



Lightning and surge protection of SSEG installations

Hano Oelofse DEHN AFRICA

AGENDA

- Damages experienced in small scale plants
- Standards and Norms related to renewable plants
- Risk Analysis SANS 62305-2
- Methodologies



Damages experienced in small scale solar plants

- Solar Module Damage
- Combiner Box Damage
- Inverter Damage
- Communication System Damage
- Sensitive Equipment Damage (Trackers, Security Systems)
- Sensing and other instruments
- Damage Statistics

Damages to small scale solar systems

Solar Module Damage

- Broken glasses, Burned/Melted DC Cables and Combiner Box
- Defective bypass diodes



Damages to small scale solar systems

Combiner Box Damage

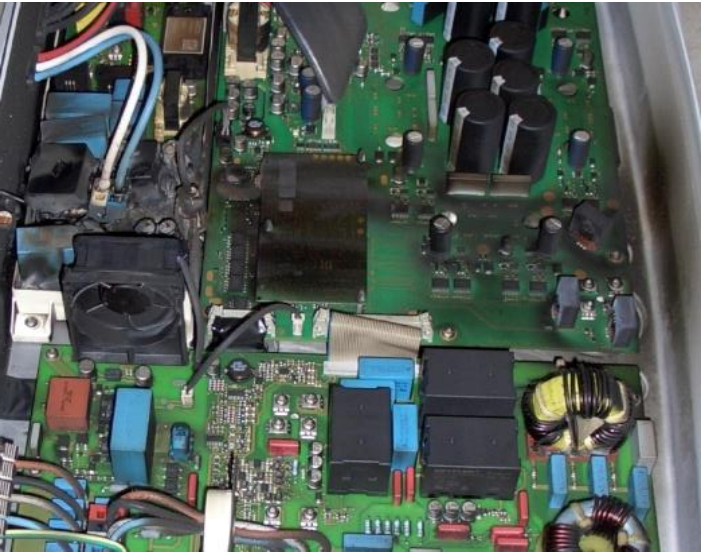
- Melted Combiner Boxes and DC Cables due to Short-Circuit currents
- Breakdown of sensitive and or monitoring components inside Combiner Box



Damages to small scale solar systems

Inverter Damage

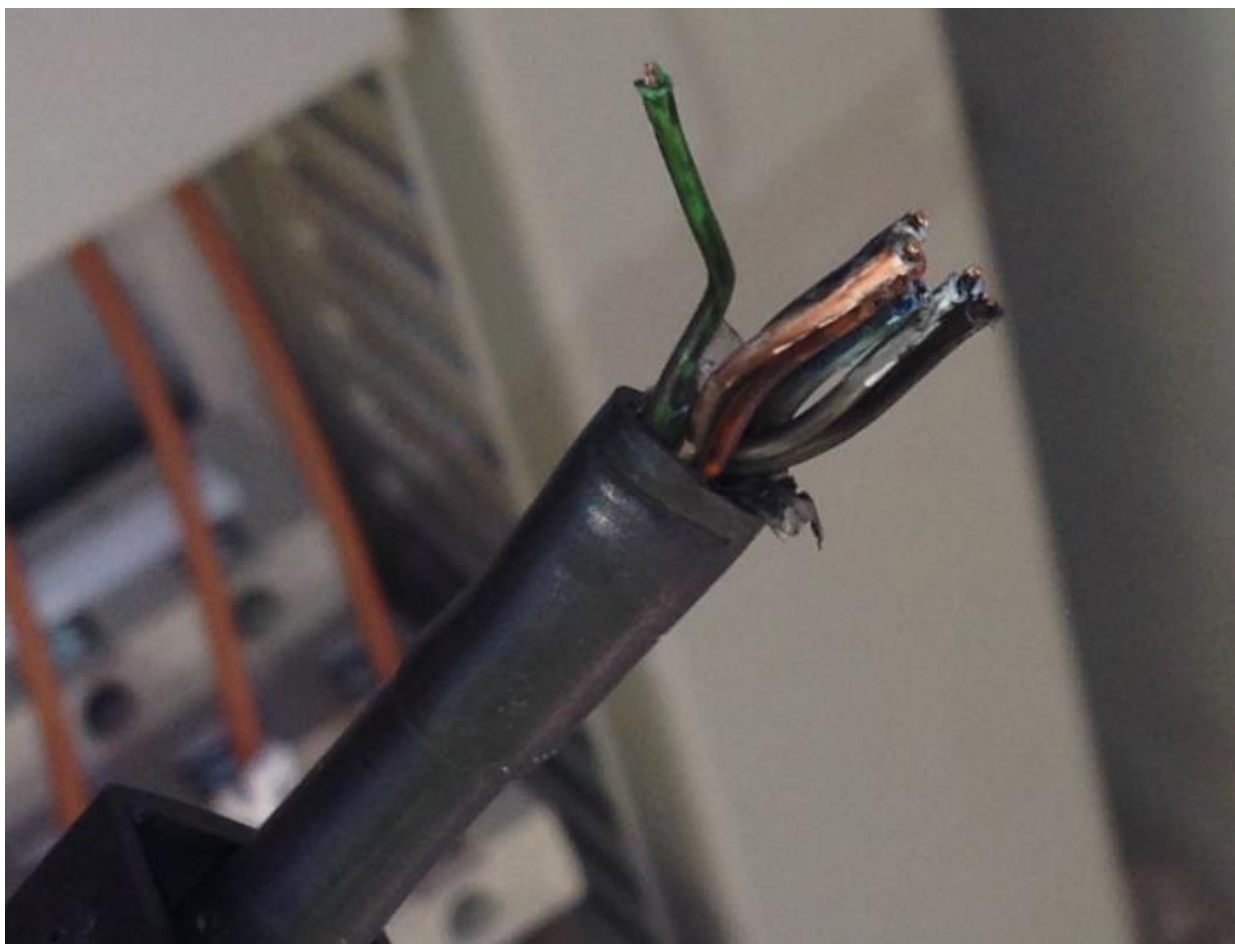
- Internal component failure inside an Inverter (Central & String)



