Recommendations for Quality of Service Data Collection, Reporting and Auditing in the Energy Community

Energy Institute Hrvoje Požar, TELVENT DSM
April 2012
RECOMMENDATIONS FOR QUALITY OF SERVICE
DATA COLLECTION, REPORTING AND AUDITING
IN THE ENERGY COMMUNITY

Energy Community Study – Final Report

2 April 2012
REPORT PREPARED BY

ENERGY INSTITUTE HRVOJE POZAR
Zagreb, Croatia

TELVENT DMS LLC
Novi Sad, Serbia

WITH SUPPORT FROM
ENERGY COMMUNITY SECRETARIAT
Vienna, Austria

Title: RECOMMENDATIONS FOR QUALITY OF SERVICE DATA COLLECTION, REPORTING AND AUDITING IN THE ENERGY COMMUNITY

Region: ENERGY COMMUNITY CONTRACTING PARTIES AND OBSERVERS

Purchaser: ENERGY COMMUNITY SECRETARIAT, VIENNA, AUSTRIA

Consultant: ENERGY INSTITUTE HRVOJE POZAR Zagreb, Croatia
General Manager: GORAN GRANIC, Ph.D.

Subcontractor: TELVENT DMS LLC Novi Sad, Serbia
Member of the Board of Directors: VLADIMIR STREZOSKI, Ph.D.

Authors:
- Tomislav Baricevic, B.Sc. tbarinevic@eihp.hr
- Nijaz Dizdarovic, Ph.D. ndizdarovic@eihp.hr
- Goran Majstrovic, Ph.D. gmajstrovic@eihp.hr
- Dino Mileta, B.Sc. dmileta@eihp.hr
- Minea Skok, Ph.D. mskok@eihp.hr
- Sonja Kanjuh, B.Sc. sonja.kanjuh@telventdms.com
- Vesna Stefani, M.Sc. vesna.stefani@telventdms.com
- Goran Svenda, Ph.D. goran.svenda@telventdms.com
- Tomislav Baricevic, B.Sc. tbaricevic@eihp.hr

Supervisors:
- Goran Granić, Ph.D. (for general aspects of the study) ggranic@eihp.hr
- Tomislav Baricevic, B.Sc. (for questions on the substance) tbaricevic@eihp.hr

Phone: +385 1 6326 144 +385 1 6326 103
Fax: +385 1 6040 599 +385 1 6040 599
e-mail: ggranic@eihp.hr tbaricevic@eihp.hr
# Contents

## I Introduction

1.1 Summary of Previous Relevant Activities

1.2 Study Objectives and Scope

1.2.1 Objectives

1.2.2 Purpose

1.2.3 Scope

1.2.4 Activities and Deliverables

1.3 Overview of the Energy Community Acquis and EU’s Third Package Legislation

1.3.1 Example of Transposition of Directive 2009/72/EC with respect to the Quality of Service and Supply

## II General Guidelines for the Quality of Supply Regulation

II.1 Fundamentals of the Quality of Supply Regulation

II.2 Definitions of Terms

II.3 General Guidelines for Service Providers Reporting to the National Regulatory Authorities

## III Continuity of Supply

III.1 Continuity of Supply Indicators

III.1.1 Indicator of Average Cumulative Duration of Power Supply Interruptions in the System (SAIDI)

III.1.2 Indicator of Average Power Supply Interruption Frequency in the System (SAIFI)

III.1.3 Indicator of Average Power Supply Interruption Duration per Customer (CAIDI)

III.1.4 Indicator of Average Power Supply Interruption Frequency per Customer (CAIFI)

III.1.5 Indicator of Average Short Power Supply Interruption Frequency in the System (MAIFI)

III.1.6 Unsupplied Energy (ENS)

III.1.7 Average Duration of Interruptions (AIT)

III.1.8 average Frequency of Interruptions (AIF)

III.1.9 Average Interruption Duration (AID)
### III.2 Guidelines for Service Providers Reporting to the National Regulatory Authorities on the Continuity of Supply

#### III.2.1 Power Supply Interruption

#### III.2.2 Network Supply Areas

#### III.2.3 Reporting Frequency and Deadlines

#### III.2.4 Data for Reporting on the Continuity of Supply Indicators

### III.3 Guidelines for Service Providers Reporting to Customers on the Continuity of Supply

### III.4 Recommendations for Complaint Handling Procedures in Relation to the Continuity of Supply

### III.5 Reporting Guidelines for Benchmarking on the Energy Community Level in Relation to the Continuity of Supply

### III.6 Guidelines for Data Collecting and Auditing in Relation to the Continuity of Supply

#### III.6.1 Recommendations for Data Collecting

#### III.6.2 Guidelines for Introducing Verifiable Data Collecting Procedures

#### III.6.3 Guidelines for Auditing Data Collecting Procedures

#### III.6.4 Guidelines for Auditing Reports by Service Providers to National Regulatory Authorities

#### III.6.5 Recommendations for Auditing Digital Registers, Software and Systems

### III.7 Recommendations on Gradual Introduction of Regulatory Instruments in Relation to the Continuity of Supply

#### III.7.1 Guidelines for Gradual Development of THE Continuity of Supply Regulation

#### III.7.2 Recommended Analyses

#### III.7.3 Methodologies for Defining Target Values of the Continuity of Supply Indicators

### III.8 General Overview of the Situation in the Energy Community Contracting Parties and Observers in Relation to the Continuity of Supply

### IV VOLTAGE QUALITY

#### IV.1 Voltage Quality Legislation, Regulation and Standardization

#### IV.2 Voltage Quality Indicators

#### IV.2 Guidelines for Service Providers Reporting to the National Regulatory Authorities on the Voltage Quality

#### IV.3 Guidelines for Service Providers Reporting to Customers on the Voltage Quality

#### IV.4 Recommendations for Complaint Handling Procedures in Relation to the Voltage Quality
## Contents

<p>| IV.5 | Reporting Guidelines for Benchmarking on the Energy Community Level in Relation to the Voltage Quality | 69 |
| IV.6 | Guidelines for Data Collecting and Auditing in Relation to the Voltage Quality | 70 |
| IV.7 | Recommendations on Gradual Introduction of Regulatory Instruments in Relation to the Voltage Quality | 74 |
| IV.7.1 | Guidelines for Gradual Development of the Voltage Quality Regulation | 74 |
| IV.7.2 | Recommended Analyses | 79 |
| IV.8 | General Overview of the Situation in the Energy Community Contracting Parties and Observers in Relation to the Voltage Quality | 81 |
| V | COMMERCIAL QUALITY | 85 |
| V.1 | Parameters of the Commercial Quality | 85 |
| V.1.1 | Connection to the Network | 85 |
| V.1.2 | Customer Care | 89 |
| V.1.3 | Technical Services | 93 |
| V.1.4 | Metering and Billing | 97 |
| V.1.5 | Consistency Level of the Commercial Quality | 99 |
| V.2 | Guidelines for Service Providers Reporting to the National Regulatory Authorities on the Commercial Quality | 100 |
| V.3 | Guidelines for Service Providers Reporting to Customers on the Commercial Quality | 102 |
| V.4 | Recommendations for Complaint Handling Procedures in Relation to the Commercial Quality | 103 |
| V.5 | Reporting Guidelines for Benchmarking on the Energy Community Level in Relation to the Commercial Quality | 109 |
| V.6 | Guidelines for Data Collecting and Auditing in Relation to the Commercial Quality | 110 |
| V.6.1 | Recommendations for Data Collecting | 110 |
| V.6.2 | Guidelines for Introducing Verifiable Data Collecting Procedures | 110 |
| V.6.3 | Guidelines for Auditing Data Collecting Procedures | 112 |
| V.6.4 | Guidelines for Auditing Reports by Service Providers to National Regulatory Authorities | 116 |
| V.6.5 | Recommendations for Auditing Digital Registers, Software and Systems | 117 |
| V.7 | Recommendations on Gradual Introduction of Regulatory Instruments in Relation to the Commercial Quality | 118 |
| V.7.1 | Guidelines for Gradual Development of the Commercial Quality Regulation | 118 |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>V.7.2</td>
<td>Recommended Analyses</td>
<td>129</td>
</tr>
<tr>
<td>V.7.3</td>
<td>Methodologies for Defining Target Values of the Commercial Quality Indicators</td>
<td>131</td>
</tr>
<tr>
<td>V.8</td>
<td>General Overview of the Situation in the Energy Community Contracting Parties and Observers in Relation to the Commercial Quality</td>
<td>132</td>
</tr>
<tr>
<td>VI</td>
<td>CONCLUSIONS AND RECOMMENDATIONS</td>
<td>135</td>
</tr>
<tr>
<td>ANNEXES</td>
<td></td>
<td>143</td>
</tr>
<tr>
<td>Annex 1</td>
<td>Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval</td>
<td>143</td>
</tr>
<tr>
<td>Annex 2</td>
<td>Grouping of Events</td>
<td>144</td>
</tr>
<tr>
<td>Annex 3</td>
<td>Example of Template for Registering Power Supply Interruption Data</td>
<td>145</td>
</tr>
<tr>
<td>Annex 4</td>
<td>Example of Report on the Continuity of Supply Indicators</td>
<td>146</td>
</tr>
<tr>
<td>Annex 5</td>
<td>Example of Calculation of Indices for Auditing the Continuity of Supply Data in Italy</td>
<td>147</td>
</tr>
<tr>
<td>Annex 6</td>
<td>Examples of Calculation and Reporting on Voltage Quality Parameters and Indicators</td>
<td>150</td>
</tr>
</tbody>
</table>
I INTRODUCTION

I.1 SUMMARY OF PREVIOUS RELEVANT ACTIVITIES

In the Energy Community’s electricity market and many others, the national regulatory authorities aim to ensure that the market liberalization is achieved without any worsening of the quality of service. The Energy Community framework requires to ensure that all household customers and, optionally, small enterprises enjoy universal service – the right to be supplied with electricity of a specified quality at reasonable, easily and clearly comparable and transparent prices.

The Third Package strengthens further the protection of customer interests and duties and powers of the national regulatory authorities with respect to the quality of electricity service. More precisely, the national regulatory authorities are obliged to monitor compliance with and review the past performance of network security and reliability rules and to set or approve standards and requirements for the quality of service and supply.

In late 2008 the Energy Community Regulatory Board (ECRB) published the “Report on the Quality of Electricity Service – Standards and Incentives in Quality Regulation” 1. The report concluded that the status and approaches to the quality of service regulation issues are very different in the Contracting Parties, and recommended the initiation of the study on introduction and improvement of the quality of supply regulation in the Energy Community.

During 2009 and 2010, the Energy Community financed the study “Assistance to regulators in introducing and improving service quality regulation in the Energy Community” 2, which was also performed by EIHP as the consultant. In the framework of the study, two workshops were organized to provide training of the regulatory staff. The consultant analyzed the reports on the quality of electricity service, which were prepared by participating national regulatory authorities of the Contracting Parties and Observers.

The results achieved within the scope of the study clearly showed the need for additional future effort in the field of the quality of electricity service in the Energy Community. The study concluded that the main preparatory activities for introduction of the quality of electricity service regulation are related to collecting and auditing of relevant data. Thus, the 2011 Work Programme of the ECRB Customer Working Group (CWG) 3 foresees a project on preparing guidelines of good practice for the quality of electricity service data collecting and auditing.

---

I.2 STUDY OBJECTIVES AND SCOPE

I.2.1 OBJECTIVES

The overall objective of the study is to start up the activities on introduction and improvement of the quality of electricity service within the ECRB (namely its CWG) and other Energy Community institutions.

The study will enable the national regulatory authorities, primarily, to ensure that liberalization of the electricity market is achieved without any worsening of the quality of electricity service.

The main preparatory activities for introduction of the quality of electricity service regulation are related to collecting and auditing of relevant data. Therefore, the objective of the study is to provide recommendations for:

- the quality of electricity service data collecting, reporting and auditing; and
- the gradual development of the quality of service (QoS) regulation.

building upon previously performed consultancy “Assistance to regulators in introducing and improving service quality regulation in the Energy Community” and “2nd ECRB Benchmarking Report On the Quality of Electricity Supply”.

I.2.2 PURPOSE

The purpose of the study is to provide recommendations for the quality of electricity service data collecting, reporting and auditing and the gradual development of the quality of service regulation, aimed at improving the quality of electricity service in the Energy Community, with regard to:

- the continuity of supply (CoS);
- the voltage quality (VQ);
- the commercial quality (CQ).

I.2.3 SCOPE

The study will cover the Energy Community Contracting Parties and Observers (excluding Norway), namely Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Georgia, Moldova, Montenegro, Serbia, Ukraine, UNMIK and Turkey.

The scope of the study consists of the following tasks:

1. to recommend data collecting methodology for different aspects of the quality and different indices,
2. to delineate detailed guidelines for collecting data needed for determining QoS indices and for statistical analyses of data/indices,
3. to provide exact and precise definitions of indices including in-depth calculation and data collecting,
4. to provide glossary of terms needed to harmonize procedures for the calculation of indices,
5. to set down guidelines for utilities reporting to the national regulatory authorities (NRAs) together with a template providing an appropriate set of indices,
6. to set down guidelines for utilities reporting to customers with examples of such reports,
7. to set down reporting guidelines for the NRAs for benchmarking on the Energy Community level together with a proposal for a benchmarking report (structure),
8. to inform on acceptable and indicative values of individual QoS indices commonly used by the utilities and NRAs,
9. to set down guidelines for introducing verifiable data collecting procedures:
   a) step-by-step guides for the NRAs to approve data collecting and reporting by the utilities,
   b) guidelines on regular auditing,
   c) guidelines on unannounced auditing,
10. to provide recommendations for auditing digital registers, software and systems used for the quality of service,
11. to provide recommendations for appropriate complaint handling with examples/best practice carried out by the utilities and NRAs,
12. to provide recommendations on gradual introduction of regulatory instruments such as Minimum Quality Standards (MQS), Penalty Reward Schemes (PRS), and Premium Contracts (PC), including
   a) for the gradual development of the QoS regulation,
   b) recommended scope and content of cost-benefit or other analyses used in the process of introducing new regulatory instruments related to the QoS,
   c) methodologies for defining target values of the quality indices on the national level respecting different regulatory schemes for the QoS regulation,
13. to provide detailed overview of the Energy Community *acquis*[^4] and the EU’s Third Package legislation regarding the QoS in the electricity sector,
14. in regard to specific aspects of the quality, the study should also provide:

[^4]: [http://www.energy-community.org/portal/page/portal/ENC_HOME/ENERGY_COMMUNITY/Legal](http://www.energy-community.org/portal/page/portal/ENC_HOME/ENERGY_COMMUNITY/Legal)
a) Continuity of Supply:
   i. appropriate definition of the *Force Majeure* with exemptions in relation to the CoS;
   ii. calculation of indices related to special events;

b) Voltage Quality:
   i. list of widespread standards related to the VQ and their relation to the VQ regulation;
   ii. recommendation for using standards in the VQ regulation;
   iii. examples of methods for individual VQ verification;
   iv. examples of system wide VQ monitoring and data collecting;

c) Commercial Quality
   i. list of indispensable and optional indices (services) to monitor related to the CQ.

### 1.2.4 ACTIVITIES AND DELIVERABLES

Within the project, the following reports are to be prepared and activities carried out:

1. Organization and preparation of the project activities with the ECRB CWG members in order to align activities and expected results.

2. The Inception Report outlining the envisaged approach to the study, provided not later than one month after signing of the contract for the study, subject to review and advice of the ECRB CWG and the Steering Committee established for the ECRB related studies financed by the Energy Community and final approval by the ECS.

3. Analysis of the current status of the quality of electricity service data collecting and auditing procedures in the Energy Community based on the data received for the Energy Community annex to the CEER’s 5th Benchmarking Report on Quality of Electricity Supply and possible additional contributions by the Contracting Parties and Observers\(^5\).

4. The Draft Final Report including all the content specified in the scope of the work and recommendations for the future steps related to the regulatory activities in the field of the quality of electricity service, submitted to the Energy Community Secretariat not later than five months after signing of the contract for the study.

