

Regulation D2:

Technical requirements for electricity metering

May 2007

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Preface

This regulation describes the technical requirements for electricity metering in Energinet.dk's area as well as the facilities and check procedures involved. The regulation consists to a large extent of references to the handbook 'Elmåling' (Electricity Metering) prepared by The Association of Danish Energy Companies, R&D (DEFU) and presents exemptions and additional requirements in relation to this handbook.

The regulation primarily applies to grid companies.

This regulation is effective within the framework of the Danish Electricity Supply (Consolidated) Act no. 115 of 8 November 2006 with subsequent amendments.

The regulation has been issued under the provisions of Section 8 of the Danish Executive Order no. 1463 of 19 December 2005 on transmission system operation and the use of the electricity transmission grid, etc.

The regulation will be filed with the Danish Energy Regulatory Authority.

Complaints in respect of this regulation can be lodged with the Danish Energy Regulatory Authority, Nyropsgade 30, DK-1780 Copenhagen V.

This regulation takes effect on 1 June 2007 and supersedes:

- Eltra's Regulation E2, version 2.1, of 15 June 2004.
- Elkraft System's Technical Regulation T6 of 17 December 2002

Requests for additional information and queries can be directed to Energinet.dk's contact person responsible for Regulation D2, see Energinet.dk's website at www.energinet.dk, where the latest applicable version of the regulation can be downloaded.

DEFU's handbook 'Elmåling' is available at The Danish Energy Association's website www.danskenergi.dk.

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1. General

This regulation applies to all remote-read metered data involving the transmission of values to be used in connection with settlement on an hourly or quarter-hourly basis.

For historical reasons, there are differences between the two areas east and west of the Great Belt:

- In the Eastern area (formerly Elkraft System), one requirement in the previously applicable technical regulation T6 is still in force to the effect that metering installations commissioned prior to 1 July 2002 must be brought to comply with stricter requirements for existing metering equipment before the end of 2007 unless an application for dispensation was submitted in 2005 at the latest and such dispensation was granted in accordance with the applicable rules.
- In the Western area (formerly Eltra) quarter-hourly registration of certain metered data is required, see Regulation D1.
- In the Eastern area (formerly Elkraft System) hourly registration of certain metered data is required, see Regulation D1.

This regulation revokes the stricter requirements introduced in technical regulation T6 governing units commissioned prior to 1 July 2002 for Eastern Denmark, see the clarification of the requirements relating to existing metering equipment in section 2 hereof.

There will still be differences between the East and West Danish systems as they use hourly and quarter-hourly registration, respectively, see the subsequent description and overview.

In pursuance of this regulation, the following technical requirements apply to new metering sites over 1 kV, requiring hourly registration and quarter-hourly registration, respectively:

- For operational as well as planning purposes, metering systems prepared for the transmission of active and reactive energy on the basis of quarter-hourly registrations (either kWh/kVARh or MWh/MVARh values) must be installed.

In the following, reference is made to the time resolution requirements in Eastern and Western Denmark, respectively, using the designations 15/60 reading, 15/60 resolution or 15/60 registration, or to the requirements in Regulation D1.

The 15/60 value is to be understood as an hourly value for East Danish players and a quarter-hourly value for West Danish players, see also Regulation D1.

With the exception of the rules concerning the time resolution mentioned above, the introduction of this regulation means that the same set of rules relating to the technical requirements for electricity metering is now in force in all of Denmark.

In this regulation, reference is made to various voltage levels using, for example, the designation 132-150 kV for requirements applying to the 132 kV and 150 kV grids. Similarly, the joint designation 50-60 kV applies to the 50 kV and 60 kV grids.

General requirements:

- With the exception of data metered in metering points for end consumption, for which purpose profile settlement is used in accordance with current rules, and generation metering in pursuance of Regulation D1, metered energy data must be registered on the basis of one hour or quarter of an hour (15/60 registration).
- In pursuance of the Danish Electricity Supply Act, the individual grid companies are obliged to ensure that the required metering systems are in place and are responsible for the daily collection of 15/60 registrations and the simultaneous distribution of checked and approved data to all legitimate recipients in accordance with regulations.
- Energinet.dk prescribes that the above be done by means of Ediel messages, see Regulations D1 and F.

