







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 – high-level questionnaire

2022

## Role of Editor

Name of editor/ organization (optional):

|  |
| --- |
|  |

E-mail:

|  |
| --- |
|  |

Country:

|  |
| --- |
|  |

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

|  |
| --- |
|  |

## Opportunities for PV integration into smart grids

Which of the following scenarios are currently regarded in your country? In addition, which will be considered in the future? [1] [2]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Scenarios for the integration of PV in the smart grid | Present | Planned | Future | Not Discussed |
| 1 | Transmit measurements  Transmission of meter data for invoicing and gird measurements for grid operation |  |  |  |  |
| 2 | Control of active power  Direct control of PV system feed-in active power, e.g. via active power curtailment |  |  |  |  |
| 3 | Control of reactive power  Using the grid-support functionalities of PV inverters for reactive power regulation (e.g. voltage support) |  |  |  |  |
| 4 | Use of existing ICT infrastructure  Realizing tele-communication without installing extra ICT devices (e.g. ICT device in customer network) |  |  |  |  |
| 5 | Change parameters for the inverter control  Amendment of inverter operation modes by configuring inverter control parameters (e.g. P(f), V-control modes) |  |  |  |  |
| 6 | Inverter Plug and Play  Automatic registration in the MDS (metering data system) and SCADA of grid operator |  |  |  |  |
| 7 | Autonomous DER functions  Autonomous control of DER on behalf of (coordinated and cascaded) DSO/TSO commands or market signal |  |  |  |  |
| 8 | Provide black start capabilities  Contributing to grid restart after local or regional grid black out |  |  |  |  |
| 9 | Storage specific function  Supporting operational or economic use cases with different types of energy storage for customers and grid operators |  |  |  |  |
| 10 | Time-based scheduling  Day-ahead time-based scheduling of PV control configuration regarding available weather/load forecast |  |  |  |  |
| No. | Scenarios for the integration of PV in the smart grid | Present | Planned | Future | Not Discussed |
| 11 | Monitor PV-Status and provide emergency alarm  Monitoring of PV system operation states and alert the stakeholder/operator in case of emergency and operational fault |  |  |  |  |
| 12 | Participation in local energy markets  Enabling energy trade of PV feed-in surplus in local energy market |  |  |  |  |
| 13 | Neighborhood energy exchange (within one feeder)  Enabling energy trade of PV feed-in surplus with consumers in neighborhood |  |  |  |  |
| 14 | Participation in flexibility-platform  Participating in flexibility trade by providing PV system capacity as reserve power (e.g. via prosumer aggregation) |  |  |  |  |
| 15 | Participation in crossing region energy markets  Enabling energy trade of PV feed-in surplus in crossing region energy market (e.g. via p2p energy trade, block-chain application) |  |  |  |  |
| 16 | Documentation of executed PV curtailments  Providing evidence for compensation of flexibility trade by documentation executed power curtailments and other kinds of power regulation restrictions |  |  |  |  |
| 17 | PV - EV compensation  Enabling compensation of EV peaks by charging with PV surplus, hybrid storage system could also be associated |  |  |  |  |
| 18 |  |  |  |  |  |
| 19 |  |  |  |  |  |
| 20 |  |  |  |  |  |

## Risks of PV integration in smart grids

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 [3]

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.

Which measures for IT security should be considered? [4] [3] [5] [6] [7]

|  |  |  |  |
| --- | --- | --- | --- |
| No. | IT security measure | Present | Future |
| 1 | Threat analysis & risk management for PV systems to identify threats and vulnerabilities |  |  |
| 2 | Regular cyber security assessment for existing infrastructure |  |  |
| 3 | User authentication |  |  |
| 4 | Device identification and authentication |  |  |
| 5 | Role-based device access control |  |  |
| 6 | Attack/intrusion detection system |  |  |
| 7 | ICT cryptographic techniques |  |  |
| 8 | Internet cryptography |  |  |
| 9 | Wireless cryptography |  |  |
| 10 | Certificate-based PKI cryptography and key management |  |  |
| 11 | Design secure network configurations |  |  |
| 12 | Implementation of security testing and validation procedures |  |  |
| 13 | Redundant communication network |  |  |
| 14 | Redundant equipment |  |  |
| 15 | Centralized monitoring and control via SCADA system |  |  |
| 16 | Centralized power system analysis and control for DER via EMS and DMS |  |  |
| 17 | Security awareness & training for system operator staffs |  |  |
| 18 | Utilization of block-chain technologies |  |  |
| 19 | Secured storage and transport of ICT devices |  |  |
| 20 |  |  |  |