5. The workshop for representatives of the national regulatory authorities and service providers in the Contracting Parties and Observers, with the objective to discuss

---

\(^5\) Instead of initially proposed questionnaire among the national regulatory authorities.
the most important topics from the scope of the study and gather advices and recommendations given by workshop participants.

6. The Final Report which should, in addition to the content of the Draft Final Report, comprise recommendations and advices of the ECRB CWG and the study Steering Committee as well as suggestions gathered from the national regulatory authorities of the Contracting Parties and Observers during the workshop.

I.3 OVERVIEW OF THE ENERGY COMMUNITY ACQUIS AND EU’S THIRD PACKAGE LEGISLATION


Directive 2003/54/EC mentions the quality as a term at the following places:

- **Preamble (24)** – in the context of universal service

  *Member States should ensure that household customers and, where Member States deem it appropriate, small enterprises, enjoy the right to be supplied with electricity of a specified quality at clearly comparable, transparent and reasonable prices.*

- **Article 3 paragraph 2** – in the context of public service obligations

  *Having full regard to the relevant provisions of the Treaty, in particular Article 86 thereof, Member States may impose on undertakings operating in the electricity sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency and climate protection. Such obligations shall be clearly defined, transparent, non discriminatory, verifiable and shall guarantee equality of access for EU electricity companies to national consumers.*

- **Article 3 paragraph 3** – in the context of universal service

  *Member States shall ensure that all household customers, and, where Member States deem it appropriate, small enterprises, (namely enterprises with fewer than 50 occupied persons and an annual turnover or balance sheet not exceeding EUR 10 million), enjoy universal service, that is the right to be supplied with electricity of a specified quality within their territory at reasonable, easily and clearly comparable and transparent prices. To ensure the provision of universal service, Member States may appoint a supplier of last resort. Member States shall impose on distribution companies an obligation to connect customers to their grid under terms, conditions and tariffs set in accordance with the procedure laid down in Article 23(2).*

---

Article 4 – in the context of monitoring of security of supply

Member States shall ensure the monitoring of security of supply issues. Where Member States consider it appropriate they may delegate this task to the regulatory authorities referred to in Article 23(1). This monitoring shall, in particular, cover the supply/demand balance on the national market, the level of expected future demand and envisaged additional capacity being planned or under construction, and the quality and level of maintenance of the networks, as well as measures to cover peak demand and to deal with shortfalls of one or more suppliers. The competent authorities shall publish every two years, by 31 July at the latest, a report outlining the findings resulting from the monitoring of these issues, as well as any measures taken or envisaged to address them and shall forward this report to the Commission forthwith.

Annex A – in the context of measures on consumer protection

… the measures referred to in Article 3 are to ensure that customers:

(a) have a right to a contract with their electricity service provider that specifies

- the services provided, the service quality levels offered, as well as the time for the initial connection,

- any compensation and the refund arrangements which apply if contracted service quality levels are not met.

Directive 2009/72/EC further expands the quality as a term:

Preamble (45) – in the context of universal service

Member States should ensure that household customers and, where Member States deem it appropriate, small enterprises, enjoy the right to be supplied with electricity of a specified quality at clearly comparable, transparent and reasonable prices.

Preamble (51) – in the context of strengthening consumer interests

Consumer interests should be at the heart of this Directive and quality of service should be a central responsibility of electricity undertakings. Existing rights of consumers need to be strengthened and guaranteed, and should include greater transparency. Consumer protection should ensure that all consumers in the wider remit of the Community benefit from a competitive market. Consumer rights should be enforced by Member States or, where a Member State has so provided, the regulatory authorities.

Preamble (61) – in the context of provision of information by regulatory authorities

Regulatory authorities should also provide information on the market to permit the Commission to exercise its role of observing and monitoring the internal market in electricity and its short, medium and long-term evolution, including aspects such as generation capacity, different sources of electricity generation, transmission and distribution infrastructure, quality of service, cross-border trade, congestion management, investments, wholesale and consumer prices, market liquidity and environmental and efficiency improvements.

Article 3 paragraph 2 – in the context of public service obligation

Having full regard to the relevant provisions of the Treaty, in particular Article 86 thereof, Member States may impose on undertakings operating in the electricity sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency, energy from renewable sources and climate protection. Such obligations shall be clearly defined, transparent, non-discriminatory, verifiable and shall guarantee equality of access for electricity undertakings of the Community to national consumers.
Article 3 paragraph 3 – in the context of universal service

*Member States shall ensure that all household customers, and, where Member States deem it appropriate, small enterprises (namely enterprises with fewer than 50 occupied persons and an annual turnover or balance sheet not exceeding EUR 10 million), enjoy universal service, that is the right to be supplied with electricity of a specified quality within their territory at reasonable, easily and clearly comparable, transparent and non-discriminatory prices. To ensure the provision of universal service, Member States may appoint a supplier of last resort. Member States shall impose on distribution companies an obligation to connect customers to their network under terms, conditions and tariffs set in accordance with the procedure laid down in Article 37(6).*

Article 4 – in the context of monitoring of security of supply

*Member States shall ensure the monitoring of security of supply issues. Where Member States consider it appropriate, they may delegate that task to the regulatory authorities referred to in Article 35. Such monitoring shall, in particular, cover the balance of supply and demand on the national market, the level of expected future demand and envisaged additional capacity being planned or under construction, and the quality and level of maintenance of the networks, as well as measures to cover peak demand and to deal with shortfalls of one or more suppliers. The competent authorities shall publish every two years, by 31 July, a report outlining the findings resulting from the monitoring of those issues, as well as any measures taken or envisaged to address them and shall forward that report to the Commission forthwith.*

Article 37 paragraph 1 indent h – in the context of regulatory monitoring

*The regulatory authority shall have the following duties:*

h) monitoring compliance with and reviewing the past performance of network security and reliability rules and setting or approving standards and requirements for quality of service and supply or contributing thereto together with other competent authorities;

Annex I – in the context of measures on consumer protection

… the measures referred to in Article 3 are to ensure that customers:

(a) have a right to a contract with their electricity service provider that specifies

- the services provided, the service quality levels offered, as well as the time for the initial connection,

- any compensation and the refund arrangements which apply if contracted service quality levels are not met, including inaccurate and delayed billing.

These provisions of Directive 2009/72/EC shall be transposed into national legislation of the Contracting Parties in a satisfactory manner.

**EXAMPLE OF TRANSPosition OF DIRECTIVE 2009/72/EC WITH RESPECT TO THE QUALITY OF SERVICE AND SUPPLY**

With respect to the quality of service and supply, the new Slovenian draft Energy Law (2011) may serve as an example for transposition. As for an illustration and guidelines, its four specific provisions on assurance of the quality in the transmission and distribution systems are given hereafter:

A) on the regulation of the quality,

B) on the monitoring of the quality of supply,

C) on the impact of the quality of supply to the regulatory framework,
D) on the minimum standards for the quality of supply.

**Specific provisions on assurance of the quality in the distribution and transmission systems**

**Article A (on the regulation of the quality)**

(1) When determining justified costs for the purpose of establishing the regulatory framework in the electricity distribution and transmission systems, the Agency shall also take into account regulation of the quality of electricity supply in the context of the distribution system operator (DSO) and the transmission system operator (TSO).

(2) In the context of performing DSO and TSO activities, the quality of supply shall be assessed on the basis of the following quality dimensions:

- the continuity of supply,
- the voltage quality, and
- the commercial quality.

(3) For each of the quality dimensions and for each DSO or the area of the distribution system, the Agency shall determine reference values for parameters of the quality dimensions, which, relating to the state of that system: 1) present the achieved level of implementation of DSO activity and performance of business operations, as well as 2) provide a realistic target for the quality of supply.

(4) DSO and TSO shall be held responsible for the quality even if they do not provide alone all services for which parameters of the quality dimensions are determined, except for the person to whom DSO or TSO transferred part or all of their duties when both of them are held responsible.

(5) Within the methodology for determining the regulatory framework and the methodology for calculating network charges, the Agency shall specify in more details parameters of the quality dimensions, their reference values, and methods for their calculation.

**Article B (on the monitoring of the quality of supply)**

(1) DSO and TSO shall implement appropriate measurements or other means for determining parameters of the quality dimensions, calculate these parameters and report them to the Agency in the prescribed manner and within the prescribed time limits.

(2) For monitoring of parameters of the quality dimensions, DSO and TSO may also authorize other persons, but they remain responsible for the proper and timely implementation of the monitoring and disclosing data to the Agency, except for the person which is by the laws required to conduct monitoring and disclose data together with the system operators.

(3) The Agency may conduct an assessment of monitoring of the quality in DSO and TSO and / or the person to whom DSO or TSO transferred part or all of their duties, or in the person who performs monitoring.

(4) The assessment procedure must be so conducted as not to obstruct business operation of DSO and TSO and performance of the system operators' activities, and
not to impose to the system operators a disproportionate burden in relation to the assessment.

(5) After the assessment, the authorized person of the Agency shall compose a report, containing an assessment of the monitoring adequacy.

(6) If the Agency finds irregularities by conducting the assessment of the monitoring in individual DSO, the largest negative impact shall be taken as the impact on justified costs.

(7) The Agency shall by a general act prescribe in further detail for DSO and TSO the procedures, methods for monitoring of the quality of supply and calculating of various parameters of the quality dimensions, manner and deadlines for disclosing data to the Agency and the procedure and method for assessment of the monitoring of the quality of supply and measures for its improvement.

Article C (on the impact of the quality of supply to the regulatory framework)

(1) The quality of supply of DSO and TSO shall have an impact on the regulatory framework, whereas in determination of justified costs for the next regulatory period the Agency shall take into account achieved values of parameters of the quality dimensions in relation to reference values of these parameters, except in case of identified irregularities.

(2) Incentives to improve the quality of supply or sanctions for the supply's poor quality shall be determined with respect to deviation of the achieved level of the quality from the reference level and shall be reflected in the share of the system operators’ justified costs.

(3) The Agency shall prescribe for DSO and TSO detailed rules for calculating the impact of the quality to the regulatory framework within the methodology for determining the regulatory framework and the methodology for calculating network charges.

Article D (on the minimum standards for the quality of supply)

(1) The minimum standards for the quality of supply of DSO in the form of the guaranteed standards, which must be provided by the system operator, shall be determined by the minimum values of parameters of the quality of service that the system operator must provide at each delivery/withdrawal point.

(2) Within the methodology for determining the regulatory framework and the methodology for calculating network charges, the Agency shall specify the minimum standards for the quality of various services of the system operator.

(3) If DSO violates the guaranteed standard of the quality to which individual system user is entitled to and is responsible for the breach itself, DSO shall pay compensation to the user on the basis of his written request.

(4) The Agency shall determine the amount of compensation and the manner and dates for its payment for each individual type of breach within the methodology for determining the regulatory framework and the methodology for calculating network charges in such a manner that the system operators are deterred from repetition of such violations.
(5) If DSO does not pay compensation to the system user within prescribed period after filing of a written request, the Agency shall decide on the right to compensation at the request of the system user. The Agency can not establish the procedure for determination of compensation by its own motion.

(6) Notwithstanding the payment of compensation, under the general rules on liability for damages the user may seek from the system operator recovery of damages for breach of the guaranteed standards for the quality, if the damage exceeds the compensation paid.

Further details in relation to the quality of service and supply shall be subject to bylaws.
II GENERAL GUIDELINES FOR THE QUALITY OF SUPPLY REGULATION

This chapter provides an overview of the quality supply regulation framework, definitions of all significant common and specific terms and general guidelines for service providers reporting to the national regulatory authorities.

II.1 FUNDAMENTALS OF THE QUALITY OF SUPPLY REGULATION

When determining justified costs for the purpose of establishing the regulatory framework in the electricity distribution and transmission systems, the national regulatory authority may, among other aspects, take into account the regulation of the quality of supply as performed by the service providers (licensees), which can be DSOs and TSOs, as well as possible separate suppliers, universal service providers (in electricity supply) and metering operators.

In the context of performing DSO and TSO activity, the quality of supply can be assessed on the basis of the following quality dimensions:

- the continuity of supply,
- the voltage quality, and
- the commercial quality.

For suppliers, universal service providers (in electricity supply) and metering operators only the commercial quality is applicable.

Generally, the national regulator authority requires the data on the quality of service for:

- monitoring and reporting on the quality of service;
- determining justified network investments based on the quality of service;
- determining guaranteed standards;
- introduction of rewards and penalties in the regulation of the quality of service; and
- participating in the international benchmarkings on the quality of service.

The service providers shall be obliged to:

1) implement appropriate measurements or other means for determining the parameters of the quality dimensions,
2) calculate the parameters of the quality dimensions, and
3) report on the parameters of the quality dimensions, including input data underlying their calculation, to the national regulatory authority and customers.

The methodology for data collecting and auditing and the regulation of the quality of supply shall be clearly defined in the legislative package covering the field of electrical energy, either in a form of special rules or, if needed for strengthening the position of the national regulatory authority or necessary due to the structure of the legislation, in a form of a special act. The purpose of the rules shall be:
• to ensure proper and uniform (standardized) registration of time required to perform services, record interruptions of supply and monitor the voltage quality in the transmission and the distribution networks;

• to provide comparable, reliable and verifiable reporting of the parameters related to the quality of supply, maintain or improve the quality of supply at the national level and reduce disparities in the quality of supply between different areas of the distribution network;

• to support the quality of service regulation conducted by the national regulatory authority;

• to promote equal treatment of the quality of supply of all customers (both in public networks and in enclosed industrial/economic complexes).

The national regulatory authority may conduct an assessment of monitoring of the quality in the service providers, taking care not to obstruct their business operations and performance of their activities and not to impose a disproportionate burden in relation to the assessment. Irregularities identified when conducting the assessment of the monitoring in individual service providers shall reflect on the justified costs, for example by taking into account the largest negative impact of the identified irregularities as the impact on justified costs.

For each of the above quality dimensions and for each service provider the national regulatory authority may determine reference values for parameters of the quality dimensions which relating to the state of that system:

1) present the achieved level of performance of business operations, as well as

2) provide a realistic target for the quality of supply.

The quality of supply of the service providers shall have an impact on the regulatory framework, whereas in determination of justified costs for the next regulatory period the national regulatory authority shall take into account achieved values of the parameters of the quality dimensions in relation to reference values of these parameters, except in case of identified irregularities.

Incentives to improve the quality of supply or sanctions for the supply’s poor quality shall be determined with respect to deviation of the achieved level of the quality from the reference level and are reflected in the share of the service provider’s justified costs.