The overall general requirements for settlement metering are described in Regulation D1.

With this regulation, DEFU's recommendations in the handbook "Elmåling" are made statutory for new units. In general, the handbook stipulates as follows:

- For installations which have had the right to market access and/or to change balance responsible party (BRP) since 1 January 2003, the cut-off date mentioned in the handbook, ie 1 July 2002, does not become effective until 1 January 2003.
- When renovating or converting units in the metering circuits, the requirements relating to metering equipment in new installations must be observed.

1.1 Background and objectives

Energinet.dk's Regulations D1 and D2 describe the practical and technical requirements relating to settlement metering.

Regulation D1 stipulates that all meters in the system have one and only one metered data collector and that this collector is always a grid company. It also stipulates that grid companies have access to all meters in the grid company's grid areas, including meters in local units.

As grid companies are metered data collectors, they are, among other things, responsible for ensuring that:

1. Meters are installed in pursuance of current regulations.
2. Metering sites always comply with the technical requirements in this regulation, including requirements for metering accuracy, remote meter reading, checking and maintenance of metering systems in operation as well as the provision and updating of documentation.
3. 15/60 metered data to be used for settlement purposes are remote-read daily and quality-checked.
4. Metered time series are distributed to all legitimate recipients at the same time.

The grid company may delegate some of its metering tasks to metering point administrators, as defined in Regulation D1, but the main responsibility for ensuring that tasks are solved in pursuance of regulations, that data are treated confidentially and independently of commercial interests and that data are only distributed to legitimate recipients always rests with the grid company. The discretionary policy is outlined in Regulation G, which is available at Energinet.dk's website.

Since 1 January 2003, all end consumers have had the right to choose electricity supplier, and this regulation therefore applies to all metering sites using 15/60 settlement in Denmark.

This regulation aims at determining the technical requirements for electricity metering with the facilities and check procedures involved.

2. Basic requirements

As mentioned previously, this regulation is based on DEFU's handbook 'Elmåling'. The corner stone of the handbook is various technical reports:

- TR353: Målerinstallationer for transformermåling (lav- og højspænding)
(Metering installations for transformer metering (low and high voltage))
- TR354: Indgangskontrol af nye og istandsatte elmålere
(Access control of new and renovated electricity meters)
- TR355: Kontrolsystem for idriftværende elmålere
(Check system for electricity meters in operation)
- TR356: Kontrolmetoder på målestedet
(Check methods at the metering site)
- TR357: Baggrundsrapport til DEFU's TR353, TR354, TR355 og TR356
(Background report for DEFU's technical regulations TR353, TR354, TR355 and TR356)
- RA436: Fjernaflæsning af elmålere
(Remote reading of electricity meters)

These reports have been prepared as recommendations, the status of which is changed by virtue of this regulation so that they must now be considered statutory requirements for new metering systems in Energinet.dk's TSO area. Documentation must be provided for existing metering equipment of 1 kV or higher, see later.

In the handbook, the "electricity supplier" is equivalent to the metered data collector mentioned in this regulation. It is emphasised that the designation "electricity supplier" is also used in Energinet.dk's set of electricity market rules but with a completely different definition.

The handbook describes in detail the requirements relating to settlement meter installation which apply to new plants.

Note that the handbook referred to is the current handbook at any given time.

Immediately after the publication of this regulation, the individual reports contained in the handbook will be revised in co-operation between the Danish Energy Association and Energinet.dk under the auspices of the Electricity Metering Technology Committee (Elmåleteknikudvalget).

Existing metering equipment in grids over 1 kV must comply with the following:

- All metered data must within a five-year deadline expiring on 1 June 2012 be brought to comply with the documentation requirements in the handbook
- Units must, however, be brought to comply with the documentation requirements during the first-coming technical inspection, renovation or conversion
- For metering circuit requirements, please see clause 7.4 of TR 353

3. Metering sites – where to meter?

Settlement metering using 15/60 registration

In accordance with the settlement metering requirements outlined in Regulation D1 and "Guidelines for the net settlement of autoproducers" the following list of necessary settlement metering sites using 15/60 registration can be compiled:

