



**Independent Acoustic
Consultancy Practice**

Crossflow Wind Turbine Noise Impact Assessment

**CISM
Swansea**

6770/NIA1



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Crossflow Wind Turbine Noise Impact Assessment

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1. INTRODUCTION

It is understood that 3no Crossflow wind turbines are proposed to be mounted on the roof of the new CISM Building at the Bay Campus of Swansea University, Swansea, SA1.

In order to support the planning for this addition to the scheme, a noise impact assessment has been requested.

No certified noise data is currently available for the proposed turbines and therefore a measurement approach of an existing turbine located at Crossflow Energy's Port Talbot Dock test site has been carried out with the aim of estimating the likely noise output during operation of the turbine.

Please note, we have not carried out any vibration assessments for the proposed units located on the roof of CISM building and this is outside of our scope of works. We understand this has been discussed with the vibration specialists involved on the scheme.

2. CRITERIA

Hunter Acoustics report 5294/ENS1 dated 14/08/2019 details the results of an environmental noise survey to establish plant noise limits at the nearest residential receptors to the CISM building.

Plant rating limits were set in accordance with Pol 05 of BREEAM (rating level at least 5dB lower than the background noise level during the day and night).

Table 2.1 – Atmospheric Plant Noise Limits

Location	Period		Plant Rating Limits $L_{A,T}$
Nearest Residential Receivers (Elba Crescent)	Daytime	(0700-2300hrs)	47dB
	Night-time	(2300-0700hrs)	35dB

3. TURBINE MEASUREMENT SURVEY

3.1 Procedures

Source noise measurements of the turbine were undertaken at the Crossflow Energy test site in Port Talbot Docks.

Continuous noise monitoring was carried out from 1045hrs on Wednesday, 12 October 2022 to 0930hrs on Monday, 17 October 2022 at position A.

Data including L_{Amax} , L_{Aeq} and background L_{A90} was logged at 1 minute intervals over the monitoring period, along with continuous audio and 100ms data to allow source identification and further detailed analysis of results if required.

Table 3.1 – Continuous Monitoring Location Details

Position	Description
A	Microphone height of 4.2m above local ground height, representative of first floor window height at a residential dwelling, approximately 18m from the base of the turbine mast, downwind of prevailing wind conditions.

Additional sample measurements were taken on Wednesday, 12 October 2022.

Parameters recorded include L_{max} and L_{eq} levels including 1/3 octave band spectra.

3.2 Meteorological Conditions

Meteorological conditions were logged at the site by the Crossflow Energy Team and provided to Hunter Acoustics. Results are shown in time history graph in Figure B.1 of Appendix B.

The weather station lost power at points throughout the survey however measured data shows wind speeds in the range 10-12m/s on the afternoon of 12/10/2022 between 1600-1700hrs.

3.3 Measurement Equipment

The following measurement equipment was used during the surveys:

Table 3.2 – Noise Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.	Calibration Due
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-14577-E0	23 June 2022	TCRT20/1313	23 June 2024
	Preamplifier	MA220	7485	23 June 2022	TCRT20/1313	23 June 2024
	Microphone Capsule	MC230	A15594	23 June 2022	TCRT20/1313	23 June 2024
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-19813-E0	04 November 2021	UK-21-096	04 November 2023
	Preamplifier	MA220	10302	04 November 2021	UK-21-096	04 November 2023
	Microphone Capsule	MC230A	A21824	04 November 2021	UK-21-096	04 November 2023
Larson Davis	Calibrator (94.00dB / 114.03dB @ 1kHz)	CAL200	19047	15 August 2022	44788-19047-CAL200	15 August 2023
Lieca	Laser Measure	DISTO D2	1282650627	01 July 2018	1282650627	-

Measurement systems were calibrated before and after the surveys and no variation occurred.

Note: Copies of traceable calibration certificates for all equipment are available upon request.

