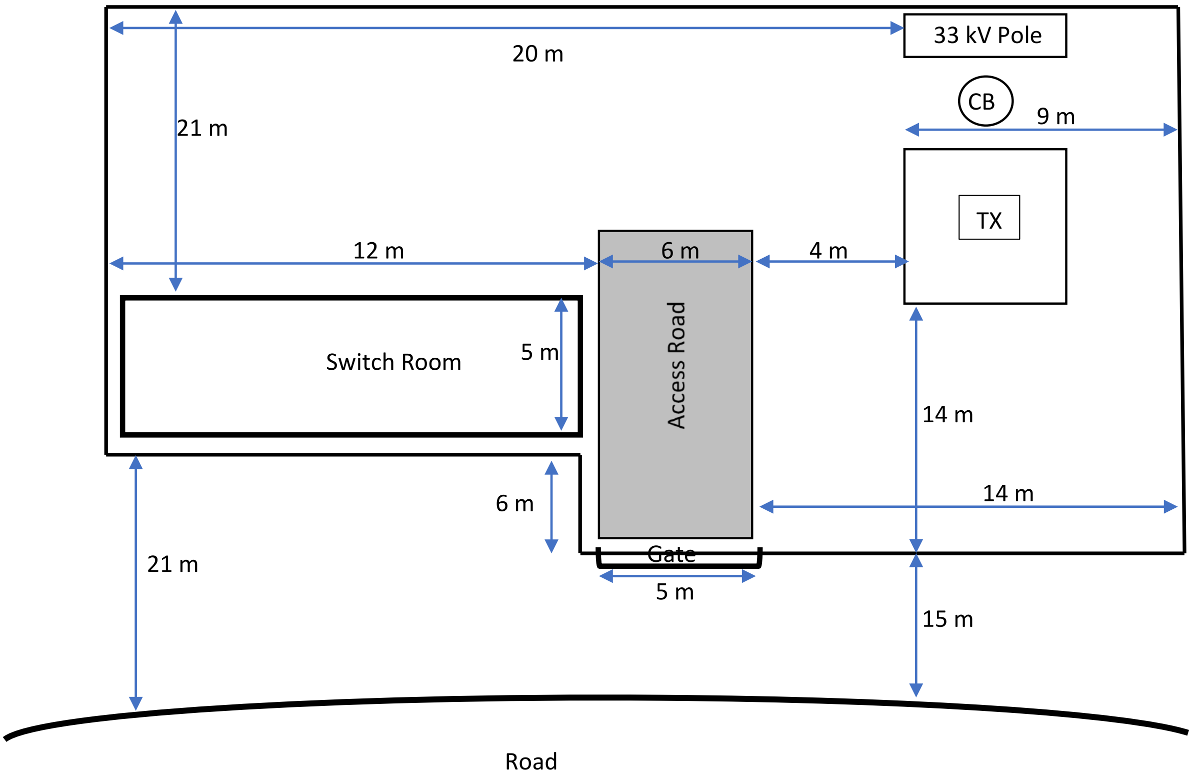
Survey Item	Comments
Space within the substation for BESS 16x10m	14 x 18 m space but under the 33 kV line. Pole height 10 m but about 8 to the conductors
Space around substation to deliver BESS. Access and roads to substation to transport BESS. (Trailer (carrying 40 feet container) and lorry, incl. space for a crane to unload the containers.	No issues at the substation – wide substation entrance and good access road. There is height limit of 4.1 m on 3 or 4 bridges between Fort William and Mallaig. No weight limit observed.
Generic discussion about construction challenges on the sites based on SSEN experience.	None highlighted. Work under 33 kV line.
Ground quality - The amount of civil works required to installed BESS containerized solution	Ground level within the substation and in front. Good access from the road to the substation compound. Space for CDM site.
Existing 11kV circuit breakers	Old South Wales Switchgear but in OK condition – no issues reported.