Category	Voltage level	Metering site type	Check meter required	MVARh-meter ¹ required
1	60-400 kV	Exchange with foreign countries	Yes	Yes ⁶
2	132-150 kV	Exchange in 400/150-132 kV substations ¹	No	Yes ⁶
3	10-150 kV	Exchange in 132-150/60-50-30-10 kV substations ²	Yes	Yes ⁶
4	50-60 kV	Exchange with adjacent grid areas to and from 50-60 kV grid areas	Yes	Yes ⁶
5	10 kV	Exchange with adjacent grid areas to and from local grid areas, typically 10 kV	Yes	Yes ⁶
6	150-400 kV	Production at central production units	Yes	Yes ⁶
7	60/50-0.4 kV	Production at local CHP plants ⁵ (including local units)	Yes, if > 2 MW*	No
8	60/50-0.4 kV	Production at wind power stations ⁴	Yes, if > 2 MW*	No
9	60/50-0.4 kV	Production and exchange with autoproducers (commercial power stations) ⁵	Yes, if > 2 MW*	No
10	10-0.4 kV	Other local production (eg hydropower) ⁴	Yes, if > 2 MW*	No
11	100-400 kV	End consumption. The end consumption of central power stations is considered in all contexts as having been drawn from the 132-150 kV grid ⁵ .	Yes ³	Yes ⁶
12	< 100 kV	End consumption for all customers using 15/60 settlement whether or not the right to freely choose supplier is exercised or not. See also Regulations H1 - H3.	Yes if ≥ 1 kV ³	No

* Totalled installed capacity included in the settlement.

Table 1: Necessary settlement metering points using 15/60 registration and indication of the necessity of installing check and MVARh meters.

¹ Reading is currently not being used for settlement purposes.

² Applies to all transformation from 132-150 kV to lower voltage levels. The meter must be placed on the border between the two grids that are at the parties' disposal.

³ In pursuance of clause 7.1 of TR 353, check meters are required at voltages ≥ 1 kV.

⁴ Wind turbines < 25 kW are exempt, see [Ref. 2].

⁵ The requirement for 15/60 registration applies to units ≥ 50 kW, see [Ref. 2]. Production units > 2 MW must always be equipped with check meter even if the voltage is lower than 1 kV. Production units settled in accordance with the Danish Executive Order no 759 of 24 August 2001 (Net settlement) must always use 15/60 registration unless they follow the rules in [Ref. 2].

⁶ The upgrading of existing units is not required at present.

If bi-directional energy flow is possible, meters must be installed in both directions.

In general, the meter accuracy classification is determined by the voltage level at which metering is actually performed.

Electricity metering performed at the lowest voltage level of a transformer must, however, comply with the same requirements for metering installations as apply to electricity metering carried out at the highest transformer voltage level. The precondition for performing metering at the lowest voltage level is that the purchase of power transformers be based on a uniform loss assessment.

Excepted from this is production with a nominal output at the metering site of < 2.0 MVA. These metering installations need only comply with the requirements applying to the current voltage level.

Production used solely as auxiliary supply for plants placed at the disposal of Energinet.dk need not be metered.

4. Metering equipment requirements

Metering equipment can be broken down into the following components:

- Current transformer
- Voltage transformer
- Metering circuit
- Electricity meter
- Registration and transfer equipment

4.1 Settlement metering requirements

Table 2 below is a copy of Table 5.1 in TR353, with the exception of the date, 1 January 2003, which applies instead of the date mentioned in the handbook, ie 1 July 2002.

	Voltage level ⁸	Main meter	Check meter	Current transformer IEC 60044-1	Voltage transformer IEC 60044-2	Max. permissible total voltage drop
Commissioned before 1 January 2003	0.4 kV	2	2	0.5	-	0.2%
	0.4-1 kV	1	2	0.5	0.5	0.2%
	1-25 kV	1	1	0.5	0.5	0.2%
	25-100 kV	0.5	1	0.5	0.5	0.2%
	over 100 kV	0.5	1	0.5	0.5	0.2%
Commissioned after 1 January 2003	0.4 kV	1	1	0.2S	-	0.2%
	0.4-1 kV	1	1	0.2S	0.2	0.2%
	1-100 kV	0.5S	0.5S	0.2S	0.2	0.2%
	over 100 kV	0.2S	0.2S	0.2S	0.2	0.2%

Table 2: Minimum requirements for accuracy classifications for settlement meters and meter transformers.

