PV system verification report

Greenfold Community Energy, Building 2 roof array

Document RK-2026-0512 Rev A Issued

Site	Greenfold Community Energy, Building 2 roof array, Marlbury
Client	Greenfold Community Energy Co-operative
System	44.3 kWp, 108 modules, 3 inverters
Inspection	12 May 2026
Standard or method	IEC 62446-1 pattern, own wording
Instrument	FLIR T560, Seaward PV150
Prepared	Anika Sorensen
Checked	Priya Venkatesan
Status	Issued

CoA 3	CoA 2	CoA 1
1	3	0



Document control

Revision	Date	Status	Issued by
P01	15 May 2026	Draft	AS
A	19 May 2026	Issued	AS

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1 Part A: System documentation

System data

SYSTEM NAME Riverside Building 2 roof array	RATED POWER DC (kWp) 44.28	RATED POWER AC (kW) 36	PV MODULES (make / model / quantity) Helion HX-410M, 410 Wp, 108 modules
INVERTERS (make / model / quantity) Veltis V-12K-3P, 12 kW, 3 units	INSTALLATION DATE 27 Sep 2023	COMMISSIONING DATE 11 Oct 2023	CUSTOMER NAME AND ADDRESS Greenfold Community Energy Co-operative, Riverside Business Park, Wharf Road, Marlbury MB5 9CK
SITE ADDRESS Greenfold Community Energy, Building 2 Riverside Business Park, Wharf Road, Marlbury, MB5 9CK	DESIGNER (name / company / contact) Solbright Installations Ltd, design office, 01632 960 400	INSTALLER (name / company / contact) Solbright Installations Ltd, 01632 960 400	