II.2 DEFINITIONS OF TERMS

Definitions of terms and indices related to the quality of supply are presented hereafter, comprising general terms, common to all aspects of the quality of supply monitoring, as well as terms specific to individual dimensions of the continuity of supply, the voltage quality and the commercial quality.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator of the reporting system</td>
<td>A responsible person of the national regulatory authority who regulates access to e-services for the reporting and cares for their availability.</td>
</tr>
<tr>
<td>Book of complaints</td>
<td>A written or an electronic compilation of views and complaints about excessively long waiting times for reception and harsh treatment of customers during a personal visit or other causes.</td>
</tr>
<tr>
<td>Call Center</td>
<td>A telecommunications system or service that allows acceptance of multiple incoming calls. These are classified in accordance with availability and number of operators which provide desired information within the framework of the service. Operating hours of the call center may be limited or unrestricted.</td>
</tr>
<tr>
<td>Commercial services regulation</td>
<td>It addresses, for a number of the commercial services, the non-technical aspects of the quality of service that arise in the relationship between customers and service providers. In practice, it employs three of the four regulatory instruments: data publication, minimum quality standards and (rarely) reward and penalty schemes. Although there are no conceptual obstacles, the premium quality contracts have never been used for the commercial quality in practice.</td>
</tr>
<tr>
<td>Compensation</td>
<td>The sum paid by DSO or supplier or universal service provider or metering operator (if it is in delay or in non performance of any guaranteed standard) which is delivered to the customer affected by delayed or missing performance, either automatically or upon the claim of the customer subsequent to a verification procedure.</td>
</tr>
<tr>
<td>Compensation claim</td>
<td>In general, a notification from the customer on its wish to receive a compensation.</td>
</tr>
<tr>
<td>Contact with the service provider (licensee)</td>
<td>Any case when the customer contacts the service provider (licensee) for any kind of reasons, which may happen in person, by phone or in writing (letter, fax, e-mail etc.).</td>
</tr>
<tr>
<td>Customer (comprehensive view)</td>
<td>(End) Customer – physical or legal person purchasing electricity for his own use.</td>
</tr>
<tr>
<td></td>
<td>User of distribution network – physical or legal person, producer (generator) of electricity or end customer.</td>
</tr>
<tr>
<td></td>
<td>User of transmission network – physical or legal person, producer (generator) of electricity, end customer or DSO.</td>
</tr>
<tr>
<td></td>
<td>Delivery/withdrawal point – the location in distribution or transmission system at which an electricity producer delivers the energy to the system or at which a customer withdraws the electricity from the system and where measurements or other means of determination of the energy exchange are performed. One customer can have one or more delivery/withdrawal points.</td>
</tr>
<tr>
<td></td>
<td>Measurement point – the location in the distribution or transmission system, generally at the delivery/withdrawal point, where measurement of electricity is performed. One delivery/withdrawal point can have one or more measurement points.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Customer complaint</td>
<td>Any expression (through various possible channels such as letter, email, phone call and/or physical claim) of a customer’s dissatisfaction made to a service provider about electricity supply or any performance related to it and expectation (explicit or implicit) of a response or resolution.</td>
</tr>
<tr>
<td>Customer enquiry</td>
<td>Request for information or advice, other than a complaint, made by the customer.</td>
</tr>
<tr>
<td>Deadlock letter</td>
<td>A final response from the service provider to the customer in which the position of the service provider is stated to be different from that of the customer.</td>
</tr>
<tr>
<td>DSO</td>
<td>Provider of economic public service of distribution system operator.</td>
</tr>
<tr>
<td>External causes</td>
<td>Among external causes are those ones that have been caused by “third parties” such as felling of trees-falling trees, land-related works, switching-off at the request of third parties, external persons, animals, fall of a flying object, terrorist acts, maintenance of the system operator's installations, failures of the system operator’s installations, the system collapse, power-related limits, energy-related limits and other external causes.</td>
</tr>
<tr>
<td>Financial incentive</td>
<td>A company performing below the performance standard will (in general) be penalized and a company performing above that standard will (sometimes) be rewarded. In case of the guaranteed standards and the premium quality contracts, financial penalties take the form of monetary compensation paid to the affected customers.</td>
</tr>
<tr>
<td>Force Majeure</td>
<td><em>Force Majeure</em> is an unpredictable event wherein environmental parameters occur outside of the boundaries which are determined by the status of techniques or given in the design conditions (thunderstorms, lightning, storm, snow, ice, snow- or land-slide, cold, heat, fire, humidity, flood, earthquake, falling rocks or other natural disasters which have been declared as emergency), which the system operator was unable to control or prevent and which prevents the provision of services at the quality level determined by minimum standards.</td>
</tr>
<tr>
<td>Guaranteed standard</td>
<td>Guaranteed standards set service levels that must be met in each individual case. If the service provider fails to provide the level of service required by a guaranteed standard, it must compensate the customer affected, subject to certain exemptions.</td>
</tr>
<tr>
<td>Indicators of the commercial quality</td>
<td>The indicators of the commercial quality which are determined for agreed structure, geographical area, and voltage level or consumption category of customers.</td>
</tr>
<tr>
<td>Information center (customer center)</td>
<td>An infrastructure built for personal reception of users by staff of the activity carrier (service provider), in which the service provider provides information and advice as well as regulates matters relating to services and relationships between the service provider and the users. Opening hours of the customer center is usually limited.</td>
</tr>
<tr>
<td>Meteorologically</td>
<td>Meteorological and other data (e.g., location data on atmospheric conditions).</td>
</tr>
</tbody>
</table>
**General Guidelines for the Quality of Supply Regulation**

<table>
<thead>
<tr>
<th><strong>correlated data</strong></th>
<th>discharges) which the provider collects and proves with them a relation between the event and the cause of disruption (Force Majeure).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum quality standards</strong></td>
<td>Minimum quality standards are expressed as either guaranteed standards or overall standards for the quality. These are the standards set within the quality of service regulation for assessment of justification of monitored costs of operation and maintenance incurred by regulated companies.</td>
</tr>
<tr>
<td><strong>Monitoring framework</strong></td>
<td>Technical standards, EU Directives, recommendations of the CEER and ERGEG, bylaws, technical documentation and software services platform with appropriate network applications and database, which the national regulatory authority provides to the responsible persons for the reporting.</td>
</tr>
<tr>
<td><strong>Normal operating state</strong></td>
<td>Condition of the network without failures or temporary established states, excluding the status during network maintenance or construction.</td>
</tr>
<tr>
<td><strong>Only monitoring</strong></td>
<td>Before issuing guaranteed standards and overall standards, the national regulatory authorities (and/or other competent parties) may monitor performances of TSOs, DSOs, suppliers, universal service providers and metering operators in order to understand the actual quality level.</td>
</tr>
<tr>
<td><strong>Operating event</strong></td>
<td>It is a change in the operating state of the network or device, detected for example by a dispatcher in the control center either through the reporting or in any other way, and establishment of the initial normal operating state.</td>
</tr>
<tr>
<td><strong>Operating statistics</strong></td>
<td>Historic data composed in the process of their collection, storage and processing as related to events and states in the electricity system. The system operator is obliged to keep these data in line with the provisions of legislation.</td>
</tr>
<tr>
<td><strong>Other available requirements</strong></td>
<td>In addition to the guaranteed standards and the overall standards, the national regulatory authorities (and/or other competent parties) may issue the other available requirements in the regulations in order to achieve a certain quality level. This is realized in a way similar to the guaranteed standards, i.e. the other available requirements are in fact the guaranteed standards but without having introduced financial penalties in case of non-compliance. If the requirements set by the national regulatory authorities are not met, in most cases they may impose sanctions (financial penalties).</td>
</tr>
<tr>
<td><strong>Overall standard</strong></td>
<td>Overall standards cover areas of service where it is not appropriate to give individual guarantees, but where customers in general have a right to expect the service providers to deliver predetermined, minimum levels of service.</td>
</tr>
<tr>
<td><strong>Performance standard</strong></td>
<td>It specifies the quality level that the service provider is expected to supply. It represents respectively: 1) a lower limit of the quality of service delivered to the individual customer in case of the minimum quality standard, 2) an average level of the quality in case of the reward and penalty schemes, and 3) an agreed-upon individual level of the quality in case of the premium quality contracts. Performance standards are given on the quality indicators.</td>
</tr>
<tr>
<td><strong>Planned event</strong></td>
<td>It is a dedicated network configuration change before and after maintenance or because of a safe repairment of the adjacent device (safety switch off).</td>
</tr>
</tbody>
</table>
may result in disruption or interruption in the electricity supply.

**Premium quality contracts**

Such contracts are especially useful for customers with a high valuation of the quality of service. They specify individual performance standards and prices for the service, as well as individual compensation payments. These are paid by the service provider if it fails to deliver the quality specified in the contract. In practice, such contracts have not been widely employed.

**Publication of data**

The dissemination of data regarding a service provider's performance with respect to a set of quality indicators, which provides unambiguous incentives for increased investments in the quality.

**Quality indicator**

It is a reliable measure of the corresponding dimension of the quality of service. Measured quality indicators describe the actual performance of the service provider. This information is in itself sufficient to make the simplest regulatory instrument – data publication – effective.

**Regulatory instruments**

The four main regulatory instruments employed today in the quality of service regulation are 1) data publication, 2) minimum quality standards, 3) reward and penalty schemes, and 4) premium quality contracts, which are applied in the three quality of service areas – 1) continuity of supply, 2) voltage quality, and 3) commercial quality.

**Repeated complaint**

It is where the customer makes contact to express dissatisfaction with the same or substantially the same matter that was the subject of a previously resolved complaint.

**Request**

Written or verbal statement of the customer directed to the service provider, which is designed to address individual (unjustified or justified) complaints.

**Resolved complaint**

A customer complaint in respect of which there remains no outstanding action to be taken by the service provider. In this case, the complaint has either (i) been resolved to the satisfaction of the relevant customer who made that customer complaint or on whose behalf that customer complaint was made, or (ii) although the customer is not openly satisfied with the outcome, the customer has agreed that the service provider has taken all action reasonably expected.

**Responsible person for the reporting**

A person responsible to report data on the quality of supply.

**Sanction**

Action with an economic impact imposed by the national regulatory authority (or other competent authority) to TSO or DSO or supplier or universal service provider or metering operator upon the non-fulfillment of a minimum requirement set in the standard. The form of sanction may be penalty, tariff reduction, or payment to the customers affected.

**SCADA**

System for supervision, control and acquisition of data on the state of remote equipment, which operation is based on coded signals transmitted over communications channels.

**Service provider (licensee)**

TSO, DSO, supplier, universal service provider, metering operator.
**Simple works**  
Intervention by TSO or DSO in the network in favor of the customer, which is made on the connection equipment in a simple case.

**Statistics of events**  
Data on events appearing in the electricity network under control of the system operator and generators.

**Status of technique**  
At given moment reached development stage of technical capability of products, processes and services which is based on relevant recognized results of science, technique and experience.

**Transitional period**  
Period during which the provider performs necessary adjustments of internal processes needed for management of the operating statistics in line with the requirements of the national regulatory authority issued for the quality of supply (the authority determines the transitional period).

**TSO**  
Provider of economic public service of transmission system operator.

**Unplanned event**  
Unplanned event is a random change in the operating state of the network or device due to fault, which results in disruption or interruption in the electricity supply. After repairment of the fault the normal operation is established by switching the power supply on.

**Visiting time interval**  
A predetermined time interval in which the user is guaranteed to get a personal visit from a representative of a service provider.

**Web services for the reporting**  
Web-based application and equipment installed in an infrastructure of the national regulatory authority, which enables secure reporting on the quality of electricity supply.

## II.3 GENERAL GUIDELINES FOR SERVICE PROVIDERS REPORTING TO THE NATIONAL REGULATORY AUTHORITIES

The reporting on the quality of supply from the service providers to the national regulatory authority shall be realized in a prescribed manner and within prescribed time limits, as defined by the national regulatory authority.

Therefore, the national regulatory authority shall first adopt a general document setting out the nature and process of disclosure of data on the quality of electricity supply, in which all three dimensions of the quality of supply shall be covered.

The indicators of the quality of supply shall be designed to support the implementation of the regulatory orders. Thus, the coverage shall be made so to enable the implementation of the quality of supply regulation to which the reporting is an important part.

The submission of the quality of supply data shall be based on the templates prescribed by the national regulatory authority.
The next level for the reporting on the quality of supply parameters, as even more coordinated approach on the common platform, may be the Web-based application\(^7\) over the templates prescribed by the national regulatory authority.

The service providers shall:

- inform themselves on their obligations in relation to the reporting on the quality of supply parameters;
- keep and maintain all data needed to calculate indicators of the quality of supply for a minimum period of three regulatory frameworks or at least 10 years;
- keep and maintain all the available documentation about the customers’ complaints for a minimum period of three regulatory frameworks or at least 10 years;
- perform registration process to use the Web-based application of the national regulatory authority;
- report to the national regulatory authority on the quality of supply parameters, which are related to the activity they perform, by using the Web-based application of the national regulatory authority.

When reporting on the quality of supply parameters, the service providers shall take into account provisions of laws and bylaws which regulate the manner of governing the public service of the distribution system operator or the transmission system operator.

The national regulatory authority may, based on the results of analysis of the effects of the quality regulation, change the set of mandatory quality of supply parameters which each individual service provider is obliged to report on.

If the set of mandatory quality of supply parameters is enlarged, the national regulatory authority shall for each individual parameter determine a transitional period allowing the service providers to prepare for monitoring of and reporting on such parameters. The national regulatory authority shall inform the service providers in writing on changes introduced in the set of mandatory parameters and on new timescales of effectiveness of the amendments. The service providers will, to the best of their abilities, provide new parameters for past periods using archived data and/or estimates.

The Web-based application shall be an integral element of the whole quality monitoring framework at the national level, i.e. it shall enable reporting on the continuity of supply, the voltage quality and the commercial quality. It shall support the process of supervision of the quality of supply which is performed by the service providers and the national regulatory authority.

The service providers shall report on the quality of supply parameters to the national regulatory authority by way of automated or manual data entry through the user interface of the Web-based application.

---

\(^7\) In the remainder of this report assumed to be in place.
To use the Web-based application the service providers must perform a registration procedure, which shall be published by the national regulatory authority on its website. Within the registration procedure, the national regulatory authority grants to a responsible person of the service provider a role in the reporting system, allowing authorization to work with the part of the Web-based application at the user level.

The national regulatory authority shall provide the following data to the responsible person:

- hyperlink to the Web-based application for the reporting purposes, and
- authentication data: username and password.

Within the registration procedure a responsible person of the service provider shall be informed on all measures necessary to ensure an adequate level of data security (user password changes, etc.).

The reported quality of supply parameters shall be kept in a common database managed by the national regulatory authority. Access to the database shall be determined by the authentication rules depending on individual database user profile or database user’s role in the reporting system. Individual database user shall be assigned a set of parameters that he/she is obliged to report on. The database shall be designed so that the parameters reported on by each database user to the national regulatory authority do not duplicate.

The national regulatory authority shall have unlimited access to all data in the database. In general, each service provider shall have access only to its own data in the database – eventual deviation from this rule shall be decided upon by the national regulatory authority. The national regulatory authority may grant access to other persons (physical or legal), if their request is in line with laws.

The service providers shall appoint persons responsible for monthly and annual reporting on the quality of supply and inform the national regulatory authority about their names. The responsible person shall log in the Web-based application with acquired authentication data or digital certificate.

The national regulatory authority shall provide to the responsible person an access to the Web-based application for the reporting on the quality of supply parameters in accordance with requirements for the availability of electronic services and inform them on any changes and developments in the reporting process.

The appointment of the responsible person shall be valid until revoked.

The national regulatory authority shall inform the responsible person about the reporting process by using electronic mail, drawing upon:

- information about the status of monthly and annual reports and submission deadlines for the individual reports from the programming part of the quality monitoring framework on the basis of automatically generated messages, and
- information via electronic mail from the responsible person of the national regulatory authority.
This chapter presents a detailed description of methods and procedures for the continuity of supply monitoring including definitions of the continuity of supply indicators, guidelines for service providers reporting to the national regulatory authorities, guidelines for service providers reporting to customers, recommendations for complaint handling procedures, reporting guidelines for benchmarking on the Energy Community level, guidelines for data collecting and auditing and recommendations for gradual introduction of regulatory instruments.

### III.1 Continuity of Supply Indicators

According to the findings from the CEER Benchmarking Reports on Quality of Electricity Supply, the continuity of supply indicators most commonly used and therefore recommended for monitoring in the Energy Community are given in the following table.

<table>
<thead>
<tr>
<th>Level of monitoring</th>
<th>Type of interruption</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution or transmission network</td>
<td>Long</td>
<td>SAIDI, SAIFI, CAIDI, CAIFI</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td>MAIFI</td>
</tr>
<tr>
<td>Transmission network</td>
<td>Long and short</td>
<td>ENS, AIT, AIF, AID</td>
</tr>
</tbody>
</table>

Definitions of the indicators are given hereafter with all the necessary explanations for their application.

#### III.1.1 Indicator of Average Cumulative Duration of Power Supply Interruptions in the System (SAIDI)

Average cumulative duration of power supply interruption in the system (SAIDI - System Average Interruption Duration Index) is the ratio between the total duration of power supply interruptions of individual customers within a specified time interval and the total number of customers in the system for the duration of this time interval.

SAIDI is calculated as follows:

\[
SAIDI = \frac{\sum N_i \cdot t_i}{N_c} \quad \text{[minute per customer]},
\]

where \( N_i \) is the number of affected customers and \( t_i \) the duration of the interruption \( i \), expressed in minutes.

