

LFDD Information slide deck for industrial Grid Users

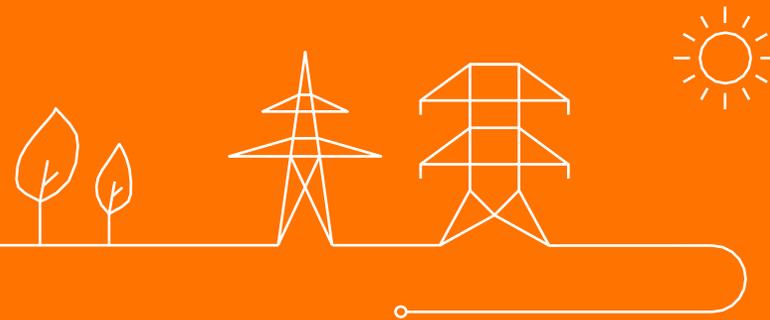
Low Frequency Demand Disconnection

Latest update: 19/03/2024

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Introduction



Context

- Increasing renewables in DSO grids lower the netted demand that can be disconnected in case of a frequency collapse in the European electric grid.
- Elia does not meet the LFDD requirements of the EU netcode E&R¹
- Elia identified multiple actions to get compliant with the EU legislation.
- The LFDD plan is part of the System Defense Plan that was submitted for approval on 6/10/23 to the Minister of energy.
 - These slides are under assumption that the Minister will approve the system defense plan, which was not yet the case at the moment of this presentation
 - Meanwhile, on 25/1/24 Elia was informed that the Minister has approved Elia's System Defense plan and Restoration Plan



¹ E&R = Emergency and Restoration

Load shedding plan in case of scarcity:

- There is sufficient time to prepare
- Minimize social and economic impact
- Detailed procedure prepared by stakeholders

There is **no need to change** this plan



LFDD plan:

- Technical: system-protection against frequency collapse should work fast and effectively at all times
- Legal: LFDD volume should comply with EU legislation
- Lowest possible social and economic risks
- Transparency for the next 5 years
- Long term strategy beyond 2027

We must **adjust this plan** to protect our system and comply with EU rules

Load shedding

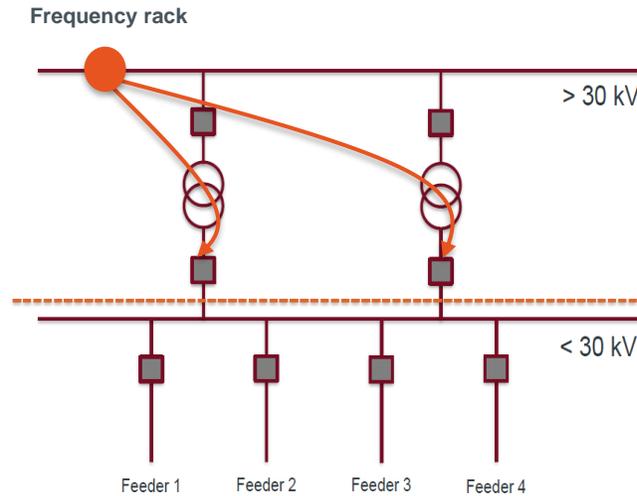
→ last resort measure = very rare activations