1.1 Single-line diagram

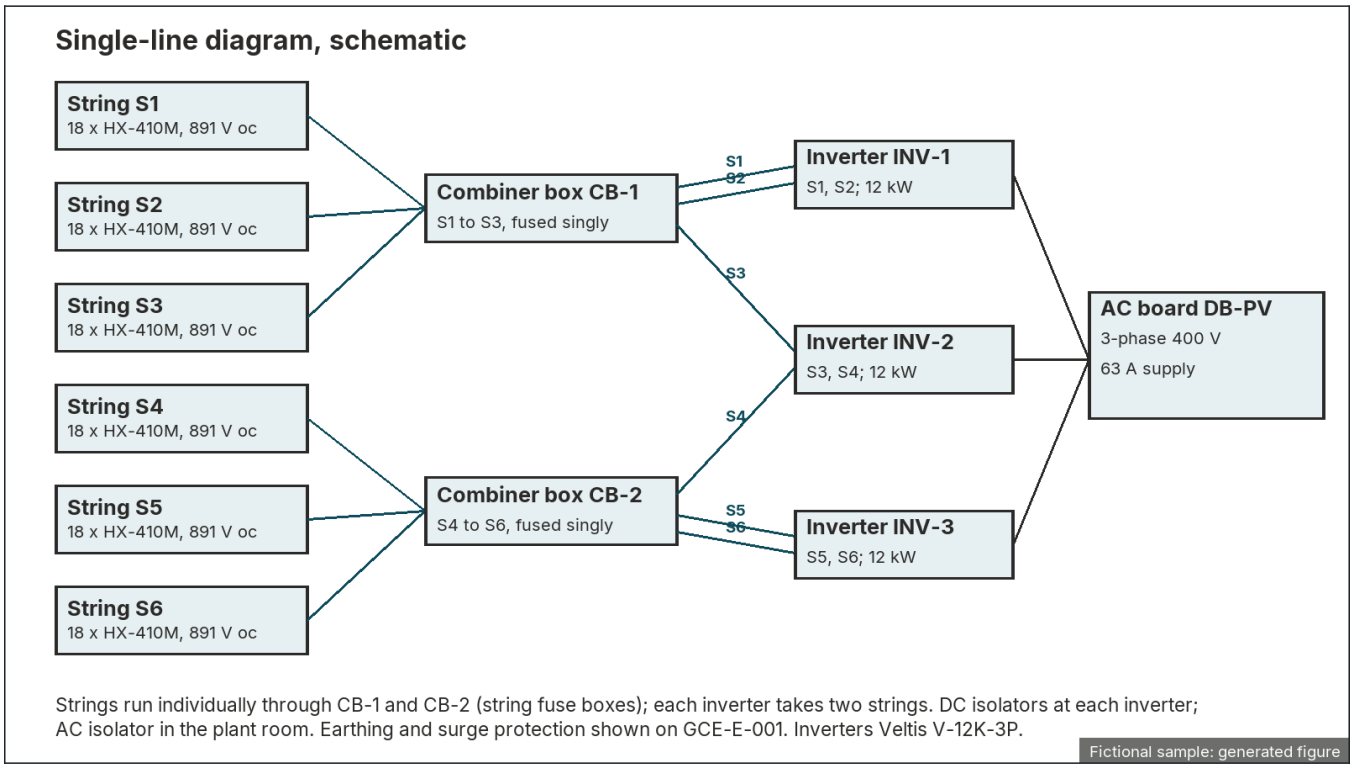


Fig. 1.1 Single-line diagram: six strings, two combiner boxes, three inverters and the AC board (schematic)

1.2 Datasheets and as-built records

Document	Reference / version	Supplied
Module datasheet	HX-410M rev C	Yes
Inverter datasheet	V-12K-3P	Yes
Mounting system datasheet	SSC-200	Yes
Array layout drawing	GCE-E-002 rev B	Yes
Cable schedule	GCE-E-003	Yes
Inverter firmware version	4.12.1	Yes

1.3 Mechanical design

Mounting

MOUNTING TYPE (roof parallel / tilted / in-roof / ground)	ORIENTATION (azimuth)	INCLINATION (°)	STRUCTURAL ASSESSMENT REFERENCE
East-west ballasted frames on a flat membrane roof	95° and 275° (east and west)	10	Structural check by Example Engineers, ref EE-2023-114

1.4 Operation and maintenance information

The system operates automatically; the inverters start when the array voltage exceeds the start threshold and shut down at dusk. If generation stops, check the AC isolator, the inverter display for fault codes and the DC isolators in that order. Emergency shutdown: open the AC isolator in the plant room, then the DC isolators at the inverters; the array remains live in daylight. Maintenance: visual inspection and cleaning annually, electrical re-test every two years, thermography every two years or after any fault.

2 Part B: Inspection

The installation was inspected visually before testing. Tests were carried out in a safe order: AC circuits first, then DC earth continuity and bonding, polarity, string open-circuit voltage, string current, functional tests and finally array insulation resistance.

DC system

Item	Result	Evidence or note
DC cables rated for the system voltage and current and suitable for the environment	Pass	
PV-rated (not mixed-brand) connectors throughout	Pass	
String fusing or overcurrent protection as designed	Pass	
DC isolator(s) correctly rated and accessible	Pass	
Surge protection devices fitted where specified	Pass	
DC cables supported, protected from mechanical damage and sunlight	Pass	
No damaged, chafed or UV-degraded cable sheath	Pass	

AC system, protection and labelling

Item	Result	Evidence or note
AC isolator and protection as designed	Pass	
Inverter installed to the manufacturer's instructions and ventilated	Pass	
Loss-of-mains protection settings correct for the network operator	Pass	
Metering and monitoring connected	Pass	
Dual-supply and shutdown labels fitted at the origin, meter position and inverter	Fail	Dual-supply notice missing at the emergency switch; see plate item 2
Warning labels on DC isolators, junction boxes and combiner boxes	Fail	DC-3 label faded; isolator labels missing below INV-1 (plate item 1); CB-2 string cables not identified (Fig. 4.1 item 6)

Mechanical, enclosures, bonding and cable routing

Item	Result	Evidence or note
Mounting system installed to the design and the manufacturer's instructions	Pass	
Roof penetrations weather-tight	Pass	
Modules fixed or ballasted to the mounting system specification	Pass	
Enclosures of the specified IP rating, glands sealed	Fail	CB-2 gland loose; tightened on site
Earthing and equipotential bonding of frames and metalwork as designed	Pass	
No corrosion between dissimilar metals	Pass	
Cable routing avoids trip, chafe and rodent hazards	Pass	