7 m

(type, age, condition etc)	
Existing 33 kV circuit breakers (type, age, condition etc)	New vacuum CB
Existing protection systems (transformer 33 and 11 kV, 11 kV feeders) and AVC, LVAC, tripping, changeover	New TX protection Old feeder protection. SuperTAPP n+ AVC
Space within Switch Room for additional CBs (1 or 2) – extension of existing 11 kV busbar	Not really on either site of the switch board. It might be difficult to extend existing 11 kV board – not possible to find new matching CB – second hand may be possible.
Earthing arrangements and space to add earthing transformers	Via resistor - New. Space for additional Tx.
Space within substation to install RaaS controller	Yes, possibly next to LVAC
Existing RTU	Modern C10e
11 kV tele-controlled switches availability/functionally	In good order – working
Back-Up for power supply of EMS ca. 2 kW and BMS and PCS auxiliary supply ca. 3x 6 kW	No
Existing grounding in place to share with BESS	Should be OK. Check earthing resistance in detail if selected.
Communication and internet access GSM, 3G, 4G availability? Broadband Line?	Good 3G and 4G Vodafone outside substation (not so good within). EE also seems to be OK.
Black-start procedure. Review possibility to connected 11kV switches to battery EMS (via ANM?)	Not specific. Standard start up with diesel generators
Other	Arisaig and Mallaig are fed from 2 different 33 kV feeders and can be fully back fed via 11 kV network. Also, under 33 kV fault Control Room can switch all load at Mallaig to Arisaig via tele controlled switches.

