

## TURNKEY SOLUTION

for utility-scale PV plants  
with central inverters

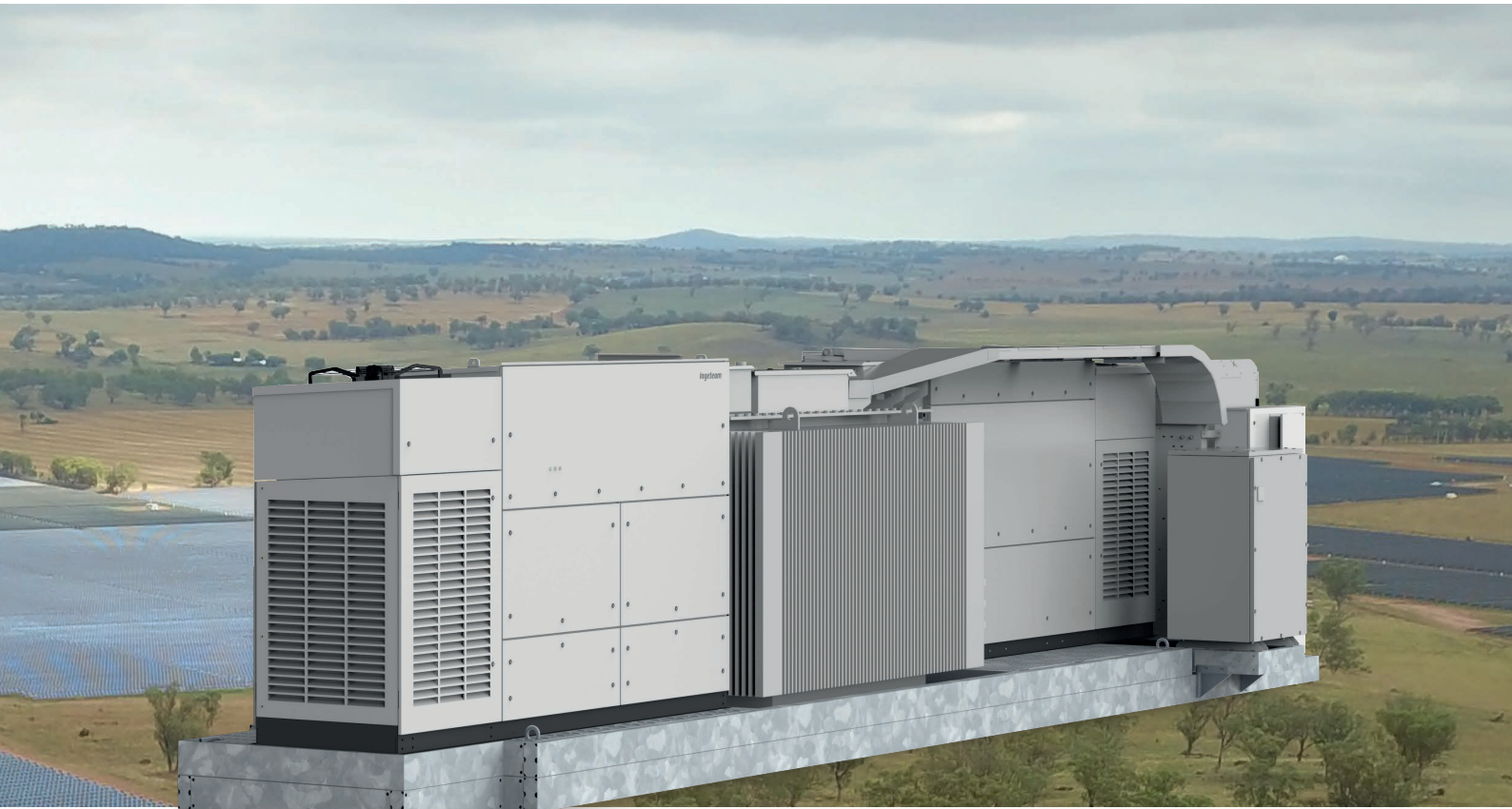
***Ingeteam***



## **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.

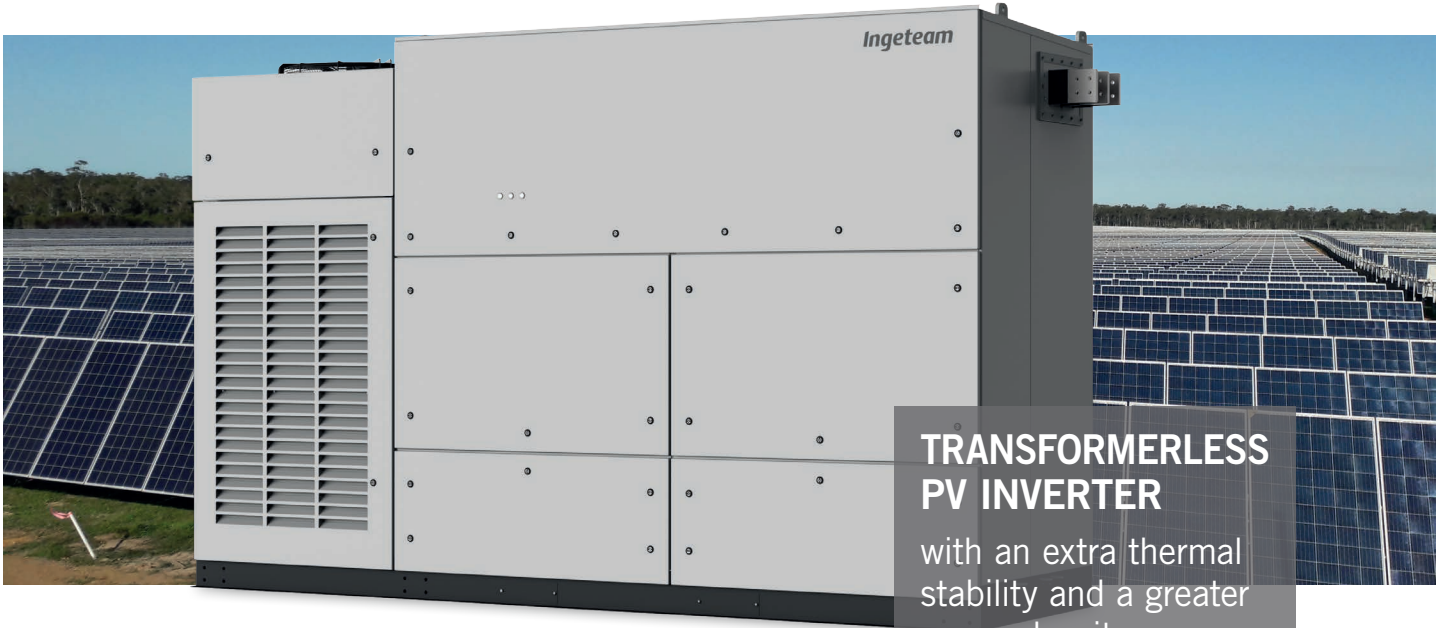
### **Maximum protection**

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.

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**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<sup>3</sup>, as it provides up to 3,825 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