Damages to small scale solar systems

Communication System Damage

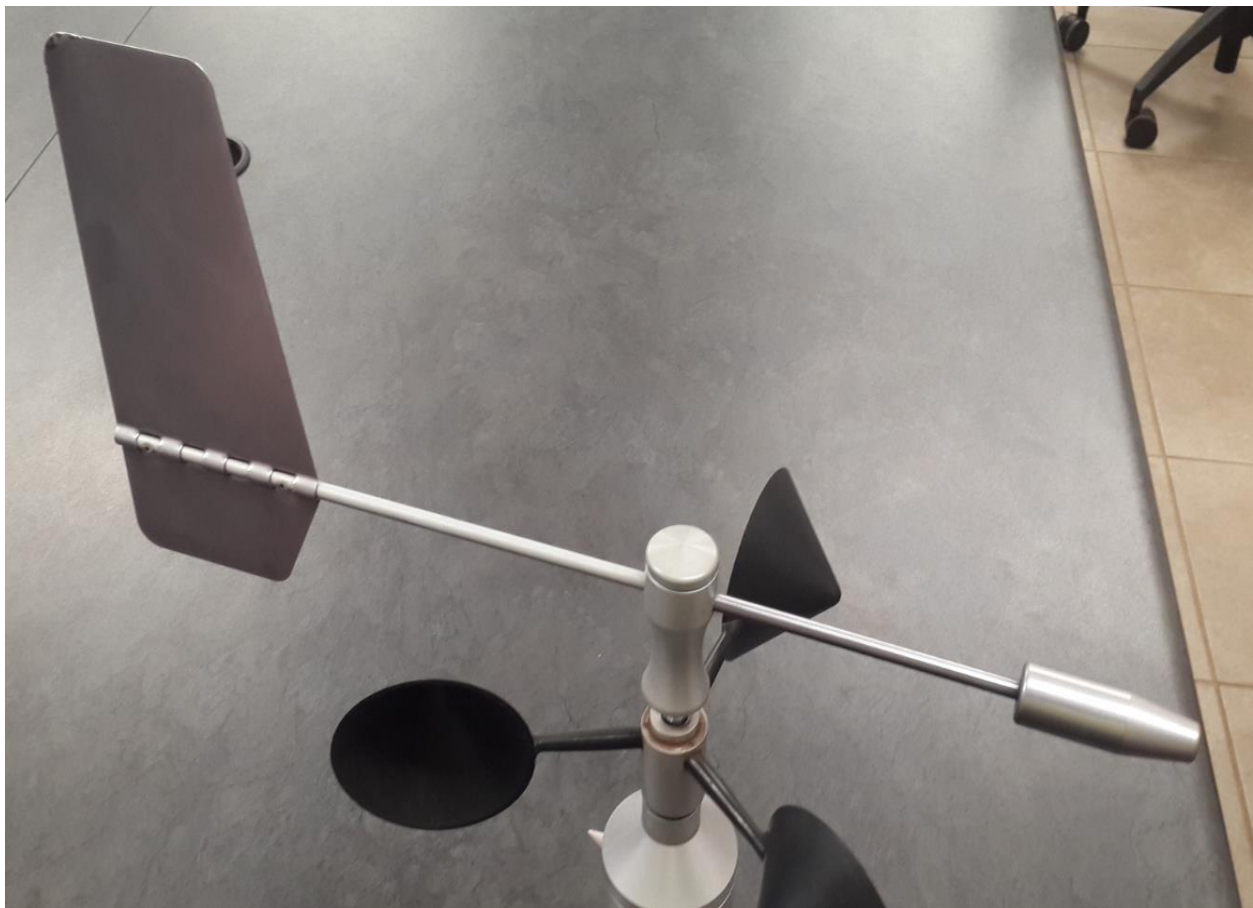
- Holes in the Cable insulation
- Data cables causing failure of Switches, PLC's etc...



Damages to small scale solar systems

Anemometer and other instruments

- Welded bolt on Anemometer due to direct lightning strike
- Internal component communication failures



Damages to small scale solar systems

PV Module Damage

- Arcing/Short-circuiting of solar Modules due to lightning
- Broken glasses, burned/Melted DC Cables and Combiner Box

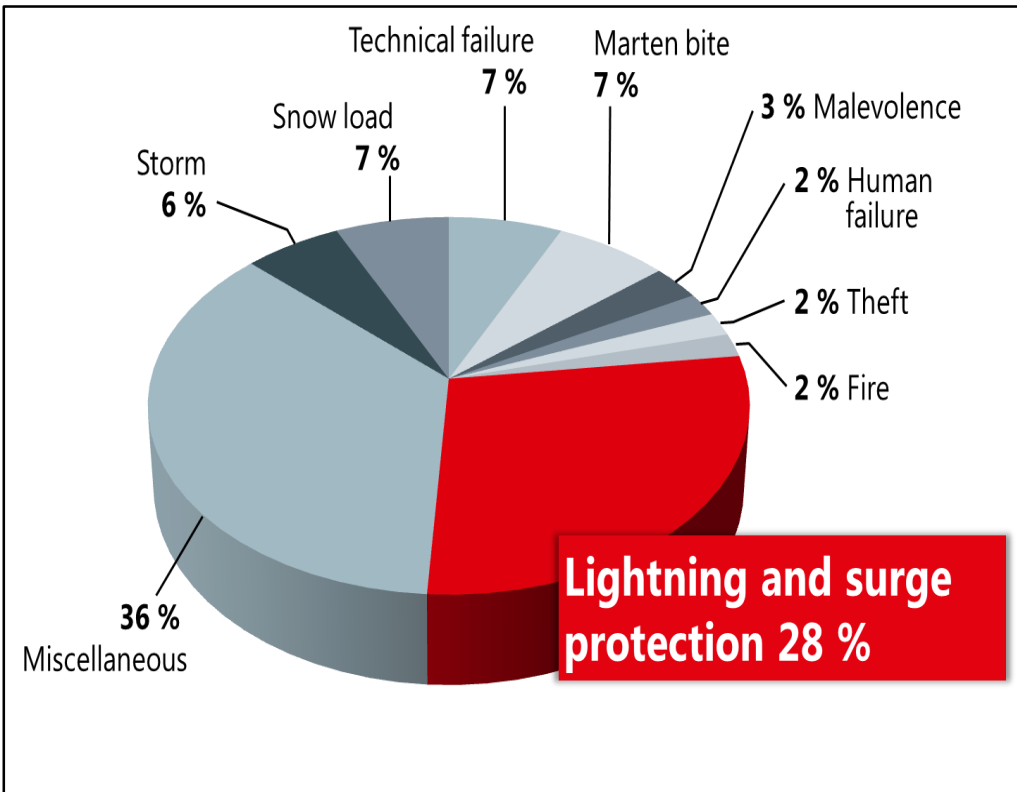


Damages to small scale solar systems

Damage Statistics – Comparison (Frequency of Occurrence)

Causes of damage (2003-2013)