Drynoch

Survey carried out on 21th August 2020 by Maciej Fila with Campbell Murray

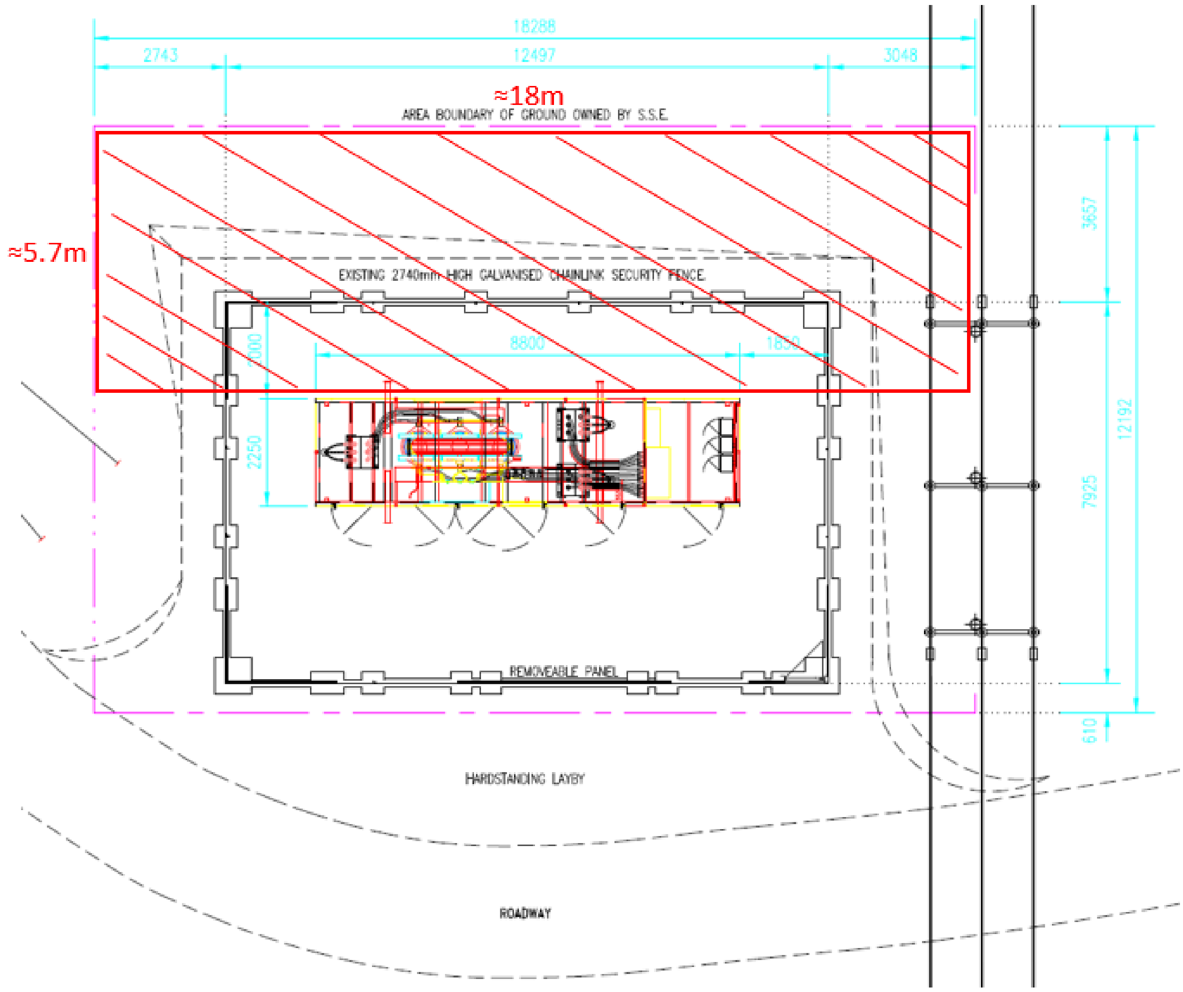


Survey Item	Comments
Space within the substation for BESS 16x10m	Good space for BESS within the substation. Two places to install the battery: – behind switch room 21x12 m – in front of transformer 14x14 m
Space around substation to deliver BESS. Access and roads to substation to transport BESS. (Trailer (carrying 40 feet container) and lorry, incl. space for a crane to unload the containers.	Good (very good) access to substation. Good space in front of substation with road next to the river. Good space to set up CDM site.
Generic discussion about construction challenges on the sites based on SSEN experience.	None highlighted.
Ground quality - The amount of civil works required to installed BESS containerized solution	Ground level within the substation and in front. Good access from the road to the substation compound. Space for CDM site.

Existing 11kV circuit breakers (type, age, condition etc)	Old Whipp and Bourne 3 x CB. Issues with operation of CB.
Existing 33 kV circuit breakers (type, age, condition etc)	New vacuum CB
Existing protection systems (transformer 33 and 11 kV, 11 kV feeders) and AVC, LVAC, tripping, changeover	Old TX protection Old feeder protection. KVGC AVC – some voltage issues reported
Space within Switch Room for additional CBs (1 or 2) – extension of existing 11 kV busbar	Good space for additional CBs but it might to be possible to find matching CB.
Earthing arrangements and space to add earthing transformers	Solid Earth. Space for additional Tx.
Space within substation to install RaaS controller	Yes
Existing RTU	C10, (not C10e) – might need to be upgraded.
11 kV tele-controlled switches availability/functionally	In good order – working. Some issues with mobile network.
Back-Up for power supply of EMS ca. 2 kW and BMS and PCS auxiliary supply ca. 3x 6 kW	No. Small (possibly 25 kVA) auxiliary TX – might need to be upgraded.
Existing grounding in place to share with BESS	Should be OK. Check earthing resistance in detail if selected.
Communication and internet access GSM, 3G, 4G availability? Broadband Line ?	Good/OK 3G and 4G Vodafone outside substation (not so good within). EE also seems to be OK.
Black-start procedure. Review possibility to connected 11kV switches to battery EMS (via ANM?)	Not specific. Standard start up with diesel generators
Other	Additional 11 kV CB required AVC issues Old TX and protections RTU might need to be upgraded to C10e

Kishorn Hill

Survey carried out on 21th August 2020 by Maciej Fila with Campbell Murray



Survey Item	Comments
Space within the substation for BESS 16x10m	No space within or around substation
Space around substation to deliver BESS. Access and roads to substation to transport BESS. (Trailer (carrying 40 feet container) and lorry, incl. space for a crane to unload the containers.	Difficult access road
Generic discussion about construction challenges on the sites based on SSEN experience.	None highlighted.

