







Task 14 Solar PV in the 100% RES Power System

PVPS

Design recommendations for PV in Smart Grids

As a function of the technical boundary conditions and depending on the desired functionalities

Survey – Use Case collection

2022

1. SCENARIO DEFINITiON

## Role of Editor

Name of editor/ organization (optional):

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E-mail (optional):

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Country:

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Role of editor:

Grid operator

Grid regulator

Metering point operator

PV-system operator

PV-system owner

Energy market retailer

Energy service provider

Scientific organization

Standardization committee

Technical / legal commission

PV-system manufacturer

IT service provider

Consulting

Other, please specify

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## Scenario description

Scenario description:

Please specify the scenario here.

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# Scenario: Country/Organization <XY>

## Regulatory Documents

Which legal requirements are relevant for the operators of grid-connected PV systems in your country?

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Which business models do PV systems have in the scope of your scenario?

Feed-in tariff (FIT)

Self-consumption

Net metering

Virtual power plant (e.g. participation with an aggregator)

Participation in energy market

Power purchase agreement (PPA)

Peer-to-peer contract

Other, please specify:

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## Grid Connection

To which voltage levels are the PV systems connected in your scenario?

LV (low voltage)

MV (medium voltage)

HV (high voltage)

More than one is possible

Which connection topologies are allowed?

Single Phase

Multiple Single Phase

3 Phase

Split Phase

Not defined

Which further specialties are regulated in your project / country concerning grid connection?

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## Metering Data for Invoicing

Which Parameters are recorded?

Mandatory Optional

Active energy

Reactive energy

Other, please specify:

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Which interval is used for the measurement and data transmission (for invoicing)?

Measurement Data transmission

Annually

Quarterly

Monthly

Weekly

Daily

Hourly

Quarter hourly

Minutes

Other, please specify

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How are these data collected?

Collected by DSO-Official

Meter operator

Costumer sends Postcard

Costumer uses an App / Webpage form

Transmitted (Smart Meter)

Is it planned to transmit the measurements in the future?

Yes, please specify

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No

If measurements are transmitted or will be transmitted in the future, please give details on technology and procedures.

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## Metering Data for grid operation

Which Parameters are recorded?

Mandatory Optional

Active energy

Reactive energy

Active power

Reactive power

Phase active power

Phase voltage

Phase currents

Grid frequency

THD or harmonics

Which interval is used for the measurement and data transmission (for grid operation)?

Measurement Data transmission

Annually

Quarterly

Monthly

Weekly

Daily

Hourly

Quarter hourly

Minutes

Other, please specify

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How are these data collected?

Collected by (DSO) Official

Meter operator

Costumer uses an App / Webpage form

Transmitted (Smart Meter)

Monitoring system

Is it planned to transmit the measurements in the future?

Yes, please specify,

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No

Please give details on technology and procedures for transmitting measurements.

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## PV System Registration

Which registrations are required for the grid interconnection of a PV system?

Registration at grid operator (asset management)

Registration at grid operator (grid operation)

Registration at renewable energy system register

Registration at energy market register

Valid certificate for PV system operation

Other, please specify

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## Ancillary Services

Which preconditions are required for the grid-connected operation of a PV inverter? [1] [2]

FRT (Fault Ride Through) capability

Automatic power limitation/disconnection in over frequency cases

Voltage rise check by DSO before installation

Communication access (e.g. for curtailment)

Other, please specify

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Which ancillary services are provided for grid operators by grid-connected PV inverters? [2] [3]

Frequency regulation & reserve power

Harmonic compensation

Fast ramping resources

Grid dynamic voltage support

Grid restart after blackout

Grid-disconnected microgrid operation (Unintentional islanding)

Reactive power capability & voltage regulation

Other, please specify

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Is there a compensation for delivering ancillary services?

No

Yes, please specify

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## Monitoring & Remote Control

Is there any regulatory document for PV monitoring?

No

Yes, please specify

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Which control methods are applied to PV systems?

Active power curtailment (set a feed-in limit)

Special commands for ancillary services (e.g. reactive power provision)

Modification of inverter parameters (e.g. set power factor of the inverter)

Forecast-based scheduling

Local regulation regarding customer home energy system

Other, please specify

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Which protocols and technologies are considered in the control commands? [4] [5] [6]

Control based on relays

IEC 60870-5-103/104 (classic standard for tele control) [7]

IEC 61850 (modern standard for tele control) [8]

IEC 61970, IEC 61968 (CIM: Common Information Model) [9] [10]

Open ADR [11]

IEEE 2030.5 [12]

SunSpec Modbus-TCP [13]

Proprietary protocols, please specify

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Which communication infrastructure is used to send the commands?