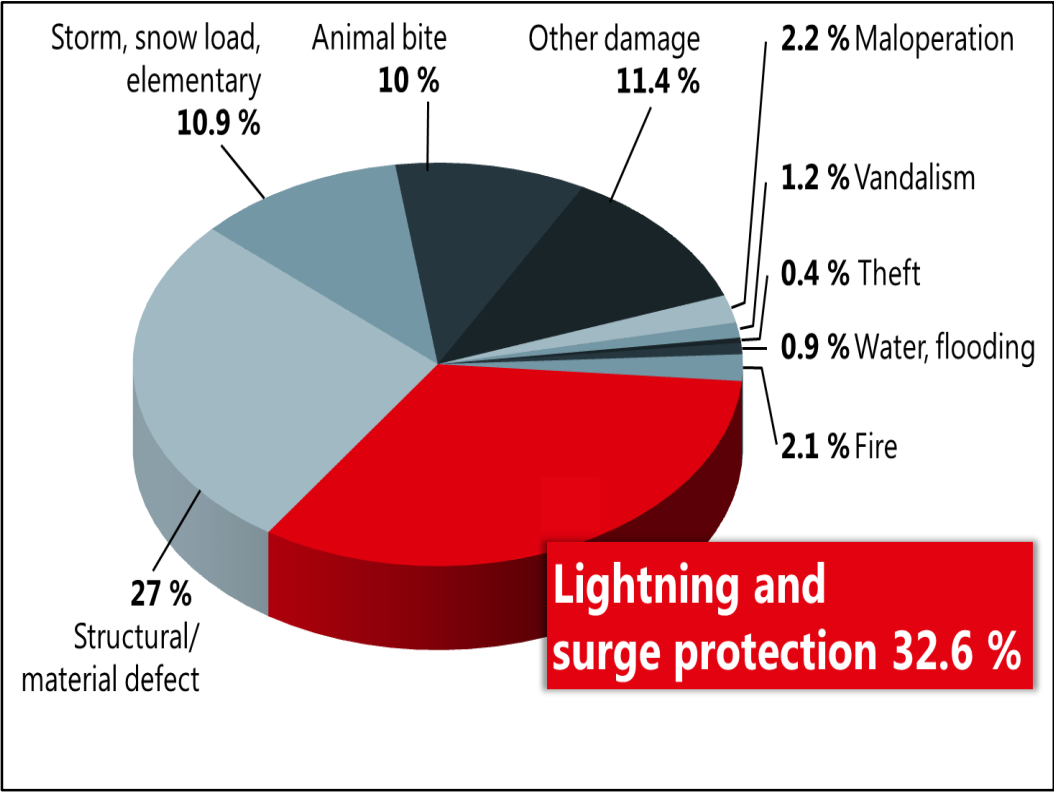
Evaluation **Mannheimer Versicherung**



source: Mannheimer Versicherung 2014

Causes of damage (2005-2014)

Evaluation **Bayerischer Versicherungsverband**

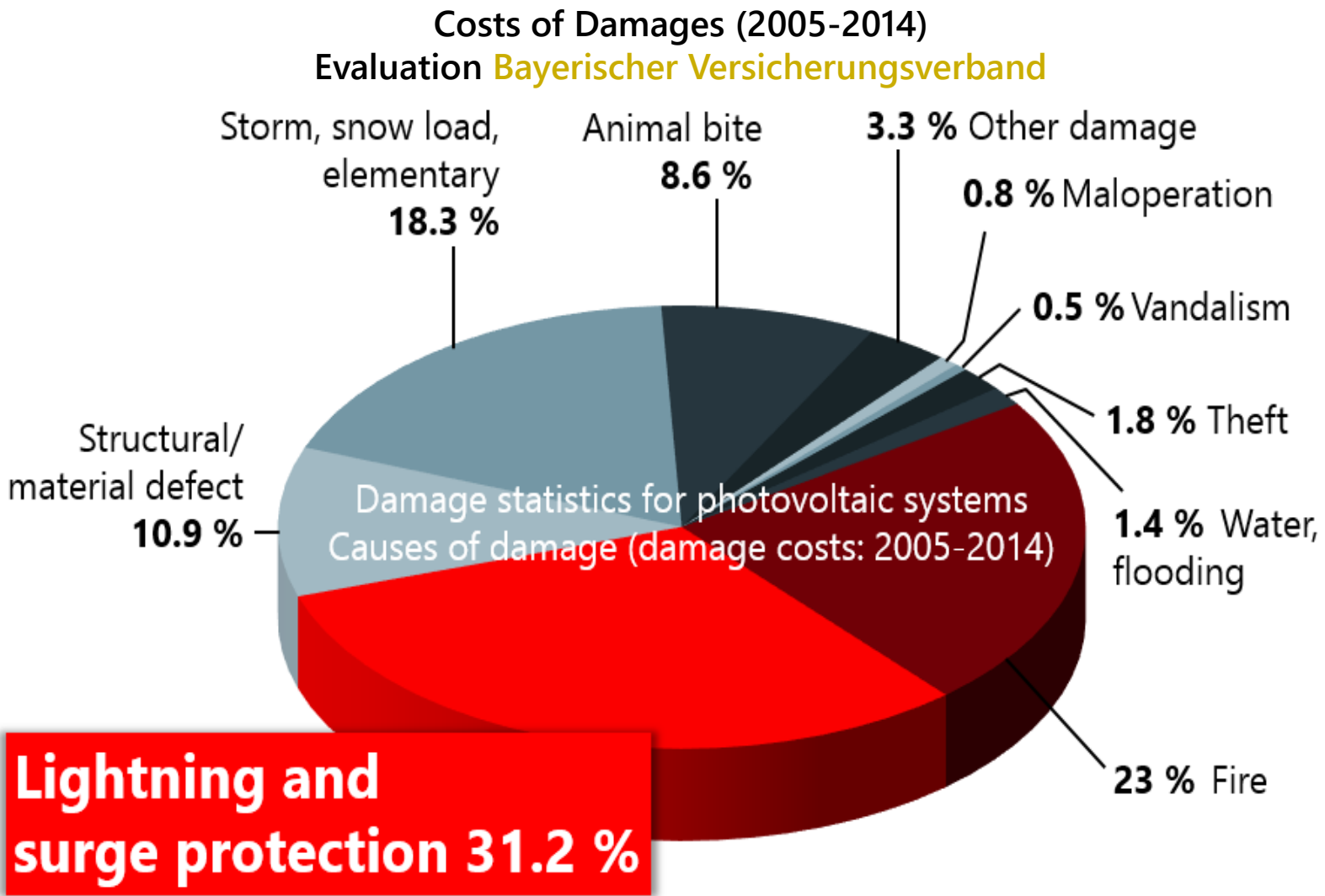


source: Bayerischer Versicherungsverband 2014

South Africa has on average **10 times** more lightning density (strikes/km²)