Ground quality - The amount of civil works required to installed BESS containerized solution	Could be difficult conditions
Existing 11kV circuit breakers (type, age, condition etc)	Containerised solution
Existing 33 kV circuit breakers (type, age, condition etc)	Containerised solution
Existing protection systems (transformer 33 and 11 kV, 11 kV feeders) and AVC, LVAC, tripping, changeover	Containerised solution SuperTAPP AVC
Space within Switch Room for additional CBs (1 or 2) – extension of existing 11 kV busbar	Containerised solution – not possible
Earthing arrangements and space to add earthing transformers	Containerised solution
Space within substation to install RaaS controller	No, possibly
Existing RTU	T100c
11 kV tele-controlled switches availability/functionally	In good order – working.
Back-Up for power supply of EMS ca. 2 kW and BMS and PCS auxiliary supply ca. 3x 6 kW	No.
Existing grounding in place to share with BESS	Queried – may be difficult
Communication and internet access GSM, 3G, 4G availability? Broadband Line ?	Vodafone poor, 1 bar 4G from EE
Black-start procedure. Review possibility to connected 11kV switches to battery EMS (via ANM?)	Not specific. Standard start up with diesel generators
Other	It would be very difficult to do anything within existing substation building – likely to require new building.

III. Second site survey reports - Drynoch, Kinloch, Lochinver

Drynoch

Risk Profiling Assessment (Hazards and Risks)				
Project:	RaaS - Drynoch			
	Name	**Position**	**Signature**	**Date**
Prepared by:	Christian Bucher	Project Manager		23.09.2020
	Richard Smith	Delivery Engineer		23.09.2020
	Gerrard Elliot	Development Engineer		23.09.2020
Reviewed by:				

Potential Hazards From:		**Comment**	**Risk**			
			High	**Medium**	**Low**	**N/A**
1.	**Existing Environment**					
1.1	Details of customer activity: complete a brief description of the activity the customer undertakes as part of their operation	Remote / automated operation of 33 / 11 kV substation. Activity on site in case of maintenance or outages.				X
1.2	Existing buildings	Main switchroom including protection units and switchboard. Toilet room adjacent.			X	
1.3	Previous/existing land/structures	None				X
1.4	Roadways	Two lane road in front of substation with access to compound			X	
1.5	Railways	None				X
1.6	Water courses (all potential over / underground)	Small river next to substation on easter side with water level much lower than substation ground.			X	
	Ground conditions:	Fully prepared flat gravel on site, inside compound			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
	Flora and Fauna	None				X
	Contamination	Tbd		X		
	Groundwater	Tbd		X		
	Instability	Tbd			X	
1.7	Mineral workings	None				X
1.8	Site Access restrictions (turning, loading of and / or limitations	Good access to site from road with sufficient space to turn incl yard on opposite side of road. Access via main gate onto prepared off-loading area.			X	
1.9	Adjacent properties and proposed / planning and development	Business activities on opposite site of road. No implications expected.				X
1.10	Concurrent site activities (other development or operational activity)	None				X
1.11	Interface with members of public; throughfare, pathways, bridleways	None				X
1.12	Occupied premises; throughout proposed construction	Tbd				X
1.13	Structural instability; all structures including buildings and ground	Tbd – none expected				X
1.14	Fragile material; roofs, glass structure etc	None				X
1.15	Hazardous material, e.g., asbestos, explosive or flammable gases, liquids or materials	Tbd			X	
1.16	Livestock, local presence	None				X