→ Significant impact, but much less severe compared to a full-scale black-out

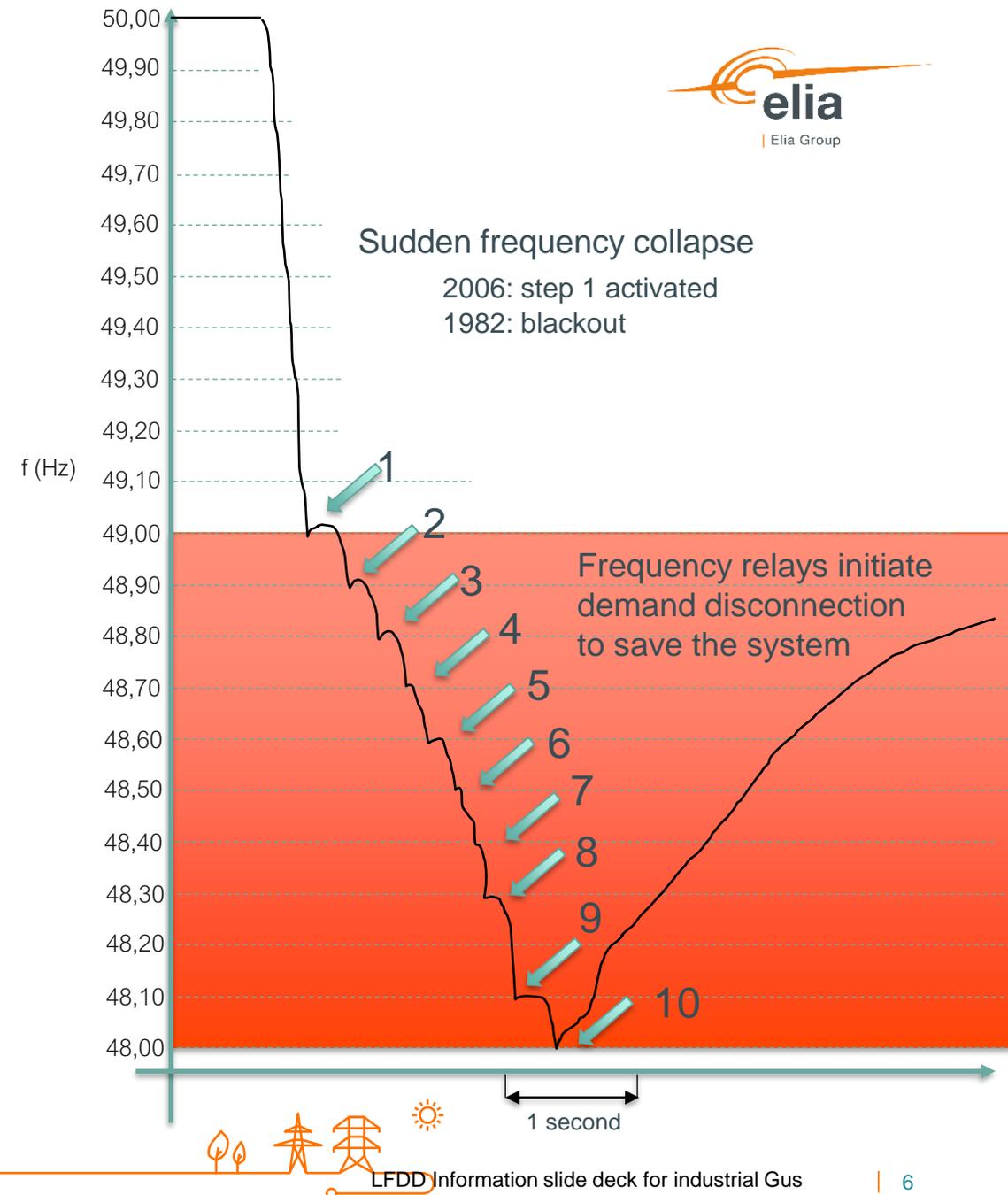


Recap of issue with LFDD plan

- Automatic defence measure of last resort to avoid total black-out
- Low-frequency demand disconnection relays are installed over the Belgian territory.
- So far in mainly “rural” communities in DSO grids → 253 substations in 10 steps



- Manual load shedding plan is not subject of this discussion!

