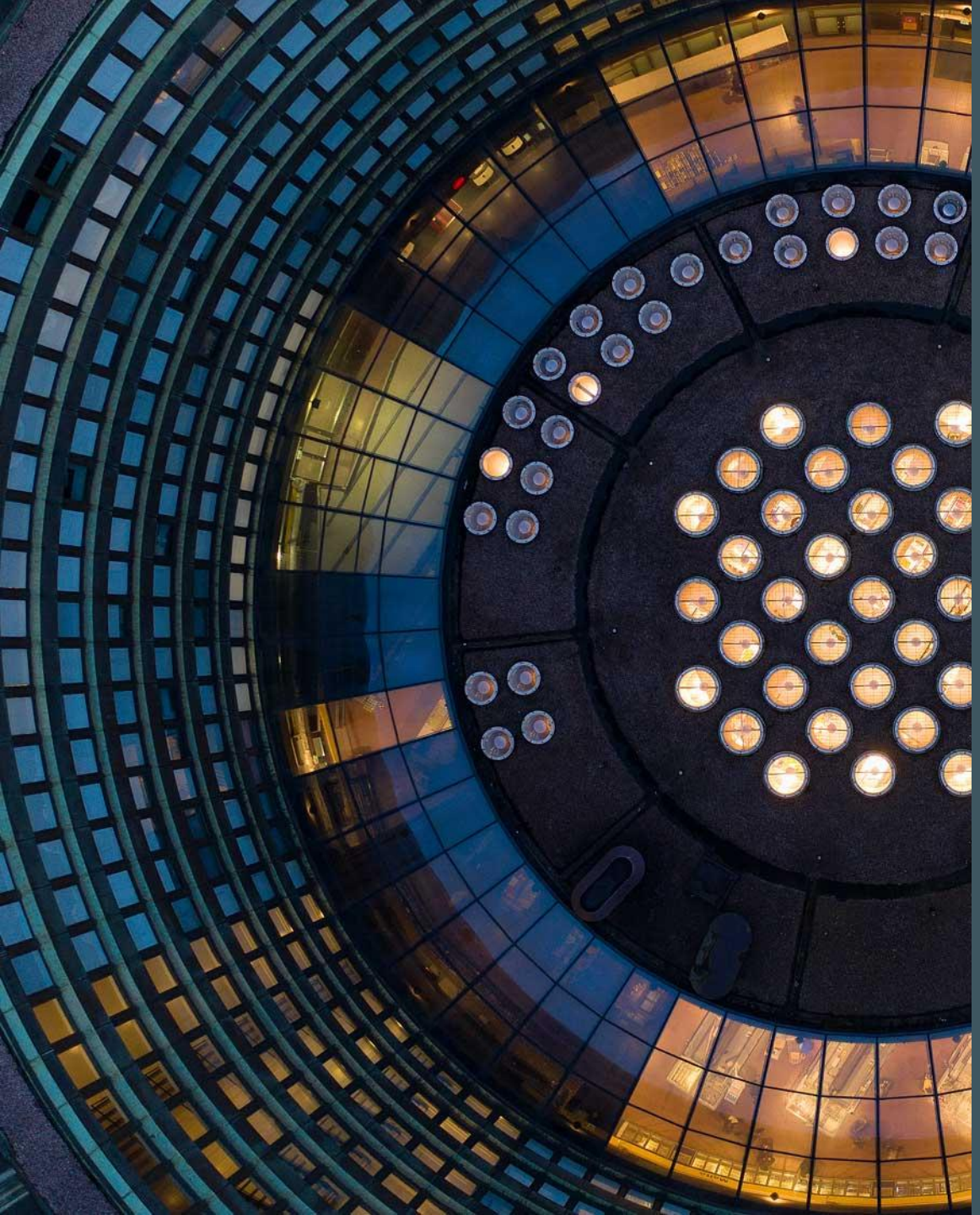

12.6.2026

KJV2026

Grid code specifications for Demand Connections

Kulutuksen järjestelmätekniset vaatimukset

Presentation for stakeholders 12th of June 2026

Esittely sidosryhmätilaisuudessa 12.6.2026

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Agenda / 12th June 2026

- Background, purpose and aim of the requirements
- Implementation of requirements
  - Scope of application
  - Public consultation and confirmation process
  - Additional release: Fingrid’s technical requirements for large demand facilities
- The requirements in detail
  - Common requirements
  - Type B and C demand facilities
  - Type D demand facilities
- Grid compliance procedure for type D demand facilities

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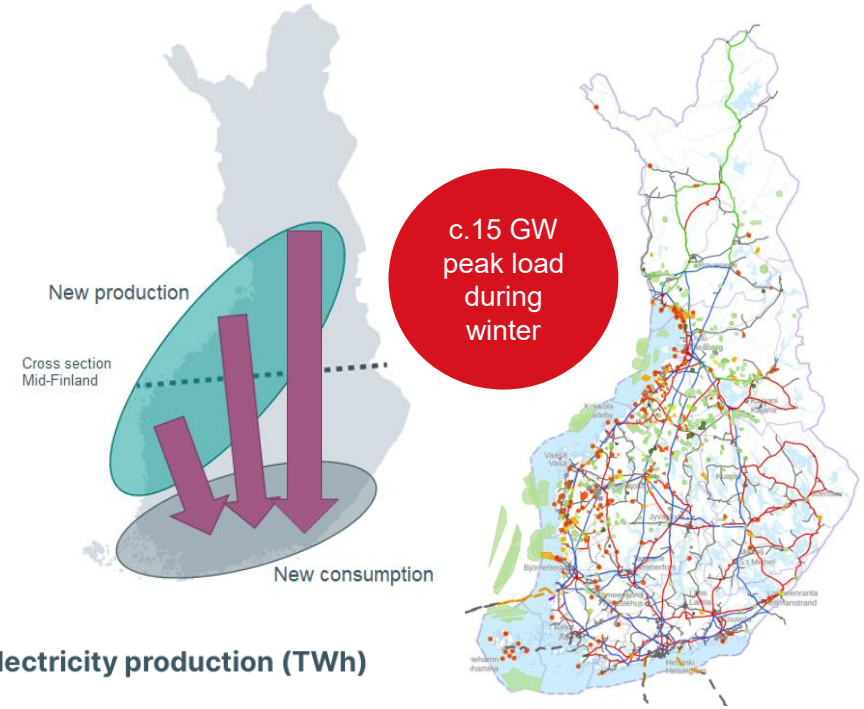
Outlook: Production vs. consumption



Development of electricity consumption (TWh)

Fingrid estimate, September 2025.

