Prepared for
433 Link Development Pty Ltd.
ABN: 30 626 633 369

Kennedys Creek Solar Farm

Operational Noise Assessment

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Client: 433 Link Development Pty Ltd.

ABN: 30 626 633 369

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Executive Summary

AECOM has assessed the potential environmental noise emissions from the operation of the proposed Kennedys Creek Solar Farm in relation to applicable environmental noise criteria. This assessment has subsequently been updated following updates to the concept design and introduction of a new transmission line between the Kennedys Creek and adjacent West Mokoan solar farms.

The noise assessment has been prepared in accordance with Victoria's Environment Protection Act and the applicable Environment Protection Regulations, including EPA Publication 1826 - Noise Protocol 2021, and EPA Publication 1996 - Assessing Low Frequency Noise 2021.

The General Environmental Duty (GED) is at the centre of the new Environment legislation. The GED requires proactive steps to be taken to eliminate or reduce the risk of harm to human health and the environment from pollution or waste.

The main sources of noise from the operation of the proposed solar farm will be the inverters associated with the Power Control Units (PCUs). The substation and solar panel tracking motors will also contribute to the environmental noise emissions from the site.

Noise limits have been determined in accordance with the procedures of the Noise Protocol for each period, Day, Evening, and Night, at the nearest and potentially worst noise-affected residential locations.

The inverters are proposed to operate at 100% load during the hours 7am to 10pm, which covers the Day and Evening periods, and operate at 50% load, thus emitting less noise, from 10pm to 7am, which is the Night period.

Computer noise modelling was performed to predict the solar farm operational noise levels at the nearest residential locations for the two inverter operating conditions. The noise levels were predicted for neutral weather conditions with no wind, and with a moderate breeze assisting noise propagation towards the sensitive receptor locations.

The computer modelling results indicate that the solar farm noise emissions will comply with the noise limits at the nearby residences for all periods. To achieve compliance during the Night period, encompassing the hours 10pm to 7am, the PCU inverters must not operate at greater than 50% load.

The predicted noise levels are also below the thresholds set by EPA Publication 1996 - Assessing Low Frequency Noise, indicating low risk of annoyance to nearby residents due to low frequency noise.

1.0 Introduction

In September 2019, AECOM Australia Pty Ltd prepared a planning permit application on behalf of the Applicant, 433 Link Development Pty Ltd (South Energy) for the proposed Kennedys Creek Solar Farm. On 22 September 2021, ownership of the Project Applicant (433 Link Development Pty Ltd) was transferred from South Energy to Lightsource bp. Previous iterations of this report refer to South Energy, however all new information within this report refers to Lightsource bp to reflect current ownership of the Project Application.

Lightsource bp subsequently proposed changes to the concept designs for the Project, therefore this Operation Noise Report has been updated to support an application under Section 72 of the *Planning and Environment Act 1987* (P&E Act) to amend the planning permit for the Project (the amendment). The amendment seeks to:

- Rearrange the layout of Kennedys Creek Solar Farm to:
  - Relocate the Substation to the north-east of the site and connection to new transmission infrastructure
  - Make minor updates and design changes as a result of the above.
- Include a new transmission line from the Kennedys Creek Solar Farm to the network connection point at West Mokoan Solar Farm.

There are residential premises in the vicinity of the site that may be affected by noise from the inverters, the solar panel tracking motors, and the substation at the solar farm, which will be the main sources of noise emission from the site.

The scope of this assessment includes prediction of the inverter and substation noise levels and consideration of the predicted noise levels in relation to applicable noise criteria. The scope does not include measurement of the existing acoustic conditions surrounding the proposed solar farm site.

This report presents noise criteria applicable at the nearby residences with respect to the operational noise emissions, the methodology used to predict the noise emissions, and discussion on the predicted noise levels in relation to the nominated criteria.

1.1.1 Summary of Updates

The key updates that have been made in this revision to the report include:

- A reduction in the number of the inverters to be located across the site
- Changes to the locations of the inverters to be located across the site
- Change of the location of the substation
- Change to the proposed inverters to a model with lower sound output.

The report has also been changed to incorporate:

- The provisions of Victoria's Environment Protection Act and the applicable Environment Protection Regulations, including EPA Publication 1826 - Noise Protocol 2021, which came into effect since the previous revision of the report was issued
- An assessment in relation to EPA Publication 1996 - Assessing Low Frequency Noise 2021
- Discussion in relation to the General Environmental Duty (GED), which is at the centre of the new Environment legislation.

2.0 Site Description

The subject site is approximately four kilometres north-east of the town centre of Benalla, within the Rural City of Benalla.

The solar farm is proposed to be constructed on the site indicated in Figure 1, below, at:

- Murray Road, Benalla (Lot 3 PS318659S and Lot 4 PS318659S);
- 51 Nelson Road, Benalla (Lot 6 PS627741K);
- 67 Nelson Road, Benalla (Lot 7 PS627741K);
- Nelson Road, Benalla (Lot 2 PS803108D); and
- 284 Benalla-Yarrawonga Road, Benalla (Lot 3 PS715932M).

The transmission line impact area affects the following additional properties (Figure 2), however these do not affect the noise assessment as there are no noise impacts associated with the operation of transmission line:

- Lake Mokoan Road, Winton North (Allotment 2020 Parish of Winton PP3843)
- 368 Benalla-Yarrawonga Road, Benalla (Lot 2 PS627741)
- 370 Benalla-Yarrawonga Road, Benalla (Lot 1 PS627741)
- 82 Snowy Lane, Benalla (Lot 2 LP123365)
- Benalla-Yarrawonga Road, Benalla (Lot 1 PS717978)
- 524 Benalla-Yarrawonga Road, Benalla (Lot 6 LP206524)
- 572-616 Benalla-Yarrawonga Road, Benalla (Lot 5 LP206524; Lot 4 LP206524 Lot 3 LP206524)
- Allotment 2019 Parish of Goorambat PP2704
- Snowy Lane, Benalla road reserve.

The nearest residential locations are as follows:

- 368 Benalla-Yarrawonga Road, approximately 120 metres from the north-western site boundary
- 130 Benalla-Yarrawonga Road, approximately 750 metres from the south-eastern site boundary
- 226 Murray Road, approximately 700 metres from the south-western site boundary
- Nelson Road, approximately 200 metres from the south-eastern corner of the site

Under the current proposal, 24 Power Control Units (PCUs), 3,584 solar panel tracking motors, and a substation are proposed to be located across the site.

Figure 1 – Proposed Kennedys Creek Solar Farm site and surrounds

Figure 2 Transmission Line Affected Properties

3.0 Noise Criteria

3.1 Victorian Policies and Guidelines

3.1 Environment Protection Act 2017

Noise in Victoria is managed primarily through the *Environment Protection Act 2017* (EP Act) and associated regulations. The EP Act applies to noise emissions and the air, water and land to protect the environment in Victoria.

The Environment Protection Regulations are used to further the purpose, and give effect to the EP Act. Provisions under the EP Act include the General Environmental Duty (GED) and the obligation not to emit or permit to emit 'unreasonable noise'. Meeting the regulatory noise limits does not mean the GED has been met. The GED requires all reasonably practicable steps to be taken to eliminate or reduce the risk from noise.

3.1.1 General Environmental Duty

The General Environmental Duty (GED) requires proactive steps to be taken to eliminate or reduce the risk of harm to human health and the environment from pollution or waste. The GED applies at all times, during construction and operation of the project, for any activities posing a risk of harm to human health and the environment. The following sections of the EP Act apply to the GED:

- Section 25(1) of the EP Act states that a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution must minimise those risks so far as reasonably practicable.

- Section 6 of the EP Act states that minimising risks of harm to human health and the environment requires the duty holder to eliminate risks of harm to human health and the environment so far as reasonably practicable and, if it is not reasonably practicable to eliminate those risks, then reduce those risks as far as reasonably practicable.
- Section 6(2) of the EP Act states factors to give regard to when determining what is reasonably practicable in relation to the minimising of risks to harm to human health and the environment.
- Section 3(1) of the EP Act states that even if the GED is met, the noise may be unreasonable if it exceeds the noise limits considering the factors in the definition of unreasonable noise.

3.1.2 EPA Publication 1856 - Reasonably Practicable

EPA Victoria Publication 1856 *Reasonably Practicable* provides guidance as to the factors to consider when defining proportionate controls to minimise harm, as follows:

- Eliminate first: Can you eliminate the risk?
- Likelihood: What's the chance that harm would occur?
- Degree (consequence): How severe could the harm be on human health or the environment?
- Your knowledge about the risks: What do you know, or what can you find out, about the risks your activities pose?
- Availability and suitability: What technology, processes or equipment are available to control the risk? What controls are suitable for use in your circumstances?
- Cost: How much does the control cost to put in place compared to how effective it would be in reducing the risk?

The items above have been considered when assessing the suitability of noise mitigation measures for the project.

3.1.3 Unreasonable Noise

The Environment Protection Regulations describes unreasonable (Section 166) and aggravated noise (Section 168) from a commercial, industrial and trade premises in Regulation 118, as follows.

1. *For the purpose of paragraph (b) of the definition of unreasonable noise in section 3(1) of the Act, noise emitted from commercial, industrial and trade premises is prescribed to be unreasonable noise if the effective noise level of the noise exceeds-*
    a. *The noise limit that applies at the time the noise is emitted; or*
    b. *the alternative assessment criterion that applies at the time the noise is emitted if the assessment of an effective noise level is conducted at an alternative assessment location in accordance with the Noise Protocol.*

Regulation 118 also sets noise limits that apply in '*noise sensitive areas'*, above which noise is prescribed to be unreasonable.

The Environment Protection Regulations also propose frequency spectrum (Regulation 120) as a prescribed factor to consider when assessing unreasonable noise for the purpose of part (a) of the definition.

Under section 166 of the EP Act, noise can be assessed as unreasonable based on the factors in paragraph (a) of the definition of unreasonable noise (Section 3(1) of the EP Act). This applies to any noise including:

- When the noise limits are met and the factors remain relevant to noise being unreasonable, such as short-term loud events and low frequency noise.

3.1.4 Environmental Reference Standard

The Environment Reference Standard (ERS) is made under section 93 of the Environment Protection Act to support the protection of human health in Victoria. It sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values.

Environmental values are the uses, attributes and functions of the environment that Victorians value. Standards for the environmental values are comprised of objectives for supporting different uses. The ERS sets out objective noise levels based on Victoria's planning zones. The noise levels outlined in the ERS are objectives and are neither noise limits nor noise design criteria.

The ERS identifies environmental values to support the following: sleep at night, child learning and development and human tranquillity and the enjoyment of outdoors in natural areas.

The ERS does not apply in situations where specific regulations apply to that part of the environment or activity, for example, those noise sources considered by the Noise Protocol. As such, the ERS does not apply to this assessment.

3.2 Operational Noise Assessment Criteria

The following guidelines are referred to for this noise assessment:

3.2.1 EPA Publication 1826 – The Noise Protocol

The Noise Protocol explains how to determine operational noise criteria for new and existing commercial, industrial and trade premises and entertainment venues as defined by the Environment Protection Regulations.

The Noise Protocol is a subordinate legislation document. It is required to be adhered to by law.

The Noise Protocol specifies the methodology to determine and assess against the regulatory noise limits applicable to operational noise. The regulatory noise limits apply at all nearby sensitive receptors during the operation of the project.

Meeting the regulatory noise limits does not mean the GED has been met. In addition to setting noise limits for industry, the Environment Protection Act requires that industry should take all reasonably practicable steps to eliminate or reduce the risk from noise.

The Noise Protocol also provides guidance for the assessment and management of cumulative noise from multiple industrial premises (existing and planned).

Table 3 Applicable Time Periods

Period	Time
Day	7am to 6pm Weekdays and Saturdays
Evening	6pm to 10pm Weekdays and Saturdays 7am to 10pm Sundays and Public Holidays
Night	10pm to 7am

Noise limits are dependent on the following factors:

- Zoning, based on the Victorian Planning Scheme
- Time, based on time of day i.e. different limits apply at different times of the day
- Background noise level (L_{A90}) in the noise sensitive area, in the absence of noise due to commercial, industrial or trade operations
- Consideration must be given to cumulative noise from multiple current or future industries operating in the same area that can impact noise sensitive receptors.

For the proposed Kennedys Creek Solar Farm, the noise limits are derived using Noise Protocol Section 2, *Noise Limits - Rural Area Method*.

The procedure that was used to derive the limits is presented below.

3.2.1.1 Step 1 – Zone Levels

Noise limits for the proposed solar farm have been established using the procedures from Part 2 of the Noise Protocol, which details the steps that are used to derive the limits for rural areas.

Step 1 in determining the noise limits involves determining 'Zone Levels', based on the zoning of the land at the noise sensitive area and at the noise-emitting premises. The Zone Levels are read from Table B.1 in Annex B of the Noise Protocol.

Referring to the relevant Planning Scheme, presented in Appendix A, the majority of the proposed solar farm site is situated on land zoned *Farming Zone* (FZ), and a small portion of the site at the south-western extent is zoned *Industrial 1 Zone* (IN1Z).

The dwellings located at 368 Benalla-Yarrawonga Road, 130 Benalla-Yarrawonga Road and Nelson Road are located on land zoned FZ. The closest portions of the site of the proposed solar farm to these residences are also zoned FZ.

For these land use zonings, i.e. noise-generating zone FZ to receiving zone FZ, from Table B.1 in Annex B of the Noise Protocol, the Zone Levels are as follows:

- Day period: 46
- Evening period: 41
- Night period: 36

The dwelling at 226 Murray Road is located on land which is zoned IN1Z. The closest portion of the site of the proposed solar farm to this residence is also zoned IN1Z.

For these land use zonings, i.e. noise-generating zone IN1Z to receiving zone IN1Z, from Table 1 of the Noise Protocol, the Zone Levels are as follows:

- Day period: 58
- Evening period: 53
- Night period: 48

3.2.2 Step 2 – Distance-Adjusted Levels

Step 2 in determining the noise criteria is to adjust the Zone Levels based on the distance from the noise sensitive receiver to the boundary of the zone in which the noise-emitting premises is located. The distance adjustment is 1 dB for every 100 metres from the boundary of the zone on which the noise emitter is located, to the noise sensitive receptor.