Damages to small scale solar systems

Damage Statistics – Damages Costs



source: Bayerischer Versicherungsverband 2014



SANS 62305: Part 2

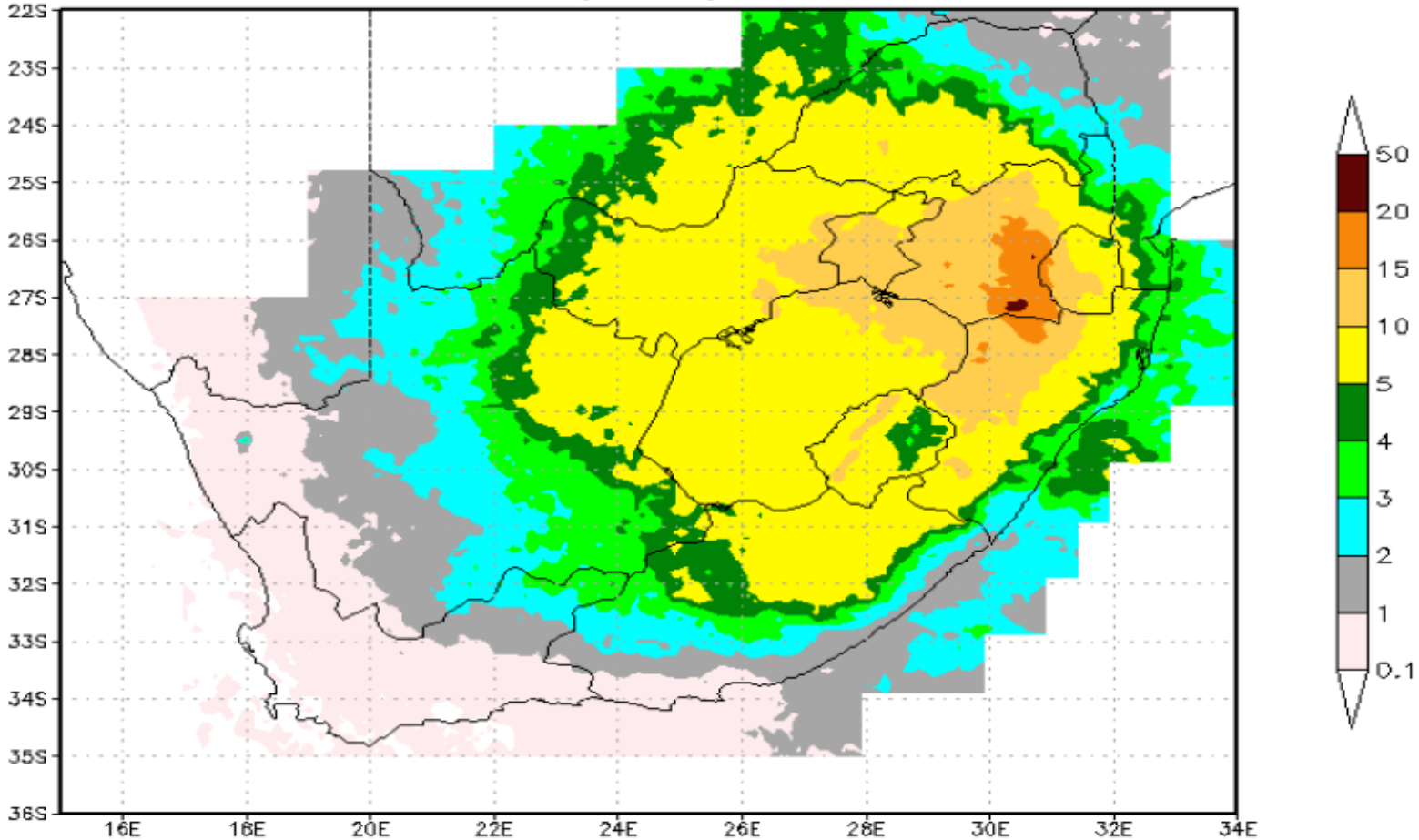
- Tolerable risk values
- Source of damage
- Risk compositions
- Frequency of lightning strikes
- Probability of damage
- Type of losses

Risk Analysis IEC 62305-2

Lightning ground flash density (N_G)



Lightning Ground Flash Density for 2006–2014
Flashes per square km



Damages to small scale solar systems

Reasons why a LPS is required by Owners/Insurers

Detail	Description
Investment (Capital)	> R Millions/Billions
Life time of the plant and equipment	> 20 years
Return on Investment (Business Model)	Linked to kWh output
Downtime due to damaged components	> Time (hrs/days)
Insurance Access payable with every claim	> R 100 k
Insurance premium hikes due to claims	TBD
Breakdown of equipment due to inherent effects	> R xxx
Degradation of equipment and components	> R xxx

➡ Lightning and surge protection measures are essential!

Damages to small scale solar systems

Frequency of the risk of a Lightning Strike in South Africa

Item	Detail
Output (KWp)	500-1MWp
Modules	> 1500
Area (km ²)	0.025
Lightning density (strikes/km ²)	10-13
Total direct lightning events (year)	0.5 - 1
Total indirect lightning events (year)	12 - 16
Total cost of the plant	R 1 – 20 Mil
Total loss as a result of lightning (year) without protection	R xxx



Lightning and surge protection measures are essential!