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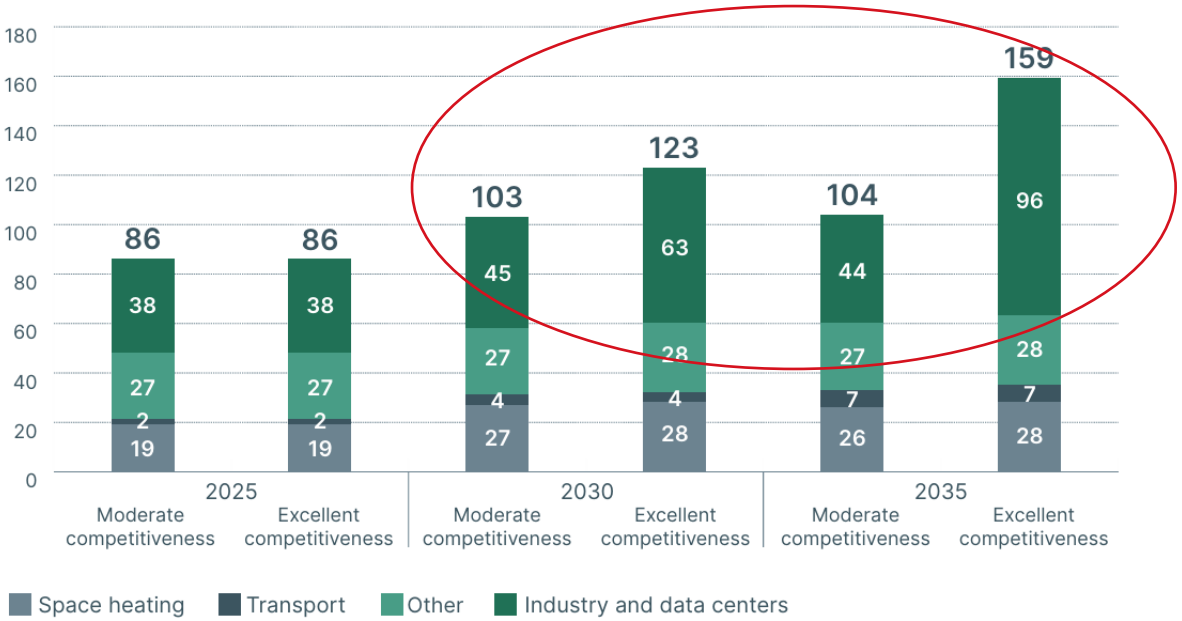
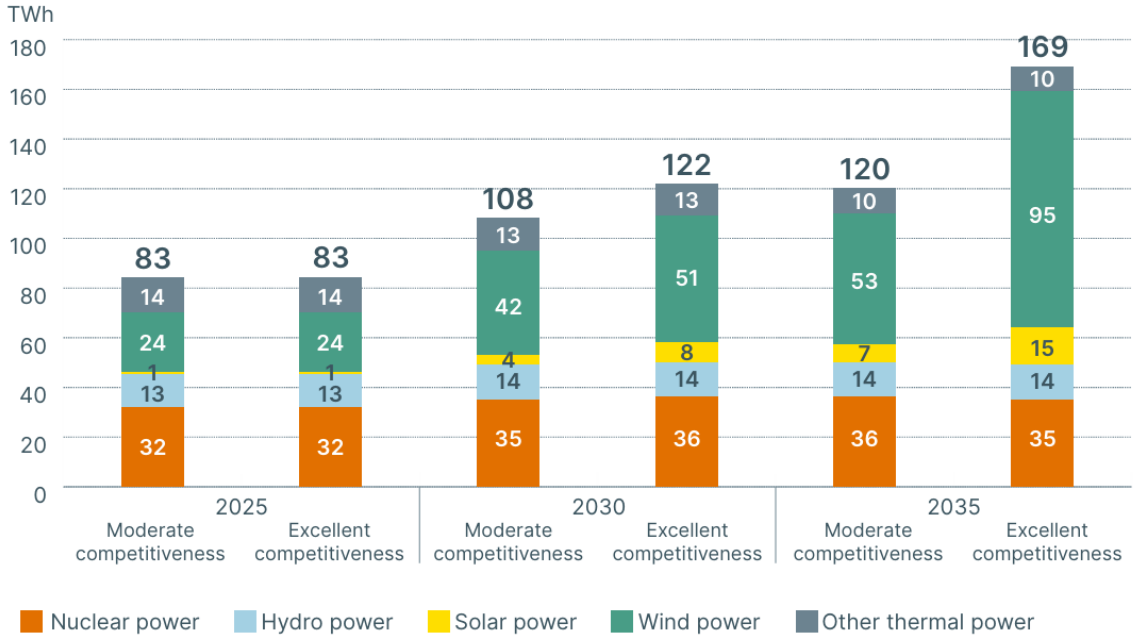


Projected development of electricity production (TWh)

Fingrid estimate, September 2025.



Background, purpose and aim

Existing level of requirements is low

What does the grid need? (design principles)

Large loads must become resilient!

Flexibility?

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Scope of application of KJV2026

Same requirements for all kinds of demand facilities – only size matters

Demand facility is an industrial consumer of electricity such as data center, electric boiler, P2G plant

- KJV2026, ”The Grid Code Specifications for Demand Connections” (Kulutuksen järjestelmätekniset vaatimukset) apply to following electrical equipment connected to Finland’s power system:
  - **Demand facilities (kulutuslaitokset)** of Table 3.1 connected to
    - transmission grid (= Fingrid’s grid) and
    - distribution networks (= DSO’s grids)
  - **Distribution networks** when connection point voltage is at least 110 kV including closed distribution systems
  - **Demand facilities used to offer demand-side management services** to relevant network operators or the transmission system operator

Table 3.1. Categorization of demand facilities by size

Type classification	Rated power of the demand facility, $P_{max,d}$
Type B	$1\ MW \leq P_{max,d} < 10\ MW$
Type C	$10\ MW \leq P_{max,d} < 30\ MW$
Type D	$P_{max,d} \geq 30\ MW$

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Requirement	No.	Required capability	Type of demand facility		
			Type B 1 MW ≤Pmax,d< 10 MW	Type C 10 MW ≤Pmax,d< 30 MW	Type D Pmax,d ≥30 MW
Active power	1	Cabability to limit active power consumption (continuous control / in steps)	Required	Required	Required
	2	Active power ramp rate limit for external controls	If needed	If needed	Required
Interactions with the grid	3	Cyclic power oscillations above certain threshold prohibited	Not required	Required	Required
Disturbances	4	Can withstand RoCoF of at least +/- 2,0 Hz	Required	Required	Required
	5	Can withstand phase jump of at least +/- 30°	Not required	Required	Required
	6	Low voltage ride-through LVRT (0 pu / 200 ms)	Not required	Not required	Required
	7	Multiple LVRT	Not required	Not required	Required
	8	Overvoltage ride-through OVRT (1,20 pu / 5 s)	Not required	Not required	Required
Post-fault active power recovery	9	Post-fault active power recovery PFAPR (<1,0 s / 90 %)	Not required	Not required	Required
Reactive power	10	Reactive power window acc. to RNO requirements	(Conn. terms)	(Conn. terms)	(Conn. terms)
Remote control	11	Fast limitation of active power (at least 30%)	Not required	Not required	Required
	12	Fast limitation of active power (at least 30%) due to undervoltage	Not required	Not required	Required
	13	Possibility to control connectee's compensation devices	Not required	Not required	If needed
	14	Other signal exchange with Fingrid via RO	Not required	Not required	Required
	15	Fingrid's direct control connection to demand facility	Not required	Not required	If needed
	16	RNO's capability to control demand facility	If needed	If needed	If needed
Measurements and instrumentation	17	Realtime measurements	Required	Required	Required
	18	Continuous recorder	Not required	Not required	Required
	19	Fault and oscillation recorders	Not required	Required	Not required
Simulation models	20	PSCAD model	Not required	Not required	Required
	21	PSSE model	Not required	Not required	Required
Specific study requirements	a	Subsyncronous interaction	Not required	Not required	If needed
	b	Geomagnetically induced currents	Not required	Not required	If needed
	c	Damping of power oscillations	Not required	Not required	If needed
	d	Low minimum short-circuit power at the connection point	Not required	Not required	If needed
	e	Converter interaction phenomena	Not required	Not required	If needed
	f	Dependency of the connected equipment from other equipment or connections	Not required	Not required	If needed
	g	Power quality	Not required	Not required	If needed
	h	Need for dynamic voltage control	Not required	Not required	If needed

Demand facility of ≥30 MW like data center, electric boiler or P2G. What will be required?