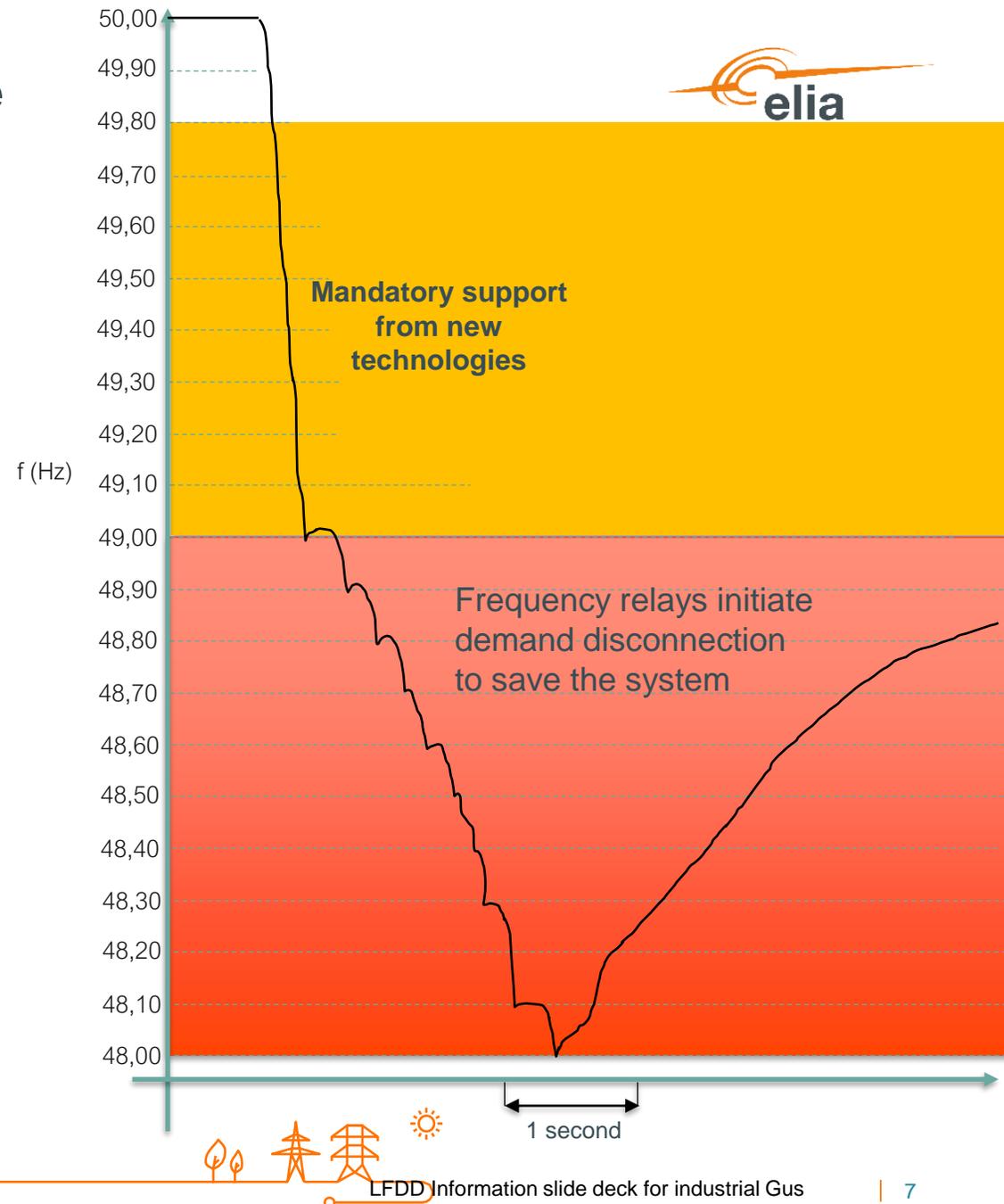


Evolutions in (draft updated) European Network code on Demand Connection

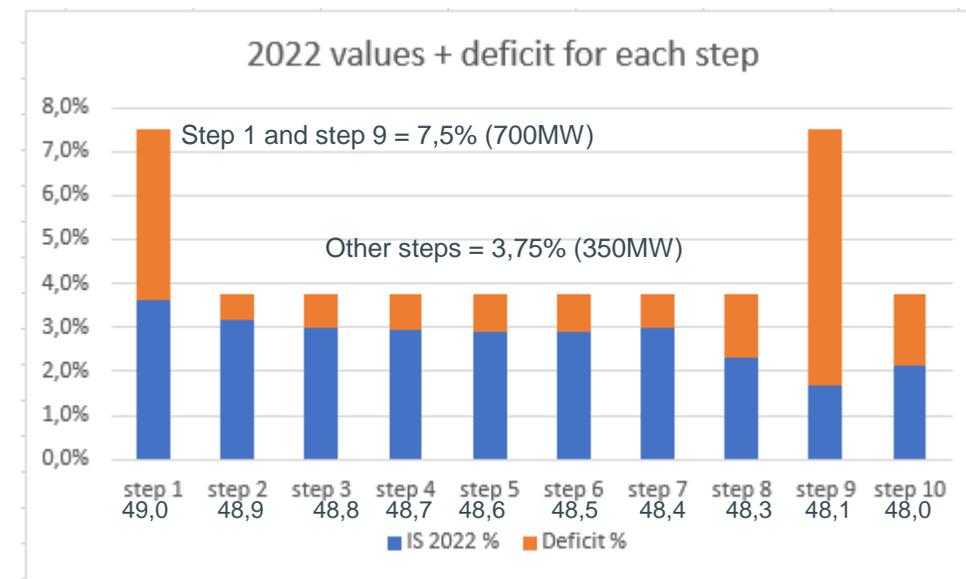
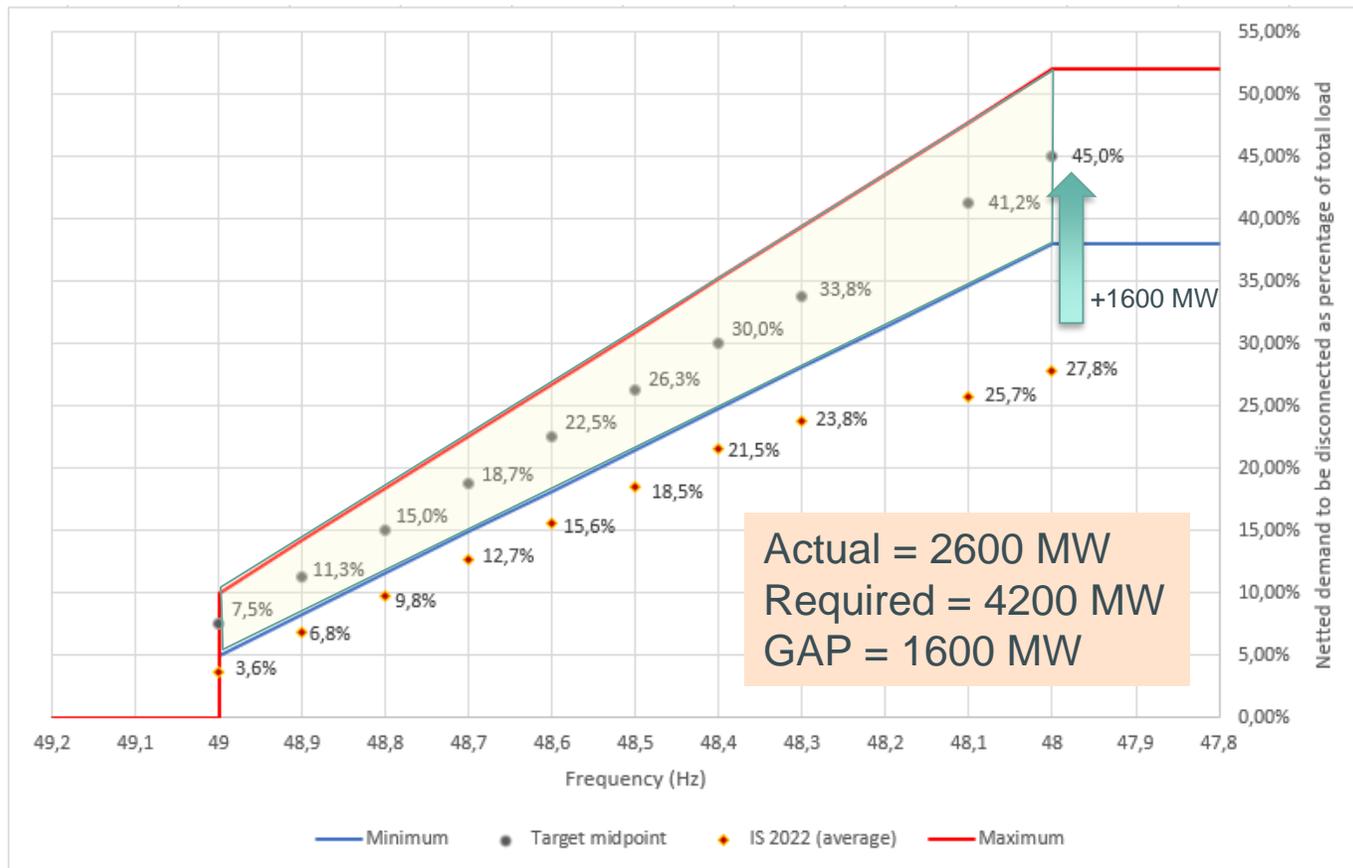
- New technologies (batteries, EV, P2G, heat pumps) should support the frequency in the emergency range ($f < 49,80$ Hz) before the first load-shedding at $f = 49,0$ Hz
- Aim is to minimize risks of triggering LFDD and minimize the consequences !
- We follow up the evolutions in EU legislation !