3.4 Results

Subjectively, it was not possible to hear any noise from the turbine at 17m away during periods of wind on site. A faint tone was occasionally just audible at 10m distance which appeared to be coming from the gearbox/brake system at the centre of the turbine.

The time history for the continuous monitoring at 17m away from the turbine base is shown in Figure B.2 of Appendix B. There were no periods of audible turbine noise recorded at this location above wind noise.

Note: Tones present at 50Hz on the spectrograph are not related to turbine noise and are likely from other industrial sources at the docks.

As this proved difficult to measure, the turbine was brought down the mast to allow a closer source measurement at 3m away. This was the most conclusive measurement of the survey.

The measurement indicated a distinct tone which changed in frequency relative to the speed of the turbine. This can be seen clearly in yellow on the 3m sample measurement spectrograph in Figure B.3 of Appendix B (tone at 160Hz dropping to 100Hz).

4. IMPACT ASSESSMENT

With no certified noise data available for the turbine, an estimation of the overall noise generated by the turbine has been made using the highest absolute level of the tones generated at 100Hz and 160Hz at 3m, assuming the overall A-weighted sound pressure level would be controlled by this tone.

The following overall A-weighted sound pressure level at 3m is therefore estimated based on the measured tones;

- Tone present at 160Hz, unweighted 160Hz level of up to 65dB
Overall resultant 52dB(A)
- Tone present at 100Hz, unweighted 100Hz level of up to 71dB
Overall resultant 52dB(A)

Based on information to date, we would therefore estimate the noise level at 3m from the turbine at 52dB(A).

We understand there are 3no turbines proposed for the roof of CISM, which increases the level by around 5dB. Overall therefore a level of 57dB(A) at 3m from the 3no units is estimated.

The nearest residential dwellings are located on Elba Crescent approximately 180m away. Based on distance loss of around 35dB, noise levels from the turbines are indicated to fall well below the proposed limits set out in Section 2 of this report.

To put the estimated turbine noise into perspective, the chiller plant on the roof is indicated at 59dB at 10m and a design limit of 70dB at 1m was set for the process extract plant.

It should also be noted that background sound levels measured to establish plant limits for the CISM project were undertaken during calm conditions to measure robust, worst-case lowest background levels at the nearest residential receptors. Therefore, in periods of higher wind speeds when the turbines are spinning faster, background sound levels are likely to be significantly higher in any case.

5. CONCLUSION

A noise impact assessment has been requested for the installation of 3no Crossflow Energy Ltd wind turbines on the roof of the new CISM building at the Bay Campus, Swansea University, Swansea, SA1.

As no certified noise data exists for the turbines, a noise survey was conducted in proximity to the turbine installed at the Crossflow Energy Ltd test site in Port Talbot docks which we understand is representative of those proposed on this scheme.

Noise levels witnessed from the turbine were considered low and significantly quieter than roof top plant already installed at CISM.

No tonal noise data was detected on the continuous monitoring at 17m from the turbine. Sample measurements of the turbine at 3m were therefore used to establish the likely source level of the units.

Based on estimated levels of 52dB(A) at 3m, noise from the turbines is unlikely to cause an adverse impact at sound sensitive receivers near the CISM building.

APPENDIX A - ACOUSTIC TERMINOLOGY

Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver

APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – Wind Speed Logged at the Test Site by Crossflow Energy Ltd