The Noise Protocol prescribes that where the noise-emitting premises and the receptor are in the same continuous zone, the distance adjustment is zero. The dwellings at 368 Benalla-Yarrawonga Road, 226 Murray Road and Nelson Road are in the same zone as the nearest portions of the noise-generating premises to each respective dwelling, therefore for these receptors the distance adjustment is zero.

However, there is an intervening zone classified *Public Use* (PUZ1) between 130 Benalla-Yarrawonga Road and the proposed solar farm site. Therefore, in accordance with the Noise Protocol, the distance adjustment must be applied to derive the limits for this receptor.

The distance from the edge of the zone on which the solar farm will be located to the noise sensitive receptor at 130 Benalla-Yarrawonga Road is 700 metres, therefore, 7 dB must be subtracted from the Zone Levels. The resulting distance adjusted levels are:

- Day period: 39
- Evening period: 34
- Night period: 29

3.2.3 Step 3 – Base Noise Level Check

Step 3 in determining the criteria is the base noise level check. For each period, the greater of the distance adjusted noise levels and the Noise Protocol 'base noise levels' are to be adopted. The base noise levels are as follows:

- Day period: 45
- Evening period: 37
- Night period: 32

Therefore, at this step in the limit derivation the base noise level for each period is to be adopted for 130 Benalla-Yarrawonga Road.

The Zone Levels determined in Step 1 are to be adopted for 368 Benalla-Yarrawonga Road, 226 Murray Road and Nelson Road.

3.2.4 Step 4 – Background Noise Level Check and Adjustment

The Noise Protocol also prescribes that if the noise sensitive area is determined to be a 'background-relevant area', a background noise assessment including background noise monitoring may be conducted. If the noise sensitive area is not a background-relevant area, the noise limits are the applicable Zone Levels, adjusted as appropriate from Steps 2 and 3.

Background-relevant area is defined in the Noise Protocol as follows:

> *'A noise sensitive area within a rural area where background levels may be higher than usual. This includes areas where freeway or highway traffic is a significant audible background noise source.. It also includes coastal areas, where representative background levels are elevated by surf.'*

For a background relevant area, the noise criteria will be the Day period background level plus 8 dB(A), and the Evening and Night period backgrounds plus 5 dB(A), if these values exceed the applicable noise limits for the respective periods.

It is considered unlikely that the background noise levels at the identified noise sensitive receivers would be sufficiently high to satisfy the background-relevant area conditions.

The determined noise limits are presented in Table 1 below.

Table 1 Noise Limits

Time Period	Time	Noise Limits [dB(A)]			
		368 Benalla-Yarrawonga Road	130 Benalla-Yarrawonga Road	226 Murray Road	125 Nelson Road
Day	7am to 6pm Weekdays and Saturdays	46	45	58	46
Evening	6pm to 10pm Weekdays and Saturdays 7am to 10pm Sundays and Public Holidays	41	37	53	41
Night	10pm to 7am	36	32	48	36

The noise limits presented above apply to the noise emitted from the proposed solar farm, outdoors within 10 metres of the dwellings at the identified nearest receptors.

4.0 Noise Modelling

This section outlines the methodology that was used to undertake acoustic computer modelling to predict the noise levels at the nearby residential locations due to the operation of the proposed solar farm.

4.1 Noise Modelling Software

The noise levels at the nearby residential locations due to the operation of the solar farm were calculated using 'SoundPLAN' environmental noise modelling software, version 8.2. This software is capable of accurately modelling environmental noise levels and mapping the results. SoundPLAN is used extensively worldwide, and takes a standards-based approach to modelling.

The modelling was undertaken using the CONCAWE[1] prediction method that is widely used in Australia for modelling environmental noise, and is accepted by EPA. The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes. It is especially suited to predicting noise propagation over large distances because it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

4.2 Noise Modelling Parameters

The following sections outline the parameters that were put into the acoustic model to calculate the noise levels at the nearest noise-sensitive locations.

4.2.1 Topography

Three-dimensional elevation data for the proposed solar farm site was based on one-metre interval contour lines that were available for the project. Terrain information outside the site boundary was sourced from AECOM's database of geographical information.

4.2.2 Ground Absorption

All ground in the study area was modelled as being 50% acoustically absorptive, as the terrain in the vicinity of the site is predominantly vegetated and soil-covered fields which will partially absorb noise.

4.2.3 Meteorological Conditions

Meteorological conditions such as the presence of a temperature inversion or light to moderate winds can have a significant effect on sound propagation. Generally, as air pressure increases, relative humidity increases and temperature decreases, noise propagation is enhanced.

Temperature inversions (i.e. when the normal temperature profile of the atmosphere is reversed such that the air temperature increases with increasing height above ground) typically occur at night and tend to assist the propagation of noise. Likewise, a light to moderate wind (i.e. 1 to 3 m/s) from the source to the receiver tends to assist the propagation of noise to the receiver, while the impact of noise for any receivers in the opposite direction would be reduced. For higher wind speeds, the wind becomes too turbulent to effectively assist the propagation of noise, and background noise levels tend to increase, masking any increases in noise level due to wind-assisted propagation.

Noise levels at the noise sensitive receptors were calculated for two meteorological conditions, as follows:

- Neutral atmospheric conditions with no wind
- A 3m/s wind from the site to the residences.

In general, the meteorological conditions in the vicinity of the site will include higher wind speeds than were modelled, however, for the reasons noted above, wind speeds of greater than 3 m/s were not incorporated into the acoustic model.

[1] CONCAWE Report No. 4/81, "The Propagation of Noise from Petroleum and Petrol Chemical Complexes to Neighbouring Communities", Published 1981.

4.2.4 Noise Sources

The main sources of noise from the operation of the proposed solar farm will be the inverters, the solar panel tracking motors, and the substation transformer.

The inverters were modelled at the locations indicated on the site layout drawing shown inAppendix B. Two inverter units were modelled at each PCU location marked on the site layout. The inverters are nominally two metres high; therefore each inverter was modelled as a point source, at a height of two metres above the local ground level.

The tracking unit motors were modelled as a continuous area-type sound source covering the project site.

The substation transformer was modelled within the substation area indicated on the proposed site plan towards the northern end of the site, at a height of three metres above the local ground level.

4.2.5 Receivers

Receiver points for the calculation of the noise levels at the residential locations were placed at heights of 1.5 metres above the local ground. Noise levels were calculated at these locations under 'free-field' conditions, i.e. without influence from any sound-reflecting structures.

4.3 Noise Level Data

4.3.1 Power Conversion Unit Inverters

Ingeteam model "Ingecon Sun FSK C Series" inverters are proposed for installation at the site. The project is to include 24 PCUs across the site, each comprising two inverters.

The Ingeteam data sheet for the Ingecon Sun FSK C Series (attached in Appendix C) presents noise level specifications for two operating conditions; 100% load, and 50% load.

The presented noise level specifications, in the form of Sound Pressure Levels at a distance of 10 metres, were used to calculate the corresponding Sound Power Levels. The Sound Power Levels were calculated based on the known relationship between Sound Power (L_W) and Sound Pressure (L_p) for a source emitting sound uniformly over an acoustically reflecting plane,

$$Lw = Lp + 10 \times Log_{10}(Area)$$

Where 'Area' is the surface area of a hemisphere centred on the sound source, and with a radius equivalent to the distance to the location at which the Sound Pressure Level is known, in this instance 10 metres.

The calculated Sound Power Levels for the two operating conditions are presented in Table 2, below.

Table 2 – Inverter Noise Level Data

Operating Condition	Overall Sound Power Level (dBA)
100% Load	85
50% Load	77.7

A one-third octave band spectrum shape for use in modelling the inverter emissions was taken from "*Acoustic Report – Determination of Acoustic Power Electric Inverter "Ingecom [sic] Sun Power C Series*" (attached in Appendix D), which presents the results of noise measurements performed at close range for each operating condition.

Lightsource bp have advised that the inverters would not operate at greater than 50% load between 10pm and 7am, i.e. the Night period. Therefore, modelling was performed for two operating conditions, as follows:

- The inverters operating at 100% load for assessment against the Day and Evening period noise limits.
- The inverters at 50% load for assessment against the Night period noise limits.

4.3.2 Substation

Noise level data for the substation transformer was not available for use in the modelling. Therefore, the transformer was modelled as having an overall Sound Power Level of 80 dB(A), which is estimated to be within the likely range of sound output for this item. If a transformer with a higher Sound Power Level is selected for installation, details of the proposed transformer should be provided for acoustic review.

4.3.3 Solar Panel Tracking Motors

The project is to include 3,584 solar panel tracking motors across the site. The final tracking motor selection has not yet been made, and will be selected prior to the construction phase, however, as an indication, Lightsource bp provided details of a solar panel tracking motor that may be used on the project, a model MB076ZT101 PL0350 DC gear motor, and the results of noise measurements that were performed on the motor. It could not be determined if the noise measurements were performed to an appropriate testing standard, or under ideal test conditions.

Therefore, noise level data for the solar panel tracking motors for use in the modelling was taken from the acoustic assessment for another AECOM project, for which was data was provided by the tracking motor supplier, NexTracker. The provided data for the NexTracker unit indicated a Sound Pressure Level of 70 dBA at a distance of one metre from the motor, which equates to a Sound Power Level of 78 dB(A) based on simple geometric sound dispersion from the motor.

The supplied measured noise levels for the MB076ZT101 PL0350 DC gear motor intended for this project indicate that this unit is quieter than the NexTracker motor, and the assessment of the tracker motors is therefore likely conservative. Also, as the final motor selection will be made closer the construction phase when newer models may be available, it is possible that the selected motors will be quieter than the units modelled as part of this assessment.

Octave band or one-third octave band noise level data was not available for the proposed tracking motors. Therefore, all noise emission from the motors was modelled at a frequency of 500 Hz.

The tracking motors operate intermittently to adjust the angle of the panels. NexTracker advised that the units typically operate for approximately 10 seconds within a 15-minute period. Therefore, a duration adjustment of – 19.5 dB was applied to the Sound Power Level used in the modelling based on this duty cycle to determine the 30-minute L_{Aeq} noise emission, as per the Noise Protocol assessment procedure.

The tracking unit motors were modelled as a continuous area-type sound source covering the project site. The Sound Power Level of the area source was calculated based on the Sound Power Level for a single unit scaled to represent 3,584 motor units.

In summary, the total Sound Power used to model the tracking motors across the site is as follow:

Sound Power Level for solar panel one motor:	78 dB(A)
Duration Adjustment for 10 seconds per 15 minutes:	19.5 dB
Adjustment to scale from one motor to 3,584 motors:	58.5 dB
Total Sound Power of all tracking motors:	94 dB(A)

4.4 Noise Modelling Results

The predicted noise levels at the nearby residences due to the operation of the proposed solar farm, for full power operation and 50% power operation, for the two meteorological conditions considered, are presented in Table 3 and Table 4, below.

Table 3 – Predicted Noise Levels due to Operation of Solar Farm – 100% Load

Receiver	Predicted A-weighted Sound Pressure Level, L_{Aeq} [dB(A)]	
	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
368 Benalla-Yarrawonga Road	30	35

Receiver	Predicted A-weighted Sound Pressure Level, L_{Aeq} [dB(A)]	
	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
130 Benalla-Yarrawonga Road	20	26
226 Murray Road	19	25
125 Nelson Road	30	34

Table 4 – Predicted Noise Levels due to Operation of Solar Farm – 50% Load

Receiver	Predicted A-weighted Sound Pressure Level, L_{Aeq} [dB(A)]	
	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
368 Benalla-Yarrawonga Road	25	30
130 Benalla-Yarrawonga Road	15	22
226 Murray Road	14	20
125 Nelson Road	25	30

The inverter noise emissions are the dominant contributors to the predicted overall noise levels. Substation noise is a relatively minor noise contributor.

In accordance with the EPA requirements, the predicted noise levels with adjustments applied are to be assessed in relation to the noise limits. This is presented in the following section.

5.0 Assessment of Compliance

5.1 Compliance Assessment

In accordance with the Noise Protocol, adjustments are to be applied to the noise level at the receiver to account for the character of the sound. The adjusted noise level is the Effective Noise Level, which is assessed in relation to the noise limits.

Noise emissions from electricity distribution and transmission equipment such as inverters can exhibit strong tonal character. The Ingeteam one-third octave band test data confirms that the inverters emit tonal noise. Therefore, a tonal adjustment needs to be considered for application to the predicted noise levels.

The magnitude of the tonal adjustment is determined based on the prominence of the tonal character of the noise as assessed at the location of the noise sensitive receiver. This will depend on the level and character of the noise in respect of the background noise conditions at the time of the assessment; a noise with strong tonal character in the presence of high background noise levels will exhibit a weaker tonal character than in the presence of low background noise levels.

Where the tonal character of the noise is 'just detectable', the Noise Protocol prescribes a tonal adjustment of +2 dB; where the tonal character is 'prominent', a +5 dB adjustment is applied.

In this instance, during times of low background noise levels, it has been assumed that the solar farm noise could be observed to exhibit prominent tonal character at the locations of the nearest receptors, such that the tonal adjustment would be +5 dB.

The resultant predicted Effective Noise Levels with the +5 dB tonal adjustment applied are presented in the tables below. Table 5 presents the Effective Noise Levels for the 100% load operating condition for assessment in relation to the Day and Evening period noise limits, which apply during the hours 7am to 10pm; Table 6 presents the 50% load noise levels for assessment of the Night period noise levels applicable during the hours 10pm to 7am.