(17) Frequency-related requirements should support the stable operation of the energy system which is being transformed to accommodate the green transition. In the future, the effectiveness of existing low frequency demand disconnection (LFDD) schemes is expected to be reduced due to the increased penetration of distributed generation. Therefore, a new limited frequency sensitive mode for various demand units (LFSM-UC) is being introduced to account for these changes. Furthermore, V1G electric vehicles and associated V1G electric vehicle supply equipment, such as V1G, power-to-gas demand units and heat-pumps are usually technically capable to fulfil such a requirement without negative consequences for the grid user.

LFSM-UC should support the frequency in an emergency case so that LFDD schemes in the best case are not even triggered and no critical demand would be disconnected.

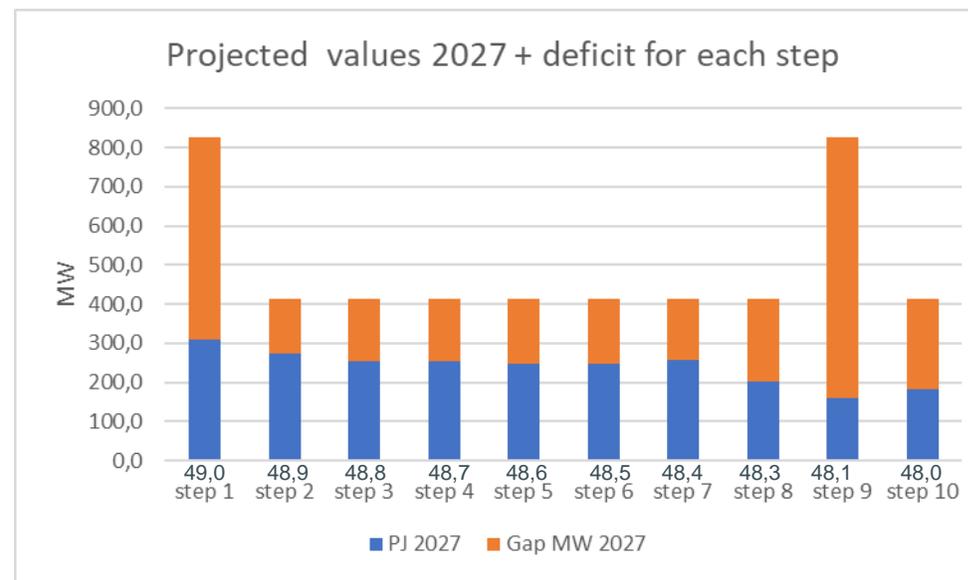
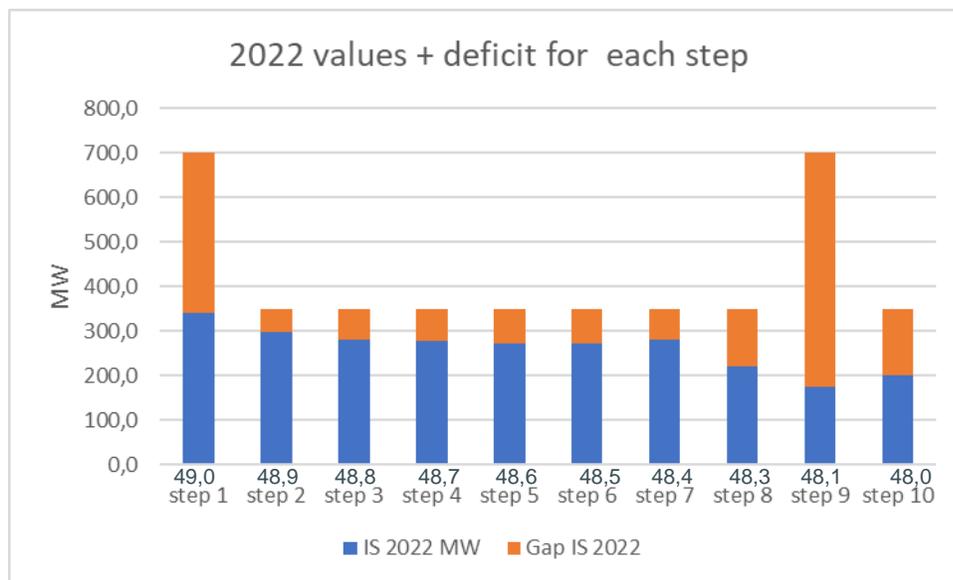


Gap analysis for each step based on monitoring 2022



LFDD plan: target and gap in 2027

The actual LFDD plan (blue bars in left figures) will further decay to from 2.6 GW in 2022 to 2.4 GW in 2027. In DSO grids, more electrification will be over-compensated by more RES



By 2027 the LFDD plan should include 5 GW (= 45% of 11 GW). Conclusion: **2600 MW additional volume** must be included in the LFDD plan by 2027

Elia proposed multiple actions in parallel to increase the LFDD volume

- Add remaining substations in rural and urban areas (DSO grids) except from large city centers.
- Accelerate **selective load shedding** with flow sense detection and **blocking of reverse flows** in DSO grids.
- Remove rural substations with dominant **reverse flow**
- Add **industrial** load
- Call for reasonable LFDD targets in **EU legislation** and make use of **new technologies** to minimize LFDD action

Elia's objective is to comply with the EU Netcode with minimum societal and economic impact