1. Do not disconnect: FRT (0pu / 200ms) and post-fault active power recovery (90% / 1s)

2. Ability to limit active power consumption (at least 30%)

3. Do not oscillate

4. Controllability: readiness to take external control requests (such as power limitation)

5. Visibility: continuous measurements, simulation models

6. Specific study requirements: site specific additional requirements are possible

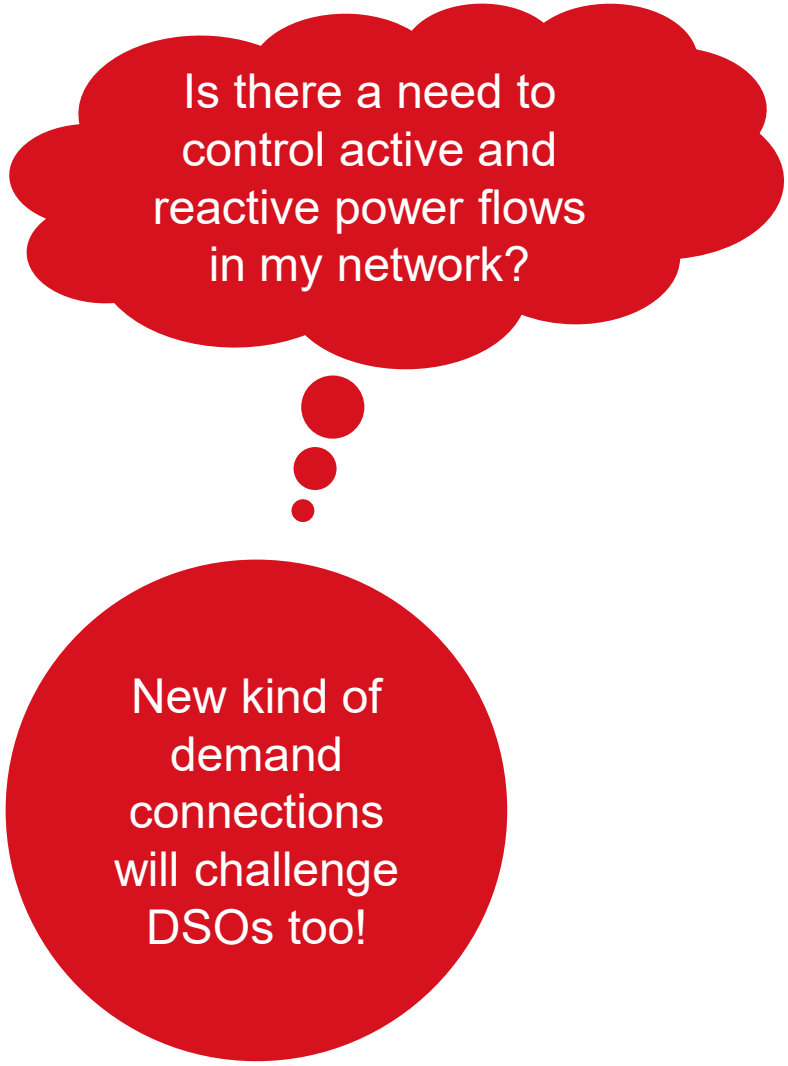
Flexibility!

Requirements			Type of demand facility		
			<	Type C 10 MW ≤Pmax,d< 30 MW	Type D Pmax,d ≥30 MW
Active power	1	Capability to limit active power consumption (continuous control / in steps)	Required	Required	Required
				eeded	Required
				quired	Required
				quired	Required
	5			quired	Required
				equired	Required
				equired	Required
	8	Overvoltage ride-through OVRT (1.20 pu / 5 s)	Not required	No ired	Required
				eq	Req
				. term	
	11	Fast limitation of active power (at least 90%)		Not required	
				equired	
				equired	
	15	Fingrid's direct control connection to demand facility	Not required	Not required	
				eeded	If n
				quired	Required
Measurements and instrumentation	16	Continuous records		Not required	Required
				uired	Not required
				equired	Required
				equired	Required
Specific study requirements	a	Subsyncronous interaction	Not required	Not required	If needed
	b	Geomagnetically induced currents	Not required	Not required	If needed
	c	Damping of power oscillations	Not required	Not required	If needed
	d	Low minimum short-circuit power at the connection point	Not required	Not required	If needed
	e	Converter interaction phenomena	Not required	Not required	If needed
	f	Dependency of the connected equipment from other equipment or connections	Not required	Not required	If needed
	g	Power quality	Not required	Not required	If needed
	h	Need for dynamic voltage control	Not required	Not required	If needed

D

How does this affect DSOs?

- There are no major changes to technical requirements that concern DSO connections (e.g. substation)
- However, when connecting demand facilities, the Relevant Network Operator (RNO, liittymispisteen verkonhaltija) must
  - monitor and guide the Connectee during the compliance procedure
  - define the scope and details for the project specific implementation of certain technical requirements
  - check & comment project documentation and makes sure it'll end up in Fingrid's Oma Fingrid service
  - issue EON/ION/FON



RNO is responsible for checking and confirming that the demand facility complies with KJV2026!

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Public consultation and confirmation of KJV2026

1) Public consultation of KJV2026 draft: 12th June – 21st August 2026
   - Finnish version of KJV2026 document available here: *KJV2026 luonnos julkisesti kuultavaksi 12062026 (in attachments section)*
   - Unofficial English translation will be available soon
   - Please send your comments to gridcompliance@fingrid.fi
   - In your comments, refer to the chapter your comment concerns or alternatively send a commented copy of the document
2) After the consultation, Fingrid will finalize KJV2026
3) KJV2026 will be sent to NRA (Energiavirasto) for confirmation in 10-11/2026
   - Public hearing and confirmation acc. to Act on Supervision of the Electricity and Natural Gas Market (590/2013, §10, §12)
   - Fingrid will prepare a response to the feedback of the public hearing and answer to possible clarification requests
4) Energiavirasto to confirm KJV2026 in early 2027?

Question: Connection agreement already made. Do the new requirements apply to my demand facility?
Answer: If the main components have not been procured by the deadline mentioned in KJV, the new requirements apply. Assuming that the timeline presented above holds, the deadline would be 1st of July 2027 but still not earlier than 3 months after Energy authority's confirmation.

Question: *Are the new requirements retroactive?*
Answer: Updated requirements apply to new connections and significant changes in existing connections. Fingrid will assess the significance of changes, i.e., whether they have relevance on power system level. For example, increasing the power of a data center with a new extension would lead to the application of the updated requirements to the extension.

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Public hearing and confirmation of KJV2026

- What will Energiavirasto confirm?
  - Exhaustive scope of European Demand Connection Code (2016/1388)
  - Terms and conditions, especially the ones set to DSOs and their connectees

- What Energiavirasto does NOT confirm and will be left for ex-post monitoring (*jälkivalvonta)* by them?
  - National *technical requirements*.
  - After KJV2026 has been confirmed, if Fingrid sees the need to revise *technical requirements* (outside the scope of DCC), updated version of KJV2026 will be released but no confirmation procedure by Energiavirasto will be initiated.