SAIDI is expressed in minutes per customer regardless of the period of observation and reporting (monthly, annually). If the time interval is expressed in years, the quantity is called the "annual average interruption time per supplied customer" and represents the average cumulative amount of time per year during which the supply to a customer is interrupted.
Note 1: Only long interruptions are taken into consideration.

Note 2: The term customer refers to a specific delivery/withdrawal point (and not the interim distribution system or company if the indicator is calculated for the transmission network).

Note 3: The alternative calculation of the SAIDI indicator:

\[
SAIDI = \frac{\sum_{i} \sum_{j} t_{ij}}{N_{c} \cdot T} \text{ [minute per customer]},
\]

where \( t_{ij} \) is the duration of \( i \)-th power supply interruption, expressed in minutes, for the \( j \)-th customer in the selected time interval \( T \), and \( N_{c} \) is the total number of customers.

For more detailed explanation on the calculation of the indicators see Annex 1: Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval.

### III.1.2 INDICATOR OF AVERAGE POWER SUPPLY INTERRUPTION FREQUENCY IN THE SYSTEM (SAIFI)

Average power supply interruption frequency in the system (SAIFI - System Average Interruption Frequency Index) is the ratio between the total number of customer supply interruptions in a given time interval and the total number of customers in the system for the duration of this time interval.

SAIFI is calculated as follows:

\[
SAIFI = \frac{\sum_{i} N_{i}}{N_{c}} \text{ [number of interruptions per customer]},
\]

where \( N_{i} \) is the number of customers affected by the interruption \( i \).

SAIFI is expressed by the number of interruptions per customer regardless of the period of observation and reporting (monthly, annually). If the time interval is expressed in years, SAIFI represents the average number of times per year that the supply to a customer is interrupted.

Note 1: Only long interruptions are taken into consideration.

Note 2: The term customer refers to a specific delivery/withdrawal point (and not the interim distribution system or company if the indicator is calculated for the transmission network).

Note 3: The alternative calculation of the SAIFI indicator:

\[
SAIFI = \frac{\sum_{j} n_{j}}{N_{c} \cdot T} \text{ [number of interruptions per customer]},
\]

where \( n_{j} \) is the number of power supply interruptions to customer \( j \) in the time interval \( T \), and \( N_{c} \) the total number of customers.
Continuity of Supply

For more detailed explanation on the calculation of the indicators see Annex 1: Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval.

### III.1.3 Indicator of Average Power Supply Interruption Duration per Customer (CAIDI)

Average power supply interruption duration per customer (CAIDI - Customer Average Interruption Duration Index) is the ratio between the total duration of power supply interruptions to customers in a given time interval and the total number of affected customers with at least one interruption for the duration of this time interval.

CAIDI is calculated as follows:

\[
\text{CAIDI} = \frac{\sum_i N_i \cdot t_i}{\sum_i N_i} = \frac{\text{SAIDI}}{\text{SAIFI}} \quad \text{[minute per customer]},
\]

where \(N_i\) is the number of affected customers and \(t_i\) the duration of the interruption \(i\), expressed in minutes.

Since CAIDI can be calculated as the ratio between indicators SAIDI and SAIFI, calculated for the same period of observation, it represents the average duration of one power supply interruption per customer.

**Note 1:** Only long interruptions are taken into consideration.

**Note 2:** The term customer refers to a specific delivery/withdrawal point (and not the interim distribution system or company if the indicator is calculated for the transmission network).

**Note 3:** The alternative calculation of the CAIDI indicator:

\[
\text{CAIDI} = \frac{\sum_i \sum_j t_{ij}}{\sum_j n_j} = \frac{\text{SAIDI}}{\text{SAIFI}} \quad \text{[minute per customer]},
\]

where \(t_{ij}\) is the duration of \(i\)-th power supply interruption, expressed in minutes, to \(j\)-th customer and \(n_j\) the total number of interruptions for \(j\)-th customer in the selected time interval \(T\).

For more detailed explanation on the calculation of the indicators see Annex 1: Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval.

### III.1.4 Indicator of Average Power Supply Interruption Frequency per Customer (CAIFI)

Average power supply interruption frequency per customer (CAIFI - Customer Average Interruption Frequency Index) is the ratio between the total number of customer supply...
interruptions in a given time interval and the total number of affected customers with at least one interruption for the duration of this time interval.

The value of CAIFI is equal to one or larger and calculated as follows:

\[
CAIFI = \frac{\sum N_i}{N_{NC}} \quad \text{[number of interruptions per customer]},
\]

where \(N_i\) is the number of customers affected by the interruption \(i\).

Note 1: Only long interruptions are taken into consideration.

Note 2: The term customer refers to a specific delivery/withdrawal point (and not the interim distribution system or company if the indicator is calculated for the transmission network).

Note 3: The alternative calculation of the CAIFI indicator:

\[
CAIFI = \frac{\sum n_j}{N_{NC} \cdot T} \quad \text{[number of interruptions per customer]},
\]

where \(n_j\) is the number of power supply interruptions to the \(j\)-th customer in the selected time interval \(T\) and \(N_{NC}\) the number of customers with at least one interruption for the duration of this time interval.

For more detailed explanation on the calculation of the indicators see Annex 1: Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval.

### III.1.5 Indicator of Average Short Power Supply Interruption Frequency in the System (MAIFI)

Average short power supply interruption frequency in the system (MAIFI - Momentary\(^8\) Average Interruption Frequency Index) is the ratio between the total number of short power supply interruptions to customers in a given time interval and the total number of customers in the system for the duration of this time interval. It represents the average number of times per year that the supply to a customer is interrupted for duration of 3 minutes or less.

MAIFI is calculated as follows:

\[
MAIFI = \frac{\sum N_i}{N_C} \quad \text{[number of interruptions per customer]},
\]

where \(N_i\) is the number of customers affected by the short interruption \(i\).

MAIFI is expressed by the number of interruptions per customer regardless of the period of observation and reporting (monthly, annually).

\(^8\) The term “momentary interruption” is used in North America as a synonym to short interruption.
**Continuity of Supply**

**Note 1:** Only short interruptions are taken into consideration.

**Note 2:** The term customer refers to a specific delivery/withdrawal point (and not the interim distribution system or company if the indicator is calculated for the transmission network).

**Note 3:** When calculating MAIFI, the so-called time-aggregation rules are very important. Multiple interruptions during a 3-minute period, due to automatic reclosing actions, may be counted as one event for MAIFI or as multiple events. This choice could significantly impact the value of MAIFI.

**Note 4:** The alternative calculation of the MAIFI indicator:

\[
MAIFI = \frac{\sum U_j}{N_C \cdot T} \quad \text{[number of interruptions per customer]},
\]

where \(U_j\) is the number of short power supply interruptions to customer \(j\) in the time interval \(T\) and \(N_C\) the total number of customers.

For more detailed explanation on the calculation of the indicators see Annex 1: Calculation of the Continuity Indicators for Different Monitoring and Reporting time interval

### III.1.6 Unsupplied Energy (ENS)

Unsupplied energy (ENS – Energy Not Supplied) is the energy that would have been supplied from the system if there was no interruption of power supply.

ENS is calculated as follows:

\[
ENS = \sum_k P_k \cdot D_k \quad \text{[MWh]},
\]

where \(P_k\) is the power, at which the power supply was interrupted, expressed in MW, and \(D_k\) time interval, during which the power supply was interrupted, expressed in hours, for the interruption \(k\).

**Note 1:** Taking into account all long and short power supply interruptions at each affected user connection point to the transmission line.

**Note 2:** Users of the transmission network with reference to power supply interruptions are delivery/withdrawal points, which may be PTS and/or PS.

### III.1.7 Average Duration of Interruptions (AIT)

Average duration of interruptions (AIT - Average Interruption Time) in the transmission network represents the cumulative duration of power supply interruptions per user in one year.

AIT is calculated as follows:
\[
AIF = \frac{\sum_i P_i}{P_T} \text{ [number of interruptions per user]},
\]

where \( P_i \) is the power that is disconnected in the \( i \)-th interruption and \( P_T \) the average power of the system, in MW, which is obtained as the electrical energy transmitted in the reporting period, in MWh, divided by this period, in hours.

Note: Users of the transmission network with reference to power supply interruptions are delivery/withdrawal points, which may be PTS and/or PS.

**III.1.8 AVERAGE FREQUENCY OF INTERRUPTIONS (AIF)**

The average frequency of interruption (AIF - Average Interruption Frequency) in the transmission network represents the average number of power supply interruptions per user in one year.

AIF is calculated as follows:

\[
AIF = \frac{\sum_i P_i}{P_T} \text{ [number of interruptions per user]},
\]

where \( P_i \) is the power that is disconnected in the \( i \)-th interruption and \( P_T \) the average power of the system, in MW, which is obtained as the electrical energy transmitted in the reporting period, in MWh, divided by this period, in hours.

Note: Users of the transmission network with reference to power supply interruptions are delivery/withdrawal points, which may be PTS and/or PS.

**III.1.9 AVERAGE INTERRUPTION DURATION (AID)**

Average duration of an interruption per network user (AID - Average Interruption Duration) is a measure of the average duration of each interruption, expressed in minutes.

AID is calculated as follows:

\[
AID = \frac{60 \cdot \sum_i ENS_i}{\sum_i P_i} = \frac{AIT}{AIF} \text{ [min per user]},
\]

where \( ENS_i \) is the amount of unsupplied energy in the \( i \)-th interruption, in MWh, and \( P_i \) the power that is disconnected in the \( i \)-th interruption, in MW.

Note: Users of the transmission network with reference to power supply interruptions are delivery/withdrawal points, which may be PTS and/or PS.
III.2 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO THE NATIONAL REGULATORY AUTHORITIES ON THE CONTINUITY OF SUPPLY

This sub-Chapter contains precise instructions for service providers reporting to national regulatory authority on the continuity of supply by use of the Web-based application. First two parts provide detailed definitions and explanations on levels of monitoring of the continuity of supply, i.e. types of power supply interruptions and types of network supply areas (elements). The third part contains the complete list of the continuity of supply data, which the service provider is obliged to report to the national regulatory authority, presented by reporting frequency and deadlines. The final part is dedicated to the most important data - the continuity of supply indicators.

III.2.1 POWER SUPPLY INTERRUPTION

Power supply interruption is a state of the network when the voltage at the customer connection point is lower than 5% of the declared voltage.

Monitoring procedures of power supply interruptions are based on the distinctions between different types of interruptions:

- planned or unplanned interruptions with regard to their predictability,
- long and short interruptions with regard to their duration,
- external, *Force Majeure* or internal interruptions with regard to their cause, and
- originating from generation, transmission system or distribution system (either high voltage, medium voltage or low voltage).

III.2.1.1 PLANNED AND UNPLANNED POWER SUPPLY INTERRUPTIONS

Planned power supply interruption is the one where customers are informed in advance on the planned works in the distribution network. The impact of planned interruptions can be reduced by appropriate measures applied at the customer’s side.

Unplanned power supply interruption is the one caused by permanent or transient fault, usually induced by an external event, equipment failure or disruption. Unplanned power supply interruptions are unpredictable, largely random events.

*Note:* The minimal advance notice time varies significantly between EU countries, from no specific obligation up to 30 days or more for some categories of customers, but the most frequently used values are 2 days and 15 days.

III.2.1.2 LONG AND SHORT POWER SUPPLY INTERRUPTIONS

Duration of power supply interruption is a time period, specified in minutes, counted from the moment of interruption of power supply to the establishment of normal supply of network users.

Long power supply interruption is a power supply interruption longer than three minutes. As a rule, long power supply interruptions are caused by permanent failures, but in exceptional
cases also by transient failures (e.g., "regeneration" of network elements (of more than three minutes) after a transient fault).

Short power supply interruption is a power supply interruption of less or equal to three minutes. As a rule, a short power supply interruption is caused by a transient failure. In exceptional cases it can be caused by a permanent failure (e.g., backup power supply successfully established by switching manipulations carried out in less than three minutes).

*Note 1:* Reporting on the duration of power supply interruptions is needed only for those power supply interruptions, which cause end-users or DSOs interruption for more than three minutes, taking into account the time needed for a complete (total) re-supply of all the affected end-users and DSOs as representative.

*Note 2:* The duration of power supply interruption includes all the intermediate complete power restorations that lasted for three minutes or less.

In relation to registering of multiple power supply interruptions, the rule is that two long power supply interruptions of the same origin are regarded separately, if the time interval between the ending of the first interruption and the beginning of the following interruption is more than three minutes, and during that time all the customers, which experienced the power supply interruption during the first event, had continuous power supply.

*Note 1:* The same source of interruption means that the occurrence of the second interruption affected part or all of those customers who were left without power supply during the first interruption.

*Note 2:* The rule of grouping of the events is not applicable for short interruptions.

*Note 3:* For more details see Annex 2: Grouping of Events.

### III.2.1.3 CAUSES OF POWER SUPPLY INTERRUPTIONS

Power supply interruptions are by their cause regarded as either:

- external causes, that have been caused by "third parties", without direct liability by the observed service provider,
- *Force Majeure,* as the events, which the system operator was unable to control or prevent, with environmental parameters outside the boundaries determined by the state of the art and given in the design conditions, or
- internal causes.

Internal causes in general are all those causes of power supply interruptions that neither fall under external causes nor under the *Force Majeure.* Specifically, internal causes are: maintenance (inspection, audit, refurbishment, restoration/reconstruction), new construction, backup power supply, switching to normal operating condition, the safety switch off, poor installation, insufficient maintenance, incorrect switching manipulation, accidental contact, malfunction of protection, overload, overvoltage, the material (manufacture, wear), aging, reverse effects, unknown cause and other internal causes. Among the internal causes are also included atmospheric and natural causes other than *Force Majeure,* for example. atmospheric effects of heat, cold, fog, dew, condensation, rain (moisture), salt, dirt, corrosion and other atmospheric causes.
Note 1: Great Britain utilizes much more extensive list of possible causes, specifically including animals (more specifically, wild or domestic ones, birds and insects). However, only severe weather conditions under certain circumstances may be regarded as exceptional events and thus excluded from the interruption statistics used for the continuity of supply regulation purposes.

Note 2: Instead of *Force Majeure*, the term of an exceptional event, related to common natural and non-natural exceptional characteristics, may be used. An exceptional event is beyond the control of the service provider and is characterized as: 1) unforeseeable, 2) unpredictable, 3) unpreventable, and 4) unavoidable. All four event characteristics must be confirmed for the event to classify as “exceptional”. According to such definition, the weather circumstances that occur once a year or more often should not be considered as exceptional events. For example, lightning should not be treated as an exceptional event anywhere in the Energy Community, as it is foreseeable and predictable event in all the Contracting Parties and Observers.

### III.2.1.4 ORIGINS OF POWER SUPPLY INTERRUPTION

The origin of the power supply interruption is in one of the following four parts of the power system:

1. generation and transmission system, consisting of generating facilities with connections to the network operated by TSO, and the transmission network operated by TSO with a nominal voltage of 110 kV and above,
2. high voltage (HV) distribution network with a nominal voltage of 110 kV, operated by DSO,
3. medium voltage (MV) distribution network with voltage levels between, but excluding, 1 kV and 110 kV, operated by DSO, and
4. low voltage (LV) distribution network with voltage levels up to and including 1 kV, operated by DSO.

### III.2.2 NETWORK SUPPLY AREAS

Network supply areas and the corresponding network elements shall be defined based on the types of supplied settlements, which are considered to be either urban or rural.

#### III.2.2.1 TERRITORIAL POWER SUPPLY AREAS

Territorial power supply areas shall be defined according to the population density and possibly other criteria for determining types of settlements, urban areas and settlements within urban areas.

Types of territorial supply areas:

- urban and
- rural.