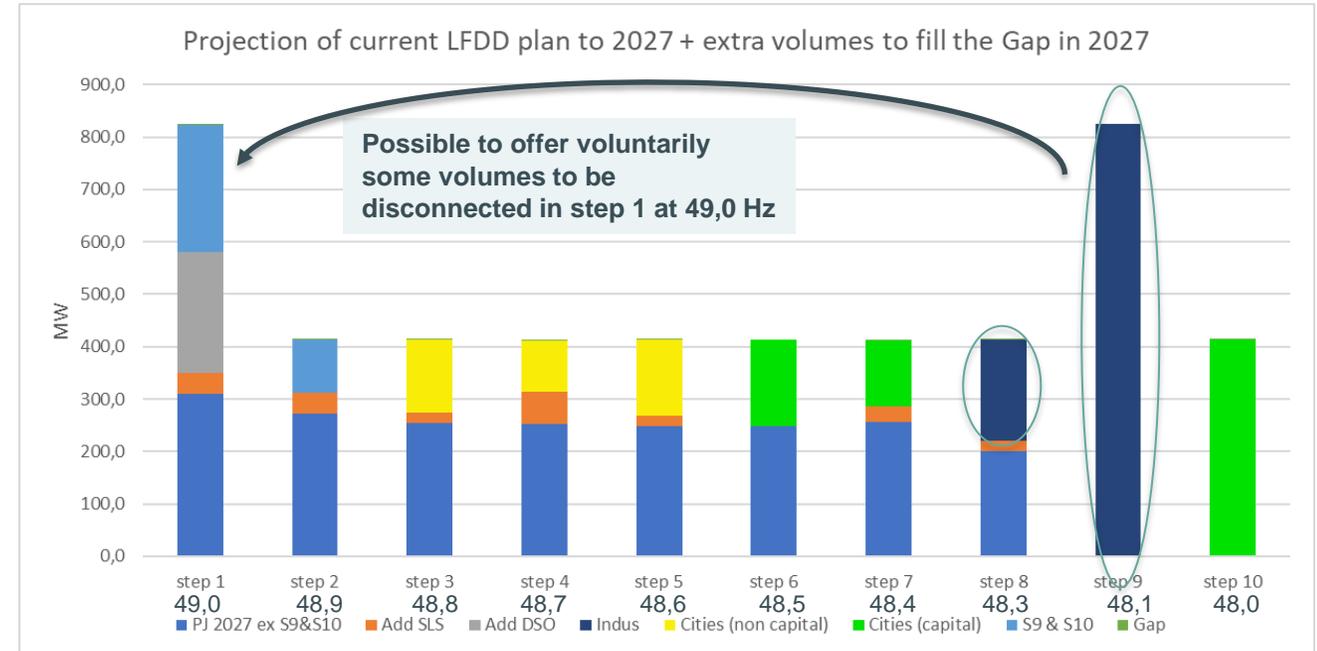
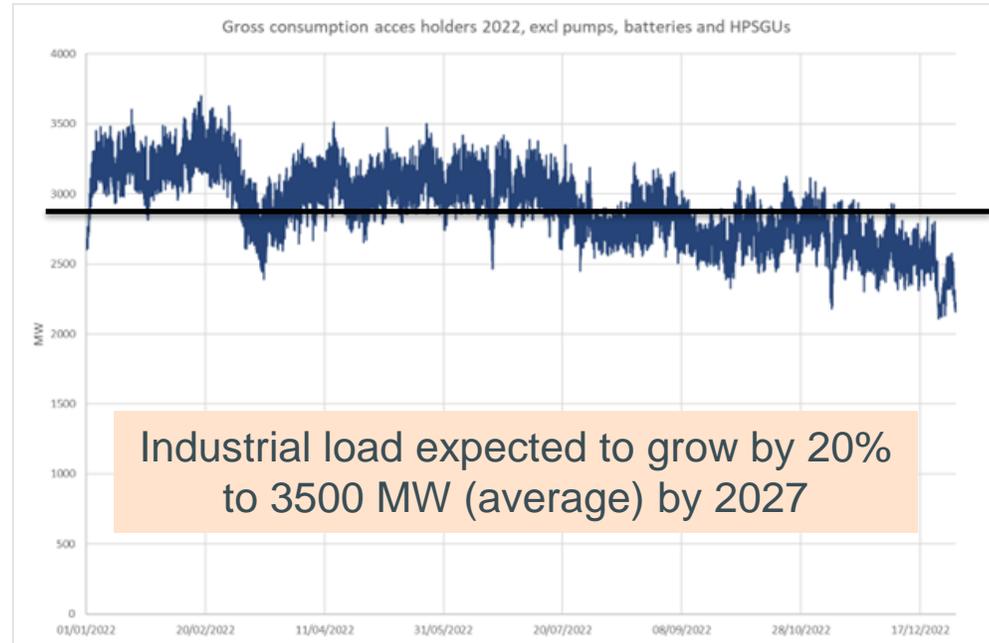


Demand facilities and closed distribution systems in steps 8 & 9

Equal burden sharing between 2 new entities: cities and industry

Remaining gap: **1017 MW**: 192 MW in step 8 and 825 MW in step 9

Load profile industry (2022)



Nuclear sites, Fluxys and Infrabel are excluded from load shedding

**30% of gross consumption must be interruptible in 2 steps:
6% in step 8 and 24% in step 9 + possible to pass obligation to another grid user.**



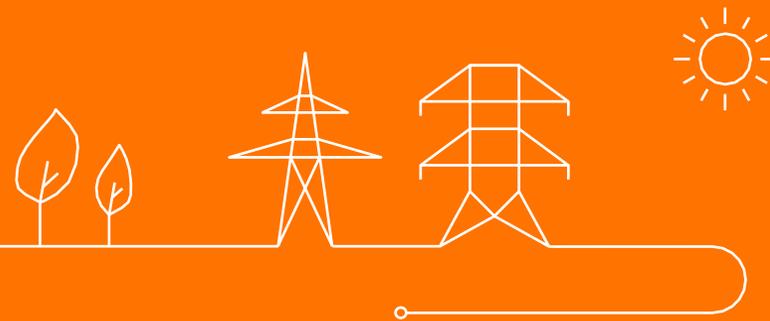
LFDD Groups are allowed

		Gross cons (MW)	30% of Gross cons (MW)	step 8	step 9
	frequency Hz			48,3	48,1
	allocation per step			6%	24%
Individual disconnection	GU1	185	56	11	44
	GU5	150	45	9	36
	GU4 (part of CDS 1)	160	48	10	38
	CDS 2	85	26	5	20
LFDD group 1	GU2	125			
	GU3 (part of CDS 1)	200			45
	GU6	125		100	
	GU7	300		35	45
	Total Group 1	750	225	45	180
LFDD group 2	GU8	240		100	
	GU9 (part of CDS 1)	250		85	
	GU10	240			
	GU11	300			124
	Total Group 2	1030	309	62	247
	Total all GU	2360	708	142	566