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Fingrid's technical requirements for large demand facilities
Suurten kulutuslaitosten tekniset vaatimukset

- On 12 June 2026, Fingrid has also released a separate document,

  ***Technical requirements for large demand facilities** (link)*

- Why? There is an urgent need to set requirements for large demand connections, especially data centers.
- The document sets requirements for all ≥30 MW demand connections. The content is almost identical to requirements given in KJV2026 draft of 12 June 2026 for type D demand facilities.
- **Is applicable to demand facilities that are or will be Fingrid's direct connectees (customers) starting from 12 June 2026**.
  - Applies to new connection agreements
  - Applies to existing connection agreements if the customer has not yet purchased main equipment
  - Applies to modifications to existing connections including power upgrades

  Each project to be evaluated by Fingrid

- **Is not applicable to DSO's connectees**
  - For DSOs, KJV2018 applies until KJV2026 has been confirmed by NRA. However, DSOs can update their connection terms.
- Approach has been discussed with Finnish NRA, Energiavirasto

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Common requirements

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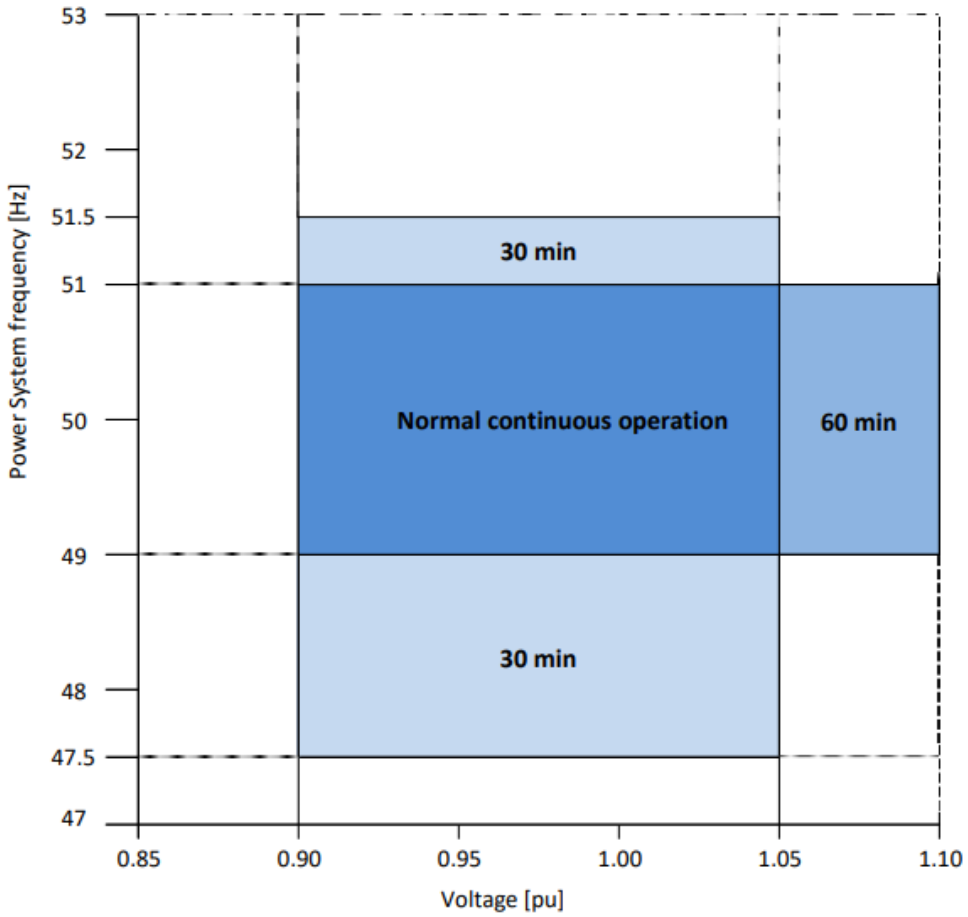
Common requirements

- No changes to general voltage/frequency limits
- No change in RoCoF (2 Hz / s) required. **Addition: observation time window is 1 second**
- Autonomous reconnection: if allowed by RNO, frequency window is 49.9−50.1Hz (not 49-51Hz) and conditions for power ramp-up have to be defined
- Power quality:
  - Former reference to Fingrid's power quality report has been replaced by more general reference to RNO/Fingrid requirements.
  - Fingrid is currently preparing new requirements for power quality. Stay tuned!



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Requirements for type B (1-10MW) and type C (10-30MW) demand facilities

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Requirements for type B demand facilities

- Common requirements of chapter 10 apply
- Capability to limit active power of the demand facility (chapter 11.1.1)
  - RNO defines technical details (amount, activation speed, ramp rate etc.)
- Capability to receive external signal for to limit active power (chapter 11.1.2)
  - RNO defines the need and requirements for connection (datalink)
- Operation in voltage disturbances (chapter 11.1.3)
  - FRT capability is NOT required, but information about the capability (if and when the demand facility disconnects) is requested
- RNO will define scope of the commissioning tests

Request especially for DSOs: please provide feedback on requirements for type B!

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Requirements for type C demand facilities

- Common requirements of chapter 10 and the requirements for type B apply to type C demand facilities
- Capability to operate normally and continuously at minimum short-circuit power level given by the RNO
- **The demand facility shall not disconnect from the grid in stepwise voltage angle changes of +/-30 degrees**. If the stepwise change is over +/-20 degrees, loads can disconnect from the grid but they must recover in 1 second to 90% of the load level before the voltage change.
- **The owner of the demand facility must designate a Relevant Operator**
- To preserve the operational security of RNO's grid, RNO has the right to require needed controls to and status information from the demand facility.
- **Interaction with the grid: the demand facility shall not cause harmful oscillations (see slide in type D requirements)**
- RNO will define scope of the commissioning tests

Request especially for DSOs: please provide feedback on requirements for type C!

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Requirements for type D demand facilities (≥30MW)

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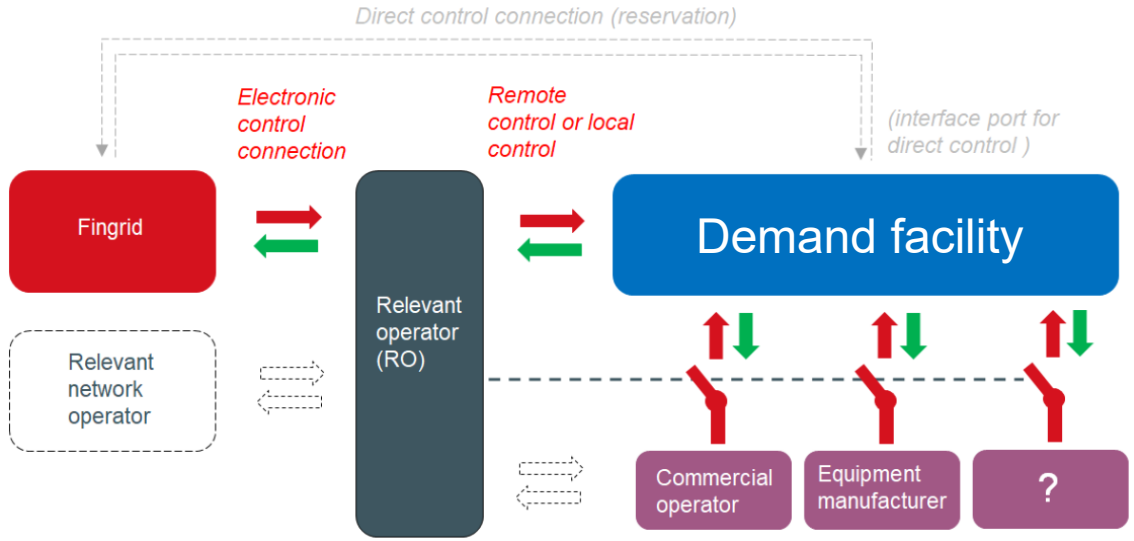
Relevant Operator and remote control

- The owner of the demand facility must designate a Relevant Operator (RO / Käytöstä vastaava toimija, KVT) who
  - knows the operating state of the facility at all times,
  - has the right and possibility to control the facility (locally or remotely)
  - change the operating point of the facility and
  - authorise or limit any controls issued outside the facility.