The requirements only apply to settlement meters, the installation of which is explicitly required, see section 3.

Electricity metering performed at the lowest transformer voltage level must comply with the same requirements for metering installations as apply to electricity metering carried out at the highest transformer voltage level. The precondition for performing metering at the lowest voltage level is that the purchase of power transformers be based on a uniform loss assessment.

Classification 2 is generally accepted for MVARh meters⁹.

Where Energinet.dk requires meters for operational or planning purposes, requirements are set individually.

Where requirements for pulse constants are concerned, reference is made to clause 6.3 of TR353 in the handbook 'Elmåling'. Furthermore, a finite number of kWh per pulse is required to safeguard against rounding errors. As such, it is necessary to multiply by a factor of, for example $n \cdot 10$, in order to calculate a finite number of kWh/kVARh. A finite number could be 1.5 and not, for example, 1.33.

⁸ Where an interval is stated, the lower limit is not included.

⁹ EN 62053-23 comprises MVARh meters, classifications 2 and 3.

Reference is made to the fact that meters installed in consumption metering points, which are covered by the Danish Executive Order on individual metering, must comply with the requirements laid down in the Danish Executive Order no. 1035 of 17 October 2006 issued by The Danish Safety Technology Authority. The executive order includes requirements for meter monitoring, type approval in Denmark and initial verification.

4.1.1 Settlement metering requirements - new units

DEFU's handbook 'Elmåling' describes the current requirements in relation to metering installations.

4.1.2 Settlement metering requirements - existing units

The requirements for the existing physical metering installations are not sharpened, see section 2, but importance is attached to providing sufficient documentation for metering installations within a five-year period in pursuance of DEFU's handbook 'Elmåling'.

4.2 Requirements for initial connection of end consumers

Reference is made to Regulation D1.

4.3 Registration equipment requirements

The following requirements apply to new units:

- Where main and check meters are required, both meters are remote-read, and data are transmitted at the same frequency. As such, two time series are transmitted.
- Registration equipment must be able to store at least ten days' data.
- Registration when switching to summer or standard daylight saving time must be performed without the loss of any data using individual 15/60 registrations (this applies in particular to the 25-hour day when switching from summer time to standard daylight saving time).

4.4 Check procedures

In pursuance of Regulation D1, the grid company must daily collect and check 15/60 registrations. The grid company must round off the check procedure by approving the individual 15/60 registrations.

4.4.1 Daily check of main and check meters (permanent monitoring)

The check must be performed in pursuance of DEFU's handbook 'Elmåling' as well as technical reports TR355 and RA436. The check method must be documentable.

5. Documentation

DEFU's handbook 'Elmåling' comprises a specification of the documentation standard for metering installations over 1 kV.

Chapter 8 of the TR353 technical report includes a specification of the minimum documentation standard for high-voltage metering installations.

There are no formal requirements to store the documentation on a specific medium.

The deadline for observing the documentation standard for high-voltage metering points can be seen in section 2 of this regulation.

The documentation standard for metering points of 25 kV and lower are described in complete detail in DEFU's handbook 'Elmåling' [Ref. 1].

6. Audit

The metering installations described in this regulation may be subjected to audit procedures involving check visits from an auditing corps appointed by Energinet.dk in accordance with instructions of which the grid companies will be notified before the audit is initiated.

7. References

[1]: DEFU's handbook 'Elmåling' (Electricity Metering), general chapters and the following technical reports:

- TR353: Målerinstallationer for transformermåling (lav- og højspænding).
(Metering installations for transformer metering (low and high voltage))
- TR354-2: Verifikation af elmålere
(Electricity meter verification)
- TR354-1: Verifikation af elmålere (produceret og/eller typegodkendt efter de nye standarder)
(Electricity meter verification (meters produced and/or type approved in accordance with the new standards).)
- TR355: Check system for electricity meters in operation.
(Check system for electricity meters in operation)
- TR356: Check methods at the metering site.
(Check methods at the metering site)
- TR357: Background report for DEFU's technical regulations TR 353, TR 354, TR 355 and TR356.
(Background report for DEFU's technical regulations TR353, TR354, TR355 and TR356)
- RA436: Remote reading of electricity meters
(Remote reading of electricity meters)

[2]: Regulation D1 "Settlement metering and settlement basis"