- LFDD grouping allows different grid users to cluster their LFDD obligations
- This allows individual industrial grid users to pass their LFDD obligation fully or partially to one or more other industrial grid users.
- The precise number of f-cubicles to be installed is still uncertain and depends on LFDD groups composition
- **Each individual grid user informs Elia by 30/06/2024 about:**
 - Implementation as individual or group member
 - Contribution to LFDD group (% and steps)

An annex including the individual contributions of the corresponding LFDD group members, signed by all group members and Elia, will be added to the **connection agreement** of the individual group members → **this is subject to later approval of the connection agreement**

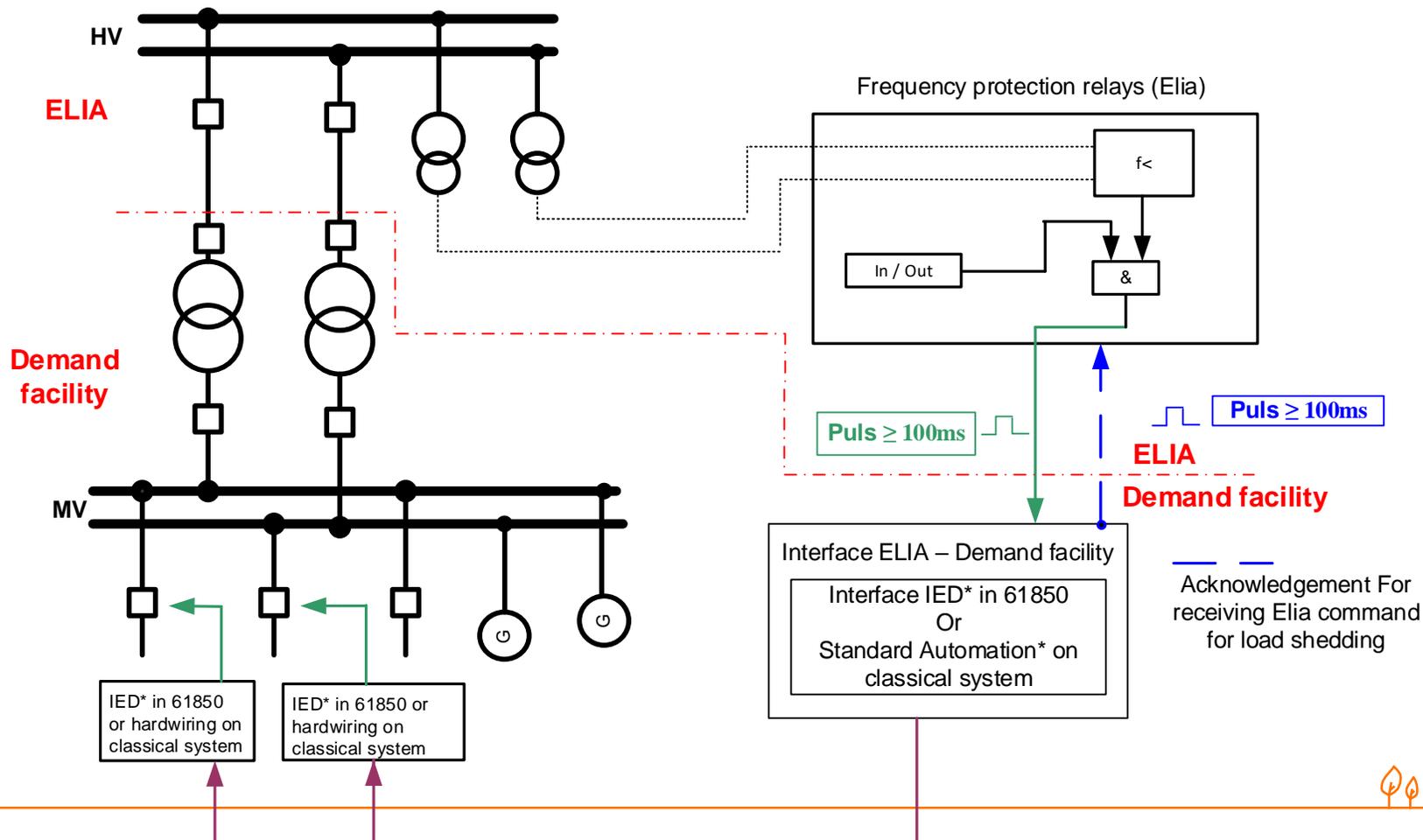
Technical concept



Practical implementation in industry

NC ER art 15(6): Elia should install the frequency relays

6. Each TSO or DSO shall install the relays necessary for low frequency demand disconnection taking into account at least load behaviour and dispersed generation.