The installation is tidy and consistent with the design drawings. Non-conformities: the DC isolators below INV-1 carry no string or polarity labels and the label on DC-3 is faded (minor; plate item 1; engraved labels to be fitted before the next visit); the AC emergency switch has no dual-supply notice (minor; plate item 2); the cable-tray end beside the window is open and unbushed (minor; plate item 3; to be capped before the cables are extended); the gland on combiner box CB-2 was not tightened, so the enclosure IP rating was compromised (major, tightened on site); and the six string cables entering CB-2 are not identified (minor; marked on the combiner box plate in Part C). The string 4 fuse holder hot connection (CoA 3) was remade on site and re-imaged. All other inspection items passed.

Fig. 2.1 | Inverters INV-1 and INV-2, plant room | Plant room, west wall



REF	DETAIL	ELEMENT	MEASUREMENT	CLASS	OBSERVATION AND ACTION
#1		DC isolator labels missing		Minor NC	**Finding:** the DC isolators below INV-1 carry no string or polarity labels. **Action:** fit engraved labels before the next visit. Labelling · Inspection
#2		Emergency switch unlabelled		Minor NC	**Finding:** the AC emergency switch at low level has no warning notice. **Action:** add the dual-supply notice required at the point of isolation. Labelling · Safety
#3		Open tray end		Minor NC	**Finding:** the cable tray end beside the window is left open and unbushed; no cable leaves it yet. **Action:** fit an end cap, and cleat the cables clear of the edge when the tray is extended. Cable management

3 Part B: Test results

Table 3.1 Test instruments

Instrument	Serial number	Calibration due	Used for
Seaward PV150 installation tester	PV150-23311	09 Jan 2027	Voc / polarity
Seaward PV150 installation tester	PV150-23311	09 Jan 2027	Isc / current
Megger MIT1025	MIT-77102	20 Nov 2026	Insulation resistance
Seaward Solar Survey 200R	SS200-0451	09 Jan 2027	Irradiance
Megger MFT1741	MFT-50921	20 Nov 2026	Earth continuity

Table 3.2 String open-circuit voltage, polarity and earth continuity

String ref	Voc expected (V)	Voc measured (V)	Deviation (%)	±5 % check	Polarity OK	Earth continuity (Ω)
S1	891.0	881.2	-1.1	Pass	Correct	0.30
S2	891.0	879.6	-1.3	Pass	Correct	0.30
S3	891.0	883.0	-0.9	Pass	Correct	0.30
S4	891.0	878.1	-1.4	Pass	Correct	0.30
S5	891.0	880.4	-1.2	Pass	Correct	0.30
S6	891.0	876.9	-1.6	Pass	Correct	0.30

Shaded figures are calculated from the table. Every string: 18 modules, Voc STC 49.5 V per module, module temperature 25 °C, temperature coefficient −0.29 %/°C.