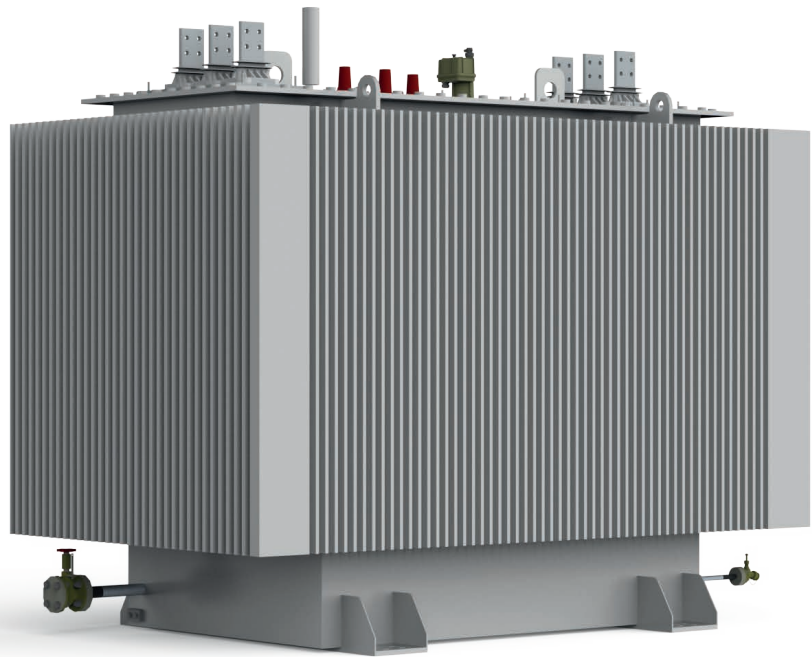
Automatic Voltage Regulation

INGECON® SUN 3825TL							
	C600	C615	C630	C645	C660	C675	C690
<b>Input (DC)</b>							
Recommended PV array power range <sup>(1)</sup>	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 <sup>(2)</sup>	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 <sup>(3)</sup>	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						
<b>Input protections</b>							
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						
<b>Output (AC)</b>							
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 <sup>(4)</sup>	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 <sup>(5)</sup>	1						
Power Factor adjustable	Yes, 0 - 1 (leading / lagging)						
THD (Total Harmonic Distortion) <sup>(6)</sup>	<3%						
<b>Output protections</b>							
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						
<b>Features</b>							
Operating efficiency	98.9%						
CEC	98.5%						
Max. consumption aux. services	9,000 W						
Stand-by or night consumption <sup>(7)</sup>	< 180 W						
Average power consumption per day	2,500 W						
<b>General Information</b>							
Ambient temperature	-20 °C to +60 °C						
Relative humidity (non-condensing)	0-100% (Outdoor)						
Protection class	IP65 <sup>(8)</sup>						
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:** <sup>(1)</sup> Depending on the type of installation and geographical location. Data for STC conditions <sup>(2)</sup> Vmpp.min is for rated conditions (V<sub>ac</sub>=1 p.u. and Power Factor=1) and floating systems <sup>(3)</sup> Consider the voltage increase of the 'Voc' at low temperatures <sup>(4)</sup> Other AC voltages and powers available upon request <sup>(5)</sup> For P<sub>out</sub>>25% of the rated power <sup>(6)</sup> For P<sub>out</sub>>25% of the rated power and voltage in accordance with IEC 61000-3-4 <sup>(7)</sup> Consumption from PV field when there is PV power available <sup>(8)</sup> Except for the LC filter and the air-water heat exchanger, that are IP54.

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## 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 <sup>(1)</sup>
Corrosion degree	C4H
Insulation oil	According to IEC 60292
No load current	< 1%
Max. inrush current peak	<12 x I <sub>n</sub> <sup>(1)</sup>
Installation	Outdoor
Cooling type	ONAN
Max. altitude above sea level <sup>(2)</sup>	4,500 m
Short-circuit impedance at 75 °C	7.5%, 8% <sup>(1)</sup>
General features	Terminal board for primary voltage adjustment, lifting lugs, earthing terminal, electrostatic shield and DGPT2 / DMCR relay

**Notes:** <sup>(1)</sup> Double secondary required for four B Series inverters or for two C Series inverters <sup>(2)</sup> 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