- Standard: Elia will install own and maintain the frequency relays and signals up to the interface cubicle
- Trip signals passed from Elia to interface cubicle
- Demand facility picks-up trip signals and sends them to selected demand interrupters
- Customer is free to choose the best way of implementing the load shedding from the interface cubicle (hardwired, IEC61850, ...) to its MV breakers

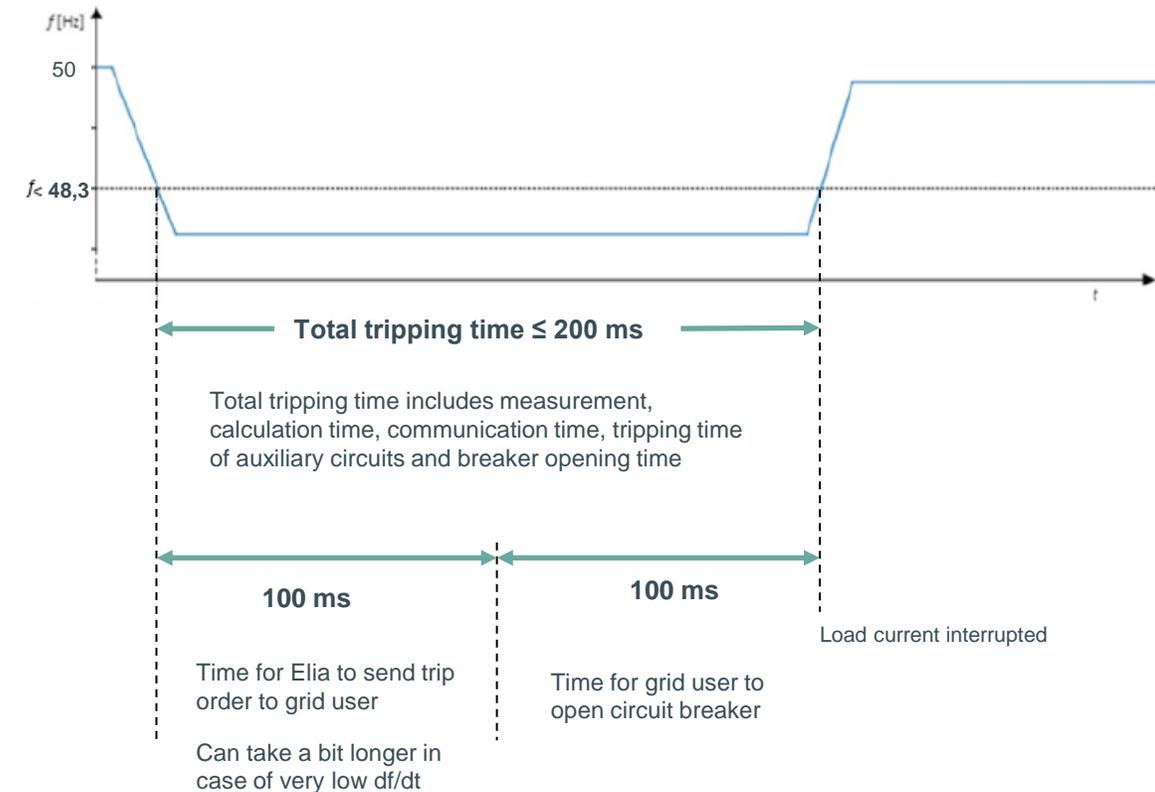


Total tripping time

- Relay requirements in the new (draft updated) European Network code for Demand Connection (art 19.1c)

(c) the low frequency demand disconnection functional capabilities shall allow for operation from an electrical input signal to be specified by the relevant system operator, in coordination with the relevant TSO, and shall meet the following requirements:

- (i) frequency range: at least between 47-50 Hz, adjustable in steps of 0,05 Hz;
- (ii) **maximum total tripping time: no more than 200 ms**, starting from the system frequency crossing the frequency setpoint to the circuit breaker opening, including all necessary relay operating times, such as measurement and calculation time and tripping time of auxiliary circuits;
- (iii) relay accuracy: lower than 30 mHz;
- (iv) **voltage lock-out**: blocking of the functional capability shall be possible when the voltage is within a range of **30 to 90 % of reference 1 pu voltage**;
- (v) provide the **direction of active power flow** at the point of disconnection;



- New Network code DCC is now following approval trajectory in the European Union
- It is expected to enter into force in 2025



Roll-out of frequency relays

- Grid users will be contacted by Elia two years before the planned due date.
- Elia plans to commission the frequency cubicle and link to the grid user before the due date.
- Grid users will have to prepare local demand disconnection equipment from the interface cubicle to the circuit breaker(s) contact on their site, so that the whole chain can be tested and commissioned on the due date.

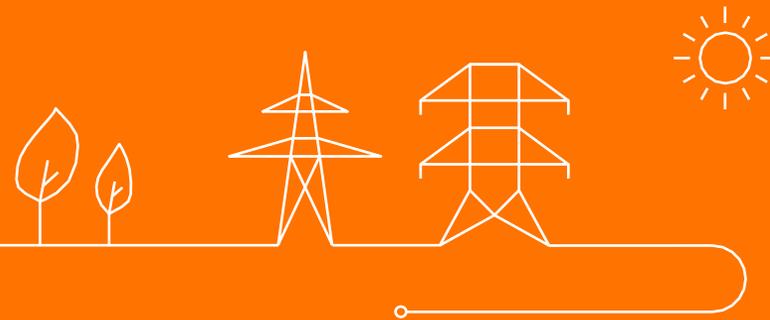


Test to be included in test plan (later this year)

- Site acceptance test (SAT) during commissioning
- Periodic test every 10 years
- Elia aims to do an end-to-end test as much as possible. However, it is not possible to test all elements of the chain (opening of the CB for example). In this case we add the time of the not tested elements based on the datasheets.
- After completing the SAT test, Elia and the grid user sign a document together engaging them that the implemented solution respects the requirements, including reaction times.



Frequently asked questions

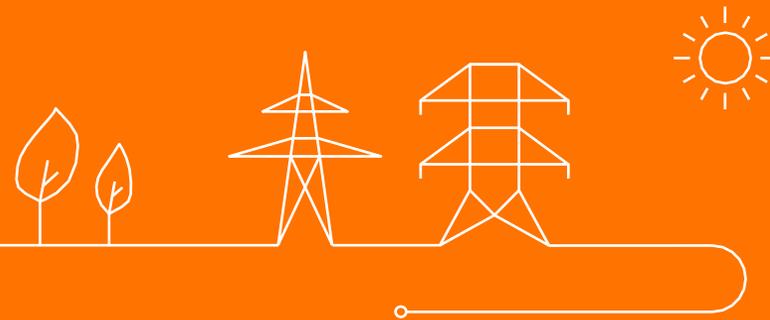


Frequently asked questions

The FAQ related to the LFDD implementation can be found on the website.