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
1.17	Weather/Sea State	Wind, Rain expected, high salt content in air		**X**		
1.18	Transport routes / bridges, restrictions	Winding road to site with mostly two lanes. No major limitations seen.			**X**	
1.19	Aerospace / Military presence	None				**X**
1.20	High risk operations – simultaneous operations (SIMOP)	None				**X**
1.21	Licences, consents and permissions	Tbd			**X**	
2.	**Existing Services**					
2.1	Underground					
	Electrical	Tbd, 11kV outgoing on western half of compound towards road		X		
	Gas	None				X
	Water	Tbd				X
	Telecommunications	None				X
	Pipelines	Drainage		X		
	History / age / condition of services	Old switchgear needs to be replaced	X			
2.2	Overhead services					
	Electrical	33 kV incoming next to proposed site		**X**		
	Telecommunications	None				X
	4G coverage	Available but best option to be confirmed			X	
	History / age / condition of services					X
3.	**Site / construction arrangements**					
3.1	Welfare arrangements	Toilets available			X	
	Location for proposed welfare	Front of compound			X	
	Services available for welfare	Water			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
3.2	Segregation of construction and existing operation					
	Traffic management	Tbd			X	
	Pedestrian Management	Tbd			X	
	Storage of materials	Storage container on western half of compound			X	
	Delivery arrangements	Tbd			X	
3.3	Site Security				X	
	CCTV / Security personnel	None			X	
	Material / tools security	Closed storage container			X	
	Fences and gated accesses	Compound fully fenced and gated			X	
3.4	Working at height / lifting operations					
	Scaffolding / Access platforms	None				X
	Rope Access	None				X
	Cranes, Cherry picker, Genie boom	Crane required		X		
3.5	Waste & Recycling				X	
	Allocation of waste (producers responsibility)	Tbd			X	
	Waste segregation points	Tbd			X	
3.6	Information availability					
	Building Management information	Tbd			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
	Services isolation and / or power generation (Safety Rules)	Tbd			X	
	Service drawings (P&ID)	Tbd			X	
	Surveys available for review (environmental, site hazards, authority, third party)	Tbd			X	
	Risk Register availability	Tbd			X	
	Location and area risk assessment(s)	Tbd			X	
4.	**Relationships**					
4.1	Authority					
	Health & Safety Executive (HSE)	Tbd			X	
	Environmental Agency (EA)	Tbd			X	
	Department of Environmental Food & Rural Affairs (DEFRA)	Tbd			X	
	Forestry Commission	Tbd			X	
	The Water Services Regulation Authority	Tbd			X	
	Local planning / building control	Tbd			X	
	Adjacent land owners / builing occupiers	None			X	

Summary:

Delivery to site and construction possible without significant extra effort in time or budget. Potential obstacles on transport route to be confirmed during detailed design. Site well prepared with levelled and gravelled ground, sufficient space to hold battery system, offloading, craning and storage and CDM site. Site fenced in with gate.

Supporting Evidence:

Photos / files and documentation

Kinloch

Risk Profiling Assessment (Hazards and Risks)				
Project:	RaaS - Kinloch			
	Name	**Position**	**Signature**	**Date**
Prepared by:	Christian Bucher	Project Manager		23.09.2020
	Richard Smith	Delivery Engineer		23.09.2020
	Gerrard Elliot	Development Engineer		23.09.2020
Reviewed by:				