- Fingrid can send control requests to the demand facility via RO



- Signals from Fingrid
  - Request to limit of active power
  - Request to limit ramp rate of active power
  - Request to switch on/off compensation devices (if needed)
  - Information: Power system status (during system restoration)
- Signals to Fingrid
  - Status information related to aforementioned signals
  - Availability of the remote connection

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Active power: controllability

- The demand facility has to be able to limit its active power at the connection point
- If the active power consumption of the demand facility can be controlled by **a third party** in connection with electricity market activities or for other reasons…

  → Required capability to limit or block control actions

  → Required capability to limit maximum rate of change of active power to 5−50 MW/min (indicative). Fingrid can request change of ramp rate via RO (remote control signal).
- The maximum single step change in power caused by the internal process of the demand facility shall be 50 MW, unless stricter limits arise from the power quality requirements
- The demand facility load shall not cause repeated step changes in power, forced power oscillations, or exhibit cyclic behaviour in such a way that it causes **power oscillations** at the connection point exceeding the limits defined in Section 11.2.5. (see separate slide)
- A study on the controllability of the active power of the demand facility is required (Section 12.2.3).

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11.3.4-5. Fast limitation of active power

Upon request by Fingrid

- Fingrid may request the limitation of the active power via RO using control signal or by telephone.
- Upon receiving a limitation request, the demand facility shall be capable of reducing its active power consumption to at least three different active power levels, e.g. 70%, 40% and minimum demand.
- The active power setpoint shall be reached within a pre-defined time agreed with Fingrid, which shall not exceed 15 minutes

Due to undervoltage

- Function can be switched on/off by Fingrid via RO using control signal or by telephone
- Undervoltage detected by relay at the demand facility (phase-to-ground measurements from all three phases)
- Time delay defined separately by Fingrid

- The reason for limiting active power may be a network fault, electricity shortage, or other exceptional operating condition.
- The active power shall be capable of being reduced by at least 30 % from the pre-activation power level
- Functions can be combined (which loads to limit)
- A study explaining the implementation of the functions is required (Section 12.2.3).

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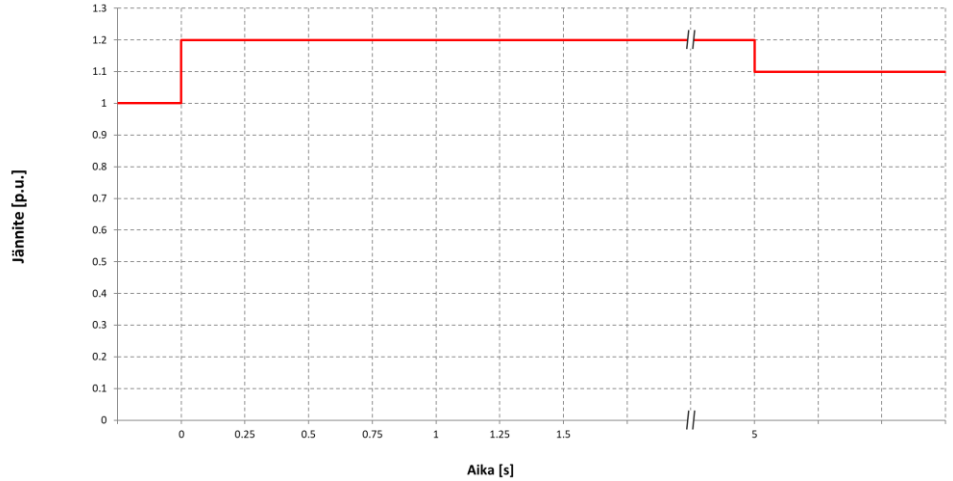
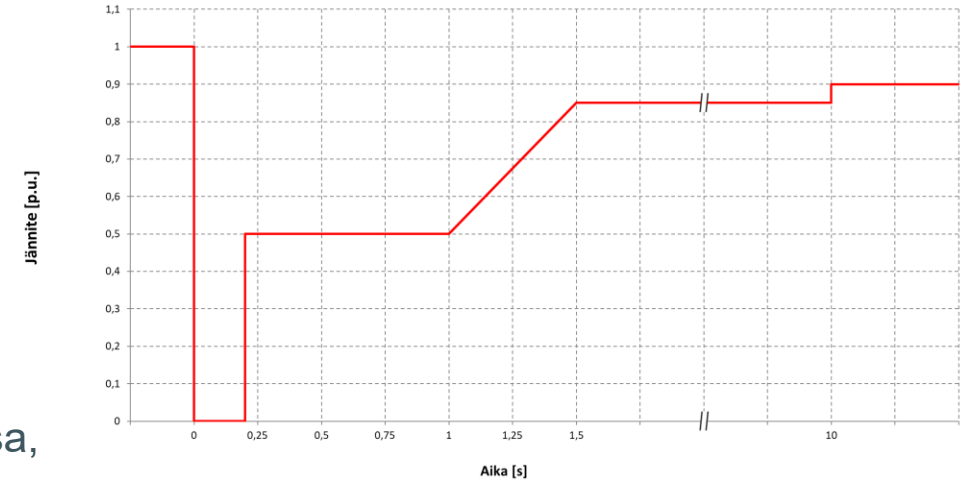
11.3.6. Fault ride-through

- Demand facility shall not disconnect from the grid during voltage disturbance. Applies to 3ph, 2ph and phase-to-ground faults.
- Voltage at the connection point:
  - 1.10-1.20pu: normal operation (5 seconds)
  - 0.90-1.10pu: normal operation
  - 0.50-0.90pu: active power consumption can be reduced acc.to component current limitations
  - 0.00-0.50pu: active power consumption can stop
  - 0.00pu voltage time is 200ms.
- When voltage recovers to 0.90pu active power consumption shall recover acc. to PFAPR requirement
- Shall withstand 8 consecutive 100 ms faults within 90 seconds
- An overvoltage event may follow an undervoltage event, or vice versa, or occur simultaneously
- A study on fault ride-through capability is required (combined with PFAPR) (12.2.1)





