

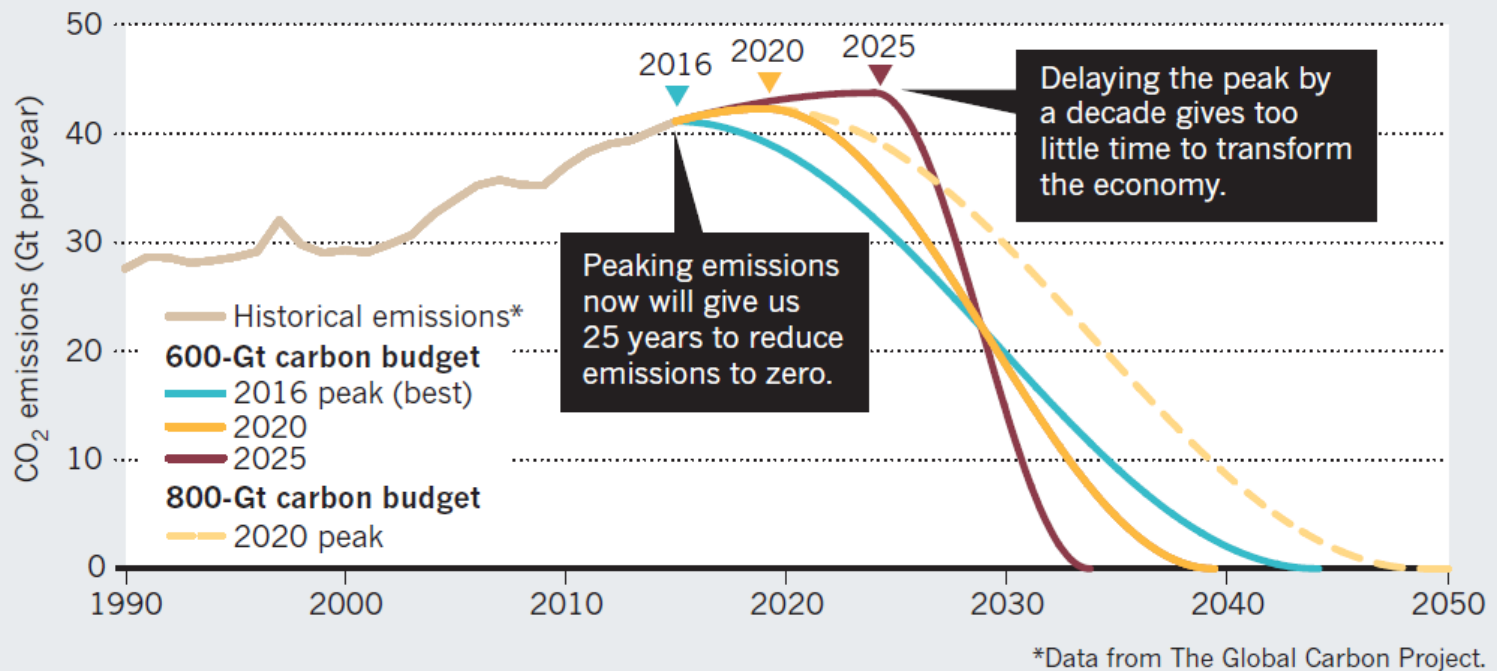
European Network Code Requirements for Generators – update on national implementation in Europe

Why are we here

SOURCES: STEFAN RAHMSTORF/GLOBAL CARBON PROJECT; [HTTP://GO.NATURE.COM/2RCPCRU](http://go.nature.com/2RCPCRU)

CARBON CRUNCH

There is a mean budget of around 600 gigatonnes (Gt) of carbon dioxide left to emit before the planet warms dangerously, by more than 1.5–2°C. Stretching the budget to 800 Gt buys another 10 years, but at a greater risk of exceeding the temperature limit.



Source: Figueres et. All 2017

CLC/TC 8X/WG 03

CENELEC

The European Committee for Electrotechnical Standardization
It is responsible for standardization in the electrotechnical engineering field.