Table 5 – Predicted Effective Noise Levels due to Operation of Solar Farm – Day and Evening Periods (7am to 10pm), 100% Load

Receiver	Noise Limit [dB(A)]		Predicted Effective Noise Level [dB(A)]	
	Day	Evening	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
368 Benalla-Yarrawonga Road	46	41	35	40
130 Benalla-Yarrawonga Road	45	37	25	31
226 Murray Road	58	53	24	30
125 Nelson Road	46	41	35	39

Table 6 – Predicted Effective Noise Levels due to Operation of Solar Farm – Night Period (10pm to 7am), 50% Load

Receiver	Noise Limit [dB(A)]	Predicted Effective Noise Level [dB(A)]	
	Night	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
368 Benalla-Yarrawonga Road	36	30	35
130 Benalla-Yarrawonga Road	32	20	27

Receiver	Noise Limit [dB(A)]	Predicted Effective Noise Level [dB(A)]	
	Night	Neutral Meteorological Conditions	3m/s Source-to-Receiver Wind
226 Murray Road	48	19	25
125 Nelson Road	36	30	35

At the nearest and potentially worst-affected receiver to the north, 368 Benalla-Yarrawonga Road:

- At 100% load the predicted Effective Noise Level for the neutral meteorological condition is 6 dB under the Evening period limit, and 1 dB under the Evening period limit during the wind condition favouring noise propagation to the receiver
- At 50% load the predicted Effective Noise Level for the neutral meteorological condition is 6 dB under the Night period limit, and 1 dB under the Night period limit during the wind condition favouring noise propagation to the receiver.

At the nearest and potentially worst-affected receiver to the south, 125 Nelson Road:

- At 100% load the predicted Effective Noise Level for the neutral meteorological condition is 6 dB under the Evening period limit, and 2 dB under the Evening period limit during the wind condition favouring noise propagation to the receiver
- At 50% load the predicted Effective Noise Level for the neutral meteorological condition is 6 dB under the Night period limit, and 1 dB under the Night period limit during the wind condition favouring noise propagation to the receiver.

The predicted Effective Noise Levels at the other receiver locations are compliant with the noise limits by several dB for all operating conditions under both modelled meteorological conditions.

5.2 Cumulative Impacts

There are two existing industrial premises located to the south of the proposed solar farm site and one to the north-west. There is the potential for the cumulative noise from the existing industries and the proposed solar farm to be non-compliant if each of the existing facilities and the solar farm were to emit levels of noise equal to, or just below the noise limits. In these circumstances, the EPA provide a methodology that allows for the combined noise produced by all industrial premises to comply with the relevant limits. In this case, each of the industrial premises would need to operate lower than the noise limits to achieve overall compliance.

The receiver at 226 Murray Road, located to the south-west of the proposed solar farm site is potentially affected by noise from the existing two industries to the south. However, the predicted Effective Noise Levels at 226 Murray Road due to the solar farm operation are more than 20 dB under the limits. Therefore, the contribution from the solar farm would not affect the state of cumulative compliance at this location.

The predicted solar farm Effective Noise Levels at the receiver at 130 Benalla-Yarrawonga Road are 12 dB below the limit under neutral meteorological conditions, such that the proposed solar farm would make a negligible contribution to cumulative non-compliance at this location. Under wind conditions favouring noise propagation from the solar farm site to this receiver the predicted level is at least 5 dB below the limit, which would enable each of the two industries to the south to contribute the same levels of noise as the solar farm and still achieve overall cumulative compliance. However, under this meteorological condition the wind would impede sound propagation from the industries to the south towards the receiver, thus minimising their noise contributions.

At 125 Nelson Road the predicted Effective Noise Levels are 1 dB under the limit under the modelled worst case meteorological conditions. However, such wind conditions would also significantly reduce the noise propagation from the existing industrial premises to this location. Further, the two industries to the south are approximately 1.4km away, such that their noise impacts at 125 Nelson Road are likely to

be minimal. If the noise levels from the existing industries were high enough to contribute to cumulative non-compliance at 125 Nelson Road, then it is likely that the noise from these industries would be significantly in excess of the noise limits at their nearest receptors, namely 130 Benalla-Yarrawonga road and potentially also 226 Murray Road.

368 Benalla-Yarrawonga Road is located to the north of the solar farm site. The two existing industries to the south are 2km and 2.5km away, and there is an existing industrial facility 2km away to the north-west.

The predicted solar farm Effective Noise Levels at 368 Benalla-Yarrawonga Road are 6 dB under the limit under neutral meteorological conditions. This would enable each of the three industries (two to the south; one to the north-west) to contribute the same levels of noise as the solar farm, as measured at 368 Benalla-Yarrawonga Road, and still achieve overall cumulative compliance. However, it is unlikely that the existing industries would generate these levels of noise as measured at the receiver due to the large separation distances.

Under meteorological conditions favouring noise propagation from the facility to the north-west, the solar farm noise would be significantly reduced by the conditions such that the solar farm's contribution to the cumulative level at 368 Benalla-Yarrawonga Road would be minimal.

Under meteorological conditions favouring noise propagation from the south, if the noise levels from the existing industries to the south were high enough to contribute to cumulative non-compliance at 368 Benalla-Yarrawonga Road, then it is likely that the noise from these industries would be significantly in excess of the noise limits at their nearest receptors.

5.3 Low Frequency Noise Assessment

Low frequency noise has been considered in relation to the outdoor low frequency thresholds outlined in EPA Publication 1996. Noise inputs were available in one-third octave bands from 50Hz and above.

Predicted low frequency noise levels for the worst-case 100% load operating condition at the worst affected noise sensitive receptor have been included with a comparison against the outdoor low frequency thresholds from EPA Victoria Publication 1996 in Table 7.

Table 7 Low Frequency Assessment

	One-third octave band centre frequency (Hz)												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
EPA Victoria Publication 1996 outdoor thresholds (dB(Z))	92	89	86	77	69	61	54	50	50	48	48	46	44
Predicted noise level at 368 Benalla-Yarrawonga Road (dB(Z))	-	-	-	-	-	-	-	28	31	22	29	32	25
Complies?	-	-	-	-	-	-	-	✓	✓	✓	✓	✓	✓

The low frequency noise assessment indicates that the predicted solar farm noise levels are at least 9 dB below the thresholds over the frequency range for which the solar farm noise data is available.

For frequencies of 40 Hz and lower, for which noise data is not available, the solar farm plant items likely produce lower levels of noise and compliance with the thresholds is expected.

Note that the assessment of low frequency noise using this guideline is separate from an assessment for compliance with the regulatory noise limits. The threshold levels provided are not set limits, rather levels that indicate potential risk of annoyance due to low frequency noise, and may be used as a tool when evaluating compliance with the GED.

5.4 Assessment of Reasonably Practicable Mitigation Measures

Additional noise mitigation measures have been considered and assessed below in order to demonstrate that the mitigation measures incorporated into the current project proposal represent the limit of measures that are considered to be reasonable and practicable for the project.

Use of quieter equipment: This has now been implemented in the current revision of the project design in the form of inverter units with lower noise output compared with the inverter units included in previous revisions of the design. The outcome of this is significantly lower predicted noise levels at the receiver locations that are compliant with the noise limits without the need for additional noise control measures. Acoustic screening around the site perimeter: The distance between noise sources and perimeter means that the noise barriers would need to be very high for a small benefit in terms of noise. The required barriers would be very expensive and introduce undesirable visual impacts.

Acoustic screening around individual PCUs: To achieve a noticeable benefit at the receiver locations, acoustic screens would need to be applied to most or all PCUs. The screens would need to surround the PCUs on all four sides, thus impeding airflow to the PCUs, and create difficulties in terms of access for maintenance. The required screens would need to incorporate weather-proof acoustically absorptive linings to the PCU-facing side, and would thus be very expensive.

Acoustic enclosures around individual PCUs: The inverter supplier has advised that they are unable to apply acoustic enclosures to the PCUs. Enclosing the PCUs creates difficulties in terms of airflow for cooling for the inverters and access for maintenance. Further, if enclosures were applied to the PCUs they would need to be applied to most or all PCUs to achieve a noticeable benefit at the receiver locations.

Locating PCUs further away from noise sensitive receptors: To achieve a noticeable reduction in the noise levels at the receiver locations, most or all PCUs would need to be moved relatively large distances towards the centre of the site. This is not possible due to the fact that each PCU needs to be located in close proximity to the solar panel array serviced by that PCU to enable effective electrical power distribution.

6.0 Discussion

The PCU inverters will be the dominant contributors to the environmental noise emissions from the proposed solar farm. Therefore, in order to achieve compliance with the noise limits it is critical that the inverter noise emissions meet the noise specifications presented on the Ingecon Sun FSK C Series data sheet (attached in Appendix C), namely:

- 57 dB(A) at a distance of 10 metres at 100% load, and
- 49.7 dB(A) at a distance of 10 metres at 50% load.

It is recommended that these acoustic performance specifications are written into the purchase agreement for the inverters, and that it is stipulated that the supplier must confirm that each inverter will generate noise levels no greater than these specified levels at a distance of 10 metres in all directions from the inverter.

Note also that the assessment findings indicate that for compliance with the noise limits to be achieved the inverters must operate at no greater than 50% load during the Night period (10pm to 7am) hours. Therefore, it is recommended that the appropriate investigation and analysis to confirm this are undertaken.

7.0 Summary

AECOM was commissioned to assess the potential environmental noise emissions from the operation of the proposed Kennedys Creek Solar Farm.

The noise assessment has been prepared in accordance with Victoria's Environment Protection Act and the requirements of the Environment Protection Authority (EPA) Regulations. Noise modelling was performed to predict the noise levels at nearby residences due to the operation of the solar farm, and the modelling results were considered in relation to the noise criteria prescribed by the Victorian Noise Protocol which applies in accordance with the Environment Protection Act.

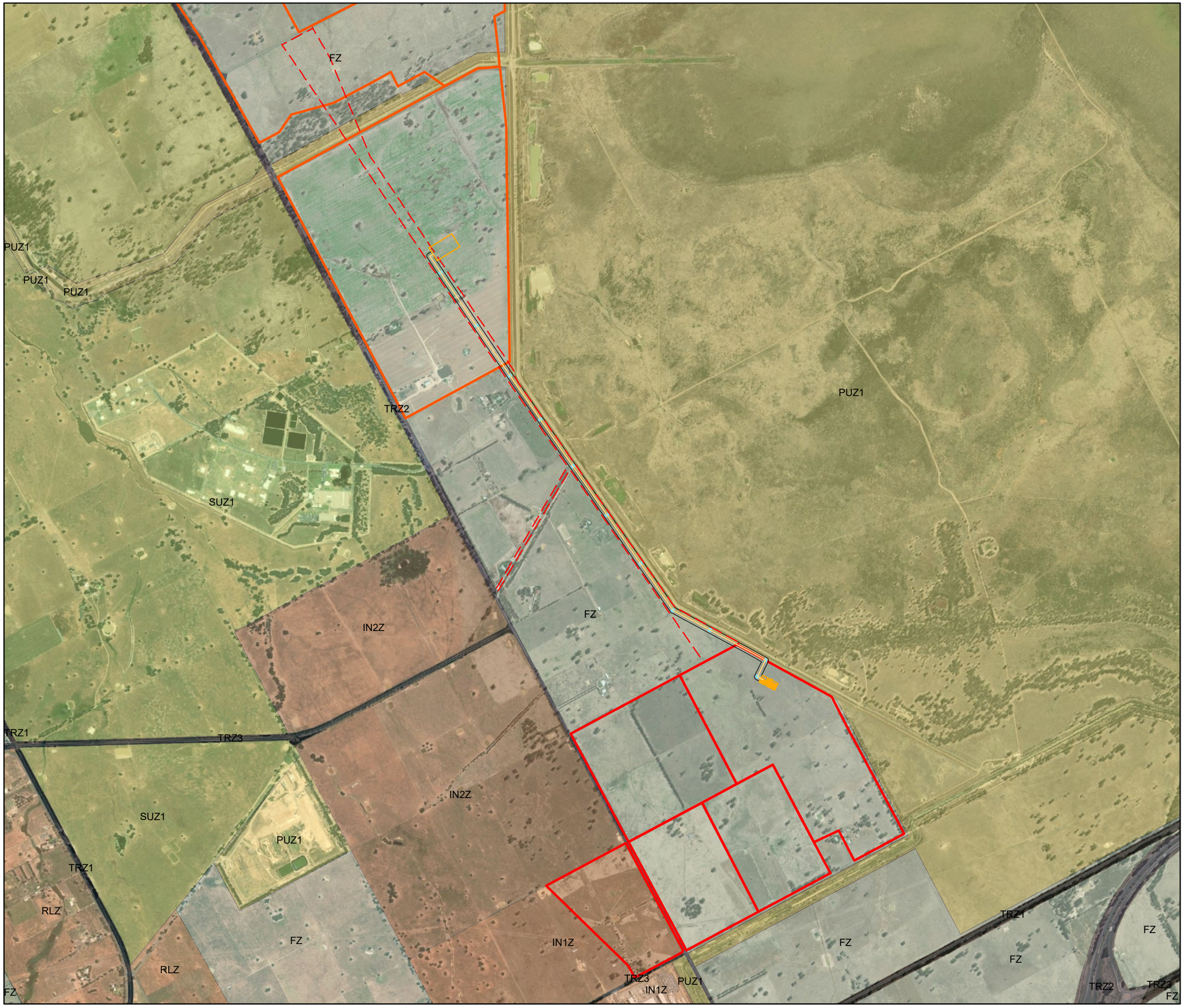
The modelling results indicate that the noise emissions from the proposed solar farm will be compliant with the noise criteria at the nearest residences. To achieve compliance during the Night period, encompassing the hours 10pm to 7am, the PCU inverters must not operate at greater than 50% load.