Urban area is the power supply area corresponding to some or all of the following four criteria for determination of the urban settlements, given in order of importance:
1. settlements that at the defined date had 3000 (or another more appropriate amount depending on the national regulatory authority’s judgment) inhabitants and more,

2. settlements that at the defined date had between 2000 (or another more appropriate amount depending on the national regulatory authority judgment) and 2999 inhabitants and the surplus of jobs over the number of economically active population living in the settlement,

3. settlements that at the defined date had at least 1400 (or another more appropriate amount depending on the national regulatory authority’s judgment, related to the share of jobs and rural self-employed households) inhabitants, are the seats of municipalities and have a surplus of jobs over the number of economically active population, and

4. settlements that by their position fall within the suburbs of a larger urban settlement, based on the following criteria:
   - physiognomic-morphologic: continuous construction between the city and its suburbs,
   - function: job connection to the center, core settlement, and
   - the share of rural self employed households in the total number of households.

Rural area is a power supply area that does not meet any of the criteria for determining the urban areas and settlements within urban areas.

*Note 1:* The above definition of an urban area arises from its basic characteristics: high population density, inbound commuting related to employment and use of land (industry and services as opposed to agriculture).

*Note 2:* If it is applicable for the continuity of supply measurement purposes, the distinction between urban and rural areas can be directly applied from the definitions given for other purposes, for example an act on local government or statistical reporting used by the national statistical office.

III.2.2.2 NETWORK ELEMENTS

Station (within the power system) is a part of the power system limited to a given area, which includes connections of transmission or distribution lines, switchgear, buildings and transformers. The station typically includes protection devices and devices for system control and management. The station is identified by the label of the designated network, such as a transmission station, distribution station, 400/110 kV or 20 kV station.

Transformer station (TS) is a station with transformers that connect two or more networks with different voltage levels.

Switching station / switchyard (SS / SY) is a station that contains switching devices and often busbars, but not transformers.

Primary distribution transformer station (PTS) is an HV/MV or MV/MV transformer station (for example: 110/35 kV, 110/20 kV, 35/10 kV).

Primary distribution station (PS) is a station without transformer, in fact an MV switchyard (for example: 35 kV or 20 kV).
Secondary distribution transformer station (STS) is an MV/LV transformer station (for example: 10/0,4 kV or 20/0,4 kV).

The service providers shall classify MV feeders from PTS and PS regarding supply areas by the following types:

- urban,
- mixed, and
- rural.

Urban MV feeder from PTS or PS is an MV feeder with at least 2/3 of all its customers connected in the urban area. MV feeding or connecting line from PTS to (one or more) PS, with no connected customers except through (one or more) PS is treated as urban MV feeder.

Rural MV feeder from PTS or PS is an MV feeder with at least 2/3 of all its customers connected outside the urban area.

Mixed MV feeder from PTS or PS is an MV feeder which does not fulfill the criteria for urban and rural feeder from PTS or PS.

If the classification of feeders from PTS and PS according to the definitions of types of feeders leads to illogical results due to specificities of the network configuration, DSO shall make the classification in favor of the customer.

Any exemption shall be reported to the national regulatory authority by electronic mail, to the address published on its website.

The service providers shall classify STS regarding supply areas by the following types:

- urban, and
- rural.

Urban STS is an STS that lies in the urban supply area.

Rural STS is an STS that lies in the rural supply area.

LV feeders from an STS shall be considered of the same type as the type of the STS.

III.2.3 REPORTING FREQUENCY AND DEADLINES

The service providers shall report data and indicators on the continuity of supply to the national regulatory authority:

- monthly, and
- annually.
III.2.3.1  MONTHLY REPORTING

Monthly reports by DSO to the national regulatory authority shall comprise:

- indicators of the continuity of supply for long planned and unplanned interruptions by type of feeders (urban, mixed, rural) at the level of PTS and the company,
- the worst three supplied MV feeders at the level of MV feeder and PTS for unplanned and planned interruptions, and
- the statistics of events and events beyond control of the company.

*Note:* Monthly reporting is envisaged mainly to increase the quality of the data and enable some procedures of their control, especially regarding *Force Majeure*, even without actual auditing in place. Some of the advantages of the data collection and control on the monthly bases are:

1. simpler checking of the meteorologically correlated data used for elaboration of *Force Majeure* events;
2. possibility of using the 2.5 beta method for detecting mayor events (defined in IEEE 1366-2003 Standard Guide for Electric Power Distribution Reliability Indices);
3. increased accuracy by use of monthly updated numbers of customers (delivery/withdrawal points); and
4. checking of the effects of some major network investments on the continuity of supply.

Due to a much lower number of the power supply interruptions, monthly reporting is not envisaged for TSO.

III.2.3.2  ANNUAL REPORTING

DSO shall report on the quality indicators at the level of individual MV feeders from PTS or PS, and LV feeders from STS. Once a year they shall disclose general data about the company, network characteristics and meteorologically correlated data on annual basis for the previous calendar year.

TSO shall disclose the quality indicators and general data, data on network characteristics and meteorologically correlated data on annual basis for the previous calendar year in such a manner that these data are imported or entered manually into the Web-based application of the national regulatory authority.

Once a year, simultaneously with other data on the continuity of supply, the service providers shall report on justified and unjustified customer complaints.

These indicators and data are calculated and prepared for the previous calendar year.

Annual values of indicators, recalculated to the company level, must match the aggregated monthly values of indicators for all 12 months of the calendar year, recalculated on the same level. The service providers must explain any deviation to the national regulatory authority.
III.2.3.3 DEADLINES FOR SUBMISSION OF REPORTS

The service providers shall disclose data to the national regulatory authority every month for the previous one and once a year for the previous calendar year, depending on the type of data.

In case of monthly reporting the service providers are obliged to present to the national regulatory authority a request for changing the network configuration data no later than the 20th day of the preceding month. The service providers are obliged to enter data on changes in the network configuration till the 5th day of the current month.

Monthly reports shall be submitted no later than the 15th day of the month for the preceding month.

The monthly report for the month of January of the current year shall be made available after submission of the annual report for the previous year, within the time limits set by the national regulatory authority to enable regular further monthly reporting for the next month.

The annual report shall be submitted no later than 15 February for the previous calendar year. The national regulatory authority may, upon request of the service provider, allow the network configuration changes for the previous year by the same procedure as set out for the monthly reporting above.

If these days are not the working ones, these activities shall be performed on the first working day which follows. Changing or updating and versioning of the reports are enabled by the deadline. The reports may also be submitted before the deadlines written, but they may be amended or supplemented only until these deadlines.

The administrator of the reporting system shall enable submission of individual reports and inform about it the responsible persons for the reporting.

III.2.4 DATA FOR REPORTING ON THE CONTINUITY OF SUPPLY INDICATORS

The national regulatory authority shall determine the mandatory set of data for monitoring the continuity of supply, which the service provider shall report on by use of the Web-based application. The data will comprise:

- general network data,
- information on the network configuration,
- indicators of the continuity of supply at different levels of observation,
- statistics of events and interruptions,
- events beyond control of the company (Force Majeure and external causes),

and may be modified in line with instructions given in Chapter II.3.
**III.2.4.1 GENERAL NETWORK DATA**

The service providers shall enter the following general data on the network in the Web-based application:

- number of all delivery/withdrawal points by voltage levels,
- length of lines by voltage levels,
- network properties,
- meteorologically correlated data, and
- other data determined by the national regulatory authority in the application.

Each individual dataset shall be further detailed in the Web-based application for the reporting on the continuity of supply.

**III.2.4.2 INFORMATION ON THE NETWORK CONFIGURATION**

Timely adequate availability of data on the network configuration is a prerequisite for the reporting on the continuity of supply.

Data on the network configuration are defined according to the level of monitoring of indicators and parameters for the continuity of supply and to the architectural properties of the network, and vary for the distribution and the transmission network.

The network configuration may change as a result of permanent changes in operating states and due to newly constructed network elements. The corresponding data on the network configuration may be changed during the year at the request of the responsible person of the service provider, whereas the user must give a notice of change and explain it. The national regulatory authority shall approve or reject the request for changing data on the network configuration.

During the year DSO may change the following data:

- add network elements (PTS / PS, MV feeders, STS, LV feeders), and
- change properties of elements (e.g., number of customers, etc.).

During the year TSO may change the following data:

- add delivery/withdrawal points (PTS, transformers), and
- change certain properties of elements.

Data on the network elements may not be deleted. If a certain element is excluded or suspended from operation, the reporting of data on its continuity of supply is not required anymore.

*Note:* Information on the network configuration is needed for precise determination of the number of customers affected by a power supply interruption. Ideally, it consists of the data...
for defining the normal operating state of the network and possible schemes for complete or partial backup power supply regarding the line of supply from the transmission network, through HV/MV transformers and MV feeders to MV/LV transformers and LV feeders for each customer. In other words, what is needed is some sort of connectivity model between customer (billing) database and technical information system database or SCADA. For monitoring on the power supply interruptions on the MV level the sufficient information would be: (1) correct number of customers per each MV/LV transformer station, (2) the list of MV/LV transformer stations by MV feeders and (3) the list of MV feeders by PTS / PS, which determines the normal operating state of the network, as well as (4) the list (and types) of switching devices along MV feeders, which determines possible complete or partial backup power supply schemes. The data under (2), (3) and (4) are normally covered by SCADA and the number of customers per MV/LV transformer station should come from the customer (billing) database.

Normal operating state of the network regularly changes with construction of new PTS / PS, MV feeders and MV/LV transformer stations and may also change as a result of optimization of the existing network operation (without new network components). DSO shall report those changes in the network configuration on the monthly bases, as prescribed in the procedure above.

III.2.4.3 INDICATORS OF THE CONTINUITY OF SUPPLY AT DIFFERENT LEVELS OF OBSERVATION

The service providers who report to the national regulatory authority on the continuity of supply shall be obliged to ensure monitoring of parameters of the continuity of supply at observation levels that enable classification of values of indicators relating to the origin of interruption, area of the network and cause of supply outage.

Values of SAIDI, SAIFI, CAIDI, CAIFI and MAIFI indicators for the distribution network shall be calculated and disclosed by using appropriate areas and observation levels for a period of:

- one month for each month of the calendar year, and
- one year each year.

Values of the SAIDI, SAIFI, MAIFI, AIT, AIF, AID and ENS indicators for the transmission network shall be calculated for a period of one year and disclosed for each year.

Observation levels for DSO are:

- the company,
- PTS or PS,
- MV feeders from PTS or PS,
- the worst three supplied MV feeders from PTS or PS,
- STS, and
- LV feeders from STS.
DSO shall classify feeders by the attained level of the continuity of supply and report the worst three supplied feeders to the national regulatory authority each month. The classification for determination of the worst three supplied MV feeders is performed by taking into account the value of the SAIDI indicator as calculated on the basis of interruptions which are result of internal causes.

Observation levels for TSO are:

- the company, and
- delivery/withdrawal points (level of PTS or transformer in PTS).

Number of customers for calculation of the continuity of supply indicators depends on the point of observation (level of monitoring) and represents a number of customers which are connected to the observed electricity network. It varies in line with planned and realized permanent changes of the network configuration (normal operating state).

Note: The examples of templates for power supply interruption data collection are given in Annex 3: Example of Template for Registering Power Supply Interruption Data, and the examples of calculation of the indicators in the MS excel tables provided with the Study.

### III.2.4.4 STATISTICS OF EVENTS AND INTERRUPTIONS

Data from the operational statistics, which the service providers shall monitor and directly or indirectly disclose (data needed to calculate parameters or indicators), are the following data used for registering of each power supply interruption:

1) network element in failure;
2) feeder, field or subset of the secondary installations, which is in failure;
3) cause: internal cause, *Force Majeure* or external cause;
4) date, starting and ending time of interruption;
5) type of interruption:
   a. planned or unplanned,
   b. long or short;
6) number of interruptions by individual type;
7) number of affected delivery/withdrawal points;
8) energy not supplied (applies to TSO);
9) average power of the electricity system (applies to TSO);
10) location of the event:
    a. generation,
    b. transmission, or
    c. distribution (HV, MV, LV network).
Note: Reliable data for registering the power supply interruptions are prerequisite for calculation of the continuity of supply indicators and their application in the continuity of supply regulation. Therefore each of the above listed data has to be precisely determined by use of a systematic methodology, rather than by an ad hoc estimation conducted by the operator. This is especially important for determination of the number of delivery/withdrawal points affected by the power supply interruption. If there is no connectivity between customer database and technical information system or SCADA, an assessment on the number of affected delivery/withdrawal points could be based on the load of the MV/LV substation, or average number per (type of) LV feeder, but the precision of such data and its impact on the precision of the calculated indicators should be thoroughly investigated before any actual application in the continuity of supply regulation.

### III.2.4.5 EVENTS BEYOND CONTROL OF THE SERVICE PROVIDER (FORCE MAJEURE AND EXTERNAL CAUSES)

Events beyond control of the service provider are either:

- *Force Majeure*, or
- External Causes.

Records shall be kept for all interruptions which the service providers identified as a result of *Force Majeure*, so it may be proven that:

1) natural events have occurred outside the limits, in combination with:
   a. status of technique, or
   b. project conditions,

2) emergency measures have been declared.

The service providers shall notify in the Web-based application causes and documents for each interruption, which serve as evidence of *Force Majeure*, for example meteorologically correlated data which the service provider collects to prove with them a relation between the event and the cause of disruption.

Records shall be kept for all interruptions which the service providers identified as a result of external cause so it may be proven to have been caused by an act of a third party.

The service providers shall notify in the Web-based application causes and documents for each interruption, which serve as evidence of the cause of interruption being an external one.

### III.3 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO CUSTOMERS ON THE CONTINUITY OF SUPPLY

The service providers shall once a year inform users of the electricity network on the level of the continuity of supply through public information channels, in the following way:
DSO shall:

- in the same way as delivering the electricity bill, inform all users of the electricity network to what type of MV feeder they are connected to (urban, mixed or rural); the notice must also contain information about name of the MV feeder and relevant minimum standards for the continuity of supply for planned and unplanned interruptions; and

- on its website publish values of SAIDI, SAIFI, CAIDI and CAIFI indicators for the continuity of supply (internal causes, *Force Majeure* and external causes) and MAIFI indicator on associated MV feeder in the past year, within fifteen days after DSO reports the same data to the national regulatory authority.

TSO shall:

- on its website publish the actual data on the number and duration of all unplanned and planned interruptions and indicators of the continuity of supply for each delivery/withdrawal point, within fifteen days after TSO reports the same data to the national regulatory authority.

*Note 1:* The information on the name of the MV feeder and the relevant minimum quality standards are important for the customers to determine their potential right to claim compensation for low level of the continuity of supply.

*Note 2:* The example of a report on the continuity of supply indicators is given in Annex 4: Example of Report on the Continuity of Supply Indicators.

### III.4 RECOMMENDATIONS FOR COMPLAINT HANDLING PROCEDURES IN RELATION TO THE CONTINUITY OF SUPPLY

Customer complaints in general are one of the most important topics of the commercial quality, which is specifically elaborated in Chapter V.4. together with detailed instructions for complaint handling. Therefore, hereafter only reporting by the service provider to the national regulatory authority on customer complaints regarding the continuity of supply is considered.

The service providers shall report to the national regulatory authority the data on the number of justified and unjustified customer complaints regarding non-compliance of achieved level of the continuity of supply with the level of the continuity of supply which is determined by the guaranteed standards for the continuity of supply.

### III.5 REPORTING GUIDELINES FOR BENCHMARKING ON THE ENERGY COMMUNITY LEVEL IN RELATION TO THE CONTINUITY OF SUPPLY

ECRB has issued so far two benchmarking reports on the quality of electricity supply:

- “Report on the Quality of Electricity Service Standards and Incentives in Quality Regulation” in 2009, and
Continuity of Supply

- “2nd ECRB Benchmarking Report on the Quality of Electricity Supply” in 2011, complementary to the CEER’s “5th CEER Benchmarking Report on the Quality of Electricity Supply”.

It is recommended to the Energy Community to continue following the guidelines and the templates established by the CEER for the purposes of the benchmarking on the quality of electricity supply in all measurable aspects, including on the continuity of supply.

So far, the CEER’s benchmarking exercise has been performed 5 times by way of sending questionnaires to the national regulatory authority of each participating country and consequent elaboration of analytical benchmarking reports – the practice which may also be replicated by the Contracting Parties.