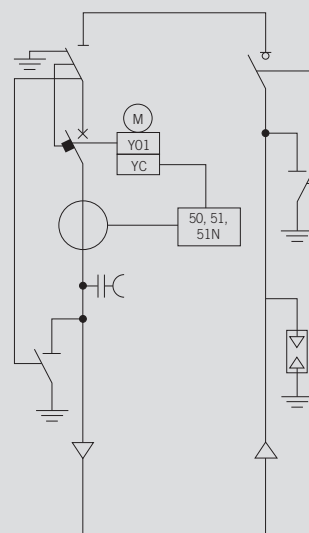
- Breaking capacity 16 kA - 1 s.
- DIN EN 50181 type C plug-in connectors.
- Intrinsically safe operation through interlocks.
- Additional interlocking for transformer room access.
- Optional fused protection available up to 2330 kVA (check climatic conditions).
- Optional circuit breaker protection 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.

	Clase 24 kV	Clase 36 kV
<b>General Information</b>		
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 disconnecter and earthing disconnector + transformer position with circuit breaker with 50-51 and 50N-51N protection functions and earthing disconnector.

Typical end of line configuration.



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## 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.

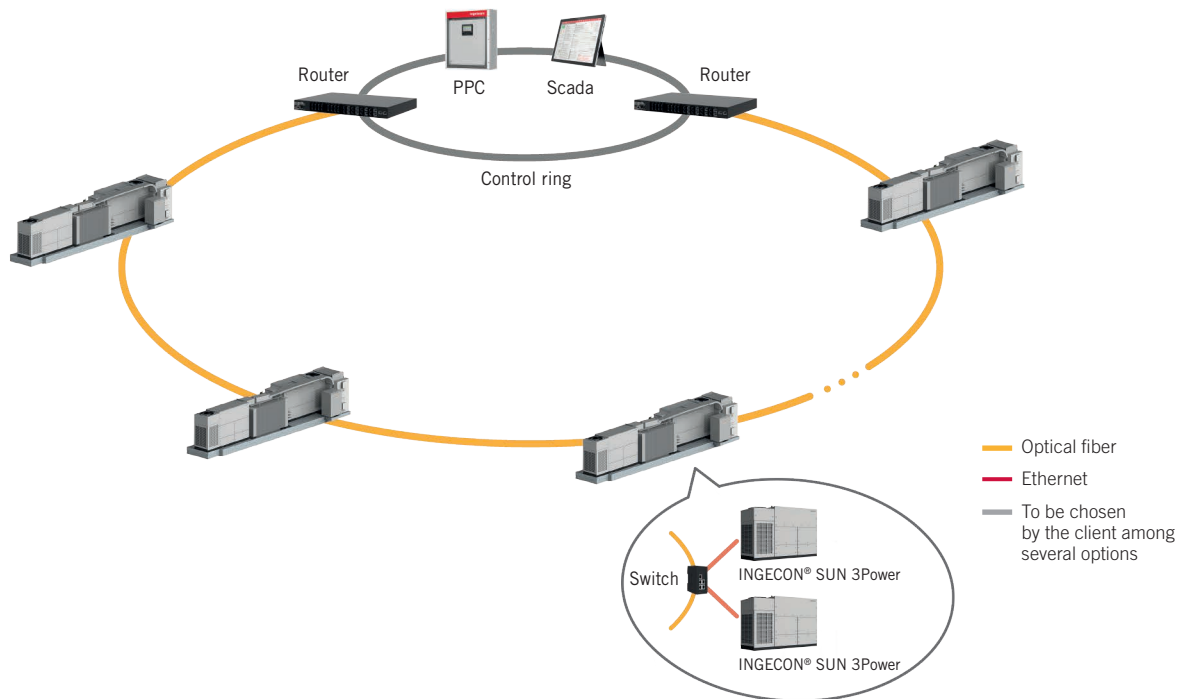
Also, this panel integrates type II surge arresters, several circuit breakers and switches.