Appendix A

ADVERTISED PLAN

Planning Zone Map

ADVERTISED PLAN



AECOM

N

0 0.5 1 Km

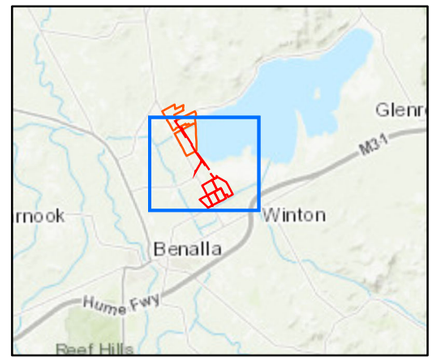
WEST MOKOAN SOLAR FARM PROJECT
KENNEDYS CREEK AMENDMENT ZONING PLAN

Legend

- Kennedys Creek Solar Farm Site Boundary
- West Mokoan Solar Farm Site Boundary
- Transmission Line Investigation Area
- Indicative Transmission Line Easement
- Indicative Substation Locations
- Indicative Transmission Line Centreline
- Indicative Transmission Line Pole Locations

Planning Scheme Zones

- FZ - Farming Zone
- IN1Z - Industrial 1 Zone
- IN2Z - Industrial 2 Zone
- PUZ1 - Public Use Zone - Service and Utility
- TRZ1 - State Transport Infrastructure
- TRZ2 - Principal Road Network
- TRZ3 - Significant Municipal Road
- RLZ - Rural Living Zone
- SUZ - Special Uses Zone

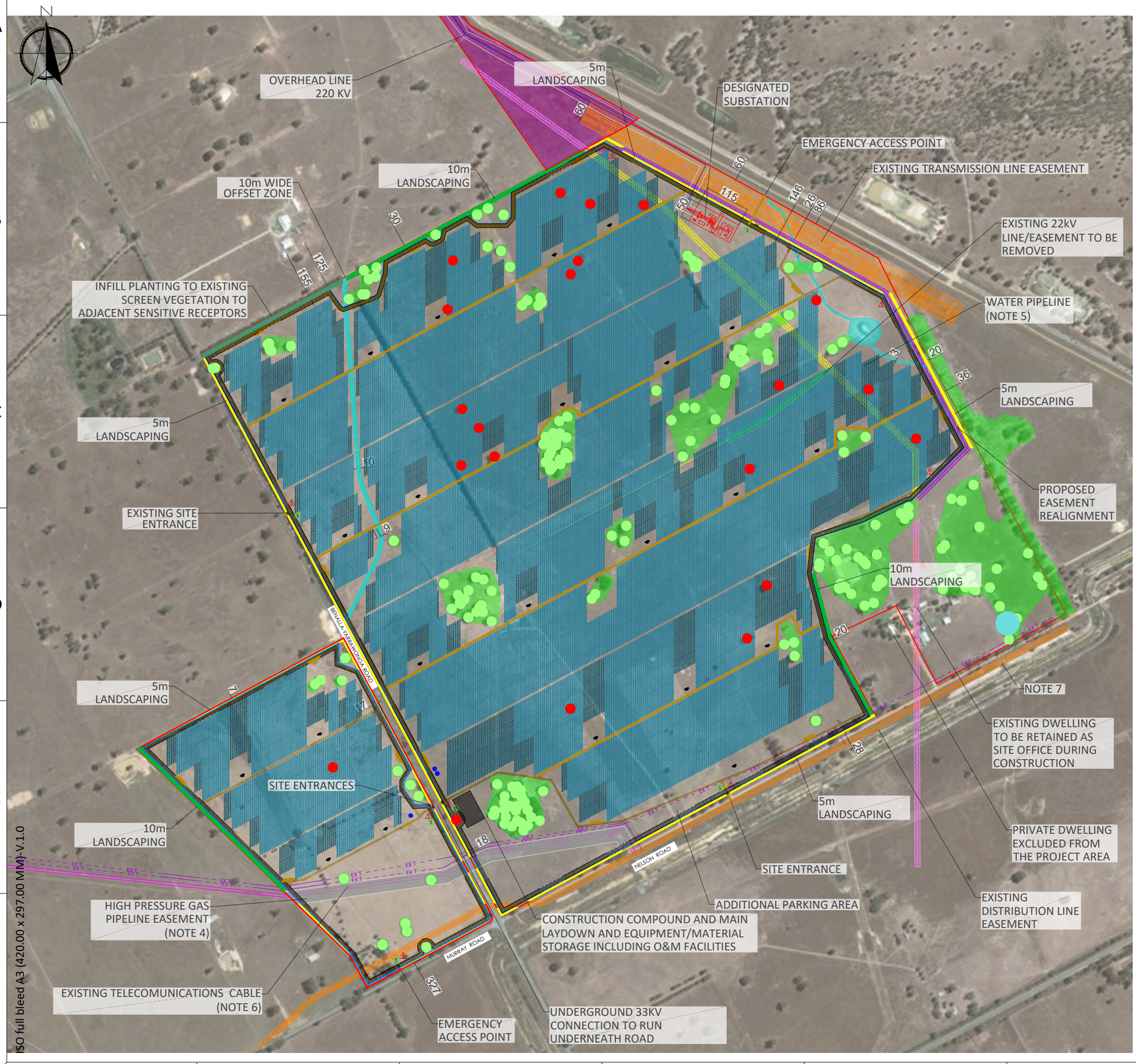


Appendix B

ADVERTISED PLAN

Concept Plan

AUS_Kennedys_LP1-IDL_15



ISO full bleed A3 (420.00 x 297.00 MM)-V.1.0

NOTES:
1. LOCATION OF PCUs AND TRACKERS TO BE CONFIRMED DURING DETAILED DESIGN.
2. 4m WIDE ACCESS TRACK DESIGN TO BE UNDERTAKEN DURING THE DETAILED DESIGN PHASE. ACCESS TRACKS SHOWN ARE INDICATIVE ONLY.
3. 14.8m WIDE DISTRIBUTION LINE EASEMENT.
4. 35m WIDE GAS PIPELINE EASEMENT.
5. 2m WIDE WATER SUPPLY PIPELINE.
6. A 4m WIDE BUFFER ZONE HAS BEEN CONSIDERED.
7. THE 66kV LINE IN FRONT OF THE FUTURE SUBSTATION HAS BEEN SHOWN AS THE EXISTING LINE. LOCATION OF THE 66kV POLES AND THE ROUTE WILL CHANGE TO SUIT THE CONNECTION ARRANGEMENT AND SOLAR FARM SINGLE LINE DIAGRAM.
8. 60m WIDE OVERHEAD TRANSMISSION LINE EASEMENT
9. SITE ENTRANCE GATES TO BE CONFIRMED DURING DETAILED DESIGN.
10. SUBSTATION DIMENSIONS ARE APPROXIMATE ONLY. TO BE CONFIRMED DURING DETAILED DESIGN.
11. DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
12. NATIVE VEGETATION THAT HAS NOT BEEN IDENTIFIED TO BE RETAINED MAY BE REMOVED WHERE NECESSARY, SUBJECT TO DELWP NATIVE VEGETATION REMOVAL PERMIT APPROVAL. NATIVE VEGETATION SHOULD BE RETAINED WHERE PRACTICABLE.
13. A 5m WIDE SETBACK FROM THE CENTRE OF THE DESIGNATED WATERWAY HAS BEEN CONSIDERED.

ADVERTISED PLAN

- Site Boundary
- Site Entrance
- Danger signage
- Security Fence
- Single Axis Tracker 84
- Single Axis Tracker 56
- PCUs (2 inverters)
- 4m solar farm access road with 20m long & 6m wide passing bays every 600 m
- Proposed 10 m wide planting zone
- Proposed 5 m wide planting zone
- Infill planting to existing boundary vegetation
- Existing Environmental Values to be retained
- Existing Overhead line Easement
- Existing Overhead line Easement to be removed
- Proposed Easement Realignmet
- Gas Pipeline
- Watercourse
- Water Supply Pipeline
- Underground telecomunication cable
- Fire Break
- Trees to be retained
- Trees to be removed
- Existing Transmission Line Easement
- 45,000l Water tanks
- Area of cultural heritage sensitivity
- 220kV Transmission line investigation area

PV SYSTEM SPECIFICATIONS	
Capacity - DC	159.12 MW_p
Capacity - AC	125.00 MW_{AC}
DC/AC Ratio	1.27
Modules	(279160) 570 W Bifacial
Mods. per string	28
Pitch	5.0 m
GCR	45.50 %
Mounting structure	(3584) Single Axis Trackers
• Full	2802
• Partial	782
• Half	
Inverters	(48) Central Inverter 3430KVA
• Nominal Power	3575 KVA
Access roads	14846 m
Fenced area	(2504355 m^2) 618.840 Acres
• Perimeter	8769 m

Revisions:

Rev	Date	Comments	Dwn	Chkd
13	30.09.22	Layout update	AG	
12	14.09.22	Layout update	AGV	
11	30.08.22	Module and Substation location update	AGV	
10	04.02.22	Updated trees to be retained	AG	
09	28.01.22	Legend update	AG	
08	18.01.22	Substation, presentation and table update	MG	
15	23.02.23	Planning updates	AG	GK
14	19.01.23	Legend updated	AG	

DRAWN	CHECKED	APPROVED	DATE
AGV			30.09.2022

PROJECT NAME & ADDRESS:
Location: Benalla, Victoria
Australia

NOTES:
- Inverter / Plant Capacity (MVA/MWac): 1.32
- Mod. dimensions (mm): 2279 x 1134
- DC System Voltage (V): 1500
- Azimuth: 0°

Paper Size:	Scale:	Sheet:
A3	1:10000	1

CAPACITY: 279160 Modules 159.12 MWp

DRAWING TITLE: AUS_Kennedys_LP1-Initial Design Layout_15

DRAWING NUMBER:	STATUS:
LP1-IDL	Preliminary

lightsource bp

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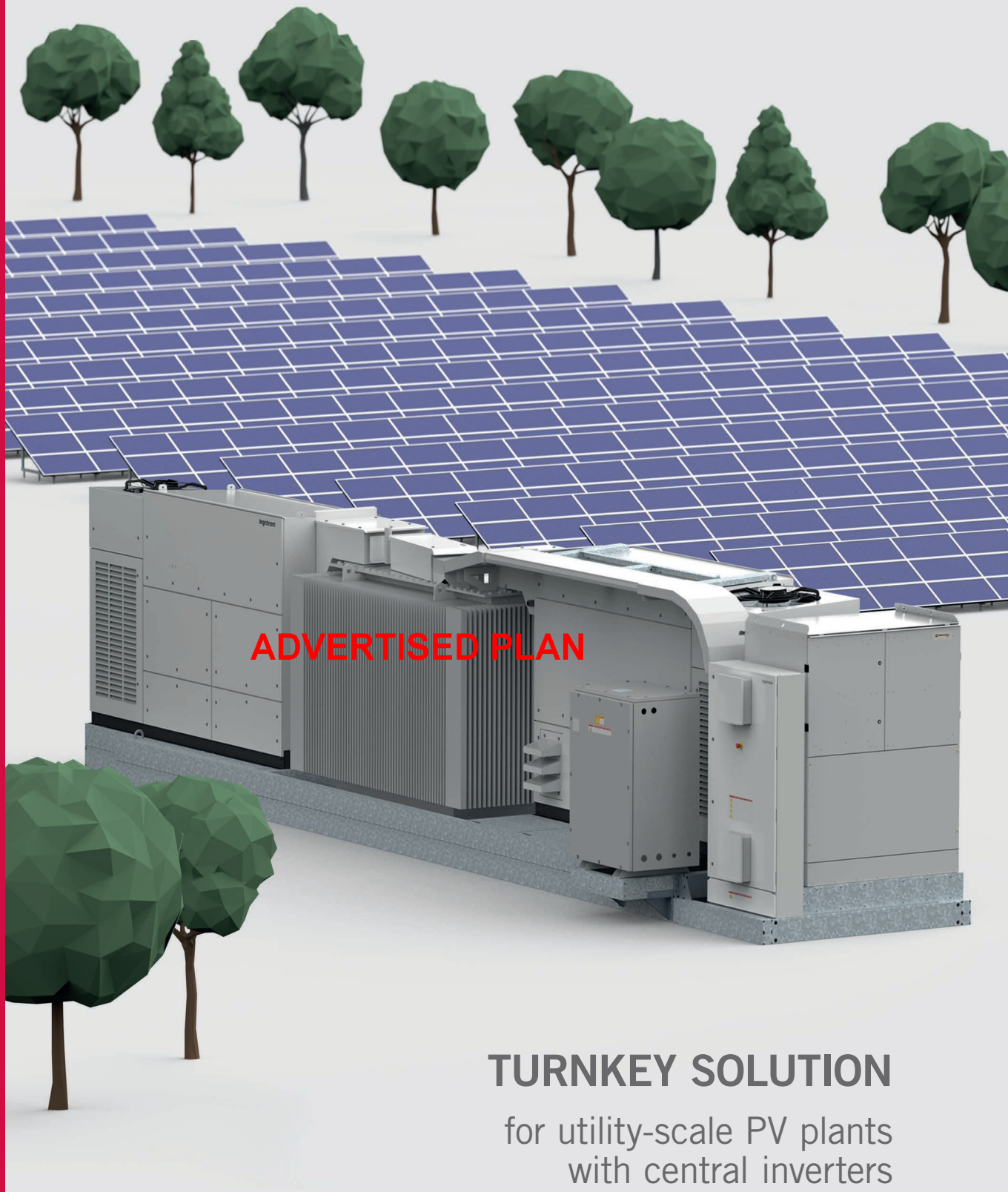
info@lightsourcebp.com