The CEER’s questionnaire, in the part related to the continuity of supply, consists of two parts:

- MS Excel file with spreadsheets for: 1) legend and definitions of basic terms, 2) the continuity of supply indicators, and 3) system (network) data, and
- MS Word document, with questions aimed to provide a detailed view on the continuity of supply monitoring procedures.

The parameters of the continuity of supply, which are given previously in this Chapter, fully match the CEER’s benchmarks ensuring thereby full compatibility at the Energy Community level.

Based on the content of the questionnaire for the 5th CEER benchmarking report on the quality of electricity supply, the section of the benchmarking report related to the continuity of supply shall cover the following topics:

- definitions of basic terms,
- overview of the continuity of supply monitoring practices,
- definitions of the continuity of supply indicators,
- analysis of the continuity of supply indicators at common levels of observation,
- audits of the continuity of supply data,
- use of standards and incentive in the quality regulation,
- individual indicators and standards/regulation for the worst served customers,
- correlation between the continuity statistics and the statistics of the technical state of the electricity network, and
- conclusions and recommendations.
III.6 GUIDELINES FOR DATA COLLECTING AND AUDITING IN RELATION TO THE CONTINUITY OF SUPPLY

III.6.1 RECOMMENDATIONS FOR DATA COLLECTING

In line with applicable regulations, the service providers are required to operate the electricity network, monitor the quality of electricity supply and perform an analysis of outages and failures, and create and store the operating statistics for at least 10 years.

In the operating statistics, the service providers shall cover unplanned and planned interruptions of supply. All types of events and interruptions shall be monitored, including long and short interruptions.

There are two main ways for monitoring the indicators of the continuity of supply:

- by use of SCADA, and
- manually.

The use of SCADA system for automatic registration of the power supply interruptions shall be regarded as a common goal and a preferred solution whenever possible, especially in HV and MV networks.

Note: The fact that SCADA still needs to be widely implemented in many Energy Community Contracting Parties and Observers provides a good opportunity to plan appropriate SCADA and DMS functions and network coverage to ensure automatic recording of short interruptions, which mainly occur in the low-load-density parts of the lower-voltage levels. This important technical issue needs to be considered when planning the introduction of SCADA. The costs needed for such a comprehensive monitoring scheme will be lower in comparison to an upgrade of existing SCADA functionalities.

Manual input of the power supply interruption characteristics in the register, for example by the dispatcher, shall be regarded as an exception in parts of the network without installed appropriate SCADA or in cases when the data from SCADA are not available. The Web-based application shall contain the information by network elements (stations and feeders) on the manner in which the data have been collected (by SCADA or manually).

Manual recording of the events in stations without installed devices for remote operation shall be performed by local recording of interruptions and storing into the registers of locally installed devices or local databases. Data shall be regularly transmitted to the center and taken into account when calculating indicators. These stations shall be properly labeled in the Web-based application for the reporting to the national regulatory authority. If these technological solutions are not introduced in the stations, maintenance personnel shall record the operating statistics manually. In the area of LV network, in such cases, the recording of interruptions may be realized on the basis of registration and processing of calls from the customers to the call center of the control center.

An automated scheme for logging power supply interruptions, especially in LV networks, may be based upon an advanced metering infrastructure (AMI). Regulatory jurisdictions with a
certain share and spatial distribution of advanced meters installed either in the network or at the customer’s metering points shall consider their usage for monitoring of power supply interruptions (both long and short ones), essentially without extra costs.

The service providers shall ensure that all interruptions which are not registered in SCADA but indicated by the network users via the call center are properly recorded. The records must contain all data prescribed in Chapter III.2.4.4, and also be subject to an assessment of the national regulatory authority.

Exceptional rules shall be applied for the following special cases with regard to the continuity of supply monitoring:

- customers belonging to one company and supplied from another one,
- feeders to and from PS (switchyard), and
- time sorting of interruptions - border line cases.

### III.6.1.1 CUSTOMERS BELONGING TO ONE COMPANY AND SUPPLIED FROM ANOTHER COMPANY

A special procedure shall be prescribed in case where a feeder from PTS or PS of some distribution company also supplies the customers from other distribution companies and is not fed simultaneously from another PTS or PS which is owned by these companies (two-sided supply).

The company whose customers are supplied from another company’s PTS or PS monitors indicators of the continuity of supply on a corresponding feeder by adding in their network configurations data a "virtual" PTS or PS and the corresponding "virtual" feeder. The accompanying indicators are monitored only for its share of customers.

The distribution company, which owns PTS or PS mentioned, monitors indicators only for its share of customers.

### III.6.1.2 FEEDERS TO AND FROM PRIMARY DISTRIBUTION STATION (SWITCHYARD)

DSO shall monitor indicators of the continuity of supply in PS in the same way as in PTS.

The values of indicators by types of feeders from a PS shall not count to the values of indicators for the type of MV feeder from PTS, which supplies that PS (connecting-feeding MV feeder).

On the connecting-feeding MV feeder from PTS to PS, only indicators of the continuity of supply for those customers who are directly connected to the feeder, before PS, shall be monitored.

### III.6.1.3 TIME SORTING OF INTERRUPTIONS - BORDER LINE CASES

Long and short interruptions, which start in one month and end in one of the following months, shall be counted to indicator of the continuity of supply for the month of termination of the interruption.
III.6.2 GUIDELINES FOR INTRODUCING VERIFIABLE DATA COLLECTING PROCEDURES

The procedures for verifiable data collecting, as well as for measuring performance and data reporting to the national regulatory authority shall be defined clearly and consistently with the regulatory instruments in use.

The service provider must recognize the type of data, the sources and locations of data for their collecting and reporting purposes.

The data collecting procedures shall be provided to all relevant staff, together with record forms and any other material they may need. The content and format of data to be recorded shall be clearly defined, ideally in a handbook or manual. Where there is a risk of inconsistent recording, copies of agreed definitions and instructions shall be issued.

The service provider shall continually keep updated the records of the power supply interruptions. Every interruption shall have a unique code, in order to attribute to the same interruption the information found in:

- records of operations;
- tables and files on computers of the remote control system or other appropriate instruments for the recording of the continuity of supply;
- lists of signals and telephone calls made by the customers demanding for interventions, where all of the telephone calls made for signaling of faults must be noted, even if there are not any interruptions;
- reports of interventions by operating crews;
- documentation of security measures and other necessary documentation; and
- schemes of network configuration at the moment of a fault and its resolving.

For the purposes of verifiability of recorded information, the service provider may also use the recordings on the events registered manually. The registration may be done later, depending on the moment of occurring of the event, but it shall be done within 10 days and must include date and hour of occurring of the recorded event.

The service provider shall keep in an organized and accessible way all documentation necessary for the verification of correctness of performed recording, for a period of two years following the year of recording.

Note: The examples of the templates for registering power supply interruptions is given in Annex 3: Example of Template for Registering Power Supply Interruption Data.

III.6.3 GUIDELINES FOR AUDITING DATA COLLECTING PROCEDURES

The national regulatory authority may conduct an assessment of monitoring of the quality in the service providers, taking care not to obstruct their business operations and performance of their activities, and not to impose a disproportionate burden in relation to the assessment.
Audits shall focus on the compliance with the rules for registration and reporting, by having the following two key objectives:

- to verify that the service providers are correctly applying the instructions and guidance for the collecting and reporting, especially with regard to causes and origins of the power supply interruptions, and
- to verify that the service providers meet specific minimum levels of accuracy while performing these tasks.

When designing an audit procedure, the national regulatory authority shall define the following three fundamental elements:

- instructions for the service providers to ensure the traceability of all reported data;
- indicators of accuracy and minimum acceptable levels of these indicators; and
- corrective actions to be taken in case of non-compliance with the minimum levels (and possibly, associated financial penalties).

Audits may be carried out by the national regulatory authority or consultants hired by the national regulatory authority (external audits), or even by the service providers themselves (internal audits), according to rules set by the national regulatory authority, which shall define:

- periodicity of the audits (e.g., once per year),
- object of the audits (e.g. recorded data, recording procedures),
- roadmap of the audits (e.g., predefined by law, published on yearly bases, announced a few days in advance to the audit), and
- fines in cases of non-compliance with the roadmap.

After the assessment, the authorized person of the national regulatory authority shall compose a report, containing an assessment of the monitoring adequacy.

Note 1: Having reliable data is crucial for incentive regulation on the continuity of supply. Measurement protocols require the service providers to measure and analyse data in a manner that is consistent with regulatory purposes, enable the national regulatory authority to control the registration process, and give credibility and fairness to financial incentive schemes. The most critical issues in measurement protocols that affect the implementation of incentive/penalty schemes are classification of causes (in particular Force Majeure), and identification (or estimation) of the number of consumers affected by the interruptions.

In order to ascertain the validity of the continuity of supply data, audits may be conducted on the representative sample of the power supply interruption data based on the following indices:

1. the $IA$ accuracy index, measuring the completeness and accuracy of records of interruptions;
2. the $IP$ precision index, measuring the total precision of the value of the indicator provided by DSO; and
3. The *IC* correctness index, measuring the degree to which the DSO has correctly attributed causes and origins of interruptions.

The examples of calculations of indices are given in Annex 5: Example of Calculation of Indices for Auditing the Continuity of Supply Data in Italy.

**Note 2**: Example of criteria for ascertaining the validity of continuity of supply data in Italy

If, as a result of sample checks of the continuity of supply data provided by distribution companies, the national regulatory authority finds that such data were not recorded in the manner prescribed by the prescribed provision, the national regulatory authority shall use the findings of its audits to establish the estimated annual value of the regulated indicator $^9$ for the territorial district involved.

This estimated annual value of the regulated indicator shall be used to calculate any penalties and any automatic compensation. Distribution companies for which the national regulatory authority has established the estimated annual value of the regulated indicator shall not be entitled to recognition of the costs for the territorial district involved.

The continuity of supply data provided by distribution companies for the territories being audited shall be considered valid if they meet all of the following conditions:

- an accuracy index value greater than 90%;
- a precision index value of between –3% and +3%;
- a correctness index value such that: $\left[1 - \frac{IC}{D_2/D_1}\right] \leq 3\%$;

where:

- $IC$ is the correctness index;
- $D_1$ is the annual value of the regulated indicator, expressed in minutes for LV customers provided to the national regulatory authority by distribution companies for each territorial district involved in the audit;
- $D_2$ is the annual value of the total duration of interruptions per LV customer, provided to the national regulatory authority by distribution companies for each territorial district involved in the audit regarding interruptions originating in the HV network and the national transmission grid as well as interruptions originating in the MV and LV networks and interruptions due to force majeure or external causes.

For territories for which $D_1$ is lower than the national reference level applicable to the density level, the condition at letter c) shall be replaced, if more favorable, by the following condition: $IC \geq 97\%$.

$^9$ **SAIDI** for long unplanned interruptions.
Continuity of Supply

If during an audit distribution companies are able to calculate the contribution of each interruption to the continuity levels for each of the territories covered by the remote control centre at which the audit is being conducted, the correctness index calculated at the level of the remote control centre shall regard a maximum of three territories for which the ratio between $D_2$ for the sampled interruptions only and $D_2$ for the entire territorial district is highest and in any case different from zero.

The estimated value of the regulated indicator shall be calculated as:

$$D_{\text{pres}} = \frac{D_1 + D_2 \times (1 - IC)}{(1 - IP)}$$

where:

- $D_{\text{pres}}$ is the estimated value, expressed in minutes per LV customer;
- $IP$ is the precision index;
- $IC$ is the correctness index (between 0 and 100%);
- $D_1$ and $D_2$ have the meaning given above.

If the ratio between $D_{\text{pres}}$ and $D_1$ is greater than 200%, distribution firms may request that the estimated value of the regulated indicator be calculated on the basis of analytical technical information, which distribution firms themselves shall supply to the Authority in a timely manner for the calculation.

Another way of validation of the correct use of causes of interruptions, or in other words identification of so called major event days utilizes statistical 2.5 beta (defined in IEEE 1366-2003 Standard Guide for Electric Power Distribution Reliability Indices).

Note 3: Examples of calculation of precision and correctness indicators for data auditing, as well as 2.5 beta method for detecting major events (defined in IEEE 1366-2003 Standard Guide for Electric Power Distribution Reliability Indices) are in MS excel tables provided with the Study.

III.6.4 GUIDELINES FOR AUDITING REPORTS BY SERVICE PROVIDERS TO NATIONAL REGULATORY AUTHORITIES

The reports for the national regulatory authority shall be audited having in mind primarily data on breaches. Data on breaches shall be recorded in accordance with process routes, responsibilities and methods defined in the collecting and reporting procedures. Breaches shall be recorded in such a way as to allow audits and reviews to be conducted.

The collecting and reporting procedures shall cover:

- how breaches will be identified;
- who shall be responsible for recording and review of apparent breaches;
- the specific data which should be entered;
The procedures for reviewing these data; and
definitions and guaranteed standards.

The recording, reporting and reviewing of breaches shall be monitored by means of planned and recorded reviews.

The review of breaches of the guaranteed standards shall consider the following questions:

- Was the data comprehensive and correctly recorded?
- Are there any inconsistencies in the data recorded?
- Was the breach allocated to the correct guaranteed standard?
- Are there any exemptions which would apply? If so, were these properly applied?
- What is the necessary follow-up action?

The results of the review shall be documented.

Where an apparent breach is not confirmed because of the existence of a specific exemption, the nature of the exemption and the name of the person authorizing it shall be recorded in accordance with defined responsibilities.

### III.6.5 RECOMMENDATIONS FOR AUDITING DIGITAL REGISTERS, SOFTWARE AND SYSTEMS

Document control principles shall apply to computer systems, software and computer-based records. These shall normally include the use of backups and passwords and other arrangements to ensure the integrity and availability of computerized records and documents.

The responsible person for the reporting shall have overall responsibility for identifying the records needed for the operation of the monitoring system and the periods for which they shall be retained. System records shall be maintained, either in documentary form or on computer, to demonstrate accurate recording of data and the effective operation of the monitoring system.

System records shall be stored and maintained in such a way as to:

- provide for ready access and retrieval;
- ensure minimal deterioration or damage; and
- prevent loss.

Records of all types shall be held for defined minimum periods. After the minimum retention period these records shall be reviewed against stated criteria before disposal, archiving or further retention.

Computer systems used to support the collecting and collating of data shall be identified in the data collecting procedures. The computer systems shall be reviewed by suitably qualified personnel before they are brought into use and whenever changes are made, to ensure their systems provide the correct results. These shall be made both initially and after any changes to the systems.
If anyone of the computer systems is found to produce erroneous results, the validity of previous data shall be considered. Appropriate action must be taken to correct the error – the action shall be recorded and the national regulatory authority shall be advised of the nature of the error and its effects. Test and control software and hardware shall be subject to appropriate backups and access controls.

### III.7 RECOMMENDATIONS ON GRADUAL INTRODUCTION OF REGULATORY INSTRUMENTS IN RELATION TO THE CONTINUITY OF SUPPLY

#### III.7.1 GUIDELINES FOR GRADUAL DEVELOPMENT OF THE CONTINUITY OF SUPPLY REGULATION

In recent years, a growing number of countries have adopted some sort of revenue regulation for electricity distribution and transmission, which requires parallel introduction of the quality of supply standards or incentive/penalty regimes for the quality of supply. The most important guidelines for the quality of supply regulation are recapitulated hereafter:

- The regulatory scheme shall be assessed with respect to: 1) its effects on the continuity of supply, and 2) its costs and benefits for the service providers and customers;
- The regulatory scheme must be built upon a relatively small number of the quality of service indicators;
- The regulatory scheme shall be implemented gradually, allowing the national regulatory authority to begin with the most critical aspect of the quality and then enlarge the scope of the regulation;
- The quality of service regulation shall be subject to periodic evaluation and revision, allowing the national regulatory authority to learn from practical results and to enlarge and adapt the scope and structure of the regulation over time;
- Periodic review shall give service providers the necessary amount of time to make investment decisions under stable regulatory conditions;
- The regulatory instruments must be fair and simple to implement. Clear rules on data measurements and collecting have a fundamental role in ensuring fairness;
- Collecting reliable data on the actual quality level shall be the first objective pursued by the national regulatory authority, allowing publication of data on actual service provider performance and use of comparisons with other service providers;
- Behind publication of data, there shall always be a process of data collecting according to the regulatory instructions and guidance, ensuring necessary accuracy and reliability of published data;
- The national regulatory authority shall further be concerned with unacceptably low quality levels, leading to protection of the worst-served customers by use of the minimum quality standards;
- The national regulatory authority shall also be concerned with the average quality level supplied by the service provider. Reward and penalty schemes respond well to the objective of inducing the service provider to deliver, on average, an efficient quality level;
- The national regulatory authority shall be concerned with the needs of customers with higher than average valuation of quality, leading to creation of mechanisms...
that will give these customers the opportunity to individually negotiate higher service levels with the service provider (premium quality contracts).