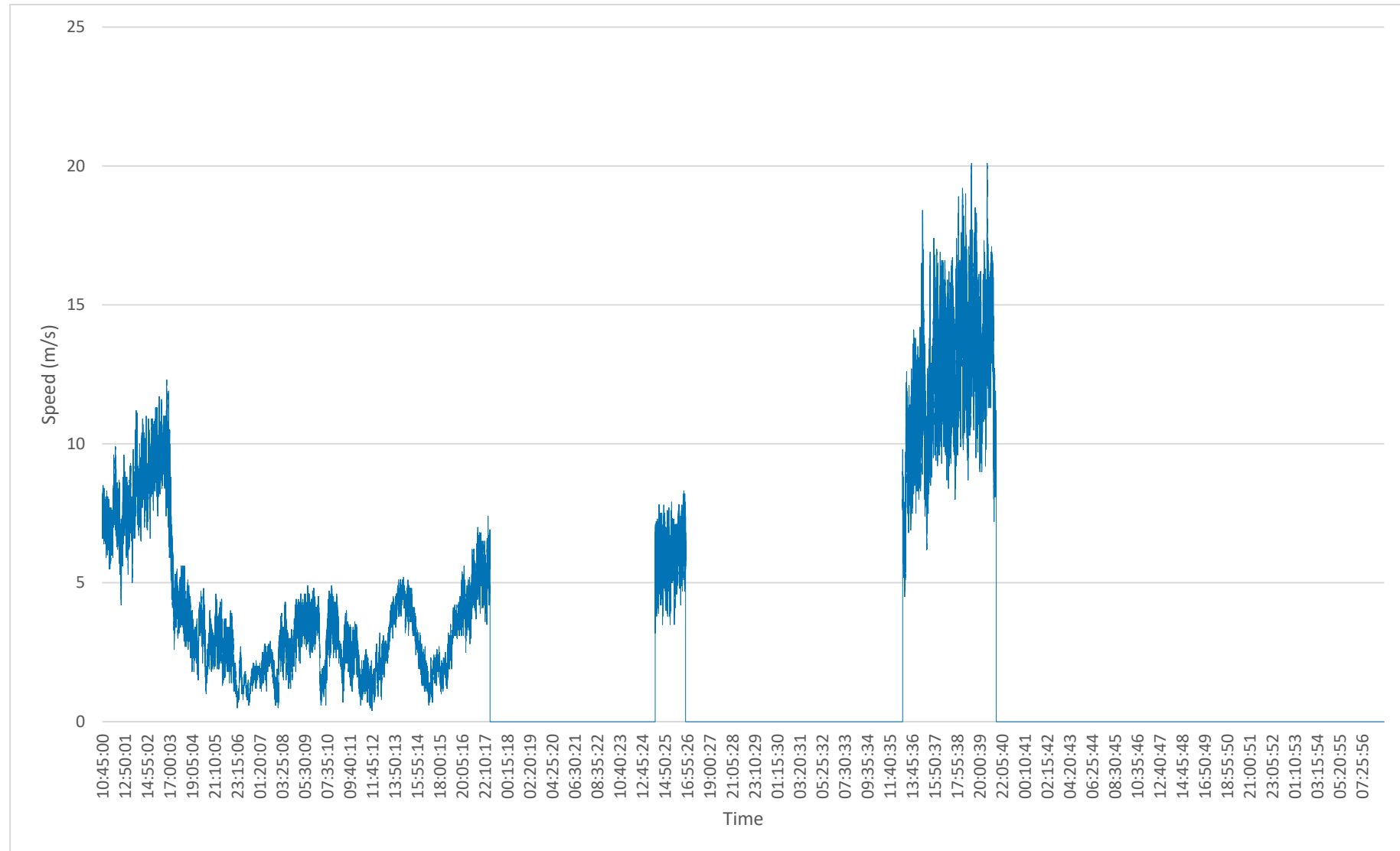
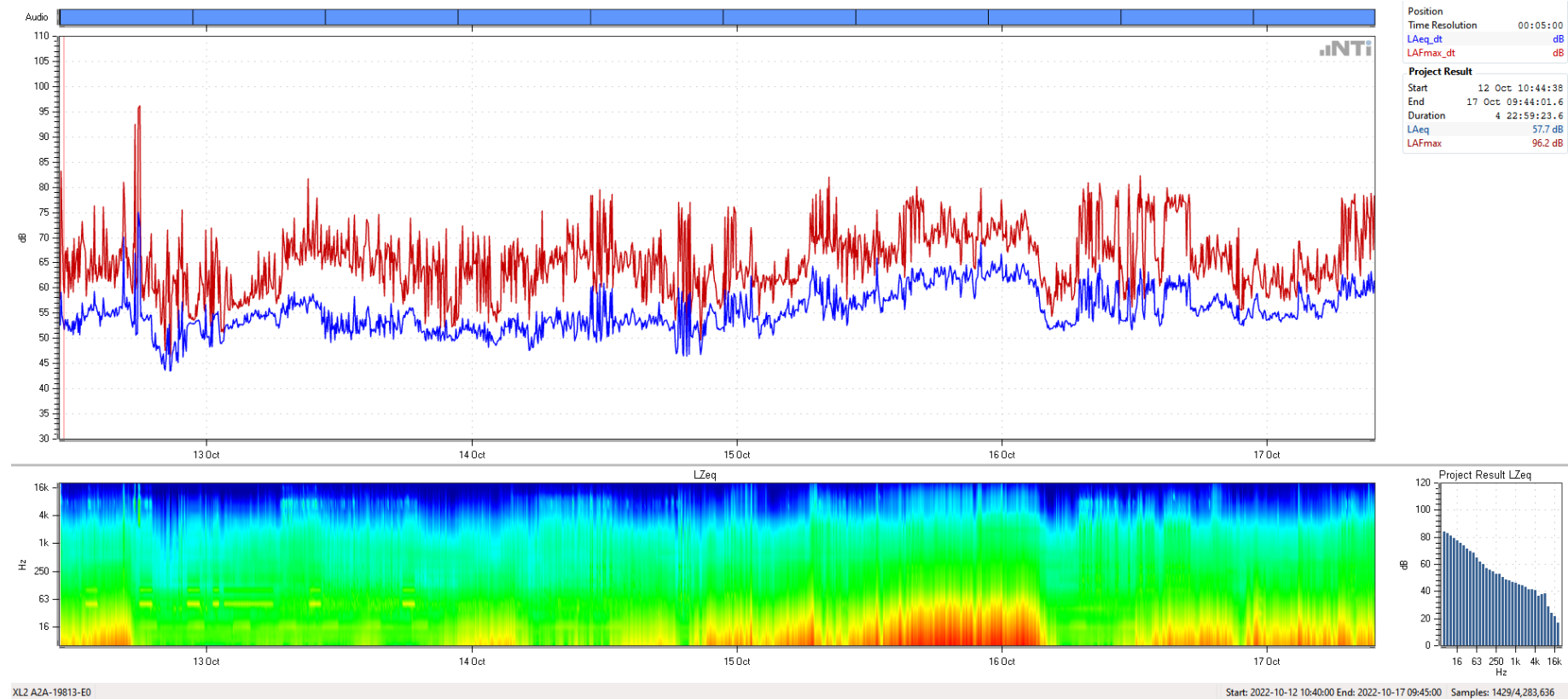
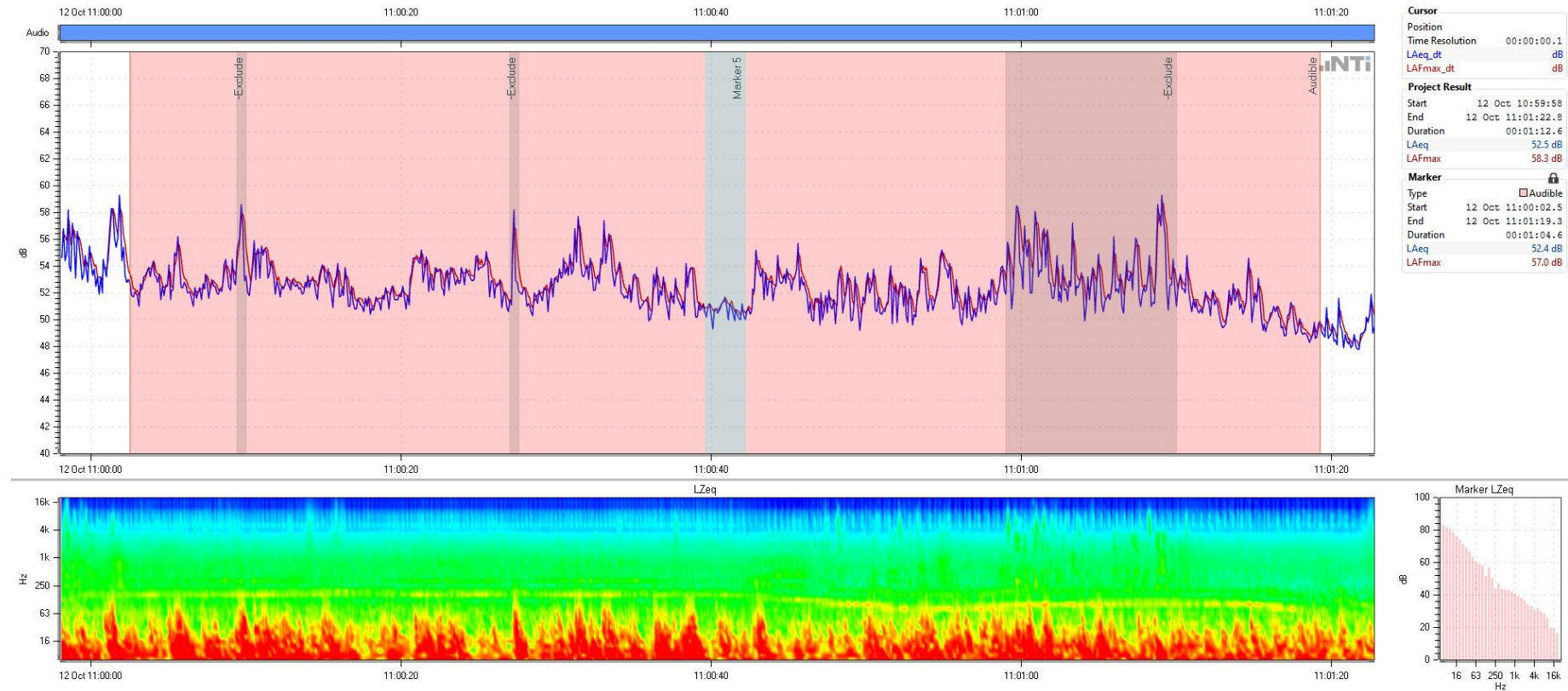


Figure B.2 – Time History of Continuous Monitoring at 17m from the base of the Turbine, 4.2m above ground height

Note: Overall noise levels controlled by wind and sea noise. 50Hz tone identified on spectrograph during periods on 12/10/2022 and 13/10/2022 is not attributed to wind turbine but other industrial sources nearby at the docks.

Figure B.3 – 3m Sample Measurement with Turbine Lowered on the Mast (Tone Falling from 160Hz to 100Hz as Speed Reduces)



APPENDIX C - DRAWING LISTS

The following Crossflow Energy Ltd drawings have been used in our assessment;

Table C.1 – Drawing List

Drawing Title	Drawing Number	Rev	Date
3.6kW Roof Mounted Turbine – Fixed Yaw (Sheet 1 of 2)	TBC	01	25/03/2022
3.6kW Roof Mounted Turbine – Fixed Yaw (Sheet 2 of 2)	TBC	01	25/03/2022
Roof mounted turbine – Swansea University CISM Project (Sheet 1 of 3)	TBC	B	18/07/2022
Roof mounted turbine – Swansea University CISM Project (Sheet 2 of 3)	TBC	B	18/07/2022
Roof mounted turbine – Swansea University CISM Project (Sheet 3 of 3)	TBC	B	18/07/2022