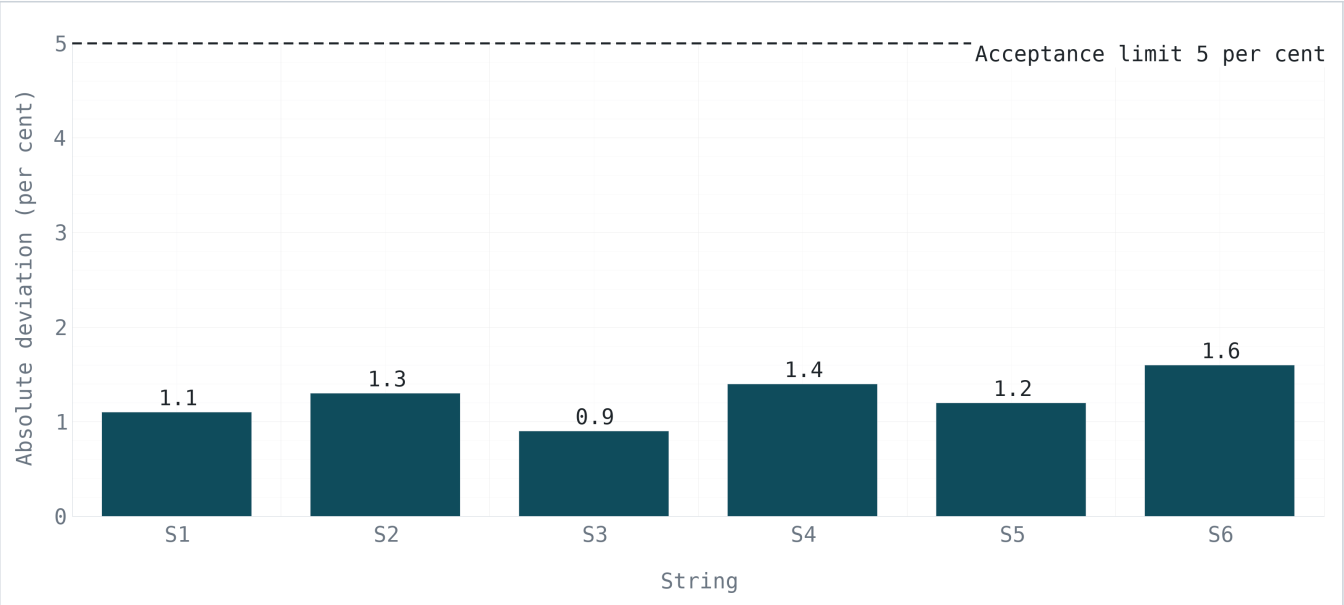


Fig. 3.1 Open-circuit voltage deviation per string

Table 3.3 String current test (irradiance-adjusted)

String ref	Irradiance (W/m²)	Isc STC (A)	Isc expected (A)	Isc / operating current (A)	Deviation (%)	±10 % check	Method
S1	812	10.90	8.85	8.72	-1.5	Pass	Isc
S2	812	10.90	8.85	8.69	-1.8	Pass	Isc
S3	812	10.90	8.85	8.75	-1.1	Pass	Isc
S4	812	10.90	8.85	8.61	-2.7	Pass	Isc
S5	812	10.90	8.85	8.70	-1.7	Pass	Isc
S6	812	10.90	8.85	8.44	-4.6	Pass	Isc

Shaded figures are calculated from the table.

Table 3.4 PV array insulation resistance (each pole to earth)

String ref	Voc STC string (V)	Ri + to earth (MΩ)	Ri − to earth (MΩ)	Lowest (MΩ)	Result
S1	891	212.0	205.0	205.0	Pass
S2	891	198.0	190.0	190.0	Pass
S3	891	240.0	231.0	231.0	Pass
S4	891	205.0	199.0	199.0	Pass
S5	891	188.0	181.0	181.0	Pass
S6	891	176.0	169.0	169.0	Pass

Shaded figures are calculated from the table. Every string: system voltage 1,114 V (Voc STC x 1.25), test voltage 1,000 V DC as required, minimum 1 MΩ.

Functional tests

Item	Result	Evidence or note
Switchgear and isolators operate correctly	Pass	
Inverter start-up and shutdown per manufacturer procedure	Pass	
Loss-of-mains protection trips on disconnection	Pass	
Monitoring reports generation	Pass	
Emergency shutdown procedure demonstrated	Pass	

Verification summary

CIRCUITS INSPECTED AND TESTED	CATEGORY 2 TESTS PERFORMED	RECOMMENDED INTERVAL TO NEXT VERIFICATION (years)	TESTER
Six strings, three inverters, two combiner boxes, AC distribution	Thermography of the array and combiner boxes (IEC TS 62446-3)	2	Anika Sorensen
DATE 12 May 2026			

I confirm that the installation was inspected and tested as recorded and that, apart from any items listed as non-conforming, it was found to comply with the design and the applicable requirements.