CLC/TC 8X

System aspects of electrical energy supply

CLC/TC 8X/WG 03

Requirements for connection of generators to distribution networks

CLC/TC 8X/WG 03 Scope

Connection criteria to public distribution networks; - protection criteria (control, switching and protection equipment) - safety criteria; - installation criteria

Business fields

RESIDENTIAL



COMMERCIAL



POWER STATIONS



FUEL SAVE



STORAGE SYSTEMS



INDUSTRIAL AND ROLLING STOCK TECHNOLOGY



Product portfolio



PV solutions from single family homes right up to megawatt parks.

Agenda

RfG motivation and structure

Status of national implementation

European standards

- EN 50549 framework and scope
- Correspondence RfG – EN 50549
- How can EN 50549 support RfG implementation in a member state

Conclusion

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RfG motivation and structure

- System split on 4 November 2006
- UCTE Final Report System Disturbance on 4 November 2006 [1]:
 - Same rules for distributed power generation as for large-scale power plants
- Maintaining system stability with increasing distributed power generation
- Improved integration of the European electricity market

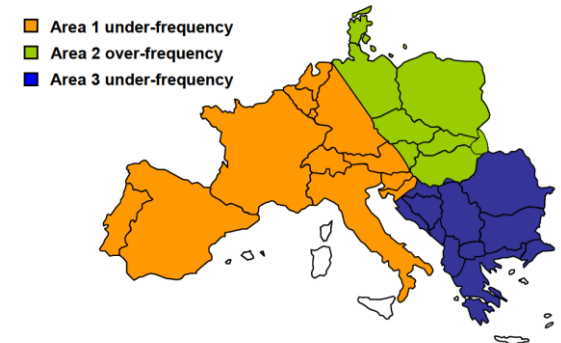


Figure 4: Schematic map of UCTE area split into three areas

Source:[1]

RfG motivation and structure process

- Commission passes (EC) 714/2009 – Art. 8 (7) : Creation of a network code applied for “cross-border network issues and market integration issues”
- ENTSO-E creates network code
- Comitology process in European parliament
- Commission issues code as regulation (EC) 631/2016
 - Issued April 14th 2016,
 - Enter into force April 27th 2016
- EU Regulations are immediately applicable in all member states
- Non-exhaustive requirements depend on national implementation

RfG motivation and structure

Dates

- Issued April 14th 2016,
- Enter into force April 27th 2016
- National implementation (submit of TSO proposal) until April 27th 2018
- National decision regarding national implementation November 27th 2018
- Application of RfG April 27th 2019

RfG Motivation and Structure

- **TITLE I GENERAL PROVISIONS**
 - Requirements discriminate by size of plant and technology
- **TITLE II REQUIREMENTS**
 - Technical requirements
- **TITLE III OPERATIONAL NOTIFICATION PROCEDURE FOR CONNECTION**
 - Connection and application process
- **TITLE IV COMPLIANCE**
 - Requirements on compliance assessment and monitoring
- **TITLE V DEROGATIONS**
- **TITLE VI TRANSITIONAL ARRANGEMENTS FOR EMERGING TECHNOLOGIES**
- **TITLE VII FINAL PROVISIONS**

ENTSO-E Network Code content for distributed power generation

■ Frequency

- Behaviour in the event of overfrequency (power reduction)
- Behaviour in the event of underfrequency (power maintenance for A+B, power increase C+D)
- Power restriction (also remote control)
- Defined connection conditions

■ Robustness

- Insensitivity to voltage dips
- Stability in the event of frequency fluctuations ($\Delta f/dt$)

■ Voltage

- Dynamic grid support (in the event of grid faults)
- Static grid support (normal operation)

Transmission system aspects not yet covered in RfG

- Robustness to voltage swells (OVRT),
- Robustness to voltage dips (UVRT) for type A generators,
- LFSM-U requirement for Type A and B and for EESS (Electrical Energy Storage Systems) (EESS is excluded from scope of RfG)

Distribution System aspects not covered in RfG

RfG is focused on the transmission system, DSO requirements must be covered separately

- Connection scheme and coordination of switch gear,
- voltage operation range (for type A and B),
- reactive power capabilities and control modes (for type A and B),
- interface protection (for type A and B) and anti-islanding function,
- generation curtailment,
- requirements to electrical energy storage systems (EESS),
- requirements to generating plants below 800 W.