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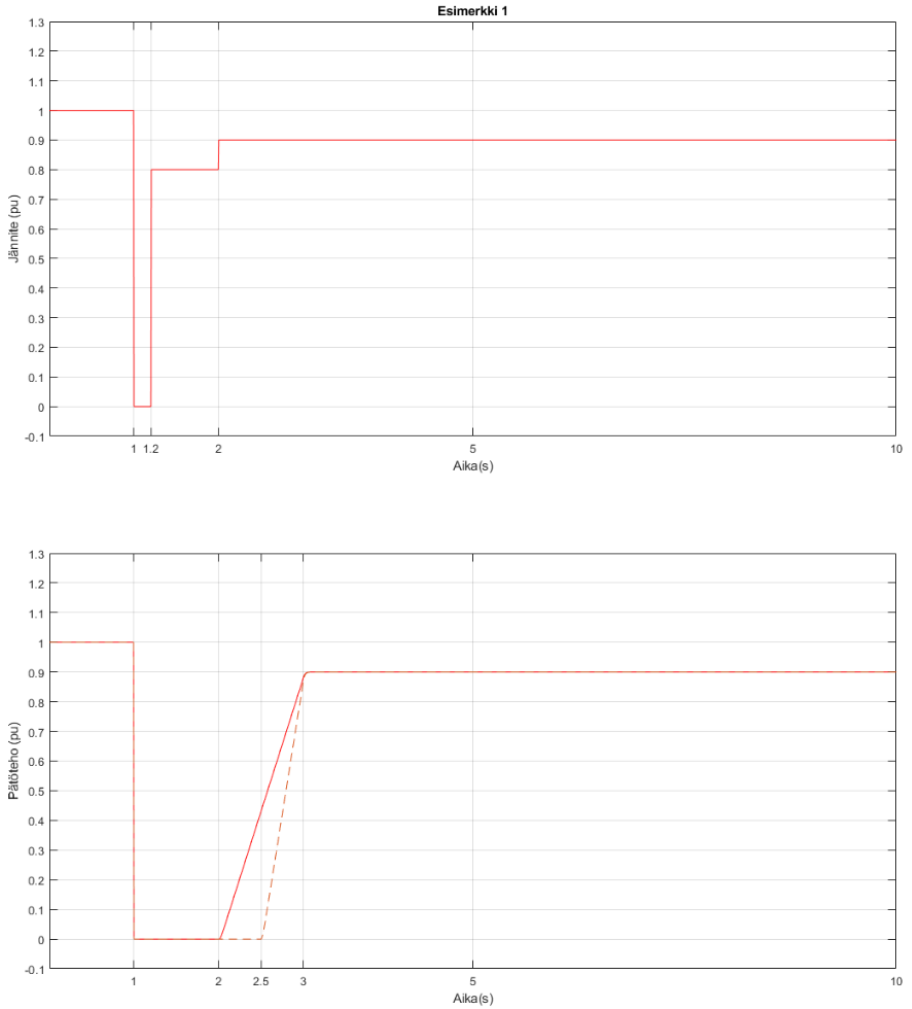
11.3.7. Post fault active power recovery (PFAPR)

- The demand facility, including its auxiliaries, shall be designed such that, following a voltage disturbance (LVRT), its active power consumption recovers to at least 90% of the pre-disturbance active power level **within 1.0s** after the voltage at the connection point has returned to the level of 0.90 pu.
- Once the active power has recovered to at least 90% of the pre-disturbance level, the demand facility shall be capable of continuing normal operation **without a need to reduce its power consumption as a result of the voltage disturbance**.
- The recovery of active power may be temporarily supported by components other than the process loads of the demand facility itself. Such components include, for example, electrical energy storage systems or resistive loads.
- A study on PFAPR shall be prepared (combined with voltage disturbance) (Section 12.2.1).



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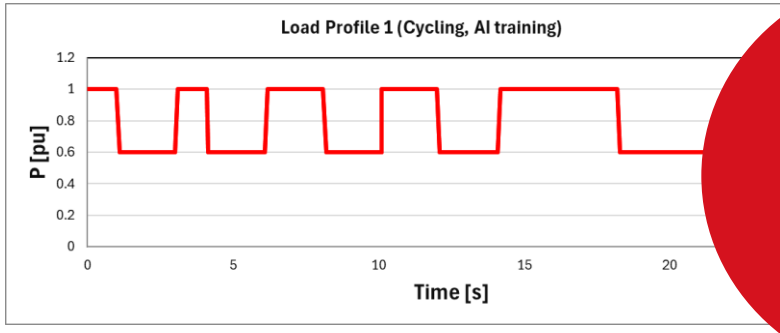
11.2.5, 11.3.9. Interaction with the grid (type C and D)

- The demand facility, including its control systems, shall be designed to operate stably as part of a series- and shunt-compensated power system in which the share of converter-connected power generating facilities and converter-connected demand installations is dominant compared to the number of synchronous generator-based power plants.
- From the perspective of small-signal stability, the demand facility shall operate stably as part of the power system. The demand facility shall not cause amplification of voltage or power oscillations in the Nordic power system.
- For type D, a separate protection device can be required to disconnect a load causing excessive oscillations to the grid



Energy storage needed to filter out oscillations?

Frequency range [Hz]	Peak magnitude of power oscillation In [%] of rated demand capacity ($P_{max,d}$)		Window length of spectral analysis [s]
	[%]	however must remain below [MW]	
0,01–0,025	20	40	300
0,025–0,05	20	40	160
0,05–0,1	20	40	80
0,1–0,2	10	20	40
0,2–0,5	3	6	20
0,5–2,0	6	12	10
2,0–6,0	3	6	2
6,0–18,0	3	6	1
18,0–45,0	3	6	0,5

Continuous cyclic power oscillations caused by the demand facility shall be limited within the thresholds specified in Table 11.1 (above).

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11.3.11. Modelling requirements

- **PSS®E and PSCAD™** simulation models of the demand facility shall be provided to Fingrid. RNO can have access to the models.
- The simulation models shall accurately represent the essential functionalities and technical characteristics of the demand facility.
- The simulation models shall include all main components of the demand facility, including compensation equipment, as well as the controllers, limiters and protection devices affecting the operation of the demand facility in the power system. Identical parallel units are aggregated.
- The technical requirements and performance expected of the models are defined in Fingrid's modelling guidelines.
- Upon submission of the simulation models, also a report demonstrating that the models comply with Fingrid's modelling guidelines shall be provided. The report shall also include the results of simulations performed with the models demonstrating that the demand facility fulfils key requirements such as FRT & PFAPR.

Models delivered at least 6 mo before ION!

Modelling instruction for data centers already available!