Standards and Norms

Applicable standards related to small scale solar systems

STANDARDS

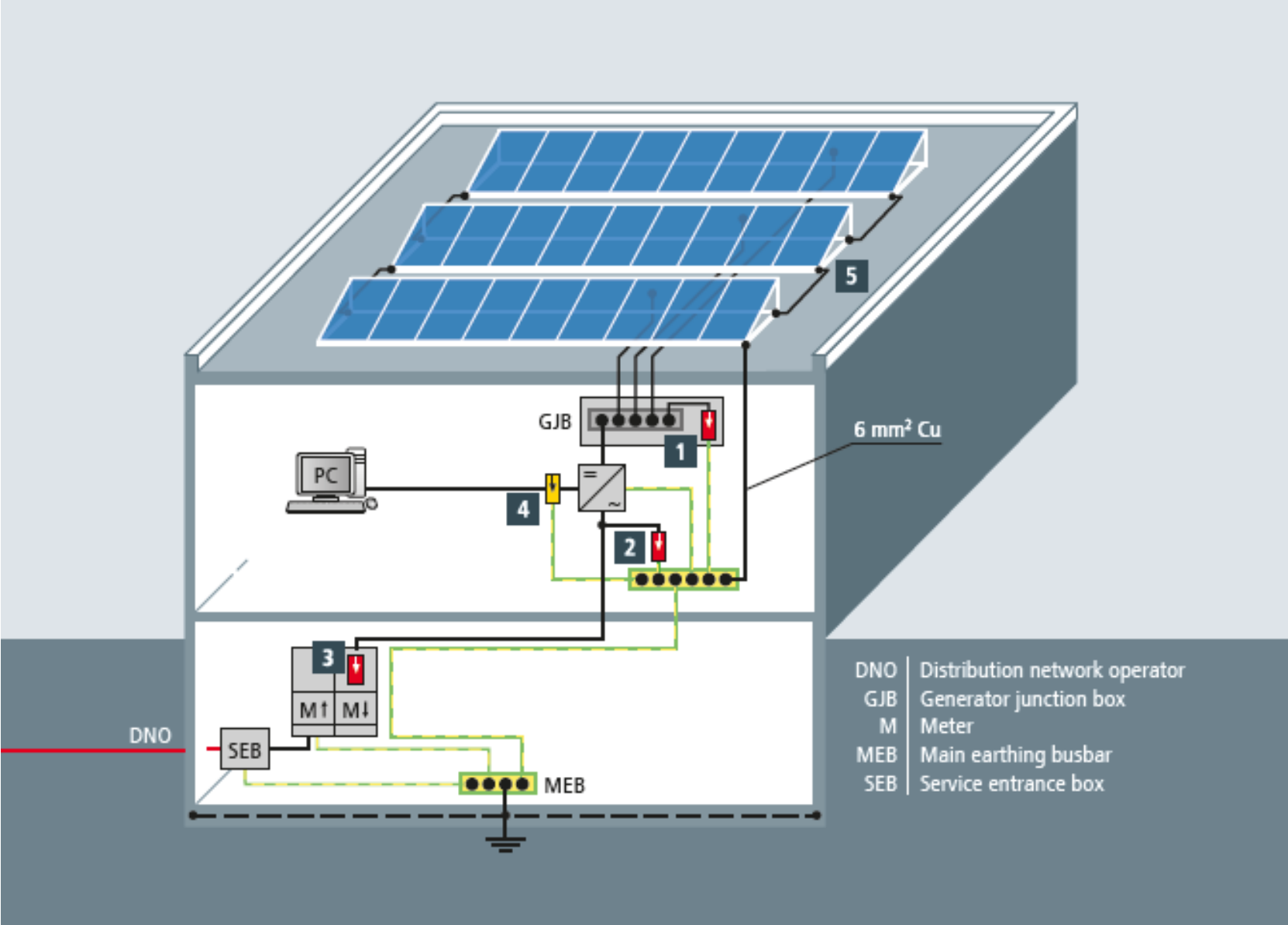
- SANS 10142-1-2**
- SANS 62305 part 1-4
- SANS 10313
- IEC 61643 - 32
- IEC 60364 – 7 - 712
- IEC 60364 – 4 - 44
- IEC 60364 – 5 -53
- IEC 61643 – 11 -12 – 21 - 22



81/262/FDIS	
FINAL DRAFT INTERNATIONAL STANDARD PROJET FINAL DE NORME INTERNATIONALE	
Project number Numéro de projet	IEC 62305-1 Ed. 1.0
IEC/TC or SC / CEI/CE/SC	Secretary / Secrétaire
81	Italy
<input checked="" type="checkbox"/> Submitted for parallel voting in CENELEC Soumis au vote parallèle au CENELEC	Distributed on / Diffusé le
	2005-08-19
Also of interest to the following committees: Intéresse également les comités suivants:	Supersedes document Remplace le document
37 A, 64, 77	81/216/CDDV - 81/237/ARVC
Functions concerned Fonctions concernées	
<input type="checkbox"/> Safety Sécurité	<input type="checkbox"/> EMC CEM
<input type="checkbox"/> Environment Environnement	<input type="checkbox"/> Quality assurance Assurance de la qualité
INTERNATIONAL ELECTROTECHNICAL COMMISSION COMMISSION INTERNATIONALE D'ÉLECTROTECHNIQUE	
THIS DOCUMENT IS A DRAFT IN SUBMITTED FOR APPROVAL. IT MAY NOT BE REPRODUCED OR BE USED IN ANY MANNER WITHOUT THE EXPRESS PERMISSION OF THE COMMISSION.	
IN ADDITION TO THEIR EVALUATION AS REFERENCED ABOVE, THE DRAFT INTERNATIONAL STANDARD MAY BE SUBJECT TO FURTHER REVISIONS IN THE LIGHT OF THE COMMENTS RECEIVED FROM MEMBERS OF THE COMMISSION.	
CE DOCUMENT EST UN PROJET D'ÉTUDE EN COURS D'APPROBATION. IL NE PEUT ÊTRE RÉPRODUIT NI UTILISÉ À DES FINS COMMERCIALES SANS LA PERMISSE EXPRÈS DE LA COMMISSION INTERNATIONALE D'ÉLECTROTECHNIQUE.	
OUTRE LE FAIT D'ÊTRE ÉVALUÉS POUR ÊTRE ACCEPTÉS EN TANT QUE NORMES INTERNATIONALES, LES PROJETS FINAUX DE NORMES INTERNATIONALES PEUVENT ÊTRE SUJETS À DE NOUVEAUX CHANGEMENTS EN VUE DE LA POSSIBILITÉ D'ÉVALUATION ET D'APPROBATION EN VUE DE LA COMMISSION INTERNATIONALE D'ÉLECTROTECHNIQUE.	
Title	
IEC 62305-1 Ed. 1.0: Protection against lightning – Part 1: General principles	
Title	
CEI 62305-1 Ed. 1.0: Protection contre la foudre – Partie 1: Principes généraux	