Contractual framework



Two new annexes about LFDD in the connection agreement (publicly consulted until 16/2/2024 (subject to later approval of connection agreement))

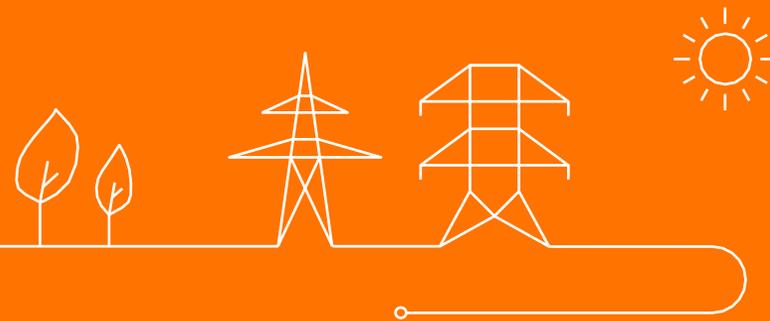
- Annex 11:
 - Individual or via LFDD group → to be specified **via EPIC or via mail** by 30/6/2024
 - Disconnect obligatory volume in either 2 steps 6% at 48,3 Hz and 24% at 48,1 Hz or in 1 step 48,3 or 48,1 Hz to be decided by Elia → **via EPIC or via mail** by 30/6/2024
 - Voluntary volume disconnected at 49,0 Hz (cfr mailing 16/11/23)
 - Summary: % to be disconnected at 49 Hz; 48,3Hz and 48,1 Hz

- Annex 11 bis
 - Specification of LFDD group
 - Contributions of each group member
 - If one member steps out, the other members update this annex

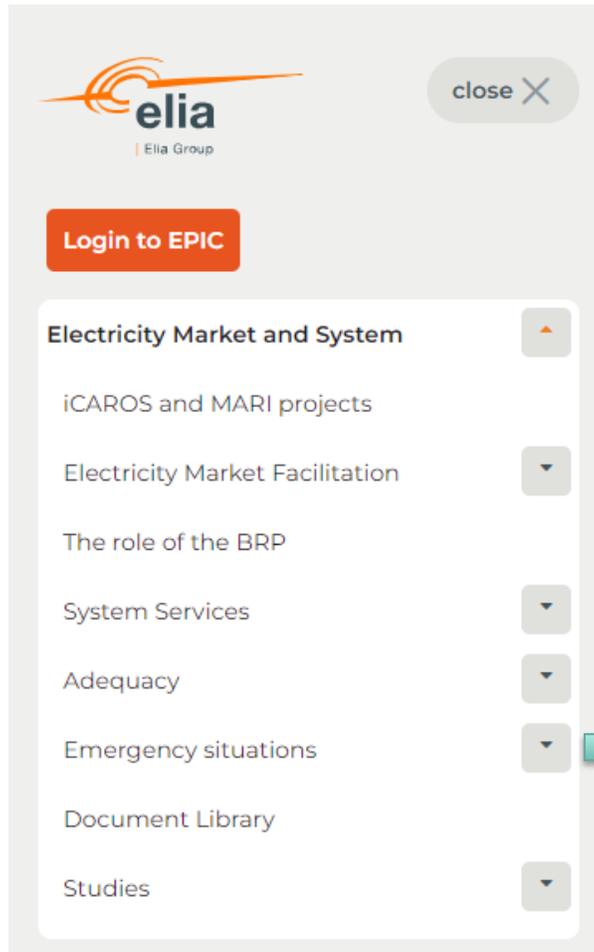
	Mede-contractant	Netgebruiker [A]	Netgebruiker [B]	...	Netgebruiker [X]
Procentuele bijdrage van elk lid van de LFDD-Groep bij een frequentie = 49.0 Hz (schijf 1).					
Procentuele bijdrage van elk lid van de LFDD-Groep bij een frequentie = 48.3 Hz (schijf 8).					
Procentuele bijdrage van elk lid van de LFDD-Groep bij een frequentie = 48.1 Hz (schijf 9).					



Next steps



LFDD documentation on Elia website



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System Defence Plan of Elia

Elia's System Defence Plan includes the automatic and manual actions to be performed in exceptional situations. The System Defence Plan also describes the communication means and notifications that will be used to alert grid users of the measures to be taken.

[Find out more](#)

Restoration Plan of Elia

Elia's Restoration Plan defines the procedures to be put in place and the communication means that will be used to communicate Elia's information and instructions to the grid users in order to restore the network as quickly as possible. The Restoration Plan also includes procedures to facilitate communication with neighbouring TSOs.

[Find out more](#)

Test plan of Elia

The Test Plan of Elia identifies equipment and capabilities relevant for the System Defence Plan and the Restoration Plan that have to be tested. It also describes the tests that should be executed for the relevant equipment.

[Find out more](#)

Low Frequency Demand Disconnection Plan

Implementation guidelines for transmission connected demand facilities and CDS

[Find out more](#)

Expected soon



- This presentation
- Technical concept note
- LFDD design note
- Further guidelines



Timeline

April 2024:	Announcement by Elia to enter LFDD choices in EPIC and/or via mail
March – June 2024	Specification of the Test Plan
June 30 th 2024:	Deadline to make choices in EPIC (or via mail)
In course of 2024	Elia will communicate “due date” to grid users
2024 – 2026	Preparation period



Roll – out and commissioning of frequency cubicles



Thank you.