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Status on national implementation

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- 35 countries are currently implementing RfG on national level
- AL, AT, BA, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, ME, MK, NL, NO, PL, PT, RO, RS, SE, SI, SK
- ETNSO-E is monitoring national implementation in an open active library
 - Linked to the Grid Connection Stakeholder Committee
 - <https://docs.entsoe.eu/cnc-al/> [2]

Example of Implementation

AT:

- Implemented in legal act

BE:

- Implemented in a TSO publication (Synergrid C10/11)

DE:

- Implemented in VDE-Standards VDE-AR-N 4100, 4105, 4110, 4120, 4130

GB:

- Implemented in ENA EREC G99 and ENA EREC G98 (LV/MV)
- Implemented by National Grid in The Grid code Issue 5 rev 27 2018/10/04 (HV/EHV)

Example of Implementation LFSM-O in example countries

Country	Limited Frequency Sensitive Mode – Over frequency (LFSM-O) [Art. 13-2 (a-g)]		
	Requirement Droop	Threshold	Delay
RfG definition	2% to 12%		
Austria	5%	50.2 Hz	none
Belgium	5%	50.2 Hz	none
Germany	5%	50.2 Hz	none
Denmark	CE: 5 % (SPG/PPM) N: 4 % (SPG/PPM)	CE: 50,2 Hz N: 50,5Hz	none
France	5%	50.2 Hz	<2 s
Netherlands	5%	50.2 Hz	none
Spain	5%	50.2 Hz	none
Italy	2.6%	50.2 Hz	None
UK	10%	50.4 Hz	<2 s
Ireland	4%	50.2 Hz	none

Source: [3]

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European standards

- RfG Recital (27)
 - Established technical standards should be taken into particular consideration in the development of connection requirements.
- RfG Article 7 Regulatory aspects
 - 3. When applying this Regulation, Member States, competent entities and system operators shall:
 - 3. (f) take into consideration agreed European standards and technical specifications.
- Until today no agreed European standard is published, applicable and taking into account RfG
- EN 50549-1 / 50549-2 is ratified,
 - Date of availability 2018-12-21

- EN 50549-1: Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network – Generating plants up to and including Type B
 - Date of availability 2018-12-21
- EN 50549-2: Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network – Generating plants up to and including Type B
 - Date of availability 2018-12-21
- Planned Project:
 - EN 50549-10: Requirements for generating plants to be connected in parallel with distribution networks – Part 10 Tests demonstrating compliance of units

Framework and scope

- EN 50549 is written to be compliant and used in conjunction with COMMISSION REGULATION 2016/631 (RfG)
- EN 50549-1 and -2 cover all technical (essential) requirements (Title II) of RfG applicable for type A and type B generating modules and as such will support technical requirements of RfG
- EN 50549-10 (in development) will cover tests to provide compliance with requirements of part 1 and part 2 and as such will support the compliance procedures (Title IV) of RfG
- EN 50549 series does not address
 - general requirements and type thresholds (Title I)
 - procedures (Title III)
 - derogation, classification as emerging technology (Title V to VII)

Framework and scope

- All RfG articles of Title II relevant for type A and type B generating modules correspond to clauses in EN 50549 part 1 and 2
 - EN 50549 clauses provide requirements being
 - detailed
 - exact
 - verifiable
 - standardized applicable all over Europe
 - EN 50549-1 and -2 clauses provide configurability of functions to allow all flexibility of RfG by maintaining verifiability
 - EN 50549-10 clauses will support conformity assessment to provide evidence of conformity

EN 50549 intends to include all capabilities of generating plants necessary to operate generating plants in parallel to distribution grids

- Therefore EN 50549-1 and -2 provides requirements needed for distribution grid management which are beyond the scope of RfG:
 - Connection scheme and coordination of switch gear,
 - voltage operation range (for type A and B),
 - reactive power capabilities and control modes (for type A and B),
 - interface protection (for type A and B) and anti-islanding function,
 - generation curtailment,
 - requirements to electrical energy storage systems (EESS),
 - requirements to generating plants below 800 W.