Appendix C

ADVERTISED PLAN

Ingeteam Inverter Information



TURNKEY SOLUTION

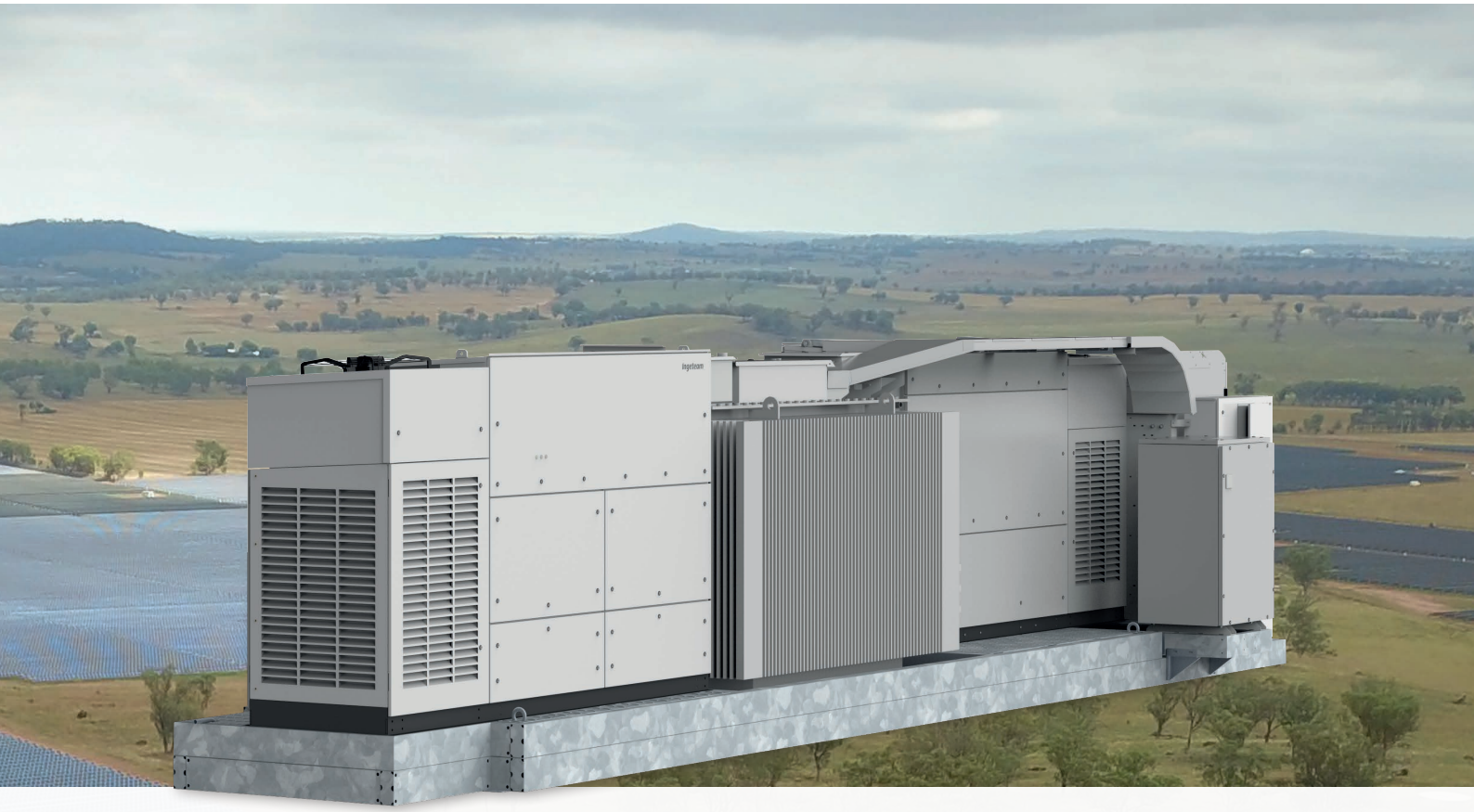
for utility-scale PV plants
with central inverters

Ingeteam

ALL-IN-ONE PLUG & PLAY SOLUTION

This turnkey power station integrates all the elements into a Full Skid solution:

- **INGECON SUN® 3POWER PV INVERTERS**
- **STEP-UP TRANSFORMER**
- **MV SWITCHGEAR**
- **AUXILIARY SERVICES PANEL**
- **AUXILIARY SERVICES TRANSFORMER**



INGECON® SUN FSK C Series

Medium voltage Power Station customized up to 7.65 MVA, with all the components supplied on top of the same skid platform

This medium-voltage solution integrates all the necessary elements to develop a large-scale solar PV plant.

Maximize your investment with a minimal effort
Ingeteam's FSK power station is a compact, customizable and flexible solution that can be configured to suit each customer's requirements. It is supplied together with up to two photovoltaic inverters. All the equipment is suitable for outdoor installation, so there is no need of any kind of housing.

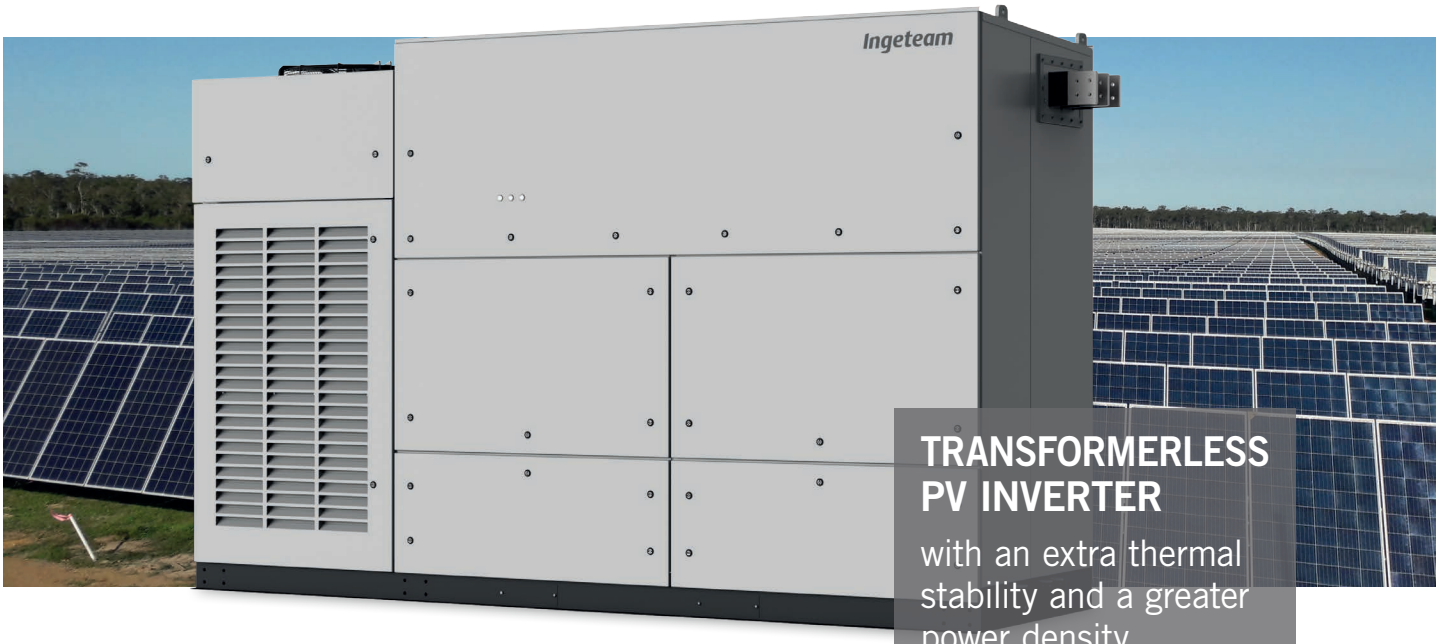
Higher adaptability and power density
This power station is now more versatile, as it presents the step-up transformer integrated into a steel platform together with the LV and MV components, including the PV inverters. Moreover, it features one of the market's greatest power densities.

Plug & Play technology
This MV solution integrates power conversion equipment (up to 7.65 MVA), liquid-filled hermetically sealed transformer up to 38 kV and provision for low voltage equipment. The MV Skid is delivered pre-assembled for a fast on-site connection with up to two PV inverters from Ingeteam's INGECON® SUN 3Power C Series inverter family.

Complete accessibility
Thanks to the lack of housing, the inverters, the auxiliary services panel, the MV switchgear and the transformer can have immediate access. Furthermore, the design of the 3Power C Series central inverters has been conceived to facilitate maintenance and repair works.

Maximum protection
Ingeteam's 3Power C Series central inverters feature an IP65 protection class for their power stacks thanks to a combined water and air cooling system that optimises the operating temperature of the power electronics.

Apart from that, they feature the main electrical protections and they deploy grid support functionalities, such as low voltage ride-through capability, reactive power deliverance and active power injection control.



TRANSFORMERLESS PV INVERTER

with an extra thermal stability and a greater power density

Up to 3.8 MVA at 1,500 V

Greater power density
This solar PV inverter achieves a market-leading power density of 492 kVA/m^3, as it provides up to 3,825 kVA kVA in just one power stack.

Latest generation electronics
The INGECON® SUN 3Power C Series PV inverter features an innovative control unit that performs a more efficient and sophisticated inverter control, as it uses a last-generation digital signal processor.

Liquid Cooling System (LCS)
Ingeteam has already supplied +52 GW of liquid-cooled wind power converters worldwide. It offers a greater thermal stability and a more optimized component usage. The LCS has been designed to refrigerate the IGBTs, the power phases and the IP65 compartment. It features less moving components, so it consumes a lower amount of power and it requires less maintenance works.

The LCS is a closed circuit supplied totally filled and purged, equipped with fast connectors with an anti-dripping system, so it offers zero risk of particle entrance. It has been designed to avoid siphons in order to easily purge it if necessary. The coolant used is a biodegradable glycol water mixture. There is no need of emptying the LCS in order to replace the phases, nor the sensors.

IP65 protection
A secondary liquid cooling system is used to refrigerate the air inside the IP65-protected compartment. A water-air heat exchanger is used for that. This compartment contains the power and control electronics, the DC fuses, the DC and AC protections, the busbars and the power phases.

Monitoring and communication
Dual Ethernet to communicate with the SCADA and the PPC (power plant controller). Moreover, it features Wi-Fi communication as access point to connect with the inverter during commissioning and O&M works. Ingeteam's advanced PV plant monitoring system INGECON® SUN Monitor is also available at no extra cost. The Smartphone application of the INGECON® SUN Monitor -available on the App Store and on the Play Store- makes it easier and more comfortable to monitor the PV plant.

Standard 5 year warranty, extendable for up to 25 years.

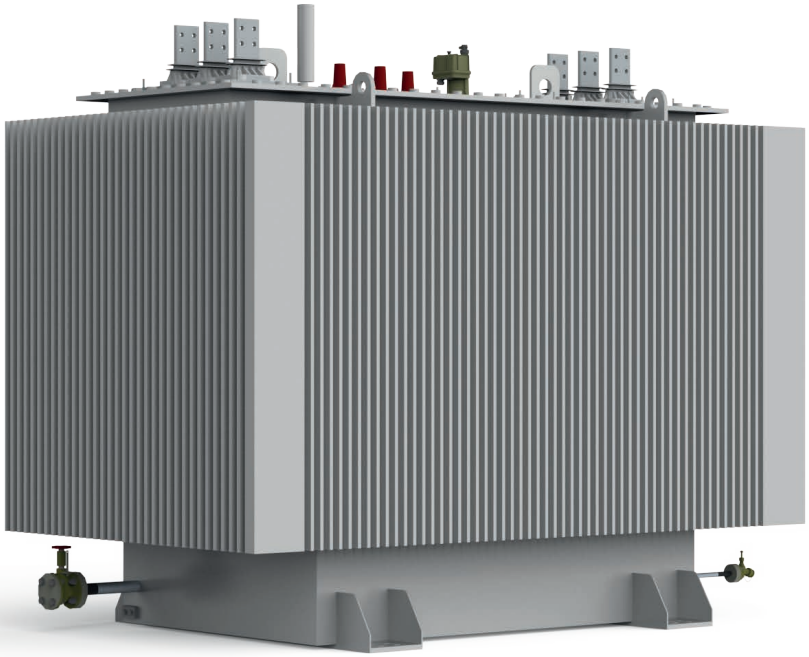
Advanced grid support

- Low Voltage Ride Through
- Fast Frequency Regulation
- Reactive Power at Night
- Voltage Droop Control
- Active Power Reserve Without Batteries
- Grid Following & Grid Forming
- Black Start Capability
- Automatic Voltage Regulation

Ingeteam

	INGECON® SUN **3825TL**						
	C600	**C615**	**C630**	**C645**	**C660**	**C675**	**C690**
Input (DC)							
Recommended PV array power range[1]	3,144 - 4,188 kWp	3,222 - 4,293 kWp	3,301 - 4,398 kWp	3,379 - 4,502 kWp	3,458 - 4,607 kWp	3,537 - 4,712 kWp	3,615 - 4,816 kWp
Voltage Range MPP[2]	853 - 1,300 V	874 - 1,300 V	895 - 1,300 V	916 - 1,300 V	937 - 1,300 V	958 - 1,300 V	979 - 1,300 V
Maximum voltage[3]	1,500 V						
Maximum current	3,965 A						
N° inputs with fuse-holders	Up to 24						
Fuse dimensions	63 A / 1,500 V to 500 A / 1,500 V fuses (optional)						
Type of connection	Connection to copper bars						
Power blocks	1						
MPPT	1						
Input protections							
Overvoltage protections	Type II surge arresters (type I+II optional)						
DC switch	Motorized DC load break disconnect						
Other protections	Up to 24 pairs of DC fuses (optional) / Reverse polarity / Insulation failure monitoring / Anti-islanding protection / Emergency pushbutton						
Output (AC)							
Power @35 °C / @50 °C	3,326 kVA / 2,858 kVA	3,409 kVA / 2,929 kVA	3,492 kVA / 3,001 kVA	3,575 kVA / 3,072 kVA	3,658 kVA / 3,144 kVA	3,741 kVA / 3,215 kVA	3,824 kVA / 3,287 kVA
Current @35 °C / @50 °C	3,200 A / 2,750 A						
Rated voltage[4]	600 V IT System	615 V IT System	630 V IT System	645 V IT System	660 V IT System	675 V IT System	690 V IT System
Frequency	50 / 60 Hz						
Power Factor[5]	1						
Power Factor adjustable	Yes, 0 - 1 (leading / lagging)						
THD (Total Harmonic Distortion)[6]	<3%						
Output protections							
Overvoltage protections	Type II surge arresters (type I+II optional)						
AC breaker	Motorized AC circuit breaker						
Anti-islanding protection	Yes, with automatic disconnection						
Other protections	AC short-circuits and overloads						
Features							
Operating efficiency	98.9%						
CEC	98.5%						
Max. consumption aux. services	9,000 W						
Stand-by or night consumption[7]	< 180 W						
Average power consumption per day	2,500 W						
General Information							
Ambient temperature	-20 °C to +60 °C						
Relative humidity (non-condensing)	0-100% (Outdoor)						
Protection class	IP65[8]						
Corrosion protection	External corrosion protection						
Maximum altitude	4,500 m (for installations beyond 1,000 m, please contact Ingeteam's solar sales department)						
Cooling system	Liquid cooling system and forced air cooling system with temperature control (400V 3 phase + neutral power supply, 50/60 Hz)						
Air flow range	0 - 18,000 m³/h						
Average air flow	12,000 m³/h						
Acoustic emission (100% / 50% load)	57 dB(A) at 10m / 49.7 dB(A) at 10m						
Marking	CE						
EMC and security standards	IEC 62920, IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-4, IEC 61000-3-11, IEC 61000-3-12, IEC 62109-1, IEC 62109-2, EN 50178, FCC Part 15, AS3100						
Grid connection standards	IEC 62116, EN 50530, IEC 61683, EU 631/2016 (EN 50549-2, P.O.12.2, CEI 0-16, VDE AR N 4120 ...), G99, South African Grid code, Mexican Grid Code, Chilean Grid Code, Ecuadorian Grid Code, Peruvian Grid code, Thailand PEA requirements, IEC61727, UNE 206007-1, ABNT NBR 16149, ABNT NBR 16150, IEEE 1547, IEEE1547.1, DEWA (Dubai) Grid code, Abu Dhabi Grid Code, Jordan Grid Code, Egyptian Grid Code, Saudi Arabia Grid Code, RETIE Colombia, Australian Grid Code						

