

EXPERIENCE WITH VOLTAGE QUALITY MONITORING IN HUNGARY

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First period of voltage monitoring

- **Regulators** invented tender for 400 voltage quality recorders compliant with EN 61000-4-30 (Class B) in 2003.
- Voltage quality recorders were installed each semester **in one** of the six DSOs.
- At **low voltage consumers only** (0.007% related to LV consumers).
- The **cost** of monitoring **was shared** between regulator (cost of VQ recorder) and DSO (bearing the cost of installation and removal).

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First period of voltage monitoring

Underlying principles

- Measured data should not be modified,
- Independent organization, financed by regulator, should carry out
 - Operation and maintenance of recorders,
 - Measurement and collection of data, and
 - Evaluation of measurements/data
- Evaluation and results of measurement should be available for the DSO.
- Regulator choose the network points randomly irrespective of previous events or complaints.
- The system uses GSM for automatic remote reading.

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First period of voltage monitoring

At the early stage

- The first years: the monitoring was a test in order
 - to check and improve the recorders,
 - to learn the correct measurement,
 - to learn remote reading,
 - to learn how to handle the enormous amount of data.

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First period of voltage monitoring

Measured parameters

Supply voltage variations (10 min mean)
Voltage unbalance
Minimum and maximum within 10 min mean
Harmonic voltages, TDH
Voltage swells
Voltage dips
Voltage outage [short and long outages (duration and frequency)]

Measurement in three LV phases

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First period of voltage monitoring

Numbers of measurements and measured values

10 minute mean r.m.s values measurements in a semester/recorder

$$6 \cdot 24 \cdot 180 = 25920$$

10 minute mean minute mean r.m.s values in a semester/DSO

$$25920 \cdot 400 = 11\,368\,000$$

Within 10 minute

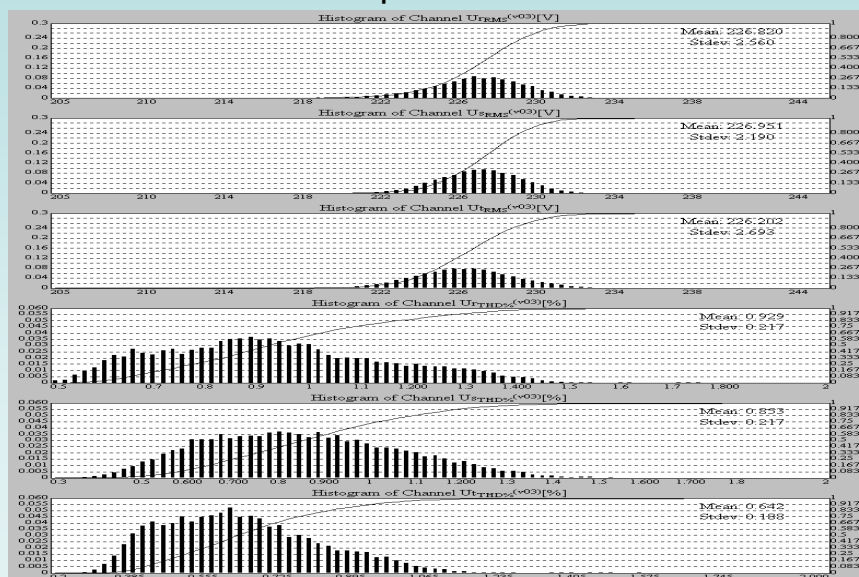
Ur.m.s., Min and Max value, Voltage unbalance, swells, dips, harmonics, TDH, flicker (number and time), furthermore short and long outage time

Total number of values in a semester/DSO

more than 100 000 000 values

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Histograms of U_{RMS} and U_{TDH} in LV R,S,T phases



First period of voltage monitoring
Statistics of phase R (per semester,
DSO, 380 recorders)

UrAv	Min	P5	Average	P95	Max
Min	210.09	214.87	220.63	225.45	229.05
P5	211.86	219.73	225.59	229.58	231.97
Average	219.99	228.58	233.11	236.96	240.47
P95	228.58	236.53	240.47	244.05	247.50
Max	234.86	241.73	245.26	249.22	251.63