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	
<b>General information</b>	
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
<b>Remote Terminal Unit (RTU) INGESYS IC2</b>	
Digital inputs	48
Digital outputs	16
Analog inputs	5
<b>Communications</b>	
Modbus TCP RJ45	2 ports
RS-485	Up to 4 ports





## Communications network

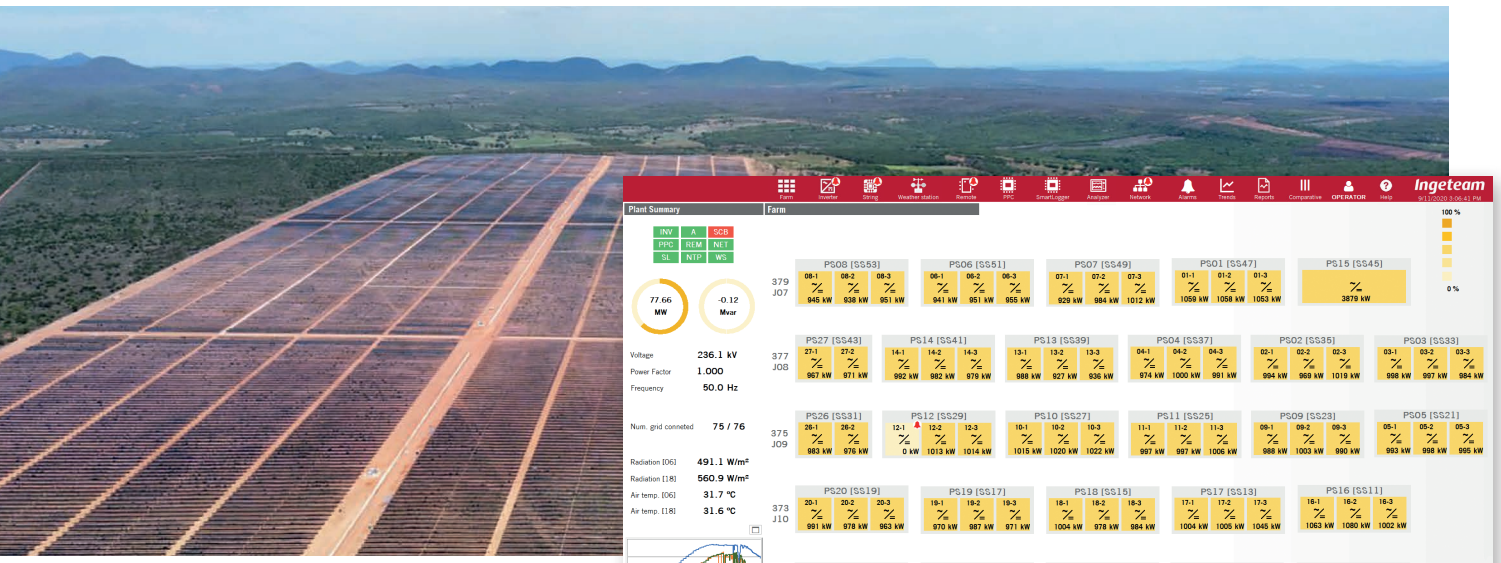
In a photovoltaic plant, the power plant control systems are increasingly fast, precise and demanding. For this reason, the communications network is a key factor in order to guarantee a correct solar plant operation. The distribution of the inverters in the communications network depends on many factors, 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 milliseconds, 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)
<b>Communication</b>	
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
<b>General Data</b>	
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 <sup>(1)</sup>	2,000 m
Marking	CE
Standards	IEC 61000-4-30, IEC 62586-1, IEC 61131-3, IEC 60204-1, IEC 61439
<b>Notes:</b> <sup>(1)</sup> For installations beyond the maximum altitude, please contact Ingeteam's solar sales department.	



## Smart SCADA to manage daily operations and optimise asset performance

**SMART SCADA**  
A system that enables to improve the management of the overall power plant

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.

