ELWY SOLAR ENERGY FARM, ST ASAPH, DENBIGHSHIRE

ENVIRONMENTAL STATEMENT APPENDIX 10.1 BATTERY SAFETY MANAGEMENT PLAN

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ON BEHALF OF SOLARCENTURY

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Energy Storage Safety Management Plan – Elwy UK

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Contents

1 Introduction

The Energy Storage Safety Management Plan ('ESSMP') has been prepared by Solarcentury to accompany the Development of National Significance ('DNS') application for Elwy Solar Energy Farm ('the Development').

The report has been produced to outline the fire and safety management plan that Solarcentury will put in place to address safety concerns around the Energy Storage System ('ESS') component of the project. Potential hazards, with a focus on fire risks have been identified, analysed, and addressed to minimise the likelihood and the severity of all foreseeable safety issues that may arise on site during the operation of the ESS.

This is an ongoing process, which will be reviewed and detailed as the development of the project moves forward and according to updates to UK regulations and guidelines.

Solarcentury will be reviewing and assessing the proposed fire safety measures from the ESS supplier to ensure that the fire prevention measures, alongside the safety limits within the Energy Management System (EMS) meet or exceed UK regulations and industry recommendations. Solarcentury will also participate in a Factory Acceptance Test ('FAT') to witness its correct functioning before installation and commissioning.

Prior to system commissioning, Solarcentury will liaise with the local fire brigade to ensure the preparation of a clear and detailed response strategy in the case a fire event should occur.

2 Background

Solarcentury is looking to develop a co-located solar photovoltaic array electricity generating facility and an energy storage facility on land to the north west of the junction of the A55 and the A525, north west of St Asaph, in northern Wales.

ESS design is currently rapidly evolving and as such the full system specifications have not yet been finalised, given the period expected to pass between the point of submitting the planning application and the point where final designs need to be specified ahead of construction. Nevertheless, Solarcentury has taken the decision that the ESS will consist of Lithium Iron Phosphate (LFP) storage modules, a popular Lithium Ion technology that is well known for being inherently safe (compared to other types of lithium

battery – such as those used in personal electronic devices) due to its low energy density that minimises risk of thermal runaway.

The ESS will consist of multiple outdoor rated enclosures containing battery modules placed in series to form a rack, racks placed beside each other in parallel, heating/cooling system, fire detection and prevention system, and a Battery Management System to ensure the safe management of a single rack/enclosure (and to isolate each rack/enclosure by opening DC contactors). The Energy Management System (EMS) forms the second layer of protection, ensuring all rack/enclosure level BMSs are operating within the safe limits, and allows the O&M team to remotely operate and monitor the system.

3 Guidance

Multiple guidance documents have been referenced in the creation of this report in order to ensure the widest range of potential risks are considered and all recommended moderation strategies follow industry standards and UK guidance. Below are the main reviewed sources:

- Safety requirements for grid-integrated EES systems — Electrochemical-based systems. IEC 62933-5-2:2020[1]
- Allianz Risk Consulting (ARC), Tech Talk Volume 26 (2019). Battery Energy Storage Systems (BESS) using Li-ion batteries[2]
- Institute of Engineering and Technology - Code of Practice for Electrical Energy Storage Systems (August 2017)[3]
- The Energy Institute: Battery Storage Guidance Note 1 - Battery Storage Planning (August 2019)[4]
- The Energy Operators Forum "Good Practice Guide" (December 2014)[5]

As previously mentioned, this is an ongoing document that will be updated and detailed as the UK regulatory environment develops by the detailed design stage of this project.

4 Risk Assessment

All identifiable risks have been classified using the following matrix to determine the residual risk following the application of respective mitigation strategies. Every mitigated risk has been scored in terms of likelihood and severity in order to determine the level of residual risk.

Severity / Likelihood	Unlikely	May Happen	Likely	Very Likely	Certain
Minor – e.g. minor component damage repaired by technician	1	2	3	4	5

[1] https://webstore.iec.ch/publication/32177#:~:text=IEC%2062933%2D5%2D2%3A2020%20primarily%20describes%20safety%20aspects,electrochemical%20storage%20subsystem%20is%20used.

[2] https://www.agcs.allianz.com/content/dam/onemarketing/agcs/agcs/pdfs-risk-advisory/tech-talks/ARC-Tech-Talk-Vol-26-BESS.pdf

[3] https://shop.theiet.org/code-of-practice-for-electrical-energy-storage-systems

[4] https://publishing.energyinst.org/topics/power-generation/battery-storage/battery-storage-guidance-note-1-battery-storage-planning

[5] https://www.eatechnology.com/engineering-projects/electrical-energy-storage/

Moderate – e.g. component damaged and replacement required	2	4	6	8	10
Serious – e.g. fire contained to one container	3	6	9	12	15
Major – e.g. fire spreading to multiple containers	4	8	12	16	20
Catastrophic – e.g. explosion, injury of personnel or public	5	10	15	20	25