Potential Hazards From:		Comment	Risk			
			High	**Medium**	**Low**	**N/A**
1.	**Existing Environment**					
1.1	Details of customer activity: complete a brief description of the activity the customer undertakes as part of their operation	Remote / automated operation of 33 / 11 kV substation. Activity on site in case of maintenance or outages. Placement and operation of 2 MVA diesel gensets incl tank in case of outage or maintenance.			X	
1.2	Existing buildings	Main switchroom containing transformer protection and 33kV CB. Transformer housing.			X	
1.3	Previous/existing land/structures	None				X
1.4	Roadways	Single track road in front of substation	X			
1.5	Railways	None				X
1.6	Water courses (all potential over / underground)	Seaside in front of substation opposite of street.			X	
	Ground conditions:	Area next to substation well prepared, sufficiently large and stable.			X	
	Flora and Fauna	None on planned construction site. Removal of small vegetation between construction site and substation compound.			X	
	Contamination	Tbd		X		
	Groundwater	Tbd		X		
	Instability	Tbd – none expected			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
1.7	Mineral workings	None				X
1.8	Site Access restrictions (turning, loading of and / or limitations	Access to site from street easy. Sufficient space for turning and off-loading. Turning space needs to be reserved and kept free of obstacles.		X		
1.9	Adjacent properties and proposed / planning and development	None				X
1.10	Concurrent site activities (other development or operational activity)	Genset operation on construction ground		X		
1.11	Interface with members of public; thoroughfare, pathways, bridleways	Tourism, travelers, bikers to be considered on street			X	
1.12	Occupied premises; throughout proposed construction	None				X
1.13	Structural instability; all structures including buildings and ground	Tbd - None expected				X
1.14	Fragile material; roofs, glass structure etc	None				X
1.15	Hazardous material, e.g., asbestos, explosive or flammable gases, liquids or materials	Tbd			X	
1.16	Livestock, local presence	None				X
1.17	Weather/Sea State	Windy, rainy, rough weather expected; high salt content in air	X			
1.18	Transport routes / bridges, restrictions	Access to island only via ferry. Majority of road from ferry to site on single track road with narrow bendings. Detailed risk assessment and assessment of transport options with local experts recommended.	X			
1.19	Aerospace / Military presence	None				X
1.20	High risk operations – simultaneous operations (SIMOP)	None				X
1.21	Licences, consents and permissions	None			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
2.	**Existing Services**					
2.1	Underground					
	Electrical	11 kV / 33 kV lines underground inside of substation compound		X		
	Gas	None				X
	Water	None				X
	Telecommunications	Tbd				X
	Pipelines	None				X
	History / age / condition of services	Old 33kV CB, no 11 kV switchgear			X	
2.2	Overhead services					
	Electrical	11 kV / 33 kV on border of site		**X**		
	Telecommunications	Telcom lines on opposite side of street			**X**	
	4G availability	Weak network availability. To be checked further.		X		
	History / age / condition of services	Tbd				
3.	**Site / construction arrangements**					
3.1	Welfare arrangements	None existing			X	
	Location for proposed welfare	On side of proposed construction site			X	
	Services available for welfare	None			X	
3.2	Segregation of construction and existing operation					
	Traffic management	Tbd, potential need to closed down parts of single track access road.	X			
	Pedestrian Management	Travelers, bikers, camper vans etc		X		
	Storage of materials	Storage containers on site proposed.			X	
	Delivery arrangements	Tbd		X		
3.3	Site Security					
	CCTV / Security personnel	None			X	
	Material / tools security	None			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
	Fences and gated accesses	Sub-station compound fenced. Proposed site gated only.			X	
3.4	Working at height / lifting operations	None				
	Scaffolding / Access platforms	None				X
	Rope Access	None				X
	Cranes, Cherry picker, Genie boom	Crane space available. Security distance to OH lines to be considered.		X		
3.5	Waste & Recycling					
	Allocation of waste (producers responsibility)	Tbd			X	
	Waste segregation points	Tbd			X	
3.6	Information availability					
	Building Management information	Tbd			X	
	Services isolation and / or power generation (Safety Rules)	Tbd			X	
	Service drawings (P&ID)	Tbd			X	
	Surveys available for review (environmental, site hazards, authority, third party)	Tbd			X	
	Risk Register availability	Tbd			X	
	Location and area risk assessment(s)	Tbd			X	
4.	**Relationships**					
4.1	Authority					
	Health & Safety Executive (HSE)	Tbd			X	
	Environmental Agency (EA)	Tbd			X	
	Department of Environmental Food & Rural Affairs (DEFRA)	Tbd			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
	Forestry Commission	Tbd			X	
	The Water Services Regulation Authority	Tbd			X	
	Local planning / building control	Tbd			X	
	Adjacent land owners / builing occupiers	None			X	

Summary:

Kinloch potentially possible site. Extra effort in time and budget required for transport. Additional risk mitigation steps in planning and during delivery to be taken to ensure transportation can be done. Sufficient space available with good access from road. Potential construction space already clear of vegetation and levelled. No significant civil works expected.

No 11kV switchboard existing. Electrical implementation and installation of 11kV board easier.

Supporting Evidence:

Photos / files and documentation

Lochinver

Risk Profiling Assessment (Hazards and Risks)				
Project:	RaaS - Lochinver			
	Name	**Position**	**Signature**	**Date**
Prepared by:	Christian Bucher	Project Manager		23.09.2020
	Richard Smith	Delivery Engineer		23.09.2020
	Gerrard Elliot	Development Engineer		23.09.2020
Reviewed by:				

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
1.	**Existing Environment**					
1.1	Details of customer activity: complete a brief description of the activity the customer undertakes as part of their operation	Remote / automated operation of 33 / 11 kV substation. Activity on site in case of maintenance or outages.				X
1.2	Existing buildings	Container containing transformer and protection units				X
1.3	Previous/existing land/structures	None				X
1.4	Roadways	Single-track road, 2.5m width + 0.9m shoulder		X		
1.5	Railways	None				X
1.6	Water courses (all potential over / underground)	None known			X	
	Ground conditions:		X			
	Flora and Fauna	Heavy vegetation on potential building ground to be removed; very uneven ground conditions; stability of ground to be assessed (wet/soft but shallow earth potentially with rock beneath)	X			
	Contamination	Tbd		X		
	Groundwater	Tbd		X		
	Instability	Tbd	X			
1.7	Mineral workings	None				X