Notes: [1] Depending on the type of installation and geographical location. Data for STC conditions [2] Vmpp.min is for rated conditions (Vac=1 p.u. and Power Factor=1) and floating systems [3] Consider the voltage increase of the 'Voc' at low temperatures [4] Other AC voltages and powers available upon request [5] For P_{out}>25% of the rated power [6] For P_{out}>25% of the rated power and voltage in accordance with IEC 61000-3-4 [7] Consumption from PV field when there is PV power available [8] Except for the LC filter and the air-water heat exchanger, that are IP54.



Three-phase oil-insulated Step-up transformers

Medium Voltage Transformer / Hermetically Sealed Completely Filled

Ingeteam provides highly performing LV / MV three phase oil-insulated type transformers. Power ratings are available up to 7,650 kVA, with voltage ratings (MV side) from 10 up to 38 kV.

The transformers are classified as per the IEC 60076 standard, offering the following benefits:

- Reduced power losses.
- Reduced maintenance needs.
- Suitable both for internal or external use.

The voltage value at the secondary winding (LV side) is compatible with the inverter output voltage from 366 V to 690 V.

STANDARD FUNCTIONS

- Reduced power losses. Other power losses upon request.
- Electrostatic shield reducing disturbances, distortions and overvoltages.
- DGPT2 / DMCR relay.
- Mineral oil insulation.

FUNCTIONS AVAILABLE UPON REQUEST

- Natural ester dielectric insulation fluid (fire point > 300 °C)
- Copper windings.
- Other functions available upon request.

	Step-up Transformer / Hermetically Sealed Completely Filled
General Information	
Category	Hermetic mineral oil-insulated transformer
Rated frequency	50 / 60Hz
Efficiency at rated power	Standard IEC or Tier II
Primary voltage regulator	± 2 x 2.5%
Insulation class	24 kV or 36 kV
Short-time withstand voltage	70 kV
Impulse withstand voltage	170 kV
Primary / secondary conductive material	Aluminium / Aluminium
Vector group	Dy11 for one C Series inverter and Dd0y11 for two C Series inverters
HV bushing	Type C - 36 kV 630 A(1)
Corrosion degree	C4H
Insulation oil	According to IEC 60292
No load current	< 1%
Max. inrush current peak	<12 x In(1)
Installation	Outdoor
Cooling type	ONAN
Max. altitude above sea level(2)	4,500 m
Short-circuit impedance at 75 °C	7.5%, 8%(1)
General features	Terminal board for primary voltage adjustment, lifting lugs, earthing terminal, electrostatic shield and DGPT2 / DMCR relay

Notes: (1) Double secondary required for four B Series inverters or for two C Series inverters (2) For installations beyond 1,000 m, please contact Ingeteam's solar sales department.

Medium Voltage Switchgear

Different MV gas-insulated switchgear adapted to every customer's needs

Ingeteam offers a number of configuration options for the Medium Voltage feeder, tailored to suit the needs of each specific customer.

In all cases, gas-insulated metal-enclosed switchgear is used, manufactured according to standard IEC 62271-200.

The key technical features, based on the insulation voltage required, are as follows:

TECHNICAL FEATURES

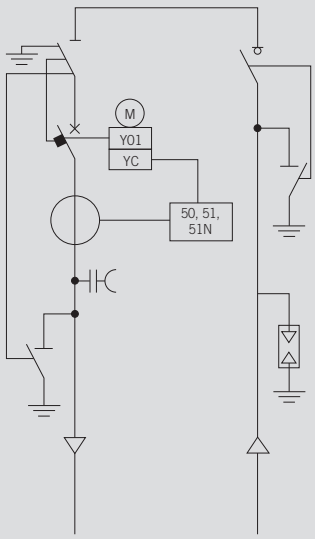
- Breaking capacity 16 kA - 1 s.
- DIN EN 50181 type C plug-in connectors.
- Intrinsically safe operation through interlocks.
- Additional interlocking for transformer room access.
- Optional fused protection available up to 2330 kVA (check climatic conditions).
- Optional circuit breaker protection with 50 / 51 - 50N / 51N function and self-powered protection relay available in the complete power range.
- IP65 for the gas insulated parts.
- Standard Temperature range: from -25 °C to +40 °C.
- Voltage presence indicators and gas pressure display.

General Information	Clase 24 kV	Clase 36 kV
Rated Voltage (Ur)	24 kV	36 kV
Rated Insulation level (Ud)	50 kV	70 kV
Rated lighting impulse withstand (Up)	125 kV / 145 kV	170 kV / 195 kV
Rated frequency (fr)	50-60 Hz	50-60 Hz
Rated normal current (Ir) and temperature raise	630 A a 40 °C	630 A a 40 °C
Rated pshot time withstands current (Ip)	16 kA, 20 kA, 25 kA (optional)	16 kA, 20 kA, 25 kA (optional)
Rated peak withstand current (Ip)	40 kA (50 kA opt)→50 Hz 41,6 kA (52 kA opt)→60 Hz	40 kA (50 kA opt)→50 Hz 41,6 kA (52 kA opt)→60 Hz
Rated duration of short-circuit (tk)	1 s (3 s optional)	1 s (3 s optional)
Rated supply voltage of closing and opening devices and of auxiliary and control circuits (Ua)	24 Vdc	24 Vdc
Installation	Outdoor or indoor	Outdoor or indoor

1L1C

Line entry with disconnector and earthing disconnector + transformer position with circuit breaker with 50-51 and 50N-51N protection functions and earthing disconnector.

Typical end of line configuration.



Auxiliary services panel

The auxiliary services panel is equipped with all the necessary protection and communications elements.

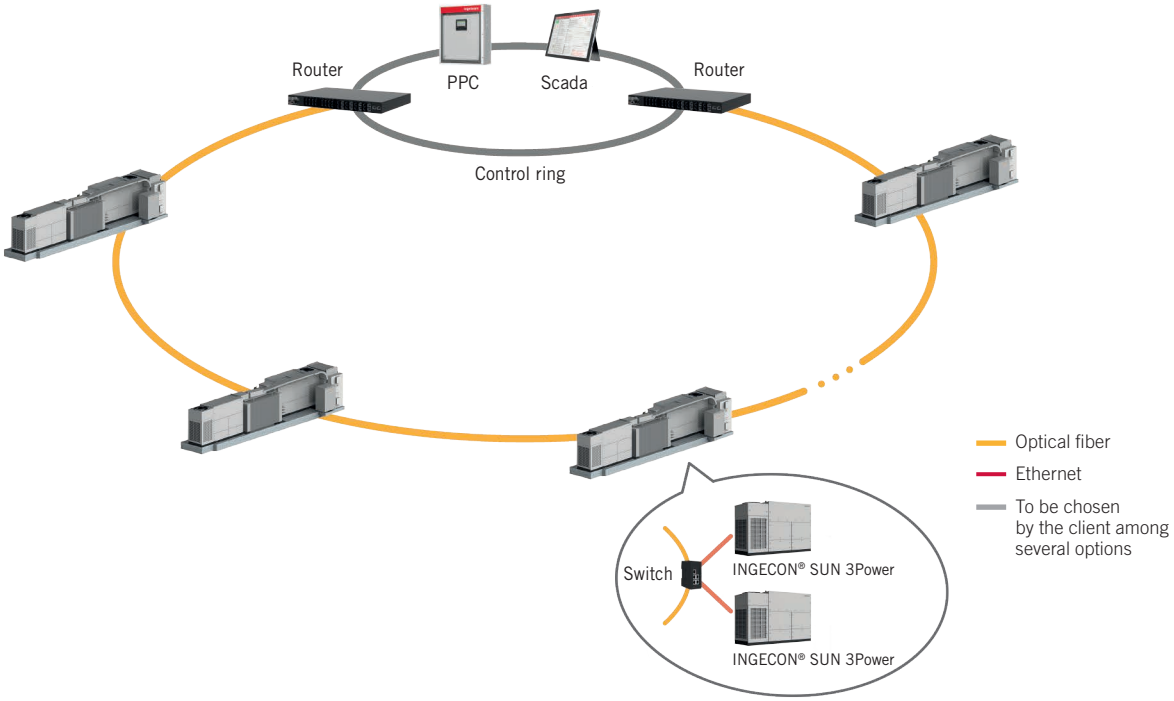
It features an Ingeteam's remote terminal unit (RTU), INGESYS IC2, with analog and digital inputs, and digital outputs to monitor the status of all the components inside the power station. This RTU is connected to the fiber optic patch panel that is also connected to the power plant controller (PPC) through the plant's communication network.

Also, this panel integrates type II surge arresters, several circuit breakers and switches.

On the other hand, the auxiliary services panel features a 24-V UPS that guarantees from 10 minutes up to 3 hours of autonomy for the communications.

The power supply for this panel comes from a 30-kVA auxiliary services transformer (Dyn11, IP54), also integrated inside the power station.

	Auxiliary services panel
General information	
Voltage	400 Vac three phase
Auxiliary services transformer	30 kVA
UPS capacity	from 10 minutes up to 3 hours
Ambient temperature	from -20 °C to 50 °C
Relative humidity (non-condensing)	0-100%
Dimensions (W x D x H)	1,000 x 300 x 1,900 mm
Weight	250 kg
Protection class	IP56
Mechanical resistance	IK10
Corrosion protection	C5H
Maximum altitude	2,000 m (for installations beyond 1,000 m, please contact Ingeteam's solar sales department)
Cooling system	Forced air ventilation
Marking	CE
Remote Terminal Unit (RTU) INGESYS IC2	
Digital inputs	48
Digital outputs	16
Analog inputs	5
Communications	
Modbus TCP RJ45	2 ports
RS-485	Up to 4 ports



Communications network

In a photovoltaic plant, the power plant control systems are increasingly fast, precise and demanding. For this reason, the communications network is a key factor in order to guarantee a correct solar plant operation. The distribution of the inverters in the communications network depends on many factors, such as the land's variability, the electric connection, the number and rated power of inverters, etc.

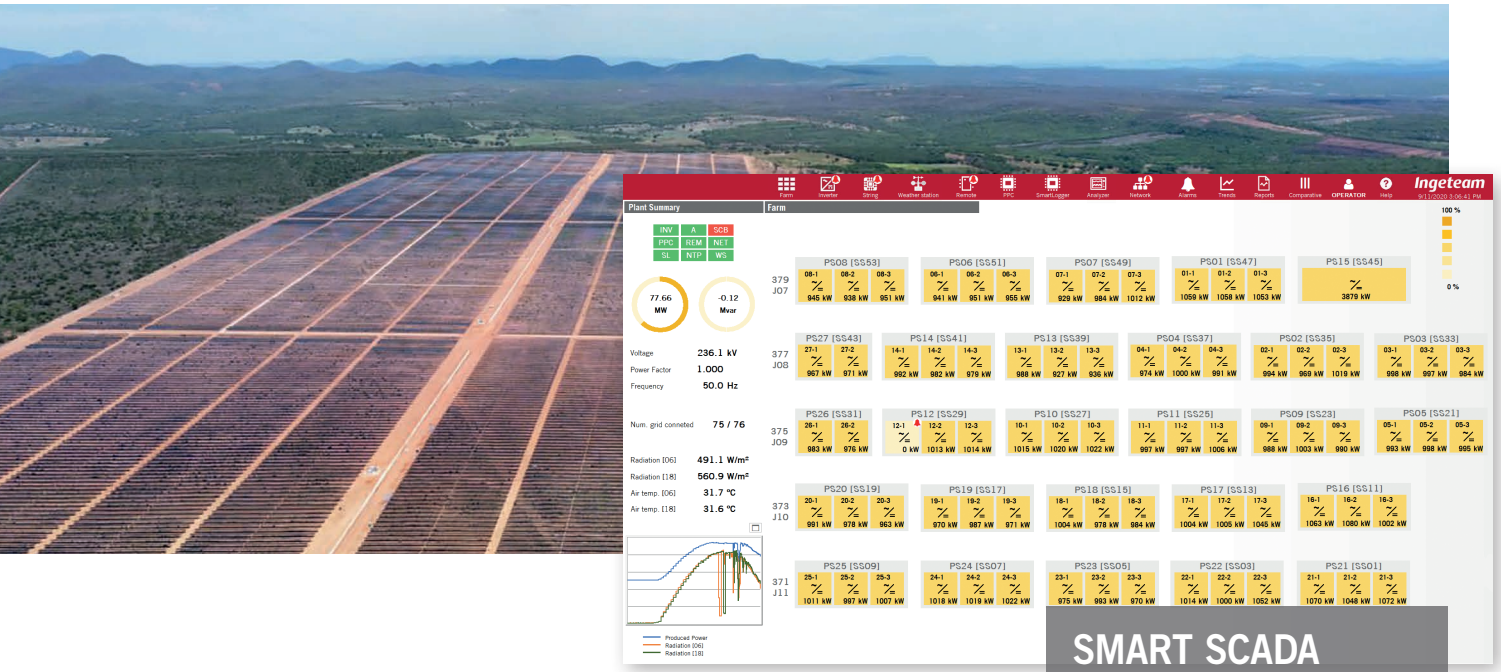
Thus, it is crucial to perform correct power plant sizing and design from the beginning.