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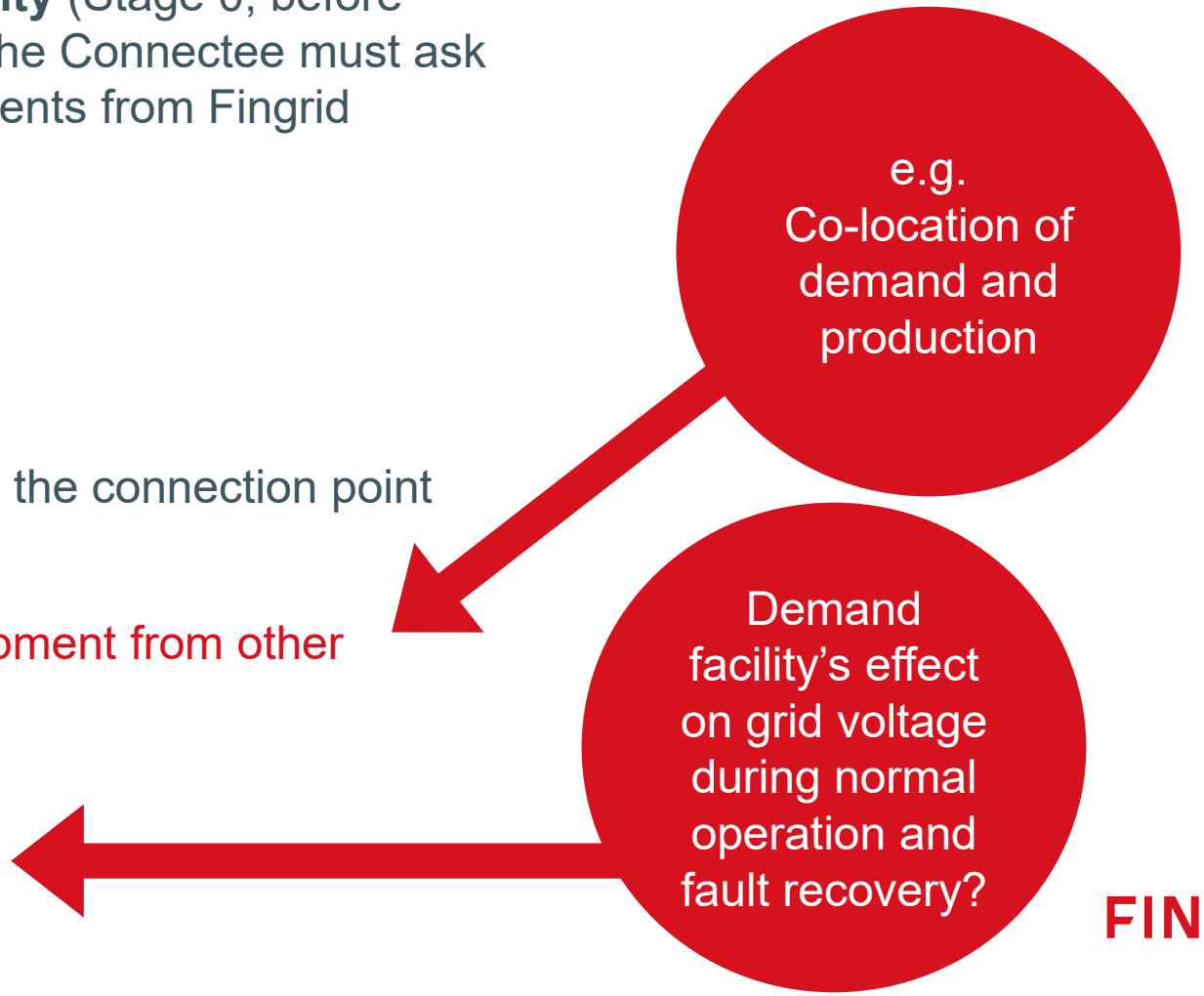
5. Specific study requirements

- During pre-design of the **demand facility** (Stage 0, before signing of the connection agreement) the Connectee must ask assessment of Specific study requirements from Fingrid
- Topics to be assessed:
  - Subsyncronous interaction
  - Geomagnetically induced currents
  - Damping of power oscillations
  - Low minimum short-circuit power at the connection point
  - Converter interaction phenomena
  - Dependency of the connected equipment from other equipment or connections
  - Power quality
  - Need for dynamic voltage control



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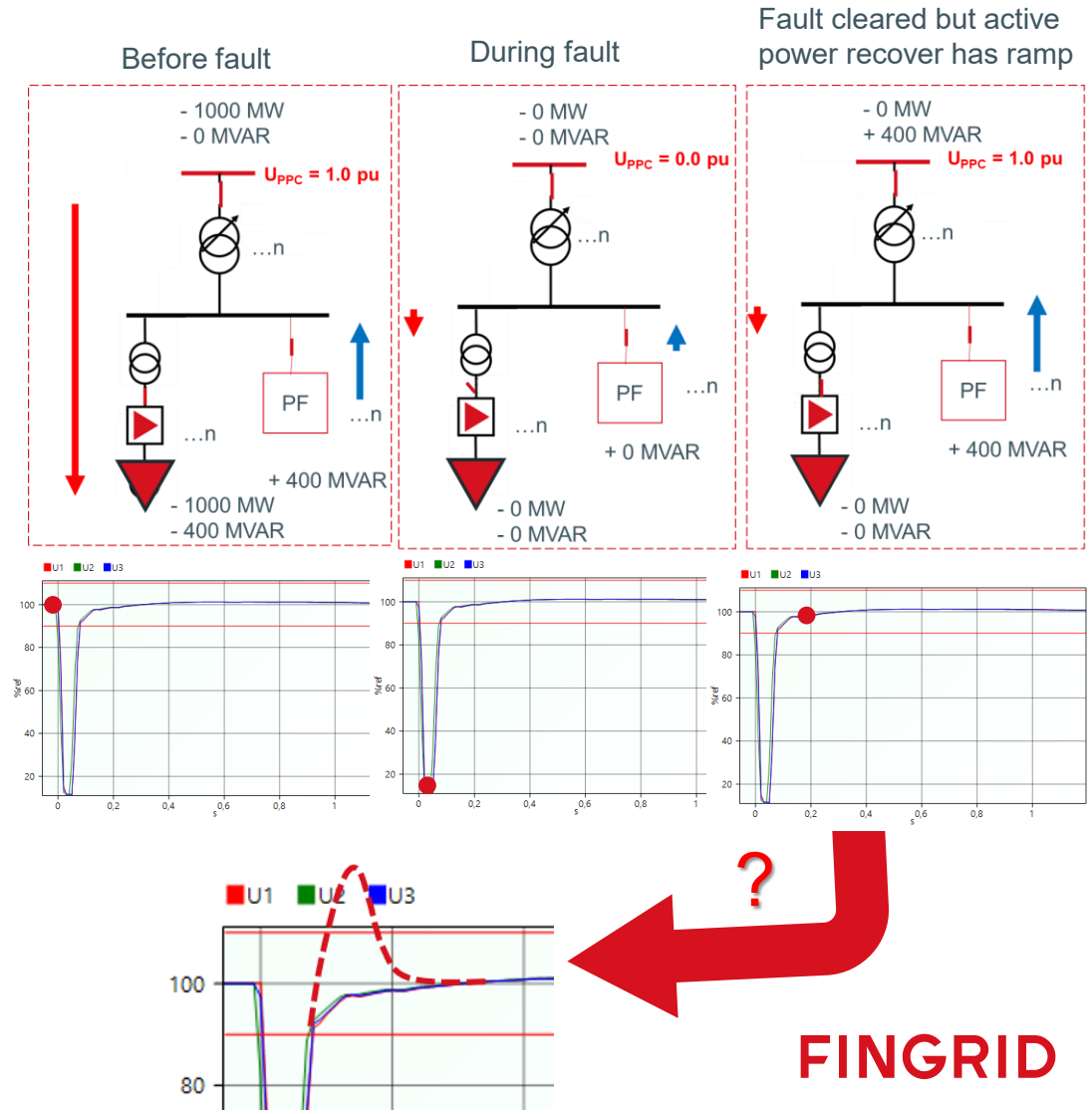
11.3.8. Reactive power limits & compensation

- RNO/Fingrid shall define the limits for allowable reactive power production and consumption at the connection point (see Section 10.6).
- During a voltage disturbance (Section 11.3.6) and the subsequent recovery of active power (Section 11.3.7), the reactive power of the demand facility shall not cause overvoltage or undervoltage at the connection point.
- Fingrid shall assess the risk related to overvoltage or undervoltage at the connection point as part of the assessment of special study requirements (Chapter 5).

May lead to additional equipment needed to reduce the voltage overshoot!