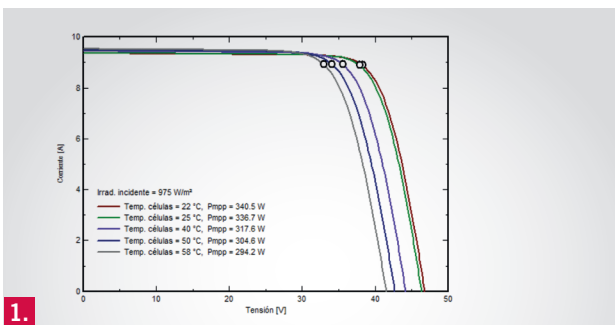




## Power plant sizing and grid code compliance

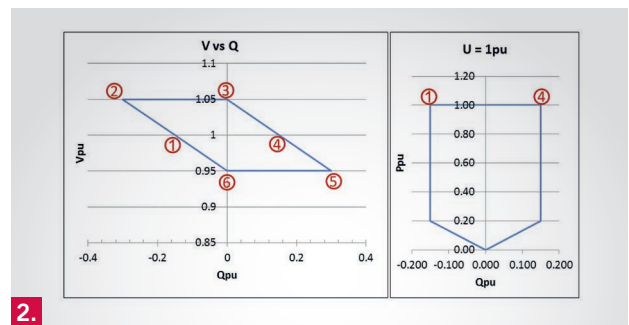
Ingeteam has developed its own PV plant sizing tool, with which we can choose all the parameters and guarantee any grid code compliance in four simple steps:

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.

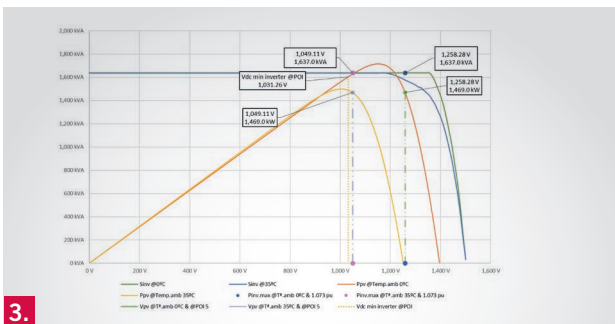
EVALUATION OF THE PV MODULE MODEL



2.

+30 GRID CODES AVAILABLE

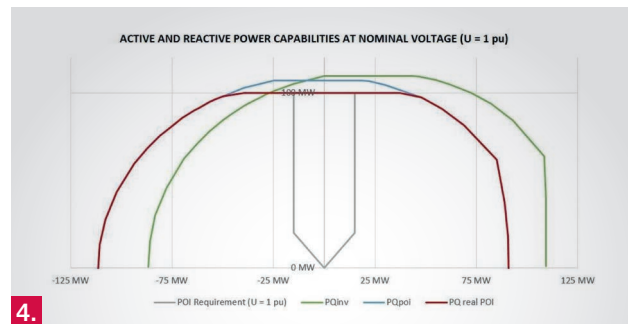
Evaluation of the grid code's requirements



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.



REQUEST  
AN OFFER

# Ingeteam

**Ingeteam Power Technology, S.A.**  
Avda. Ciudad de la Innovación, 13  
31621 Sarriguren (Navarra) - Spain  
Tel.: +34 948 288 000  
Fax: +34 948 288 001  
e-mail: solar.energy@ingeteam.com

**Ingeteam S.r.l.**  
Via Emilia Ponente, 232  
48014 Castel Bolognese (RA) - Italy  
Tel.: +39 0546 651 490  
Fax: +39 054 665 5391  
e-mail: italia.energy@ingeteam.com

**Ingeteam SAS**  
La Naurouze B - 140 rue Carmin  
31670 Labège - France  
Tel.: +33 (0)5 61 25 00 00  
Fax: +33 (0)5 61 25 00 11  
e-mail: france@ingeteam.com

**Ingeteam INC.**  
3550 W. Canal St.  
Milwaukee, WI 53208 - USA  
Tel.: +1 (414) 934 4100 / +1 (855) 821 7190  
Fax: +1 (414) 342 0736  
e-mail: solar.us@ingeteam.com