Comparative publication of the continuity of supply indicators by service providers is the simplest way of “regulation”, without the need to set performance standards or financial incentives. However, performance of truly comparative data publication is possible only if the same methodologies for data collecting are used.

Guaranteed standards shall be designed to ensure that every customer has a minimum level of quality, which can be achieved regulation of the continuity of supply indicators at individual customer level.

Reward and penalty schemes shall be designed as incentives to the service providers to deliver desirable levels of the continuity of supply. They are intended to modify the regulated service providers’ revenues according to the continuity of supply performance measured by the predefined performance standards. The important steps not to be missed when introducing such regulatory approach shall be the following ones:

- definition of the regulatory objectives,
- selection of the quality indicators to be regulated,
- definition of the performance standards over a regulatory period of several years, and
- design of functional relations between performed quality and realized revenues.

Regulation of the continuity of supply at the system level shall be based on the impact on the service providers’ tariffs (network charges). Reward/penalty schemes have in most cases the same duration as the price control period, but the approach without a predetermined duration is also possible. All schemes shall be periodically reviewed: in the first case, with the same frequency as the tariff, whereas in the second one at the discretion of the national regulatory authority.

Regulation of the continuity of supply at individual customer level is usually based on the compensations made upon customer’s request. However, there are a lot of examples of automatic compensations, which are expected to produce better compliance of the service provider with the standards. Compensation amounts depend on customer types (households or non-households) and generally increase as a function of distance from the standards.

Individual regulatory indicators which are typically implemented can be divided into two groups:

1. Indicators concerning duration of interruptions:
   a. duration of single long unplanned interruption, and
   b. cumulative annual duration of long unplanned interruptions;

2. Indicators concerning number of interruptions:
   a. annual number of long unplanned interruptions,
   b. annual number of short interruptions, and
   c. annual number of (all) interruptions.

Examples of the standards for the regulation of the continuity of supply in the EU are given in the CEER’s “Third Benchmarking Report on Quality of Electricity Supply” published in 2005,
and more up-to-date data is available in the CEER’s “5th Benchmarking Report on Quality of Electricity Supply”. Examples of the continuity of supply standards in Italy, Moldova and Slovenia are given in the following tables.

Table III.2  The examples of the continuity of supply standards in Italy in the period of regulation from 2008 to 2011.

<table>
<thead>
<tr>
<th></th>
<th>Overall long interruptions without notice</th>
<th>Duration of interruptions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>- for territories with high concentration: 25 minutes;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for territories with medium concentration: 40 minutes;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for territories with low concentration: 60 minutes.</td>
</tr>
<tr>
<td></td>
<td>Number of interruptions:</td>
<td>- for territories with high concentration: 1,0 interruption/customer;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for territories with medium concentration: 2,0 interruption/customer;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for territories with low concentration: 4,0 interruption/customer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Individual long interruptions without notice for MV customers or other MV users</th>
<th>Number of interruptions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>- high density: 3 for years 2008 and 2009 and 2 for years 2010 and 2011;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- medium density: 4 for years 2008 and 2009 and 3 for years 2010 and 2011;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- low density: 5 for years 2008 and 2009 and 4 for years 2010 and 2011.</td>
</tr>
<tr>
<td></td>
<td>Exceptions:</td>
<td>- long interruptions without notice attributed to force majeure causes;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- long interruptions without notice attributed to external causes (damages caused by customer, accidental contacts or damages to conductors caused by third parties, failures of production facilities);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- long interruptions without notice caused by the same customer in question;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- short or transient interruptions without notice;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- long interruptions without notice started within sixty minutes after the conclusion of a previous long interruptions without warning, including those with sources and/or other causes;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for customers with interruptible supply contracts, for the interruptions caused by the application of clause of interruptibility;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- for the interruptions that are prolonged or extended in accordance with Title 7, Part I of this provision and that bring to repayment by way of compensation by a distribution company;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- interruptions with notice and interruptions due to shedding of generators previously placed in service for the restoration of continuity of service.</td>
</tr>
</tbody>
</table>

Table III.3  The examples of the continuity of supply standards in Moldova.

<table>
<thead>
<tr>
<th></th>
<th>System level</th>
<th>SAIDI for the next 4 years:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System level</td>
<td>2011: 600 minutes/customer;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012: 550 minutes/customer;</td>
</tr>
</tbody>
</table>
- 2013: 500 minutes/customer;
- 2014: 450 minutes/customer.
2 Individual level

A) The duration of one planned interruptions shall not to exceed:
- 2 hours, in case of executing works for new connections at LV level;
- 4 hours, in case of new connections, reconnections at MV level;
- 12 hours, in case of works for prophylaxis, current repairs of electric equipment etc.
- 24 hours, in case of a capital repair of electric lines;

B) The duration of one unplanned interruptions shall not to exceed:
- 24 hours, where it is necessary to repair or replace a damaged electric line sector;
- 16 hours, for interruptions, produced at nighttime and caused by defects of MV networks;
- 6 hours in urban areas and 8 hours in rural areas in other cases;

C) The annual number of planned interruptions:
- 5 for urban areas;
- 8 for rural areas;

D) The annual number of unplanned interruptions:
- For urban areas – 6 (at MV level) and 9 (at LV level);
- For rural areas – 9 (at MV level) and 12 (at LV level);

E) The annual duration of unplanned interruptions:
- For urban areas – 36 hours;
- For rural areas – 48 hours;

Compensations payments are differentiated in 3 groups:
- Household customers;
- Non-household consumers, under installed power less than or equal to 100 kW;
- Non-household consumers, under installed power higher than 100 kW;

Exemptions from compensations are as well defined:
- force majeure situations;
- events caused by end consumers’ installations, emergencies at interconnection lines;
- special meteorological conditions;
- in the case of electricity supply interruptions caused by third parties.

Table III.4 The example of the guaranteed standards in Slovenia.

<table>
<thead>
<tr>
<th>Voltage level</th>
<th>Type of MV feeder from PTS / PS</th>
<th>Connection of the customer to MV feeder from PTS / PS</th>
<th>Total annual duration of long unplanned interruptions without external causes and Force Majeure (minutes)</th>
<th>Total annual number of long unplanned interruptions without external causes and Force Majeure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium voltage</td>
<td>rural</td>
<td>directly</td>
<td>480</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>suburban</td>
<td></td>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>urban</td>
<td></td>
<td>180</td>
<td>4</td>
</tr>
<tr>
<td>Low voltage</td>
<td>rural</td>
<td>indirectly</td>
<td>960</td>
<td>16</td>
</tr>
</tbody>
</table>
III.7.2 RECOMMENDED ANALYSES

Introduction of the continuity of supply regulation shall be well prepared in terms of consultations with the service providers and customers.

The consultation with the service providers may take the form of joint analyses of the specific topics regarding the quality of supply regulation currently in focus. The most important goal is the estimation of the expected costs versus improvements of the service providers performance.

General or specific customer surveys are the best form of collecting the evaluation of the quality of supply from the customers. They may provide useful information on customer satisfaction and expectations, as well as so-called Willingness To Pay (WTP) for different aspects of the quality of supply, including the continuity of supply. This information shall be very useful when making regulatory decisions regarding the choice of the continuity of supply indicators to be monitored and/or regulated. The most frequently explored issues through customer research in relation to the continuity of supply are:

- customer satisfaction with the service provider’s performance,
- customer expectations regarding duration of very long interruptions, accurate information during interruptions and numbers and durations of interruptions, and
- customer willingness to pay, as a quantitative research intended to help the national regulatory authority in setting incentive rates of the incentive schemes.

According to the CEER’s Guidelines of Good Practice (GGP) on Estimation of Costs due to Electricity Interruptions and Voltage Disturbances, based on the practical experience available in some countries, the conclusions on the issue of analyses needed for preparation of the continuity of supply and the voltage quality regulation are as follows:

- The national regulatory authorities shall perform nationwide cost-estimation studies regarding the continuity of supply and the voltage quality;
- A pre-study shall be performed in advance of a main study in order to define the objectives and to clarify country-specific characteristics, budget and consultancy needs, possible funding partners, timeline and possibilities in general for the main study;
- The GGP shall be used as a reference when performing a nationwide cost-estimation study, always taking into account country specific issues and needs;
- Society costs shall be considered in addition to customer costs when doing a cost estimation study, as these can differ significantly;
- Results from cost-estimation studies on customer costs due to the continuity of supply are of key importance as they help in the setting of proper incentives for the continuity of supply;
- Results and experience from cost-estimation studies shall be disseminated among interested parties.

There are several important recommendations for conducting studies on costs due to the continuity of supply and the voltage quality:
- definition of objectives,
- choice of consultants,
- specification of customer groups,
- choice of cost-estimation method,
- choice of normalization factor and clarification of data needs,
- check for available data, and
- choice of method (means by which the survey/case analysis is performed).

Relating to methods used for conducting the analysis, a typical structure for a cost-estimation study on the continuity of supply and the voltage quality can be divided into a “survey-based approach”, which typically includes the design of a questionnaire for a large representative sample, and a “case-based approach” which focuses on a few single cases aimed to identify consequences of power supply interruptions or voltage disturbances for these typical cases.

### III.7.3 METHODOLOGIES FOR DEFINING TARGET VALUES OF THE CONTINUITY OF SUPPLY INDICATORS

Setting continuity-related minimum quality standards as well as incentive/penalty schemes requires firstly reliable data and secondly that the outputs to be regulated are relevant and important for customers. This means that there are two main prerequisites for setting standards and incentives/penalties:

- continuity measurement systems, and
- customer surveys on satisfaction, expectations and/or willingness to pay.

The factors that influence a service provider’s performance, which shall be taken into account when setting the minimum quality standards, can be grouped into three classes:

- Inherent factors, such as weather conditions, geography and population density of a particular area;
- Inherited factors, such as the design of the network at the starting moment of incentive regulation (e.g., some companies or areas may have long, predominantly overhead circuits, whilst others may have more underground lines); and
- Incurred factors, such as managerial performance, how well assets are maintained, and how effectively resources are used.

There are basically two ways for defining the target values, while taking into account the above factors: 1) to look at the service provider’s performance over time, and 2) use of mathematical or engineering models (for example regression).

The first approach shall be based on the following few basic principles:

- The reference shall be the achieved continuity of supply level (during a few years, in order to account for weather conditions and other stochastic factors);
- The future target values shall take into consideration the performance in the past, but they can be set as more or less demanding than the observed trend, depending on the goals of the regulation (higher quality or reasonable expenses);
- Incurred factors are very significant in the short-term (i.e., regulated period of a few years), and the general principle which shall enable a convergence of the quality levels for the entire jurisdiction shall be the following – the service...
providers that begin with lower quality levels can be expected to improve more, within the set time span and with the same level of expenditures, than the service providers that already offer higher quality levels;

- Inherent and inherited factors shall be considered by differentiating the target values according to geography and network design (e.g., different sets of the target values for different service providers or even for different geographical areas within one service provider); and
- Periodic adjustments of the target values, especially rescaling to the new achieved quality level in the beginning of the new regulatory period.

The second, more complex approach, is based on network performance assessment methodologies, which enable comparisons of the service providers by their performance with regard to the continuity of supply. They are objective and fair tools for taking differences in network designs into account.

*Note:* In Great Britain the national regulatory authority (Ofgem) collects physical characteristics and performance information for each MV circuit for each DSO. These circuits are then divided into 22 circuit groups with physically similar characteristics, defined in such a way that differences in the percentage of overhead line, circuit length and number of connected customers are minimised and that no group is dominated by a single DSO. The national regulatory authority compares and benchmarks performance within each circuit group, and the benchmark for each DSO is defined based on its mix of circuit types.

### III.8 GENERAL OVERVIEW OF THE SITUATION IN THE ENERGY COMMUNITY CONTRACTING PARTIES AND OBSERVERS IN RELATION TO THE CONTINUITY OF SUPPLY

In the Energy Community Contracting Parties and Observers the monitoring of continuity of supply is performed in different ways - the differences comprise different types of interruptions, different sets of indicators, as well as different approaches to detailed reporting. Harmonization, where existing, has not been enforced by law, but has been implemented through examples of good practice in the EU.

All regulatory jurisdictions use some sort of the interruptions monitoring, with the actual focus put mainly on long interruptions, which is essential for calculation of the continuity of supply indicators that are widely used in the quality of supply regulation.

In many Contracting Parties and Observers there is only a limited use of SCADA, so the manual recording of interruptions prevails. Lack of rules for automatic recording of interruptions has a direct impact on completeness, robustness and the quality of data.

Usually, there are also distinct and separate data collecting procedures for planned and unplanned interruptions. Unplanned long interruptions are monitored in all regulatory jurisdictions. However, this type of interruptions is not monitored everywhere at all voltage levels. Rules on noticing the customers affected are applied, whereas the requirements for advance notice vary from 24 hours up to 10 days.

Incidents on MV and HV level are monitored in all regulatory jurisdictions. The lack of monitoring or inefficient monitoring on LV level could result in a significant underestimation of the number and duration of interruptions experienced by LV customers (unplanned and planned), especially in urban areas but also on the whole jurisdiction level.
Mostly, the information on the cause of interruption is collected, but there is no harmonization as regards the classification of reasons for interruption. The definitions of Force Majeure show a lack of harmonization, which is probably caused by different legal concepts relating to obligations and by inherent climate differences. Therefore, stringent harmonization might not be feasible at all. The lack of harmonization as regards exceptional events significantly affects the comparison of interruption data between the regulatory jurisdictions.

There are no significant differences between the continuity of supply indicators typically used across the regulatory jurisdictions. Regarding the measurement of long interruptions, the most common indicators for measuring the continuity of supply are SAIDI and SAIFI for the distribution network and ENS and AIT for the transmission network. MAIFI values are used for short interruptions.

The indicators calculated for the whole jurisdiction are regularly published, while only rarely the indicators are calculated per system operator and/or region/city. A distinction based on voltage level is made everywhere. Information on the cause of the incident is also provided everywhere. However, the classifications used for the voltage levels and causes significantly differ.

Mostly, exceptional events are not excluded from statistics on the continuity of supply. It is not possible to neutralize the consequences of these differences from the reported values of the continuity of supply indicators by excluding the impact of exceptional events. Moreover, it is also very difficult to assess how exceptional events influence the interruption statistics. Accordingly, any conclusion concerning the level of the continuity of supply that exclusively relates to the responsibility of the performance of system operators is not feasible.

Due to the lack of availability of required data and the problems of comparability, the benchmarking analysis is focused only on the indices:

- representing the value aggregated on the whole jurisdiction level,
- comprising interruptions at all voltage levels monitored, and
- including the interruptions caused by exceptional events.

Relating to the values of the indicators, the following is noticed:

- in average, 85% of both SAIDI and SAIFI for LV network users are caused by incidents in MV networks (however, in some jurisdictions the contribution of interruptions in MV networks on SAIDI is below the European average);
- the range of values of indicators extremely differs between the regulatory jurisdictions;
- on average there is an improvement of the SAIDI index;
- the average rates of underground circuits in both MV and LV networks are much lower in the Contracting Parties and Observers compared to the EU (therefore, the level of the continuity of supply is expected to be much lower as well).