PREPARED BY
Anika Sorensen
BEng (Hons), MCS accredited, ISO 9712 Level 2 thermographer
Sorensen Renewables Testing
19 May 2026

4 Part C: Thermographic inspection (annex)

Conditions, camera, validity, the anomaly register and the combiner box plate

This annex records an outdoor infrared inspection of the PV modules and balance-of-system components, following the approach of IEC TS 62446-3. Inspection level: **detailed**.

Personnel

PV EXPERT	THERMOGRAPHER AND QUALIFICATION (ISO 9712 level or equivalent)	ATTENDING PERSONS	DAY AND TIME OF INSPECTION
Anika Sorensen	Anika Sorensen, ISO 9712 Level 2	Site caretaker; co-operative energy officer	12 May 2026, 11:50 to 13:10

Camera system

MAKE AND MODEL	SERIAL NUMBER	LENS	SPECTRAL RANGE (µm)
FLIR T560	FT560-004412	24° (f = 17 mm)	7.5 to 14
THERMAL SENSITIVITY NETD (mK) 30	RESOLUTION (px) 640 x 480	LAST TRACEABLE CALIBRATION 14 Oct 2025	MONTHS SINCE CALIBRATION 7
VISUAL CAMERA (make / resolution) Built-in 5 MP			

Environmental conditions

AIR TEMPERATURE (°C)	WIND (Bft) AND DIRECTION	CLOUD COVER (okta) AND TYPE	IN-PLANE IRRADIANCE (W/m²)
19	2 Bft SW	1 okta, cirrus	812
DC LOAD DURING IMAGING (% of rated)	THERMAL STEADY STATE REACHED (≥15 min after >10 %/min change)		
84	Yes; inverters on for over 60 minutes before imaging		

INFORMATION

Validity

Irradiance 812 W/m² (minimum 600) Pass; wind 2 Bft (maximum 4) Pass; cloud 1 okta cirrus (maximum 2 okta cumulus) Pass; steady state over 60 minutes Pass; camera calibration 7 months (maximum 12) Pass.

4.1 Soiling

Light, uniform dust with localised bird droppings on rows 1 and 2 (about 2 per cent of module area). The soiling was not sufficient to affect the thermal results except at module 1-7, where the soiling shows as a hot spot 4.9 K above the neighbouring cells, recorded as anomaly A4 (CoA 2; clean and re-image at the next visit).

4.2 Scope

Contracted scope

COMPONENT TYPE DESIGNATIONS	PV MODULE EFFICIENCY (%) / BOS NOMINAL RATING	COMPONENTS INSPECTED (list or reference)	MOUNTING, ORIENTATION AND INCLINATION
Crystalline silicon modules; string inverters; DC combiner boxes	21.0% / 36 kW AC	All 108 modules; CB-1 and CB-2; three inverters	East-west ballasted, 95° and 275°, 10°
BOS LOCATION (roof / conduit / open air)			
Combiner boxes on the roof; inverters in the plant room			

4.3 Inspection procedure

The array was inspected from the roof walkway at a viewing angle of 60° to 80° to the module plane using a FLIR T560 with the 24° lens, emissivity set to 0.85 for glass and reflected temperature measured by the reflector method (31 °C). Irradiance was logged with a reference cell in the plane of the array and remained above 780 W/m² throughout. The inverters were on and the strings loaded. Each module was imaged individually and the combiner boxes were imaged with the covers removed.

4.4 Classes of abnormality

Each thermal anomaly is given a Class of Abnormality (CoA 3, 2 or 1). Non-conformities found by the visual inspection in Part B are rated Major NC or Minor NC; they are not thermal classes and are not counted with them.

Rating	Class	Meaning
CoA 3	**CoA 3**	Safety-relevant thermal abnormality: interrupt operation promptly, establish the cause and rectify within a reasonable period.
CoA 2	**CoA 2**	Thermal abnormality: establish the cause and, where necessary, put it right within a reasonable period.
CoA 1	**CoA 1**	No abnormality: the component is working normally and no action is imminent.
Major NC	**Major NC** Counted separately	Major non-conformity found by the visual inspection (Part B): a defect that affects safety or protection and is put right before the system is relied on. Not a thermal class.
Minor NC	**Minor NC** Counted separately	Minor non-conformity found by the visual inspection (Part B): labelling, records or workmanship to correct at the next visit. Not a thermal class.