Please rate the following scenarios for IT security with respect to utilization vs danger (risk vs opportunity) with the following rating:

* -2: This is a great danger
* -1: we consider the use but have doubts
* ND: Not discussed
* +1: it is interesting and offers potential
* +2: This is the way to go

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Scenarios for the integration of PV in the smart grid** | **-2** | **-1** | **ND** | **+1** | **+2** |
| 1 | Transmit measurements  Transmission of meter data for invoicing and gird measurements for grid operation |  |  |  |  |  |
| 2 | Control of active power  Direct control of PV system feed-in active power, e.g. via active power curtailment |  |  |  |  |  |
| 3 | Control of reactive power  Using the grid-support functionalities of PV inverters for reactive power regulation (e.g. voltage support) |  |  |  |  |  |
| 4 | Use of existing ICT infrastructure  Realizing tele-communication without installing extra ICT devices (e.g. ICT device in customer network) |  |  |  |  |  |
| 5 | Change parameters for the inverter control  Amendment of inverter operation modes by configuring inverter control parameters (e.g. P(f), V-control modes) |  |  |  |  |  |
| 6 | Inverter Plug and Play  Automatic registration in the MDS (metering data system) and SCADA of grid operator |  |  |  |  |  |
| 7 | Autonomous DER functions  Autonomous control of DER on behalf of (coordinated and cascaded) DSO/TSO commands or market signal |  |  |  |  |  |
| 8 | Provide black start capabilities  Contributing to grid restart after local or regional grid black out |  |  |  |  |  |
| 9 | Storage specific function  Supporting operational or economic use cases with different types of energy storage for customers and grid operators |  |  |  |  |  |
| 10 | Time-based scheduling  Day-ahead time-based scheduling of PV control configuration regarding available weather/load forecast |  |  |  |  |  |
| 11 | Scenarios for the integration of PV in the smart grid |  |  |  |  |  |
| 12 | Monitor PV-Status and provide emergency alarm  Monitoring of PV system operation states and alert the stakeholder/operator in case of emergency and operational fault |  |  |  |  |  |
| 13 | Participation in local energy markets  Enabling energy trade of PV feed-in surplus in local energy market |  |  |  |  |  |
| 14 | Neighborhood energy exchange (within one feeder)  Enabling energy trade of PV feed-in surplus with consumers in neighborhood |  |  |  |  |  |
| 15 | Participation in flexibility-platform  Participating in flexibility trade by providing PV system capacity as reserve power (e.g. via prosumer aggregation) |  |  |  |  |  |
| 16 | Participation in crossing region energy markets  Enabling energy trade of PV feed-in surplus in crossing region energy market (e.g. via p2p energy trade, block-chain application) |  |  |  |  |  |
| 17 | Documentation of executed PV curtailments  Providing evidence for compensation of flexibility trade by documentation executed power curtailments and other kinds of power regulation restrictions |  |  |  |  |  |
| 18 |  |  |  |  |  |  |
| 19 |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |

List of abbreviations

|  |  |
| --- | --- |
| CLS | Controllable Local System |
| DER | Distributed Energy Resources |
| DMS | Distribution Management System |
| DSO | Distribution System Operator |
| EMS | Energy Management System |
| EV | Electric Vehicle |
| ICT | Information and Communication Technologies |
| PKI | Public Key Infrastructure |
| PV | Photovoltaic |
| SCADA | Supervisory Control and Data Acquisition |
| TSO | Transmission System Operator |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

References

|  |  |
| --- | --- |
| [1] | 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. |
| [2] | EEBUS Initiative e.V. , "EEBUS UC Technical Specification," Cologne, 2019. |
| [3] | IEC, "IEC Smart Grid Standardization Roadmap," IEC, 2010. |
| [4] | BDEW, "Stellungnahme zur Konsultation zum Festlegungsver-fahren zur Informationsbereitstellung für Redispatch-Maßnahmen," Berlin, 2020. |
| [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] | BNetzA, "Marktstammdatenregister (MaStR, eng. Market Master Data Register), online: http://https://www.marktstammdatenregister.de," 2019. |
| [7] | Netztransparenz.de, "EEG-Anlagenstammdaten( eng. Renewable Energy System master data), online: https://www.netztransparenz.de/EEG/Anlagenstammdaten". |

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)