**Ingeteam, a.s.**  
Technologická 371/1  
70800 Ostrava - Pustkovec  
Czech Republic  
Tel.: +420 59 747 6800  
Fax: +420 59 732 6899  
e-mail: czech@ingeteam.com

**Ingeteam Shanghai, Co. Ltd.**  
Shanghai Trade Square, 1105  
188 Si Ping Road  
200086 Shanghai - P.R. China  
Tel.: +86 21 65 07 76 36  
Fax: +86 21 65 07 76 38  
e-mail: shanghai@ingeteam.com

**Ingeteam, S.A. de C.V.**  
Leibnitz Ext 13 Int 1102, Colonia Anzures  
11590 - Miguel Hidalgo  
Ciudad de México - Mexico  
Tel.: +52 81 8311 4858  
Fax: +52 81 8311 4859  
e-mail: northamerica@ingeteam.com

**Ingeteam Ltda.**  
Rua Estácio de Sá, 560  
Jd. Santa Genebra  
13080-010 Campinas/SP - Brazil  
Tel.: +55 19 3037 3773  
e-mail: brazil@ingeteam.com

**Ingeteam Pty Ltd.**  
Unit 2 Alphen Square South  
16th Road, Randjiespark  
Midrand 1682 - South Africa  
Tel.: +2711 314 3190  
Fax: +2711 314 2420  
e-mail: southafrica@ingeteam.com

**Ingeteam SpA**  
Los militares 5890, Torre A, oficina 401  
7560742 - Las Condes  
Santiago de Chile - Chile  
Tel.: +56 2 29574531  
e-mail: chile@ingeteam.com

**Ingeteam Power Technology India Pvt. Ltd.**  
2nd Floor, 431  
Udyog Vihar, Phase III  
122016 Gurgaon (Haryana) - India  
Tel.: +91 124 420 6491-5  
Fax: +91 124 420 6493  
e-mail: india@ingeteam.com

**Ingeteam Sp. z o.o.**  
Ul. Koszykowa 60/62 m 39  
00-673 Warszawa - Poland  
Tel.: +48 22 821 9930  
Fax: +48 22 821 9931  
e-mail: polska@ingeteam.com

**Ingeteam Australia Pty Ltd.**  
iAccelerate Centre, Building 239  
Innovation Campus, Squires Way  
North Wollongong, NSW 2500 - Australia  
Tel.: +61 429 111 190  
e-mail: australia@ingeteam.com

**Ingeteam Panama S.A.**  
Av. Manuel Espinosa Batista,  
Ed. Torre Internacional  
Business Center, Apto./Local 407  
Urb.C45 Bella Vista  
Bella Vista - Panama  
Tel.: +50 761 329 467

**Ingeteam Service S.R.L.**  
Bucuresti, Sector 2,  
Bulevardul Dimitrie Pompeiu Nr 5-7  
Cladirea Hermes Business  
Campus 1, Birou 236, Etaj 2  
Romania  
Tel.: +40 728 993 202

**Ingeteam Philippines Inc.**  
Office 2, Unit 330, Milelong Bldg.  
Amorsolo St. corner Rufino St.  
1230 Makati  
Gran Manila - Philippines  
Tel.: +63 0917 677 6039

**Ingeteam Power Technology, S.A.**  
Level 1, Al Bateen Tower C6 Bainunah  
ADIB Building, Street 34  
PO BOX 30010 - Abu Dhabi  
United Arab Emirates  
Tel.: +971 50 125 8244

**Ingeteam Vietnam Ltd.**  
Spaces - 28A Tran Hung Dao Street  
Phan Chu Trinh Ward  
Hoan Kiem District  
Ha Noi City - Vietnam  
Tel.: +84 24 71014057  
e-mail: vietnam@ingeteam.com

**Ingeteam Uruguay, S.A.**  
Avenida 18 de Julio, 1474, Piso 12  
11200, Montevideo - Uruguay  
Tel.: +598 934 92064