Power plant controller

Ingeteam's power plant controller features a control algorithm with response times of less than 10 miliseconds, thanks to which it can develop a precise and effective control of the active and reactive power injected to the grid.

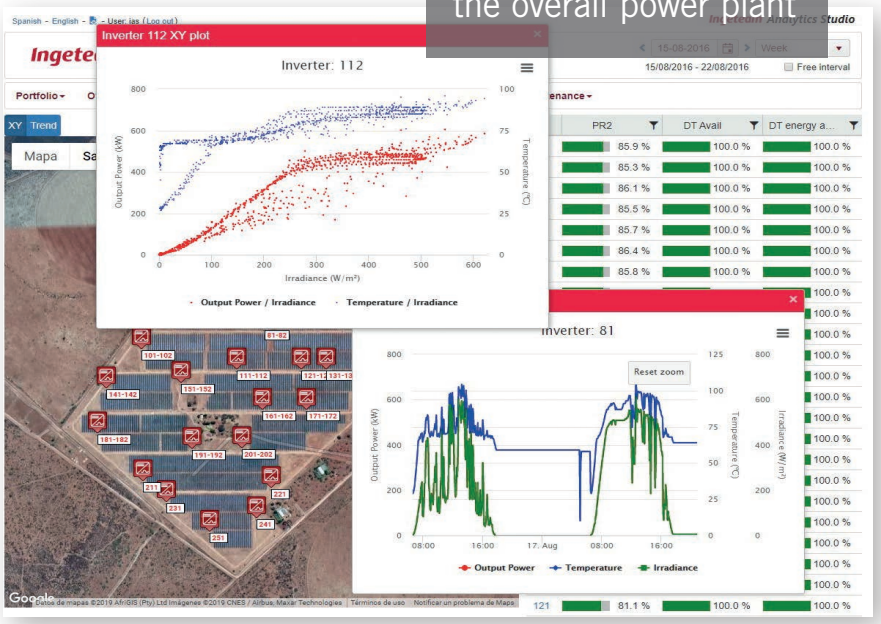
	Power plant controller (PPC)
Communication	
Standard protocols	Modbus / TCP (client and server), FTP (client and server), NTP (client and server)
Compatible protocols	Modbus / RTU (Master and slave), 101 (Slave), 104 (Slave), DNP3 (Slave), OPC UA (Server)
Outer connectivity	10 / 100BaseT(X), 100BaseFX with patch panels
Managed communication	Optional
Redundancy	Optional
General Data	
Dimensions (H/W/D)	1,005 / 860 / 360 mm
Weight	120 kg
Protection class	IP65
Operating temperature	-20 to 50 °C / -4 to 122 °F
Maximum altitude(1)	2,000 m
Marking	CE
Standards	IEC 61000-4-30, IEC 62586-1, IEC 61131-3, IEC 60204-1, IEC 61439

Notes: (1) For installations beyond the maximum altitude, please contact Ingeteam's solar sales department.



Smart SCADA to manage daily operations and optimise asset performance

Ingeteam's SCADA is a smart system that enables to improve the management of the overall power plant, adopting best-in-class digital tools to create a complete suite, accompanying the data from real-time acquisition to supporting O&M and strategic management decisions. Ingeteam offers a modular platform divided into two modules:



Real-time monitoring and operation
This module is responsible for the real-time data acquisition and permits the operation of the assets. It provides highly interactive graphical interface allowing for an optimised real-time operation through a unified graphical interface.

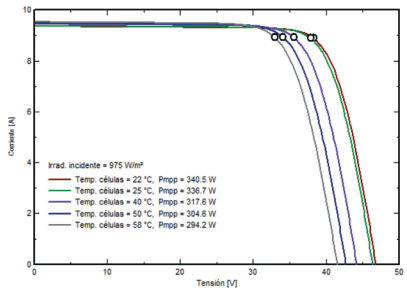
Analytics Studio
This module permits the advanced analytics of SCADA data and makes it possible to focus efforts on the optimization of the asset's production with the use of the following features:

- Key performance indicators (KPIs).
- Alarm statistics.
- Analysis of the weather station's measurements.
- Analysis of the PV array.
- Comparison between inverters.
- Flexible alert configuration.
- Detection of atypical values.
- Generation of reports.
- Interactive data exploration.
- Advanced graphic displays.

Power plant sizing and grid code compliance

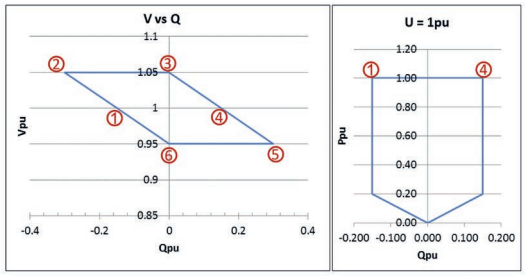
Ingeteam has developed its own PV plant sizing tool, with which we can choose all the parameters and guarantee any grid code compliance in four simple steps:

1. Evaluation of the PV module parameters from PVsyst.
2. Evaluation of the country's grid code requirements.
3. Evaluation of the model and number of solar inverters.
4. Final simulation to ensure the grid code compliance.



1.

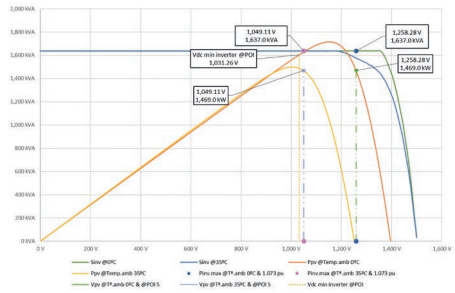
EVALUATION OF THE PV MODULE MODEL



2.

+30 GRID CODES AVAILABLE

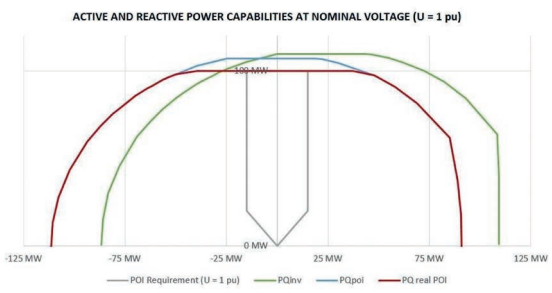
Evaluation of the grid code's requirements



3.

EVALUATION OF THE INVERTER MODEL

Automatic calculation to obtain the best operation point.



4.

FINAL ANALYSIS

The final results are uploaded into DIgSILENT, thus the customer can simulate his/her own PV plant with real P and Q values for the chosen DC voltage.

CE

REQUEST
AN OFFER

ADVERTISED PLAN

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Appendix D

ADVERTISED PLAN

Ingeteam Acoustic Test

ADVERTISED PLAN

SUMMARY OF RESULTS

DETERMINATION OF ACOUSTIC POWER AND SOUND LEVELS AT DISTANCES OF 1 M, 2 M, 5 M AND 10 M FOR MODEL INVERTERS "INGECOM SUN POWER C SERIES" IN DIFFERENT OPERATING CONFIGURATIONS

The objective of this study is to evaluate acoustic power by measuring sound pressure levels. (UNE-EN ISO 3744:2011) and by sound intensity levels UNE_EN ISO 9612-1:2010.

Configurations	Conditions
Configuration 1	50% generation inverter and 50% fans
Configuration 2	75% generation inverter and 75% fans
Configuration 3	75% generation inverter and 100% fans
Configuration 4	100% generation inverter and 100% fans

Berriozar, 20/09/2021

RESULTS.

1. Determination of acoustic power through sound pressure levels

   a) Average sound pressure levels in the different configurations

Archivo		Soun pressure level			
Fuente		Conf 1	Conf 2	Conf 3	Conf 4
		Leq	Leq	Leq	Leq
		Fuente	Fuente	Fuente	Fuente
Localización		dB	dB	dB	dB
Ch. 2	[1/3 Oct 50Hz]	61.1	61.9	68.1	68.3
Ch. 2	[1/3 Oct 63Hz]	60.3	61.5	71.7	71.7
Ch. 2	[1/3 Oct 80Hz]	62.8	60.8	63.4	63.4
Ch. 2	[1/3 Oct 100Hz]	67.5	68.6	68.6	73.0
Ch. 2	[1/3 Oct 125Hz]	59.1	72.9	76.7	77.2
Ch. 2	[1/3 Oct 160Hz]	65.0	64.4	70.3	69.4
Ch. 2	[1/3 Oct 200Hz]	62.7	66.5	67.8	68.1
Ch. 2	[1/3 Oct 250Hz]	62.3	73.7	74.3	73.6
Ch. 2	[1/3 Oct 315Hz]	62.7	66.8	73.9	73.9
Ch. 2	[1/3 Oct 400Hz]	63.0	67.2	71.6	71.4
Ch. 2	[1/3 Oct 500Hz]	66.4	70.5	72.7	73.2
Ch. 2	[1/3 Oct 630Hz]	62.0	69.3	73.3	73.3
Ch. 2	[1/3 Oct 800Hz]	61.1	68.0	71.4	71.3
Ch. 2	[1/3 Oct 1kHz]	62.2	67.6	70.8	70.7
Ch. 2	[1/3 Oct 1.25kHz]	59.7	68.5	71.5	71.4
Ch. 2	[1/3 Oct 1.6kHz]	59.0	66.5	71.4	71.1
Ch. 2	[1/3 Oct 2kHz]	58.6	63.8	68.0	67.6
Ch. 2	[1/3 Oct 2.5kHz]	63.0	65.3	67.1	68.1
Ch. 2	[1/3 Oct 3.15kHz]	69.3	70.0	70.8	72.7
Ch. 2	[1/3 Oct 4kHz]	53.4	57.3	60.8	60.8
Ch. 2	[1/3 Oct 5kHz]	53.8	55.9	58.4	58.7
Ch. 2	[1/3 Oct 6.3kHz]	58.8	59.6	60.5	62.3
Ch. 2	[1/3 Oct 8kHz]	50.6	51.8	53.5	53.6
Ch. 2	[1/3 Oct 10kHz]	48.4	49.6	50.9	51.4
Global		**74.2**	**78.2**	**81.2**	**81.5**

b) Correction for noise environment K2

Frec		RT average	K2
		Leq	Leq
		Fuente	Fuente
Localización		dB	dB
Ch. 2	[1/3 Oct 50Hz]	0.48	1.6
Ch. 2	[1/3 Oct 63Hz]	0.69	2.2
Ch. 2	[1/3 Oct 80Hz]	0.84	2.5
Ch. 2	[1/3 Oct 100Hz]	1.27	3.4
Ch. 2	[1/3 Oct 125Hz]	1.76	4.2
Ch. 2	[1/3 Oct 160Hz]	1.55	3.9
Ch. 2	[1/3 Oct 200Hz]	1.92	4.4
Ch. 2	[1/3 Oct 250Hz]	1.79	4.3
Ch. 2	[1/3 Oct 315Hz]	2.10	4.7
Ch. 2	[1/3 Oct 400Hz]	2.18	4.8
Ch. 2	[1/3 Oct 500Hz]	2.48	5.2
Ch. 2	[1/3 Oct 630Hz]	2.54	5.3
Ch. 2	[1/3 Oct 800Hz]	2.57	5.3
Ch. 2	[1/3 Oct 1kHz]	2.44	5.1
Ch. 2	[1/3 Oct 1.25kHz]	2.42	5.1
Ch. 2	[1/3 Oct 1.6kHz]	2.47	5.2
Ch. 2	[1/3 Oct 2kHz]	2.21	4.9
Ch. 2	[1/3 Oct 2.5kHz]	1.87	4.4
Ch. 2	[1/3 Oct 3.15kHz]	1.71	4.1
Ch. 2	[1/3 Oct 4kHz]	1.71	4.1
Ch. 2	[1/3 Oct 5kHz]	1.49	3.8
Ch. 2	[1/3 Oct 6.3kHz]	1.37	3.6
Ch. 2	[1/3 Oct 8kHz]	1.25	3.4
Ch. 2	[1/3 Oct 10kHz]	1.08	3.0

a) Background noise average

Archivo		Average Background noise
Fuente		RF
		Leq
		Fuente
Localización		dB
Ch. 2	[1/3 Oct 50Hz]	56.4
Ch. 2	[1/3 Oct 63Hz]	43.9
Ch. 2	[1/3 Oct 80Hz]	41.2
Ch. 2	[1/3 Oct 100Hz]	43.1
Ch. 2	[1/3 Oct 125Hz]	44.0
Ch. 2	[1/3 Oct 160Hz]	46.2
Ch. 2	[1/3 Oct 200Hz]	45.5
Ch. 2	[1/3 Oct 250Hz]	45.0
Ch. 2	[1/3 Oct 315Hz]	45.0
Ch. 2	[1/3 Oct 400Hz]	46.4
Ch. 2	[1/3 Oct 500Hz]	47.2
Ch. 2	[1/3 Oct 630Hz]	47.0
Ch. 2	[1/3 Oct 800Hz]	44.2
Ch. 2	[1/3 Oct 1kHz]	48.9
Ch. 2	[1/3 Oct 1.25kHz]	46.8
Ch. 2	[1/3 Oct 1.6kHz]	42.1
Ch. 2	[1/3 Oct 2kHz]	41.1
Ch. 2	[1/3 Oct 2.5kHz]	39.4
Ch. 2	[1/3 Oct 3.15kHz]	36.5
Ch. 2	[1/3 Oct 4kHz]	34.5
Ch. 2	[1/3 Oct 5kHz]	31.6
Ch. 2	[1/3 Oct 6.3kHz]	28.1
Ch. 2	[1/3 Oct 8kHz]	24.2
Ch. 2	[1/3 Oct 10kHz]	20.9
Global		**54.9**

d) Acoustic power measured from sound pressure level (UNE-EN ISO 3744:2011)