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
1.8	Site Access restrictions (turning, loading of and / or limitations	Limitations for off-loading and turning of trucks due to narrow road. Entrance into road okay.	X			
1.9	Adjacent properties and proposed / planning and development	Close-by housing	X			
1.10	Concurrent site activities (other development or operational activity)	None				X
1.11	Interface with members of public; throughfare, pathways, bridleways	Likely noise impact on close neighbours	X			
1.12	Occupied premises; throughout proposed construction	None				X
1.13	Structural instability; all structures including buildings and ground	Ground stability to be assessed	X			
1.14	Fragile material; roofs, glass structure etc	None				X
1.15	Hazardous material, e.g., asbestos, explosive or flammable gases, liquids or materials	Tbd				x
1.16	Livestock, local presence	None				x
1.17	Weather/Sea State	Wind, Rain likely, high salt content in air		X		
1.18	Transport routes / bridges, restrictions	Long single-track road to site; highway patrol / closing road off might be necessary	X			
1.19	Aerospace / Military presence	None				X
1.20	High risk operations – simultaneous operations (SIMOP)	None				X
1.21	Licenses, consents and permissions	Tbd			X	
2.	**Existing Services**					
2.1	Underground				X	
	Electrical	33kV underground at back of substation			X	
	Gas	None				X
	Water	None				X
	Telecommunications	Tbd – potential BT line under proposed site			X	
	Pipelines	None				X
	History / age / condition of services	Tbd –old switchgears and protection	X			

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
2.2	Overhead services					
	Electrical	11 kV / 33 kV OH line on opposite site of building – no impact on planned construction		**X**		
	Telecommunications	OH line on opposite site of road – no impact on planned construction		**X**		
	4G availability	4G available on site. Breaks away if 33kV outage occurs.			X	
	History / age / condition of services					
3.	**Site / construction arrangements**					
3.1	Welfare arrangements	None			X	
	Location for proposed welfare	Front of existing building			X	
	Services available for welfare	None			X	
3.2	Segregation of construction and existing operation					
	Traffic management	Tbd	X			
	Pedestrian Management	Tbd	X			
	Storage of materials	Tbd		X		
	Delivery arrangements	Craining place & off-loading, turning area for trucks to be defined	X			
3.3	Site Security			X		
	CCTV / Security personnel	None existing		X		
	Material / tools security	None existing		X		
	Fences and gated accesses	None existing		X		
3.4	Working at height / lifting operations					
	Scaffolding / Access platforms	None				X
	Rope Access	None				X
	Cranes, Cherry picker, Genie boom	Crane required	X			
3.5	Waste & Recycling					
	Allocation of waste (producers responsibility)	Tbd			X	
	Waste segregation points	Tbd			X	

Potential Hazards From:		Comment	Risk			
			High	Medium	Low	N/A
3.6	Information availability					
	Building Management information	Tbd			X	
	Services isolation and / or power generation (Safety Rules)	Tbd			X	
	Service drawings (P&ID)	Tbd			X	
	Surveys available for review (environmental, site hazards, authority, third party)	Tbd		X		
	Risk Register availability	Tbd			X	
	Location and area risk assessment(s)	Tbd			X	
4.	**Relationships**					
4.1	Authority					
	Health & Safety Executive (HSE)	Tbd			X	
	Environmental Agency (EA)	TBd			X	
	Department of Environmental Food & Rural Affairs (DEFRA)	TBd			X	
	Forestry Commission	TBd			X	
	The Water Services Regulation Authority	Tbd			X	
	Local planning / building control	Lower permitting requirements due to SSEN ownership of land			X	
	Adjacent land owners / builing occupiers	Good relationship with adjacent land owners high priority for SSEN with regards to potential noise issues		X		

Summary:

Site in principal suitable. Increased effort in time and budget expected for transportation and construction. High effort on civil works expected. High risk of exceeding existing budget. Main concern on customer side regarding noise implications on neighbouring housing from PR perspective regardless of existing regulations.

Supporting Evidence:

Photos / files and documentation