4.5 Anomaly register

Estimated annual energy loss from listed anomalies **239** kWh/yr

Estimated annual cost of losses **58.57** £/yr

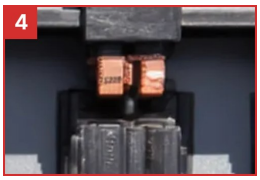
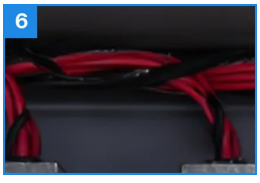
Table 4.1 Thermal anomaly register

ID	Location (≥2 identifiers)	Abnormality	CoA	T max (°C)	T ref (°C)	ΔT (K)	ΔT at 1000 W/m² (K)	Module Wp	Est. loss (%)	Est. kWh/yr	Est. £/yr	Remedial action
A1	Row 3, module 14	Single hot cell	CoA 2	48.6	31.2	17.4	21.4	410	2.5	11	£2.70	Inspect module; replace if cell cracked
A2	Row 5, module 2	Substring open circuit (bypass diode active)	CoA 2	39.8	31.0	8.8	10.8	410	33.0	143	£35.04	Test diodes; replace module
A3	Combiner box CB-2	Heated connection, string 4 fuse holder	CoA 3	61.4	33.5	27.9	34.4	7,380	1.0	78	£19.11	Isolate and remake the connection immediately
A4	Row 1, module 7	Hot spot under soiling (bird droppings)	CoA 2	36.1	31.2	4.9	6.0	410	1.5	7	£1.72	Clean; re-image at the next visit

Shaded figures are calculated from the table. G = 812 W/m² in the array plane for every anomaly; x = 1 (ΔT scales linearly with irradiance).

Fig. 4.1 | Combiner box CB-2, cover removed | Roof, north-east corner



REF	DETAIL	ELEMENT	MEASUREMENT	CLASS	OBSERVATION AND ACTION
#4		Hot connection	61.40 °C	CoA 3	**Finding:** anomaly A3, the string 4 fuse carrier (fourth from the left) 28 K above its neighbours at 61 °C: a high-resistance connection and a fire risk (CoA 3). **Action:** isolated, remade on the day and re-imaged within 2 K of its neighbours. Anomaly A3 · String 4
#5		Gland not tightened		Major NC	**Finding:** gland plate entry not tightened, so the IP rating of the enclosure is compromised. **Action:** tightened on site; recorded as a major non-conformity rectified. Enclosure · IP rating
#6		String cables unlabelled		Minor NC	**Finding:** the six string cables (S4 to S6, positive and negative) entering at the top of the enclosure are not identified. **Action:** label each cable and fuse carrier with its string and polarity so they can be matched. Labelling

5 Thermogram

Anomaly A3

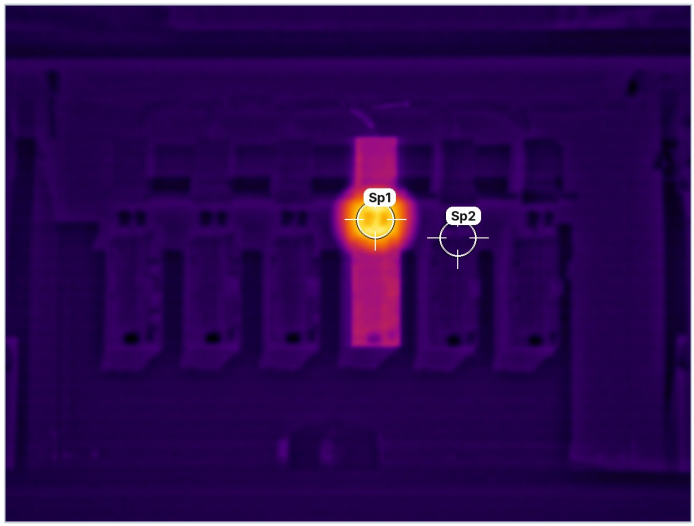






Fig. 5.1 Thermogram, Electrical (Ironbow palette) Visible image

SCALE 28.0 to 64.0 °C	PALETTE Ironbow	EMISSIVITY 0.95	REFLECTED TEMPERATURE 31.0 °C
AMBIENT TEMPERATURE 19.0 °C	DISTANCE 0.8 m	RELATIVE HUMIDITY 48 %	CLASSIFICATION Electrical
SEVERITY CoA 3			