Archivo		Acoustic power			
Fuente		Conf 1	Conf 2	Conf 3	Conf 4
		Leq	Leq	Leq	Leq
		Fuente	Fuente	Fuente	Fuente
Localización		dB	dB	dB	dB
Ch. 2	[1/3 Oct 50Hz]	76.3	77.5	84.8	85
Ch. 2	[1/3 Oct 63Hz]	76.6	77.9	88.1	88.1
Ch. 2	[1/3 Oct 80Hz]	78.9	76.8	79.5	79.5
Ch. 2	[1/3 Oct 100Hz]	82.7	83.8	83.8	88.2
Ch. 2	[1/3 Oct 125Hz]	73.4	87.3	91.1	91.6
Ch. 2	[1/3 Oct 160Hz]	79.7	79.1	85	84.1
Ch. 2	[1/3 Oct 200Hz]	76.8	80.6	81.9	82.2
Ch. 2	[1/3 Oct 250Hz]	76.6	88	88.6	87.9
Ch. 2	[1/3 Oct 315Hz]	76.5	80.7	87.8	87.8
Ch. 2	[1/3 Oct 400Hz]	76.7	81	85.4	85.2
Ch. 2	[1/3 Oct 500Hz]	79.8	83.9	86.1	86.6
Ch. 2	[1/3 Oct 630Hz]	75.2	82.6	86.6	86.6
Ch. 2	[1/3 Oct 800Hz]	74.3	81.3	84.7	84.6
Ch. 2	[1/3 Oct 1kHz]	75.4	81	84.2	84.1
Ch. 2	[1/3 Oct 1.25kHz]	73	82	85	84.9
Ch. 2	[1/3 Oct 1.6kHz]	72.3	79.9	84.8	84.5
Ch. 2	[1/3 Oct 2kHz]	72.3	77.5	81.7	81.3
Ch. 2	[1/3 Oct 2.5kHz]	77.2	79.5	81.3	82.3
Ch. 2	[1/3 Oct 3.15kHz]	83.8	84.5	85.3	87.2
Ch. 2	[1/3 Oct 4kHz]	67.8	71.7	75.3	75.3
Ch. 2	[1/3 Oct 5kHz]	68.6	70.7	73.2	73.5
Ch. 2	[1/3 Oct 6.3kHz]	73.8	74.6	75.5	77.3
Ch. 2	[1/3 Oct 8kHz]	65.8	67	68.7	68.8
Ch. 2	[1/3 Oct 10kHz]	64	65.2	66.5	67
Global		**88.2**	**92.0**	**94.9**	**95.2**

2. Determination of sound pressure levels at 1 m, 2 m, 5 m and 10 m

From the average levels measured in the test of UNE-EN ISO 3744: 2011 and the correction for environment, presented previously.

a) Sound pressure level in free field at 1 m

Archivo		Sound pressure leve 1m			
Fuente		Conf 1	Conf 2	Conf 3	Conf 4
		Leq	Leq	Leq	Leq
		Fuente	Fuente	Fuente	Fuente
Localización		dB	dB	dB	dB
Ch. 2	[1/3 Oct 50Hz]	59.5	60.3	66.5	66.7
Ch. 2	[1/3 Oct 63Hz]	58.1	59.3	69.5	69.5
Ch. 2	[1/3 Oct 80Hz]	60.3	58.3	60.9	60.9
Ch. 2	[1/3 Oct 100Hz]	64.1	65.2	65.2	69.6
Ch. 2	[1/3 Oct 125Hz]	54.9	68.7	72.5	73.0
Ch. 2	[1/3 Oct 160Hz]	61.1	60.5	66.4	65.5
Ch. 2	[1/3 Oct 200Hz]	58.3	62.1	63.4	63.7
Ch. 2	[1/3 Oct 250Hz]	58.0	69.4	70.0	69.3
Ch. 2	[1/3 Oct 315Hz]	58.0	62.1	69.2	69.2
Ch. 2	[1/3 Oct 400Hz]	58.2	62.4	66.8	66.6
Ch. 2	[1/3 Oct 500Hz]	61.2	65.3	67.5	68.0
Ch. 2	[1/3 Oct 630Hz]	56.7	64.0	68.0	68.0
Ch. 2	[1/3 Oct 800Hz]	55.8	62.7	66.1	66.0
Ch. 2	[1/3 Oct 1kHz]	57.1	62.5	65.7	65.6
Ch. 2	[1/3 Oct 1.25kHz]	54.6	63.4	66.4	66.3
Ch. 2	[1/3 Oct 1.6kHz]	53.8	61.3	66.2	65.9
Ch. 2	[1/3 Oct 2kHz]	53.7	58.9	63.1	62.7
Ch. 2	[1/3 Oct 2.5kHz]	58.6	60.9	62.7	63.7
Ch. 2	[1/3 Oct 3.15kHz]	65.2	65.9	66.7	68.6
Ch. 2	[1/3 Oct 4kHz]	49.3	53.2	56.7	56.7
Ch. 2	[1/3 Oct 5kHz]	50.0	52.1	54.6	54.9
Ch. 2	[1/3 Oct 6.3kHz]	55.2	56.0	56.9	58.7
Ch. 2	[1/3 Oct 8kHz]	47.2	48.4	50.1	50.2
Ch. 2	[1/3 Oct 10kHz]	45.4	46.6	47.9	48.4
Global		**69.7**	**73.4**	**76.3**	**76.6**

b) Sound pressure levels in free field at 2m, 5m and 10 meters:

From the sound levels in free field at 1 meter, the sound levels in free field at 2, 5 and 10 meters are obtained.

Free field attenuation is governed by the following equation:

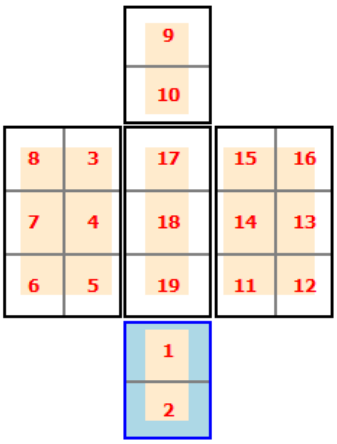
$$SPL = 20 * Log (r_2 / r_1)$$

From the levels obtained at 1 meter and using the previous equation, where r2 is the distance at which the sound level is to be obtained and r1 is the distance at which it is known (in this case 1 meter), the following are obtained sound levels:

Configurations	Sound level 2 m	Sound level 5 m	Sound level 10 m
Configuration 1	63.7 dBA	55.7 dBA	49.7 dBA
Configuration 2	67.7 dBA	59.7 dBA	53.7 dBA
Configuration 3	70.7 dBA	62.7 dBA	56.7 dBA
Configuration 4	71.0 dBA	63.0 dBA	57.0 dBA

2. Determination of power through intensity levels (UNE EN ISO 9612-1: 2010)

The following images show the scheme of intensity probe positions defined in the UNE-EN ISO 9614-1: 2010 standard and used in the test.



a) Acoustic power measured from sound intensity (UNE-EN ISO 9612-2: 2010)

Archivo		Acoustic power			
Fuente		Conf 1	Conf 2	Conf 3	Conf 4
		Fuente	Fuente	Fuente	Fuente
Localización		dB	dB	dB	dB
Ch. 2	[1/3 Oct 80Hz]	82.5	89.2	85.3	90.1
Ch. 2	[1/3 Oct 100Hz]	85.1	88.5	87.6	90.9
Ch. 2	[1/3 Oct 125Hz]	74.5	92.3	93.2	92.6
Ch. 2	[1/3 Oct 160Hz]	80.4	80.1	81.9	82.2
Ch. 2	[1/3 Oct 200Hz]	78	82.6	83.5	83.9
Ch. 2	[1/3 Oct 250Hz]	78.7	89	90.4	90.4
Ch. 2	[1/3 Oct 315Hz]	80.3	82	88.1	88.5
Ch. 2	[1/3 Oct 400Hz]	77.3	82.8	86.3	86.4
Ch. 2	[1/3 Oct 500Hz]	80.6	85.3	87.8	88.4
Ch. 2	[1/3 Oct 630Hz]	77.5	84	87.8	87.7
Ch. 2	[1/3 Oct 800Hz]	77.5	82.8	86.3	86.2
Ch. 2	[1/3 Oct 1kHz]	79	81.6	87.1	85
Ch. 2	[1/3 Oct 1.25kHz]	75.3	82.4	85.2	85.2
Ch. 2	[1/3 Oct 1.6kHz]	73.9	80.2	84.5	84.6
Ch. 2	[1/3 Oct 2kHz]	72.5	77.7	81.4	81.5
Ch. 2	[1/3 Oct 2.5kHz]	71.4	76	79.2	79.7
Ch. 2	[1/3 Oct 3.15kHz]	79.9	79.7	80	81.9
Ch. 2	[1/3 Oct 4kHz]	67.5	71.7	74.6	74.7
Ch. 2	[1/3 Oct 5kHz]	66	69.4	72	72.2
Ch. 2	[1/3 Oct 6.3kHz]	68.3	70.1	73.1	74.7
Global		**87.3**	**91.8**	**95.2**	**95.1**

- **ANNEXES.**

Certificates and technical characteristics of the equipment used.

CERTIFICADO DE VERIFICACIÓN

Instrumentos de medición de sonido audible y calibradores acústicos

LACAINAC
LABORATORIO DE CALIBRACIÓN DE INSTRUMENTOS ACÚSTICOS
UNIVERSIDAD POLITÉCNICA DE MADRID

CAMPUS SUR UPM. ETSI Topografía. Ctra. Valencia, km 7. 28031 – Madrid.
Tel.: (+34) 91 067 89 66 / 67
www.lacainac.es – lacainac@i2a2.upm.es

TIPO DE VERIFICACIÓN:	PERIÓDICA
INSTRUMENTO:	SONÓMETRO
MARCA:	01dB MICRÓFONO: G.R.A.S. PREAMPLIFICADOR: G.R.A.S.
MODELO:	Symphonie MICRÓFONO: 40 AF PREAMPLIFICADOR: 26 AK
NÚMERO DE SERIE:	01415, CANAL: 2 MICRÓFONO: 15714 PREAMPLIFICADOR: 22341 Nº CONTROL METROLÓGICO: S-00245-002
EXPEDIDO A:	ACOUSTICS ANALYSIS, S.A. Pol. Ind. Berriainz, calle C, nave 103 31013 Berriozar NAVARRA
FECHA VERIFICACIÓN:	07/01/2021
CÓDIGO CERTIFICADO:	20LAC21700F03
REGISTRO DE AJUSTE:	51.68 mV/Pa (fecha no disponible)
PRECINTOS:	16-I-0219609 (lateral) 16-I-0219610 (lateral)

Firmado digitalmente por: 52979086N RODOLFO FRAILE (C:G80455231)
Fecha y hora: 08.01.2021 12:59:38

Director Técnico

Este Certificado se expide de acuerdo a la Orden ICT/155/2020, de 7 de febrero, por la que se regula el control metrológico del Estado de determinados instrumentos de medida (BOE nº47 24/02/2020).

El presente Certificado tiene una validez de un año a contar desde la fecha de verificación del mismo, y acredita que el instrumento sometido a verificación ha superado satisfactoriamente todos los ensayos y exámenes administrativos establecidos en la Orden ICT/155/2020. Los ensayos y exámenes administrativos, han sido realizados por el Laboratorio de Calibración de Instrumentos Acústicos.

La presente verificación solo es válida si se mantienen las condiciones que dieron lugar a los ensayos de verificación; por ello, no se debe realizar ningún tipo de ajuste de servicio, que provocaría la anulación del presente certificado.

LACAINAC es un Organismo Autorizado de Verificación Metrológica para la realización de los controles metrológicos establecidos en la Orden citada, por la Dirección General de Industria, Energía y Minas de la Consejería de Economía, Empleo y Hacienda de la Comunidad de Madrid (Resolución de 11 de marzo de 2019), con número de identificación 16-OV-1002.

LACAINAC actúa de acuerdo con la disposición transitoria cuarta de la Orden ICT/155/2020, de 7 de febrero, por la que se regula el control metrológico del Estado de determinados instrumentos de medida.

CERTIFICADO DE VERIFICACIÓN

Instrumentos de medición de sonido audible y calibradores acústicos

LACAINAC
LABORATORIO DE CALIBRACIÓN DE INSTRUMENTOS ACÚSTICOS
UNIVERSIDAD POLITÉCNICA DE MADRID

CAMPUS SUR UPM. ETSI Topografía. Ctra. Valencia, km 7. 28031 – Madrid.
Tel.: (+34) 91 067 89 66 / 67
www.lacainac.es – lacainac@i2a2.upm.es

TIPO DE VERIFICACIÓN:	PERIÓDICA
INSTRUMENTO:	CALIBRADOR ACÚSTICO
MARCA:	RION
MODELO:	NC-74
NÚMERO DE SERIE:	34873191 Nº CONTROL METROLÓGICO: S-00181-001
EXPEDIDO A:	ACOUSTICS ANALYSIS, S.A. Pol. Ind. Berriainz, calle C, nave 103 31013 Berriozar NAVARRA
FECHA VERIFICACIÓN:	07/01/2021
PRECINTOS:	16-I-0201123 (interno)
CÓDIGO CERTIFICADO:	20LAC21700F05

Firmado digitalmente por: 52979086N RODOLFO FRAILE (C:G80455231)
Fecha y hora: 07.01.2021 14:42:31

Director Técnico

Este Certificado se expide de acuerdo a la Orden ICT/155/2020, de 7 de febrero, por la que se regula el control metrológico del Estado de determinados instrumentos de medida (BOE nº47 24/02/2020).

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