EN 50549 intends to include all capabilities of generating plants necessary to operate generating plants in parallel to distribution grids

- Therefore EN 50549-1 and -2 provides requirements needed for the stability of the interconnected system not (yet) included in RfG:
 - Robustness to voltage swells (OVRT),
 - Robustness to voltage dips (UVRT),
 - Recommended also for type A generators,
 - LFSM-U requirement,
 - explicitly required for EESS (Electrical Energy Storage Systems),
 - recommended for all other generating modules.

EN 50549-1 and -2 scope excludes aspects of system integration:

- Selection of point of connection,
 - power system impact assessment e.g. assessment of effects on power quality, local voltage increase, impact on line protections operation,
 - connection assessment, the set of technical verifications made as part of the planning of the connection.
-
- These issues depend on the structure of the distribution grid and the management procedures of the DSO.

Annex C and H provide an overview over all described functions and the relevance in view of RfG

■ Annex C

- lists all parameters providing flexibility in the clauses and typical ranges,
- might be used as a template to publish national parameters.

■ Annex H

- is structured similar to a CENELEC Annex ZZ,
- provides a clear overview which Articles of RfG are covered in the Standard.

Generating plants compliant with the clauses of this European Standard are considered to be compliant with the relevant Article of COMMISSION REGULATION (EU) 2016/631, provided, that all settings as provided by the DSO and the responsible party are complied with.

Correspondence RfG – EN50549

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- Annex H provides a clear overview which Articles of RfG are covered in the Standard

<i>Article</i>	Clause(s) / subclause(s) of this EN
13.1(a)	4.4.2 Operating frequency range
13.1(b)	4.5.2 Rate of change of frequency (ROCOF) immunity
13.2	4.6.1 Power response to overfrequency
13.3	4.4.3 Minimal requirement for active power delivery at underfrequency
13.4	4.4.3 Minimal requirement for active power delivery at underfrequency
13.5	4.4.3 Minimal requirement for active power delivery at underfrequency
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How can EN 50549 support RfG implementation in a member state

Generating plants of type A and type B
are mass market products

- Example: In Germany more than 1,6 Million PV plants have been installed within the last 15 years.
- Standardised requirements and compliance procedures **are of high importance.**

Standardisation allows efficient
procedures for

- generating unit manufactures,
- generating plant developers,
- distribution system operators.

How can EN 50549 support RfG implementation in a member state

- EN 50549 is applicable for type A and B generating modules (mass market)
- EN 50549-1 and -2 support the essential requirements of RfG (Title II)
- EN 50549 -1 and -2 can be used as reference documents for the national implementation
 - EN 50549 -1 and -2 can be referenced by national documents clause by clause or as complete standard
 - If needed, parameters can be specified according RfG and used in EN 50549
 - Annex C can be used as template to publish national specification of non-exhaustive requirements
- EN 50549-10 will support compliance process once in place

Conclusion

- RfG shall be applied starting April 27th 2019
- National implementation is still ongoing, majority of member states will publish implementation until November 27th 2018
- EN 50549 is written to be compliant and used in conjunction with COMMISSION REGULATION 2016/631 (RfG).
- EN 50549 intends to include all capabilities of generating plants necessary to operate generating plants in parallel to distribution grids, therefore goes beyond the scope of RfG.
- As RfG does not foresee the support of harmonized standards, support to RfG depends on national implementation of RfG.
- EN 50549 -1 and -2 can be used as reference documents for the national implementation.
- EN 50549-1 and -2 is expected to cover most national implementations for type A and B

- [1]:
Union for the co-ordination of transmission of electricity: Final Report System Disturbance on 4 November 2006
https://www.entsoe.eu/fileadmin/user_upload/_library/publications/ce/otherreports/Final-Report-20070130.pdf access Oct 17th 2018
- [2]:
ENTSO-E homepage <https://docs.entsoe.eu/cnc-al/> access Oct 17th 2018
- [3]:
Bründlinger et. all.: Implementation of the European Network Code on Requirements for Generators on the European national level. 8th Solar integration workshop 2018



Thank you for your attention!

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