Ref	Label	Type	Position	Temperature (°C)
Sp1	string 4	Spot	54 %, 42 %	61.4
Sp2	string 5	Spot	66 %, 45 %	33.5

Interpretation

String 4 fuse holder 28 K hotter than its neighbours under the same load: a high-resistance connection. Classified CoA 3 (fire risk); rectified on site and re-imaged.

Image record

OBJECT DESCRIPTION	FILE NAME	DATE AND TIME	CAMERA SERIAL AND LENS
Combiner box CB-2, cover removed, string fuse holders	IR_CB2_0412.jpg	2026-05-12 12:40	FT560-004412, 24° lens
EMISSIVITY USED	**REFLECTED TEMPERATURE (°C)**	**AMBIENT TEMPERATURE (°C)**	**EXACT LOCATION IN PLANT (row / column / serial)**
0.95	31	19	Roof, north-east corner, CB-2
CELL DESIGNATION (row letter / column number)			
Not applicable (combiner box)			

Combiner box CB-2, string 4 fuse carrier (fourth from the left), 28 K above the neighbouring holders at 61 °C. This is a loose or corroded connection and is classified CoA 3 because of the fire risk. The connection was isolated and remade on the day; a repeat image after 30 minutes showed the holder within 2 K of its neighbours. Recommend checking torque on all fuse holders in CB-1 and CB-2 and repeating the thermography in two years.

6 Summary of results and recommendations

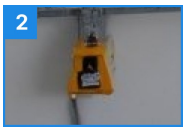
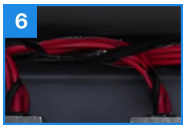
All six strings passed the open-circuit voltage, current and insulation resistance tests with deviations within 5 per cent and insulation resistance above 160 MΩ. Functional tests passed. Thermography found four anomalies, listed in the register: one CoA 3 (combiner box connection, rectified on site), three CoA 2 (a hot cell at 3-14 and an open substring at 5-2, to be replaced, and a soiling hot spot at 1-7, to be cleaned). The visual inspection recorded five non-conformities, one major (the CB-2 gland, tightened on site) and four minor (labelling and the open tray end); all are listed below with the thermal anomalies. The estimated annual loss from the listed anomalies is small. The system is fit for continued operation; the next periodic verification is due in two years.

Strings tested	Pass	Anomalies	Non-conformities	Worst class
6	6 of 6	4 in the register	5 visual, Part B	CoA 3 rectified



Element	CoA 3	CoA 2	CoA 1	Total
Part C: Thermographic inspection (annex)	1	3	0	4
Total	1	3	0	4

Ref	Element	Location	Class	Detail	Observation and action
A3	Heated connection, string 4 fuse holder	Combiner box CB-2	CoA 3		Isolate and remake the connection immediately
A1	Single hot cell	Row 3, module 14	CoA 2		Inspect module; replace if cell cracked