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Main results of the first period of monitoring

- **Both** the regulator and DSO learned the voltage monitoring culture,
- All of the DSOs learned the **same technology**,
- **Practical outcomes** of first period of monitoring:
 - It gives the possibility to introduce the same monitoring method **in the country**,
 - Regulator could limit the acceptable numbers of short interruption on consumer's site
 - Regulator could propose **recommendation for uniform electric voltage quality monitoring system for all DSOs.**

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Second period of voltage monitoring

- On the ground of the experiences of the first period **Regulator prepared a proposal** for DSOs to monitor voltage quality.
- **Consultation process** was applied for proposal
- After consultation process **the Regulator issued in 2008**
„Professional recommendation for the establishment of uniform electric voltage quality monitoring system”.

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Second period of voltage monitoring

The objective of the professional recommendation

- **To establish** a uniform voltage quality monitoring system in Hungary on the basis of the domestic experiences gained up to now.
- **To determine** a voltage quality monitoring system to be performed by uniform measuring devices.
- **To continue** the measurements started by the Regulator, and the DSOs could apply this practice.
- **To develop** permanently the monitoring measurements method.

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Second period of voltage monitoring

Main parts of the professional recommendation

- **Country-wide measurement**
 - Tasks to be done by DSOs
 - Requirements relevant to the measuring points
 - Uniform system of requirements of the applied measuring devices
- **Handling of voltage complaint**
 - Separation of the subjects of voltage quality
 - Viewpoints relevant to the installation of the measuring devices
 - Selection of the place of installation of the measuring device
- **Report to the regulator**

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Second period of voltage monitoring

Data supply to Regulator by March 31 subsequent to the reference year

- **Total number and the duration** of the measurements.
- Way of installation of the measuring devices and the **duration by measuring sites.**
- Distribution of the measurement **by voltage levels: MV, LV.**
- **Duration of being beyond** from the $\pm 10\%$ tolerance range based on the 10 minute mean voltage values in 100% of the measurements.
- Number of measuring sites supplied with non-standard voltage on a **permanent basis.**

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➤ To fill in the following table for turnover voltage (summarizing all measurements, Duration t [ms]):

Turnover voltage U [%]	20 < t ≤ 200	200 < t ≤ 500	500 < t ≤ 1000	1000 < t ≤ 5000	5000 < t ≤ 60000
120 < U					
120 > U ≥ 115					
115 > U ≥ 110					
90 > U ≥ 80					
80 > U ≥ 70					
70 > U ≥ 40					
40 > U ≥ 10					
10 > U					

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Special Voltage monitoring: Guaranteed standards 2/1

Voltage quality requirements in Hungary

- In general EN 50160 except for supply voltage variations
- Requirements based on experiences gained before EN 50160 and privatization;
- The **supply voltage variations for LV consumers**:
 - **At least 95%** of the 10 minute mean r.m.s values of supply voltage shall be within the limit of **Un±7,5%** in a week,
 - **100%** of all 10 min mean r.m.s. shall be within **Un ±10%** in a week;
 - **Each 1 minute** mean r.m.s. value of supply voltage variations shall not be beyond the limit of **Un+10% and not below Un-15%** (no exemption for remote areas);
 - **70 short interruptions** for LV and MV customers in a year;
 - Max. 25 short interruptions in a quarter year.

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Special Voltage monitoring: Guaranteed standards 2/2

Checking up voltage complaint

- ❖ DSO **initiates** the measurement within 10 days,
- ❖ DSO finishes **the measurement** in 5 days after agreement with the customer,
- ❖ DSO **gives information** on the results in 15 days.

Total compensation in year 2007: around € 1,3 million.

Compensation if the voltage requirements are not fulfilled in the first year

- ❖ **In the first semester of the second year:** quarterly compensation,
- ❖ **From second semester and on:** every monthly compensation.

Total compensation in year 2007 around € 0,3 million.

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Thank you for your attention!



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