Risk		**Mitigation Strategy**
Temperature and humidity level dangerously increasing within the battery enclosures leading to irreversible equipment damage, overheating and potentially a fire event		The temperature and humidity within the battery containers will be regulated by suitably sized heating and cooling equipment
Likelihood: 1	Severity: 3	Residual risk: 3
Heating and cooling system failure causing uncontrolled temperature management within enclosures		The heating and cooling system status will be monitored by the EMS Energy Management System. In the event of a heating/cooling failure being detected, the enclosure will be automatically switched into standby mode, preventing the battery modules from charging or discharging, and sending a notification to the O&M team. This reduces the risk of temperature rise within the modules and allows adequate time for a repair to take place on site, before the system is restarted. The heating/cooling system will be subject to quarterly routine maintenance inspections to ensure the risk of failure is minimised.
Likelihood: 2	Severity: 3	Residual risk: 6
Dust and salt particles, due to vicinity to coast, entering the containers and corroding the electrical equipment, causing short circuit, and leading to fire event.		The battery containers will be suitably insulated and specified for the relative ambient conditions (IP 55), to prevent external agents to enter the enclosures.

		Periodic maintenance plan will include the cleaning of the container, changing of filters i.e. heating/cooling system, and a detailed inspection of the equipment to ensure all equipment and connections are in good state.
Likelihood: 1	Severity: 3	Residual risk: 3
Battery modules falling to dangerously low voltage and state of charge levels that could cause irreversibly damage the equipment but also result in thermal runaway.		The EMS will continuously monitor the state of every module rack (voltage, state of charge etc) and thanks to in-built safety limits, it will not allow the battery, or any individual component, to reach a dangerous state that could lead to safety issues.
Likelihood: 1	Severity: 3	Residual risk: 3
The EMS safety limits do not work as expected and the ESS, or one if its components, reaches a dangerous state.		If the minimum threshold values are reached or a fault arises, an alarm is triggered, and the O&M team is made aware of the issue. The O&M team will be able to act remotely, initiate a remote shutdown if required, or send a technician to site to investigate the issue and perhaps replace damaged/faulty components.
Likelihood: 1	Severity: 3	Residual risk: 3
The O&M team fail to respond to the plant controller alarm for an extended period, and the battery exceeds both its minimum/maximum voltage, and its safe voltage limits.		If rack voltage or state of charge drops below or rises above safe levels, the battery DC contactors are automatically opened, isolating each rack individually preventing current continuing to flow between racks, essentially isolating and significantly reducing the risk of thermal runaway.
Likelihood: 1	Severity: 3	Residual risk: 3
In the case of a thermal runaway/short circuit causing smoke or starting a flame		Thermal runaway will be mitigated by procuring an LFP ESS. This specific Lithium Ion technology has lower energy density compared to other technologies, therefore minimising the risk of thermal runaway. This technology has been extensively safety tested by Tier 1 battery manufacturers. In the event of runaway occurring it has proven that whilst it is possible for the battery to catch fire it does not pose any risk of explosion. Every battery enclosure is equipped with two different types of fire detection systems, smoke

		and heat detectors. Multiple sensors of each type are installed to increase redundancy in the event one or more are faulty. This enables early fire detection and the activation of a fire suppression system if installed. If the fire detection system is triggered, an alarm is sent to the local fire brigade that will promptly intervene to further contain the fire if necessary.
Likelihood: 1	Severity: 5	Residual risk: 5
Fire detection system faulty or not working properly		The fire detection system will have multiple sensors to ensure redundancy, and will be subject to quarterly routine maintenance and testing. In the case that all sensors were faulty and a fire broke out, the BMS would be able to report an alert of malfunctioning equipment to the O&M team who would be able to take further action and notify the fire brigade if necessary.
Likelihood: 2	Severity: 3	Residual risk: 6
In the case of fire suppression system failing to contain the fire.		The local fire brigade will be promptly notified whenever the fire detection system is triggered. The fire brigade will be provided with necessary information and documentation to ensure a clear and detailed understanding of the storage technology and site layout to ensure the preparation of an adequate response strategy to a fire emergency. This will allow a coordinated and pre-planned response to quickly contain the fire, prevent it spreading, and minimise damage to equipment.
Likelihood: 1	Severity: 5	Residual risk: 5
In the case of a fire event in one enclosure, and puts other enclosures, nearby buildings and the public at risk		The enclosures will be made of non-combustible equipment to minimise the spread of the fire outside the enclosure. Individual enclosures will be separated by a minimum distance of 3m or according to future UK regulations and industry recommendations. The site will also be at a minimum distance of 20m from buildings and areas with public access. This will minimise the likelihood of fire spreading from one container to others and potentially becoming a hazard for the public.
Likelihood: 1	Severity: 5	Residual risk: 5

Risk of site flooding and equipment becoming wet		All containers and other equipment will be placed on concrete slabs and raised off the ground to provide protection from flooding. A site flood risk assessment has been carried out and the proposed location of the ESS compound is on elevated ground which is highly unlikely to flood.
Likelihood: 1	Severity: 2	Residual risk: 2

5 Conclusion

The report outlines the precautions that Solarcentury will take to manage all foreseeable risks around the ESS component of the project and minimise their potential impact. This report will be reviewed and updated at a more detailed stage of the ESS design in consultation with North Wales Fire and Rescue Service, incorporating ESS supplier recommendations and in accordance with current and future UK regulations, guidelines and industry recommendations.

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