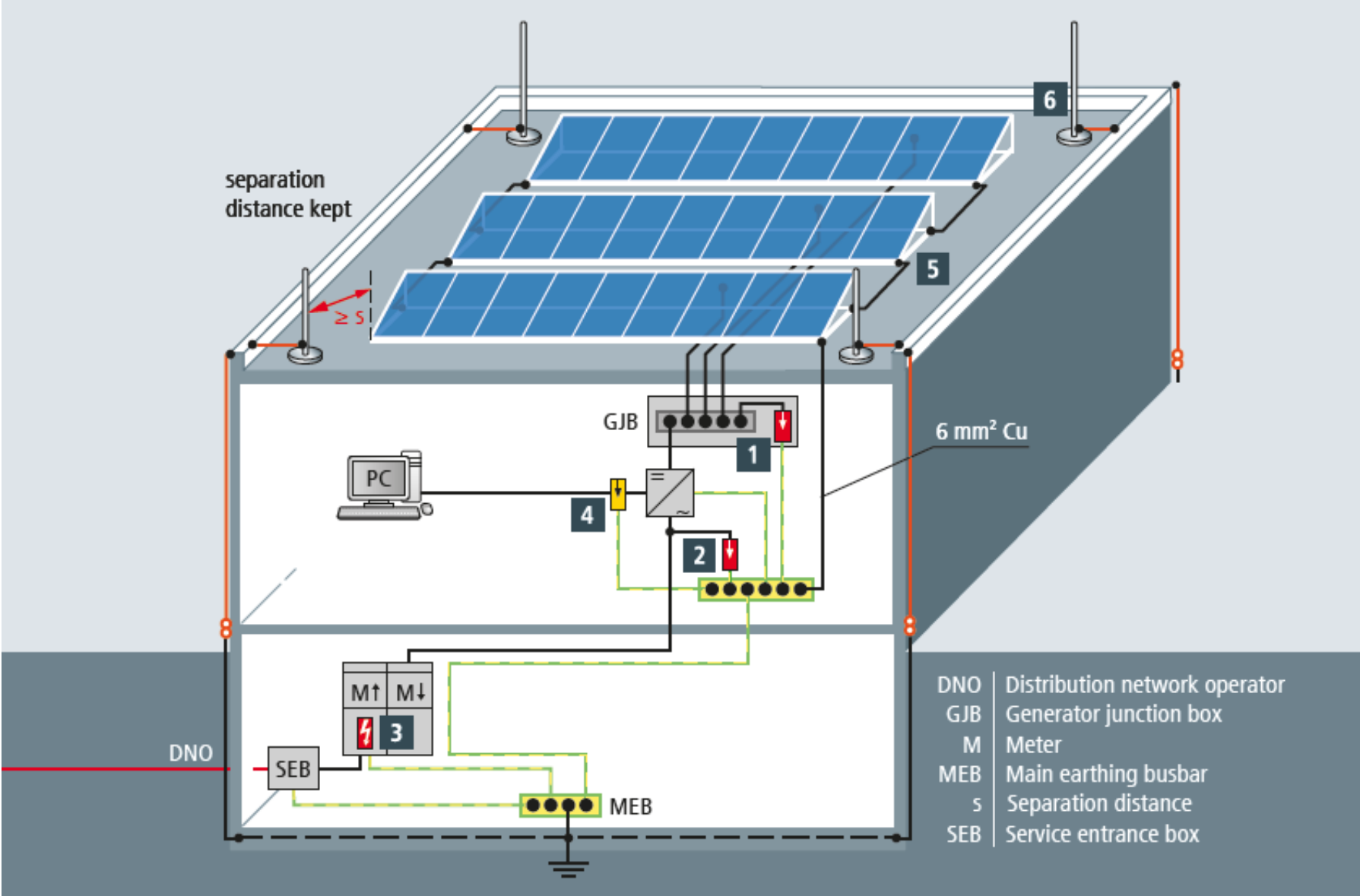
LIGHTNING PROTECTION CONCEPTS

PV system without external lightning protection system



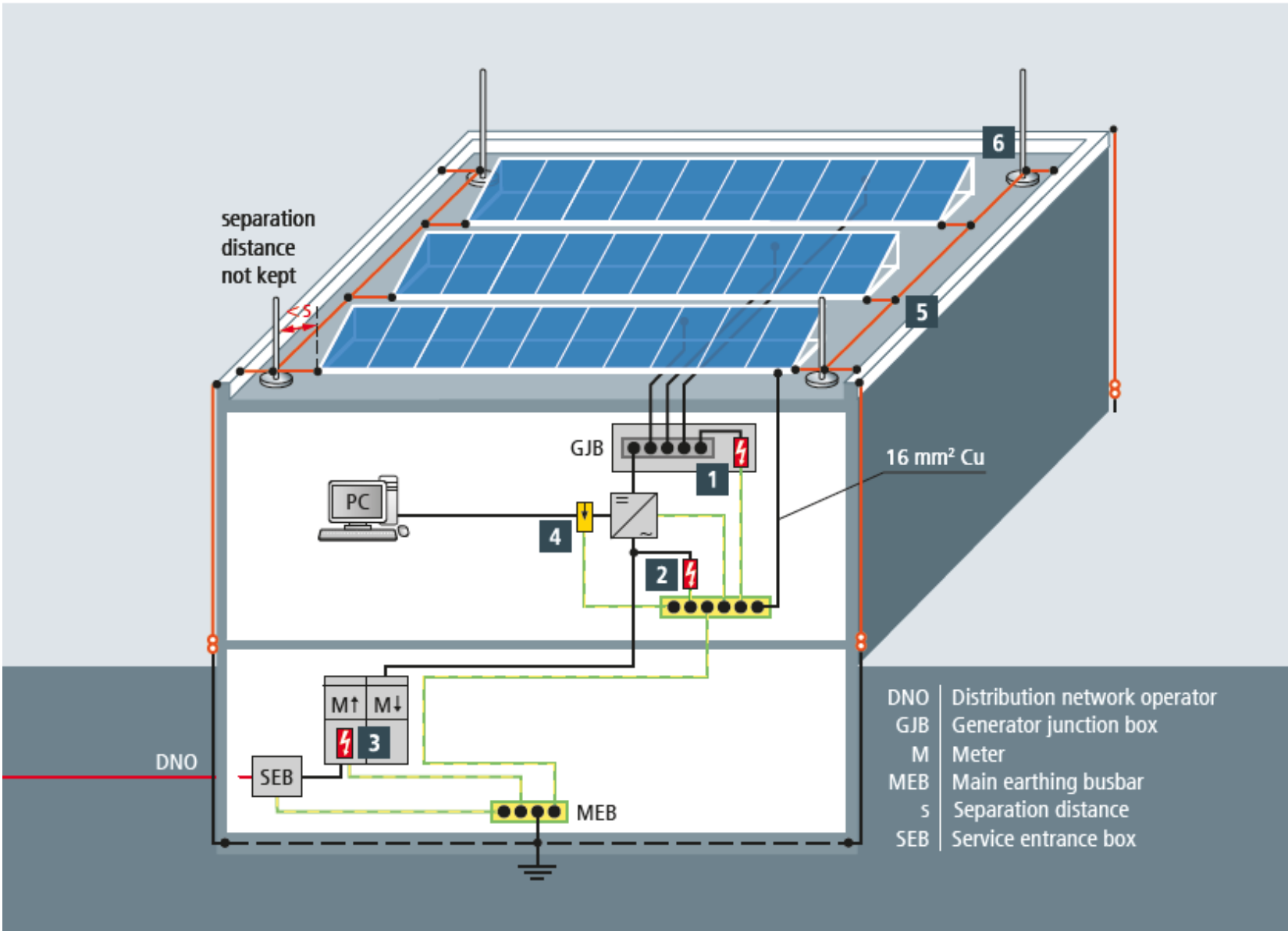
LIGHTNING PROTECTION CONCEPTS

PV system with **ISOLATED** external lightning protection system



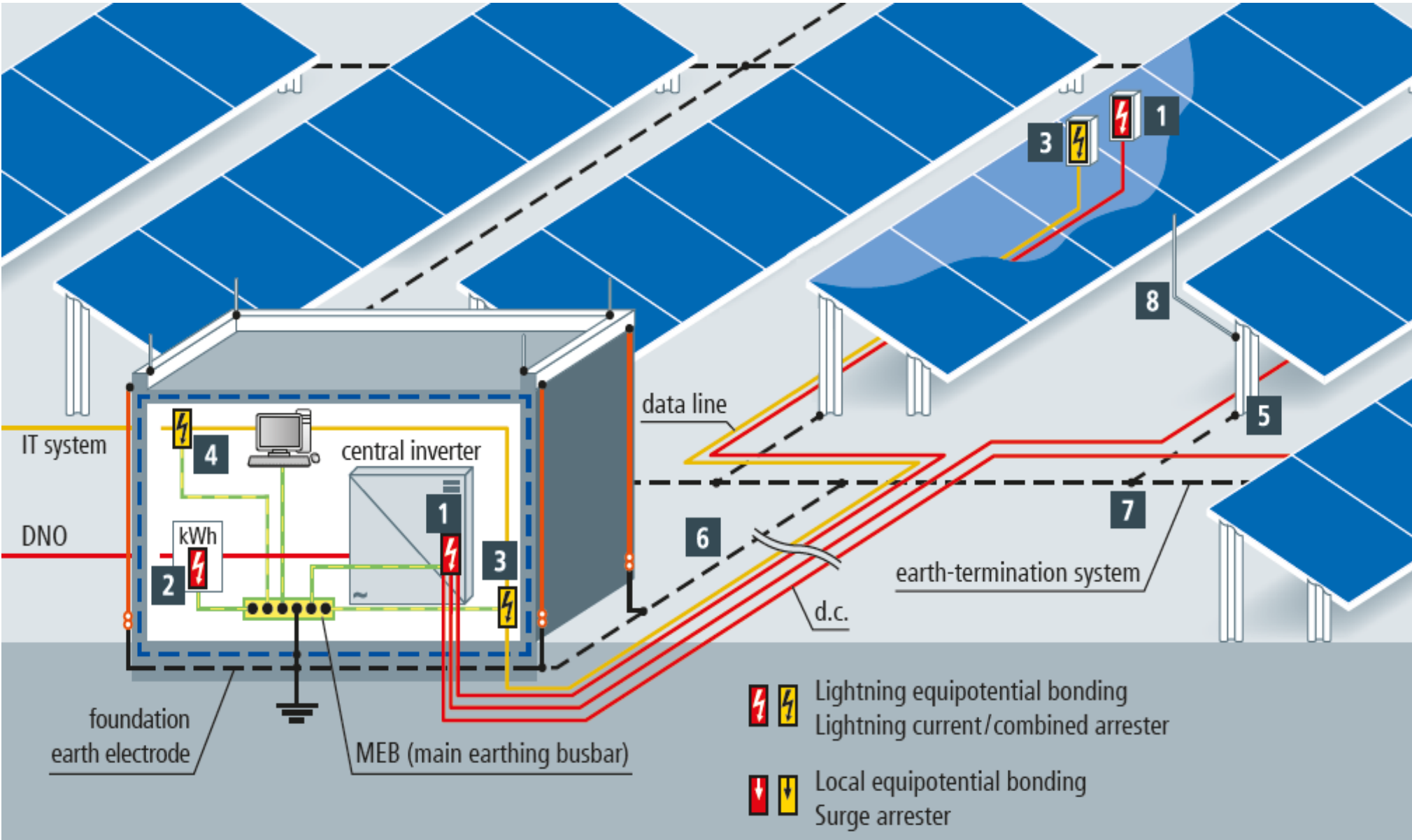