Ripple control (long wave radio)

DSL

Power line communication

Fiber optics

GSM /UMTS/LTE

5G

Fax or Papers exchange or telephone

Other, please specify

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## Security

Which of the 4 Goals of an IT system security policy / discussion is rated the most? Please give numbers to rate the 4 different goals from 0 = not considered / not important to 10 = most important [14]

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| No. | Goals | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Confidentiality (also considers privacy issues) |  |  |  |  |  |  |  |  |  |  |  |
| 2 | Integrity |  |  |  |  |  |  |  |  |  |  |  |
| 3 | Availability |  |  |  |  |  |  |  |  |  |  |  |
| 4 | Accountability |  |  |  |  |  |  |  |  |  |  |  |

CIA triad[[1]](#footnote-1):

Confidentiality is roughly equivalent to privacy. Confidentiality measures are designed to prevent sensitive information from unauthorized access attempts. It is common for data to be categorized according to the amount and type of damage that could be done if it fell into the wrong hands. More or less stringent measures can then be implemented according to those categories.

Integrity involves maintaining the consistency, accuracy and trustworthiness of data over its entire lifecycle. Data must not be changed in transit, and steps must be taken to ensure data cannot be altered by unauthorized people (for example, in a breach of confidentiality).

Availability means information should be consistently and readily accessible for authorized parties. This involves properly maintaining hardware and technical infrastructure and systems that hold and display the information.

**Accountability[[2]](#footnote-2)** It is the authority of information systems to successfully scrutinize the actions of an entity and hold them accountable for the aforementioned actions.

List of abbreviations

|  |  |
| --- | --- |
| ADR | Automated Demand Response |
| CIM | Common Information Model |
| CLS | Controllable Local System |
| DER | Distributed Energy Resources |
| DSL | Digital Subscriber Line |
| DSO | Distribution System Operator |
| EEG | Erneuerbare-Energien-Gesetz (English: German Renewable Energies Act) |
| EMS | Energy Management System |
| EnWG | Energiewirtschaftsgesetz (English: German Energy Industry Act) |
| EV | Electric Vehicle |
| FIT | Feed in Tariff |
| FRT | Fault Ride Through |
| GDEW | Gesetz zur Digitalisierung der Energiewende (English: Law on the Digitization of the Energy Transition) |
| GSM | Global System for Mobile Communications |
| HAN | Home Area Network |
| HV | High Voltage |
| ICT | Information and Communication Technologies |
| IEA | International Energy Agency |
| IEC | International Electrotechnical Commission |
| LMN | Local Metrological Network |
| LTE | Long Term Evolution |
| LV | Low Voltage |
| MDS | Metering Data System |
| MV | Medium Voltage |
| NABEG | Netzausbaubeschleunigungsgesetz Übertragungsnetz (English: Grid Expansion Acceleration Act) |
| PKI | Public Key Infrastructure |
| PPA | Power Purchase Agreement |
| P2P | Peer to Peer  Peer-to-PeerPeer  Peer-to-Peer |
| PV | Photovoltaic |
| SMGW | Smart Meter Gateway |
| TSO | Transmission System Operator |
| THD | Total Harmonic Distortion |
| UMTS | Universal Mobile Telecommunications System |
| VDE | Verband der Elektrotechnik, Elektronik und Informationstechnik (English: Association for Electrical, Electronic and Information Technologies) |
| WAN | Wide Area Network |

References

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| --- | --- |
| [1] | VDE, "Power Generating Plants in the Low Voltage Grid (VDE-AR-N 4105)," VDE, Berlin, 2019. |
| [2] | IEEE, "Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces," IEEE, New York, 2018. |
| [3] | IRENA, "Innovation landscape brief: Innovative ancillary services," Abu Dhabi, 2019. |
| [4] | IEC, "IEC Smart Grid Standardization Roadmap," IEC, 2010. |
| [5] | M. Kuzlu et al., "A comprehensive review of smart grid related standards and protocols," in *2017 5th International Istanbul Smart Grid and Cities Congress and Fair (ICSG)*, Istanbul, 2017. |
| [6] | I. Onunkwo, "Forthcoming report: Recommendations for Data-in-Transit Requirements for Securing DER Communications, No. SAND2020-12704. Sandia National Lab. (SNL-NM)," Albuquerque, 2020. |
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| [8] | IEC, "IEC 61850 Series: Communication networks and systems for power utility automation," 2020. |
| [9] | IEC, "IEC 61970 Series - Energy management system application program interface (EMS-API)," 2020. |
| [10] | IEC, "IEC 61968-11: Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distributio," IEC, 2013. |
| [11] | O. Alliance, "OpenADR 2.0 Profile Specification," 2012. |
| [12] | IEEE, "Standard for Smart Energy Profile Application Protocol," 2018. |
| [13] | S. Alliance, "SunSpec Modbus Technology Overview, Model Reference & Model Specification," 2020. |
| [14] | BSI, "BSI-Standard 200-1: Information Security Management Systems (ISMS)," BSI, Bonn, 2017. |

1. https://www.techtarget.com/whatis/definition/Confidentiality-integrity-and-availability-CIA [↑](#footnote-ref-1)
2. https://medium.com/coinmonks/a-little-more-than-the-cia-triad-6c54d6263083 [↑](#footnote-ref-2)