Ref	Element	Location	Class	Detail	Observation and action
A2	Substring open circuit (bypass diode active)	Row 5, module 2	CoA 2		Test diodes; replace module
A4	Hot spot under soiling (bird droppings)	Row 1, module 7	CoA 2		Clean; re-image at the next visit
#5	Gland not tightened	Combiner box CB-2, cover removed	Major NC		**Gland not tightened.** Finding: gland plate entry not tightened, so the IP rating of the enclosure is compromised. Action: tightened on site; recorded as a major non-conformity rectified.
#1	DC isolator labels missing	Inverters INV-1 and INV-2, plant room	Minor NC		**DC isolator labels missing.** Finding: the DC isolators below INV-1 carry no string or polarity labels. Action: fit engraved labels before the next visit.
#2	Emergency switch unlabelled	Inverters INV-1 and INV-2, plant room	Minor NC		**Emergency switch unlabelled.** Finding: the AC emergency switch at low level has no warning notice. Action: add the dual-supply notice required at the point of isolation.
#3	Open tray end	Inverters INV-1 and INV-2, plant room	Minor NC		**Open tray end.** Finding: the cable tray end beside the window is left open and unbushed; no cable leaves it yet. Action: fit an end cap, and cleat the cables clear of the edge when the tray is extended.
#6	String cables unlabelled	Combiner box CB-2, cover removed	Minor NC		**String cables unlabelled.** Finding: the six string cables (S4 to S6, positive and negative) entering at the top of the enclosure are not identified. Action: label each cable and fuse carrier with its string and polarity so they can be matched.

Unless stated otherwise, the next periodic thermographic inspection is recommended in 2 years.

The results describe the system as inspected and tested on the inspection date. Output and condition change with soiling, weather and use; repeat the verification at the interval IEC 62446-1 recommends, or after any modification or repair to the DC side.

A Thermal abnormality reference

Typical patterns for crystalline and thin-film modules, summarised from the IEC TS 62446-3 matrix in our own words. ΔT values are at 1000 W/m².

Abnormality	CoA	Typical ΔT	Pattern / action
Module in open circuit	2	2–7 K (typically 4–6 K)	Whole module uniformly warm; check module, inverter state, cabling, connectors and fuses
Module in short circuit	2	2–7 K average	Patchy pattern similar to PID or cell defects; check module and cabling

Abnormality	CoA	Typical ΔT	Pattern / action
Broken front glass (crystalline)	3	0–7 K average	Insulation lost: high-voltage hazard; may look normal at first
Substring in short circuit	2	Substring 2–7 K warmer	Check module and bypass diodes under reverse bias
One substring open circuit	2–3	2–7 K	One third of module warm with active bypass diode; an arc at the rear raises it to CoA 3
Two substrings open circuit	2–3	2–7 K	Two thirds of module warm; arc raises it to CoA 3
Single hot cell	2 / 3	10–40 K over the cell / above 40 K	Broken cells; check shading and soiling; may damage encapsulant or diodes
Cells shaded by soiling	1 / 2	A few K (wet climates) / above 40 K (dry)	Clean where the climate is dry
Broken front glass (thin film)	3	0–7 K average	Insulation lost
Transfer resistance at cross-connections (thin film)	2–3	Above 10 K	Point abnormality, poor soldering; review by a Level 2 thermographer
Transfer resistance at cell connections (crystalline)	2–3	Above 10 K	Broken ribbon or missed solder joint; review by a Level 2 thermographer
Heated junction box	2–3	3 K or more against neighbouring boxes	Contact resistance or leaky bypass diode; high voltage

Declaration

I confirm that the inspection, tests and thermographic survey recorded in this report were carried out as stated.

PREPARED BY
Anika Sorensen
BEng (Hons), MCS accredited, ISO 9712 Level 2 thermographer
Sorensen Renewables Testing
19 May 2026

CHECKED BY
Priya Venkatesan
BEng (Hons) MIET
Sorensen Renewables Testing
19 May 2026

Sorensen Renewables Testing
PV commissioning, testing and thermography

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testing@sorensen.example
www.sorensen.example
Registered in England and Wales, company no. 09539865 (fictional)

INSTRUMENTS

INSTRUMENT	SERIAL	CALIBRATION DATE
FLIR T560	FT560-004412	14 Oct 2025
Seaward PV150	PV150-23311	09 Jan 2026

REVISIONS

REV	DATE	DESCRIPTION	BY	CHK	APP
P01	15 May 2026	Draft for internal check	AS	PV	
A	19 May 2026	First issue to client	AS	PV	PV

This report is for the named client and its professional advisers; no liability is accepted to any other party. The inspection was visual and non-destructive and reports the condition on the day. Concealed parts, services and areas without safe access were not inspected. This is a fictional sample report. The property, people, findings and photographs (AI-generated illustrations) are invented to demonstrate the template.

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