LIGHTNING PROTECTION CONCEPTS

PV system with BONDED external lightning protection system



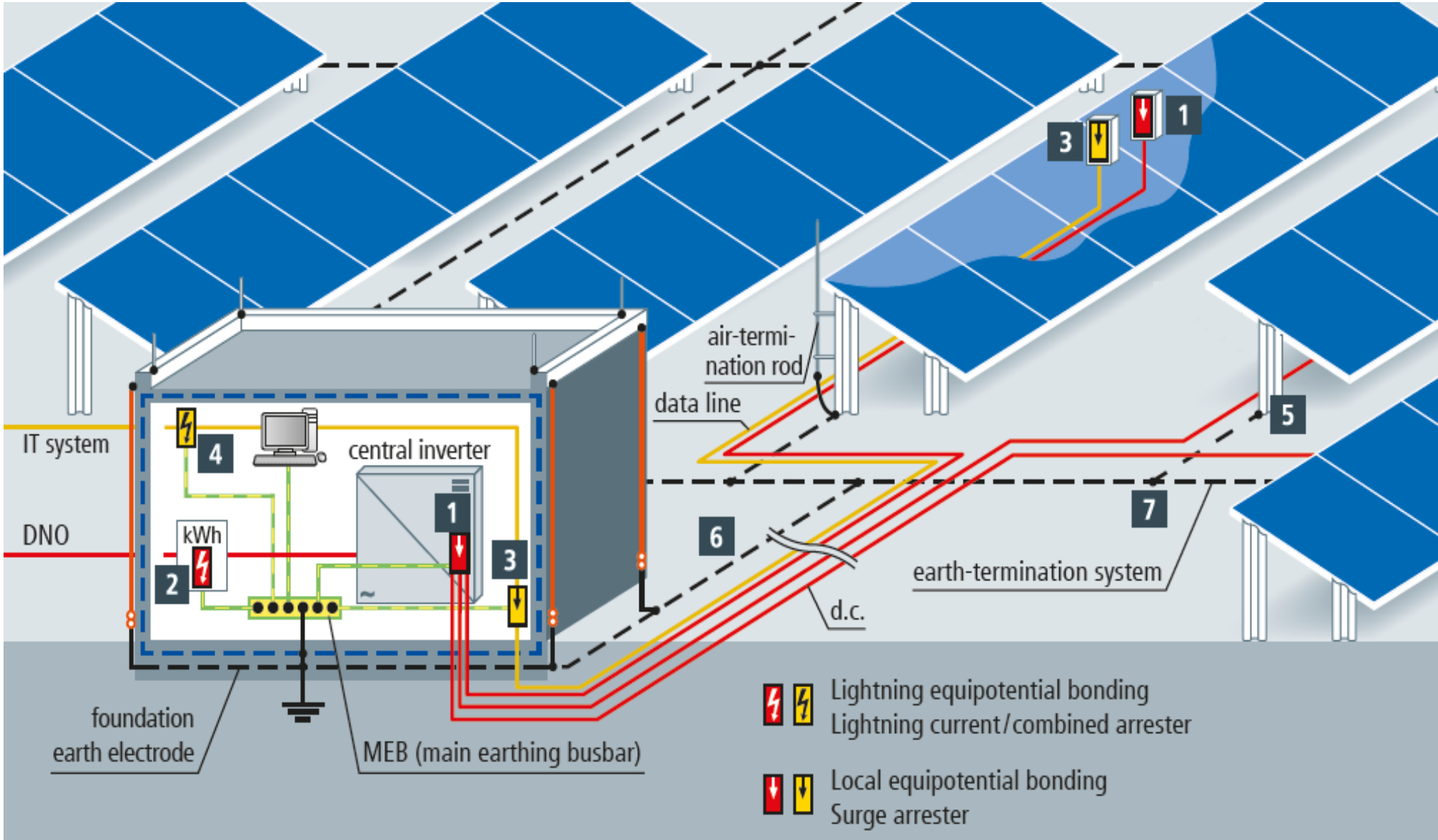
LIGHTNING PROTECTION CONCEPTS





PV system with BONDED external lightning protection system



LIGHTNING PROTECTION CONCEPTS

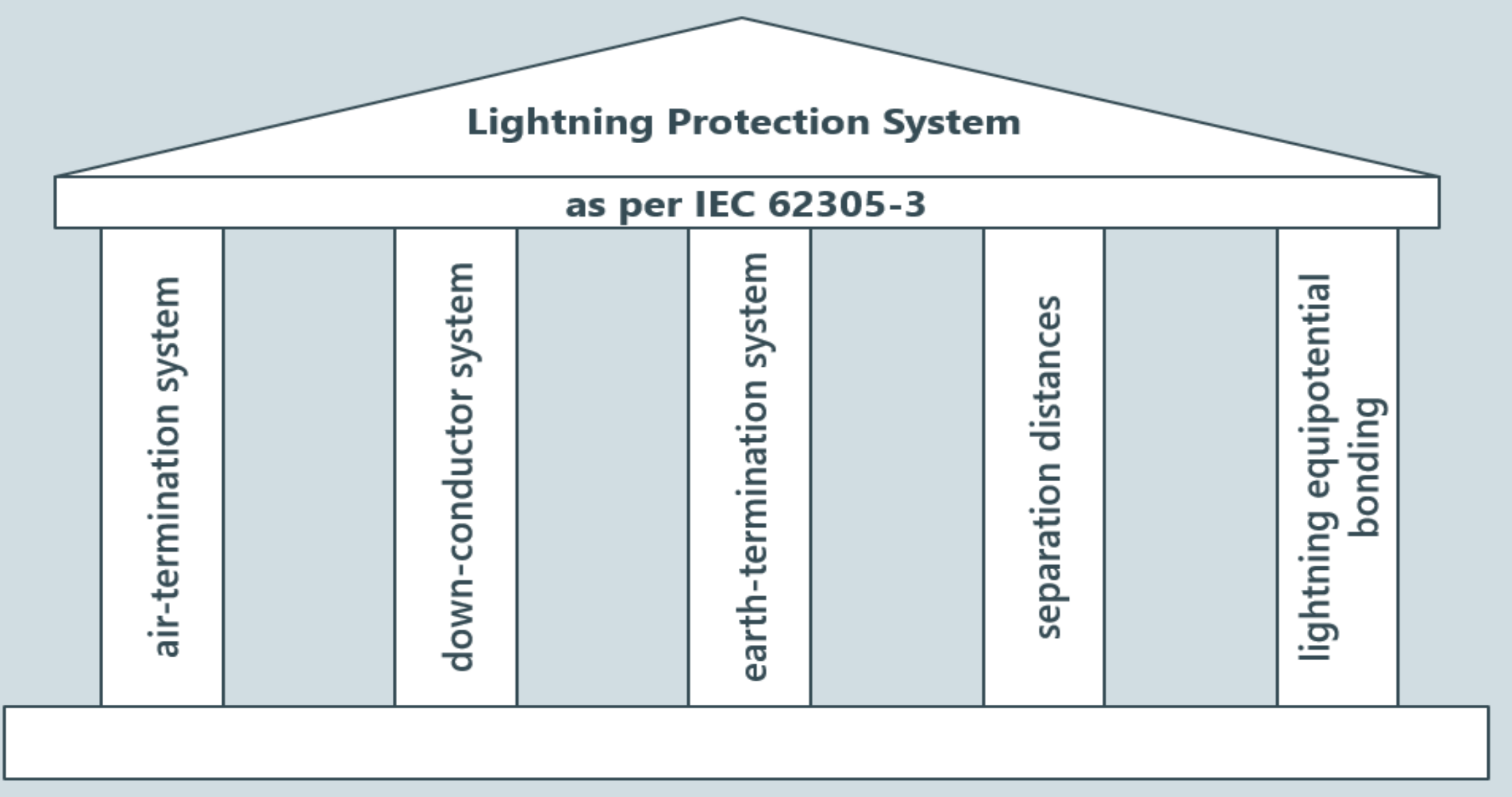
PV system with **ISOLATED** external lightning protection system



-   Lightning equipotential bonding
Lightning current/combined arrester
-   Local equipotential bonding
Surge arrester

LIGHTNING PROTECTION CONCEPTS

PV system with **ISOLATED** external lightning protection system





DEHN protects.

Thank you for
your attention!