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11.3.10. Instrumentation

- The demand facility must be equipped with a continuous recording system, and the RO must be able to access the measurements quickly. The recording system shall enable the operation of the demand facility to be recorded continuously whenever the facility is connected to the grid.
- The equipment must accurately record power system disturbances and changes.
- Phase currents and voltages measured at the point of connection (or other point defined by RNO/Fingrid)
- High sample rate of 4 kHz or more in transients
- Time synchronized (e.g. process automation system or GNSS)
- RO has gain access to recordings within 1 hour and RNO/Fingrid within 8 hours
- 30 days of memory capacity

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Grid compliance procedure for type D demand facilities

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Grid compliance procedure (KJV2026)

Oma Fingrid web service is the primary tool for communication and exchanging documentation!

Connection agreement

Phase 0: Pre-planning

- Big picture: what is being built and how can it meet the requirements?
- Specific study requirements
- Outline of the Compliance verification plan

Phase 1a: Planning of the grid connection

- RNO will check planning documents

EON

Phase 2a: Commissioning of the grid connection

- Delivery of commissioning test report

Phase 1b: Planning of the demand facility

- RNO will check planning documents
- Fingrid will check simulation models

ION*

Phase 2b: Commissioning of the demand facility

- Delivery of commissioning test report
- Delivery of validated & updated simulation models

Phase 3 (Final Operational Notification, FON)

- RNO will check commissioning report and updated design documentation
- Fingrid will check simulations models

Type tests for equipment (+possible certification)

RNO = Relevant Network Operator (liittymispisteen verkonhaltija). Fingrid is the RNO of the transmission system, Local DSO is the RNO of the distibution network.
EON = Energisation Operation Notification (kytkentäilmoitus) = permission to energise the grid connection
ION = Interim Operation Notification (väliaikainen käyttöönottoilmoitus) = permission to start the demand process
FON = Final Operation Notification (lopullinen käyttöönottoilmoitus)

*Planning documents incl. simulation models to be delivered 6 months before planned ION!

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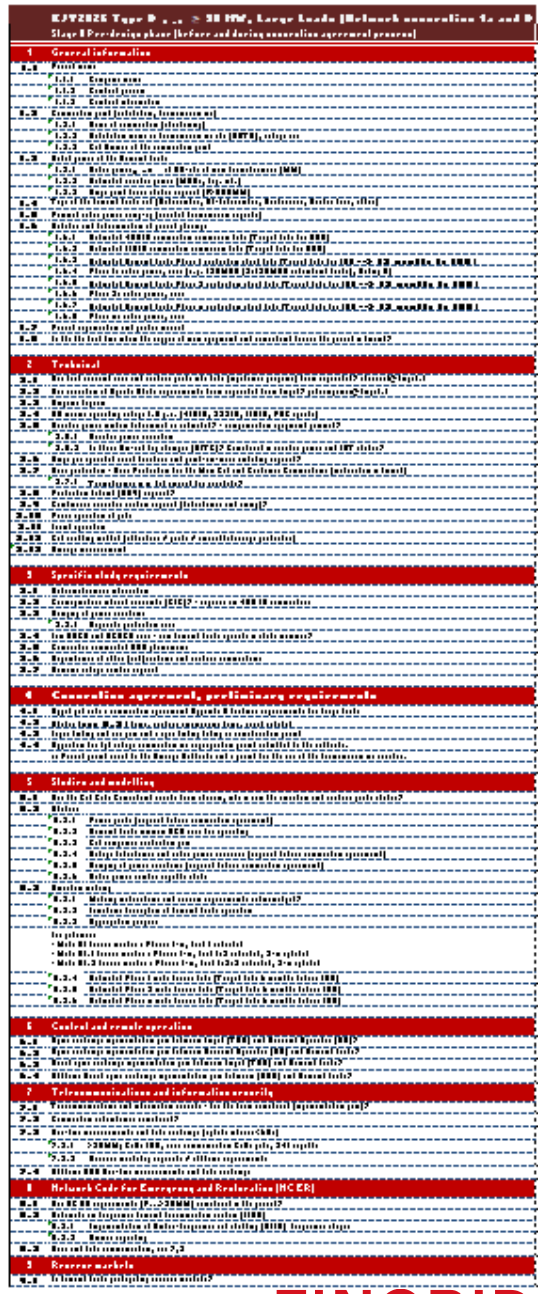
6.3.1 Stage 0: Pre-planning

- Connectee is responsible for arranging the kick-off meeting to discuss compliance monitoring process with Fingrid and the relevant network operator. Meeting should be held in good time before connection agreement.
- **Main purpose of the meeting is to identify topics that may have notable technical and financial effects on project realization and timeline (e.g. construction permit).**
- Topics to be discussed in the meeting:
  - Initial technical data
  - Key design principles
  - Compliance verification plan (next slide)
  - Specific study requirements
    - Studies needed already before connection agreement?
  - Agree project follow-up practices and delivery of documentation and studies
  - Project schedule and power ramp-up plan



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12. Compliance verification plan (Vaatimusten todentamissuunnitelma)

- The objective of the compliance verification plan is to identify the equipment and systems that are critical for demonstrating compliance of the demand facility and to ensure that they fulfil the requirements in practice (e.g. with respect to fault ride-through capability).
- Outlined in Phase 0 with Fingrid and relevant network operator
- Delivered in Phase 1 (as early as possible!)

- The compliance verification plan describes how compliance is shown in various ways & project stages
  - Compliance studies to be carried out (next slide)
  - Equipment testing, such as factory acceptance tests or type tests
  - Commissioning tests
  - Validation of simulations models
  - Continuous monitoring

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12.2. Compliance studies (Vaatimustenmukaisuudesta laadittavat selvitykset)

- The Connectee shall prepare following studies as part of Stage 1 documentation
  - Chapter 12.2.1: Study on fault ride-through capability and post-fault active power recovery
    - A study to justify that the demand facility is capable of riding through voltage disturbances (LVRT and HVRT) and the active power will recover after the disturbance
  - Chapter 12.2.2: Study on interaction phenomena
    - A study describing the situations in which interaction phenomena may occur, the causes of such phenomena, their magnitude, and the measures by which exceedance of the specified limits is prevented.
  - Chapter 12.2.3: Study on active power controllability
    - A study describing the functionalities of active power control and the limitations related to controllability, both for downward and upward regulation.

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12.3. Equipment testing and certification

- Scope of tests to be defined in Compliance verification plan
  - Existing test reports showing compliance
  - Which equipment is tested and how to show compliance
- Equipment certification
  - Possible to obtain a certificate that confirms the compliance of e.g. modular device (such as UPS)
  - Requires type tests acc. predefined scope
  - Note! Does NOT replace system-level studies prepared for the entire demand facility (Section 12.2), which demonstrate that the demand facility complies with the requirements as a whole

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12.4. Commissioning tests

- To be performed on site, either on facility level or unit level
- Exact scope to be defined based on the type and structure of the demand facility
- Tests to be performed:
  1) Autonomous reconnection (if in use)
  2) Damping of power oscillations
  3) Fast limitation of active power
  4) Fast limitation of active power due to undervoltage
  5) Limitation of active power ramp rate (if in use)
  6) Dynamic and static voltage dependency
  7) Fault ride-through capability and post-fault active power recovery (”CB open & close” test)
  8) Site specific functionalities (if needed)
  9) Remote control (FG <-> RO <-> DF)
  10) Instrumentation (access to recordings)

Simulation models to be validated against selected commissioning tests

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Thank you!
Questions?

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Please send your comments to gridcompliance@fingrid.fi

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