On-site audits are rarely regularly executed in relation to the continuity of supply data provided by the companies. Auditing is only somewhere foreseen. In general, audit procedures have not been designed yet but there is an interest in implementing such procedures in the future according to the development of their service quality regulation frameworks.
The regulatory frameworks are assessed on two different levels of the continuity of supply standards:
- at system level with the quality reward/penalty regimes, and
- at single-customer level with the customer compensation schemes.

Development of the regulatory frameworks is still in an initial stage in the prevailing number of observed jurisdictions. However, the activities for assuring maintenance and improvement of the continuity of supply levels, as well as activities for protecting the worst served customers are ongoing or will start soon. Data on indicators are not published everywhere, but wherever applied they are published mostly on annual basis.
IV  VOLTAGE QUALITY

Voltage quality is the most technical and complex part of the quality of electricity supply. It can be affected by all the parties connected to the power system: network companies (TSO/DSO), power producers and end users. Voltage quality can be divided into several different voltage disturbances that are grouped into voltage events and continuous phenomena for which the latter can be most easily regulated in European norms or national regulations by minimum requirements.

Continuous phenomena are variations that occur continuously over time and can often be satisfactorily monitored during measurement over a limited period of time, e.g. 1 week:

- supply voltage variations,
- flickers (voltage fluctuations),
- voltage unbalance,
- harmonic distortions,
- interharmonic, subharmonic voltages,
- mains signalling voltages superimposed on the supply voltage.

Voltage events are typically due to the unpredictable events (e.g. faults) or to external causes and occur only once in a while. Therefore to be able to measure voltage events, continuous monitoring is necessary:

- supply voltage dips,
- supply voltage swells (temporary power frequency overvoltages),
- rapid voltage changes,
- transient overvoltages.

Voltage quality regulation is just beginning even in Europe. Regulators and network companies are today mostly engaged in collecting data on the characteristics of the voltage supplied by network companies (i.e. service provider).

The objectives of the recommendations and guidelines which are given hereafter on the voltage quality are the following:

- to protect the rights of the end users by use of minimum requirements of the voltage quality (i.e. voltage quality standards), as well as by use of timeliness for eliminating voltage quality related problem and penalties for cases in which voltage quality requirements are not met,
- to ensure fair and consistent record of licensees performance measured by reliable, comparable and verifiable parameters of the voltage quality,
- to allow provision of adequate information from the service provider to the national regulatory authority as well as to the customers on the voltage quality,
- to enable benchmarking of the parameters of the voltage quality between the regulatory jurisdictions in the Energy Community in a manner which is compatible and comparable to the CEER’s one in the European Union, and
- to gradually introduce regulatory instruments in relation to the voltage quality.
IV.1 VOLTAGE QUALITY LEGISLATION, REGULATION AND STANDARDIZATION

The most important norm regarding voltage characteristics of electricity supplied by public distribution networks is CENELEC norm EN 50160 (Voltage characteristics of electricity supplied by public distribution networks). Regarding standardized methods for measurements of voltage quality the most important norm world wide is the IEC norm 61000-4-30 (Testing and measurement techniques – Power quality measurement methods).

While approaching voltage quality, regulators have so far mostly relied on the EN 50160. The ERGEG paper “Towards Voltage Quality Regulation in Europe” published in 2007, contains the European regulators’ position on several aspects of EN 50160 needing improvements and indentifies gradual steps that can be taken in order to achieve such improvements. New edition of norm was approved by CENELEC on 01/03/2010.

Generally, network performance in Europe is already better than EN 50160 limits. Many regulators think that stricter voltage standards are required; in this sense some countries have already gone beyond EN 50160. The CEER 4th Benchmarking report on Quality of Electricity Supply (2008) reports on national VQ regulations and standards that are different from EN 50160 (Table 3.5). It is too early now to tell if this will be a general trend in the future or not. It is important to note, however, that defining voltage quality standards that differ form EN 50160 is not an easy task. For this reason, in addition to the work carried out individually, regulators shall be engaged in a joint effort to improve the existing technical norms.

Some countries will probably always refer to EN 50160 no matter how loose limits or definitions may be, and some countries will instead choose a “two-level” option, adopting definitions and measurement rules given in international standards and introducing national VQ limits and requirements by the national regulators. EN 50160 has been generally considered as reasonable starting point for protecting the worst served customer. The future will depend upon how satisfactory future editions of international standards (e.g. EN 50160) will turn out to be.

In line with ECRB Quality of Electricity Supply in the Energy Community Benchmarking Report10 (December, 2011), the study suggests introduction of EN 50160 and IEC 61000-x-x in national standardization, legislation and regulation. Countries that adopted but have not translated EN 50160 should make the effort to translate the norm with a view to have precise definitions in national language. This also applies to other widespread standards like IEC 61000-x-x.

To verify the fulfilment of the regulatory limits and contractual disposals the study suggests the national legal and regulatory framework to introduce measurements of power (voltage) quality to be carried out by the monitoring instruments of class A specified in IEC 61000-4-30. Class B monitoring instruments specified in IEC 61000-4-30 can be used for statistics purposes and research. The instruments used shall be calibrated in accordance with the instrument suppliers' specifications with respect to frequency and methodology. The calibration traceability for the individual measurement parameters shall be documented. The

---

10 Annex to the 5th CEER Benchmarking Report on Quality of Electricity Supply.
precision and limitations of the measuring equipment shall be stated in the documentation of the measurement results.

### IV.2 VOLTAGE QUALITY INDICATORS

Voltage quality indicator is an overall indicator of achieved level of compliance of the voltage quality parameters with national voltage quality requirements (limits).

National voltage quality requirements (limits) shall be implemented, if not already, by adoption of EN 50160 in standardization, legislation and regulation. EN 50160 can be considered as the basic instrument for voltage quality assessment. Countries that have not adopted EN 50160 and have not referenced to this norm in legislation/regulation or have created VQ provisions in line with EN 50160 requirements, are encouraged to do so. Implementing provisions in national legislation (i.e. grid codes or voltage quality rules) that are consistent or stricter than EN 50160 provisions is recommended.

For different voltages, the voltage quality indicator shall be calculated as follows:

\[
I_{VQ} = \left(1 - \frac{\sum_{i=1}^{n} N_{\text{inconsistent weeks } i}}{\sum_{i=1}^{n} N_{\text{weeks measured } i}}\right) \times 100\% 
\]

where is:

- \( I_{VQ} \) the voltage quality indicator, expressed in % by individual voltage levels,
- \( N_{\text{inconsistent weeks } i} \) number of weeks during which individual voltage quality parameters at the "i-th" measuring point are not consistent with the requirements of the standard,
- \( N_{\text{weeks measured } i} \) number of weeks in a calendar year for which the data on the quality of electricity were measured and authenticated at the "i-th" measuring point and
- \( n \) the total number of measuring points at each voltage level.

The indicator shall be calculated separately for at least the following voltage variations (continuous phenomena):

- supply voltage variations,
- harmonic distortions and
- flickers (voltage fluctuations).

*Note*: The study suggests starting with continuous phenomena (voltage variations) as for them EN 50160 sets binding limits and they can often be satisfactorily monitored over a limited period of time (e.g. 1 week).
With respect to the voltage quality indicators the Slovenian *Akt o posredovanju podatkov o kakovosti oskrbe z električnom energijo*\(^{11}\) may serve as an example for transposition. It obliges licensees to calculate voltage indicators for the following three voltage variations: supply voltage variations, harmonic distortions and flickers. However, some DSOs calculate voltage indicators for two additional voltage variations: voltage unbalance and mains signaling voltages (thus covering all EN 50160 voltage variations).

For voltage events the EN 50160 provides only indicative values of the frequency with which the events can be expected to occur. Besides, to be able to measure voltage events, continuous monitoring is necessary since they occur only once in a while. A measurement period of at least one year is recommended by a number of sources including CIGRE/CIRED/UIE JWG C4.110\(^{12}\).

In Annex 6 an example is given describing calculation of voltage quality indicators for the supply area of one system operator.

**IV.2 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO THE NATIONAL REGULATORY AUTHORITIES ON THE VOLTAGE QUALITY**

The reporting to the national regulatory authority shall be based on the following key parameters in line with the national standard adopting EN 50160 (*Voltage characteristics of electricity supplied by public distribution networks*):

- supply voltage variations,
- voltage dips and swells,
- flickers,
- harmonic distortions and interharmonic voltages,
- voltage unbalance,
- mains signalling voltages superimposed on the supply voltage,
- power frequency and
- any other parameter which is set by valid standard.

The final goal shall be web-based application for the voltage quality data reporting and publication. In the mean time other applications can be used (e.g. Excel tables, see tables in Annex 6).

The voltage quality limits (minimum requirements) shall be given either by reference to EN 50160 (*Voltage Characteristics in Public Distribution Networks*), national legislation (e.g. network codes) and regulation on quality of supply or in the voltage quality contracts. TSO and DSO may require more stringent parameters of the voltage quality standards than required by the EN 50160. Also, it should be noted that the standard 50160 is used in a number of countries for voltage quality regulation of high voltage networks.

---

\(^{11}\) *Akt o posredovanju podatkov o kakovosti oskrbe z električnom energijo*, Uradni list Republike Slovenije, No. 89, November 2010.

Voltage Quality

The service providers shall be obliged to keep data on the voltage quality, as the basis for the reporting to the national regulatory authority. The voltage quality data shall be collected by way of continuous monitoring of the voltage quality in the transmission and distribution networks and through planned systematic weekly measurements. It is strongly suggested to store as much data as feasible for several years, including raw data, where feasible in an easily accessible format to allow future queries that can not be foreseen yet.

The service providers shall keep records for all parameters whose values have exceeded the voltage quality requirements and which the service providers have identified as the *Force Majeure* or external cause (having same definitions throughout all three quality dimensions).

Data on voltage disturbances, obtained by the service providers by way of continuous and periodic monitoring, shall not be differentiated per cause for each individual measuring point: only events caused by *Force Majeure* or external cause and which have large-scale consequences shall be separately recorded for the reporting.

The service providers shall provide the following general data on the voltage quality:

1) Data obtained by way of continuous monitoring:
   a) name (identifier) of measuring points and location of the continuous monitoring in the network,
   b) status of equipment for continuous monitoring of the voltage quality:
      i) total number of measuring points in HV network,
      ii) share of established permanent monitoring in HV network with respect to the planned extent (or total number of points in HV network),
      iii) total number of measuring points in MV network,
      iv) share of established permanent monitoring in MV network with respect to the planned extent (or total number of points in MV network),
      v) total number of measuring points in the whole network,
      vi) share of established permanent monitoring in the whole network with respect to the planned extent,

2) Data obtained by way of periodic (rolling) monitoring (see Annex 6, Table VQ. 4):
   a) number of systematically selected measuring points,
   b) results of the analysis of measured values (differentiated per voltage disturbances and organizational units of network operator),

3) Data obtained upon the customer complaint:
   a) number of complaints on deviation of the voltage quality,
   b) status of the network users’ complaints (conformity or non-compliance),

4) A brief analysis of the situation, accompanied with a comment that includes a description of events which appeared due to *Force Majeure*,

5) Other data.

*Note:* Periodic (planned, systematic, rolling) monitoring is conducted with portable instruments during shorter but predefined periods of time like 1-4 weeks (with an aim to cover all points in some area or at some voltage level within prescribed period, e.g. 2-4 year period). Operators shall separately provide data on continuous and periodic VQ monitoring.
Table VQ. 4 is an example of VQ data obtained by way of periodic (rolling) monitoring in LV network points (e.g. busbars in MV/LV substations). By way of portable VQ recorders 27 weeks of monitoring were performed during one calendar year, out of which in 17 weeks at least one voltage disturbance limits have been exceeded.

Based on measurements of the voltage quality, as performed in line with the status of technique (according to applicable technical standards, i.e. IEC 61000-4-30), the service providers shall submit to the national regulatory authority the following data by voltage levels and by individual objects or network points, where a permanent/continuous monitoring of the voltage quality has been established (see Annex 6, Tables VQ. 1-3):

a) number of weeks under continuous monitoring,
b) number of inconsistent weeks (any deviation from the voltage standard),
c) number of consistent weeks,
d) number of weeks during which limits have been exceeded for:
   - supply voltage variation,
   - flickers,
   - harmonic distortions,
   - voltage unbalance,
   - mains signaling voltages and
   - power frequency.

Based on actual measurements at given points with continuous monitoring in the network, the service providers shall calculate and report to the national regulatory authority the following (see calculation example in Annex 6: Examples of Calculation and Reporting on Voltage Quality Parameters and Indicators):

- overall indicator of the voltage quality in the supply area (all voltage levels),
- overall indicator of the voltage quality at HV level,
- overall indicator of the voltage quality at MV level,
- overall indicator of the voltage quality at LV level,
- indicator of the supply voltage variations at HV level,
- indicator of the supply voltage variations at MV level,
- indicator of the supply voltage variations at LV level,
- indicator of the harmonic distortions at HV level,
- indicator of the harmonic distortions at MV level,
- indicator of the harmonic distortions at LV level,
- indicator of the flickers at HV level,
- indicator of the flickers at MV level and
- indicator of the flickers at LV level.
Data on voltage dips and swells shall be separately reported. Monitoring shall be performed in accordance with EN 50160 and IEC 61000-4-30. When reporting the results from voltage dip monitoring the voltage-dip tables recommended in EN 50160:2010 should be used.

The calculation of voltage dip indices consists of three stages:

- Calculation of the “dip characteristics” (also known as “single-event indices”) from the sampled voltage waveform. This calculation is often performed by the monitoring instrument.
- Calculation of the “site indices”, typically the number of dips per year with certain characteristics (for each location/site separately).
- Calculation of the “system indices”, for example the average number of dips per year per site.

Site indices shall be calculated based on voltage dips recorded at one location over a period of one year. System indices should not only include the average number of dips per site per year (Table VQ.6, Annex 6), but also values not exceeded at a certain (e.g. 95 %) of sites (Table VQ.7, Annex 6; this is a dip level higher than the one registered in 95 % of monitored sites). These so called percentiles give a better impression of the actual voltage quality as experienced by individual customer than the average number of dips only. In line with EN 50160 as well as international expert groups recommendations, phase-to-phase voltages at MV and HV shall be measured.

The report from the service providers to the national regulatory authority shall include data derived from systematic (planned, rolling) monitoring and monitoring upon network users’ complaints (see Annex 6, Tables VQ.4-5).

Network operators shall disclose data obtained by way of periodic (rolling) monitoring and upon obtained upon the customer complaint/enquiry at different levels of observation (e.g. see Table VQ.5, Annex 6, with respect to individual VQ complaints and Table VQ.4, Annex 6, with respect to periodic monitoring):

- supply area of each organizational unit of the network operator (e.g. supply area of each HV/MV and MV/MV substation) and
- entire area of supply of the network operator.

The report to the national regulatory authority on the voltage quality may contain further detailed data belonging to each individual set from above. If in the country network operators are offering to their customers customized contracts with assigned voltage quality levels (contractual levels), these operators shall send a report to the national regulatory authority, relating to the power quality contracts containing at least the following information for every signed contract or existing in the previous year:

- name of the customer, territory (supply area) and performed activity,
- voltage level and connection power,
- signing date, starting date and duration of contract,
quality indicators and levels of agreed quality as subject of contract,

manner of recording,

amount of paid premiums by the customers and

amount of paid compensations to the customers.

The annual reports to the national regulatory authority shall be presented on behalf of the network operators under the signature of nominated individuals.

In their annual reports to the national regulatory authority, the network operators shall disclose all data on the voltage quality for the previous year. The reporting shall be made before 15 February in the current year for the previous calendar year.

### IV.3 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO CUSTOMERS ON THE VOLTAGE QUALITY

The network operators shall be legally obliged to inform the users of the electricity network about the voltage quality on their websites, once a year. This information shall be provided within 15 days after the service providers reported the same aggregated and individual (per monitoring site) voltage quality data to the national regulatory authority (see Chapter IV.2). At least aggregated data in an annual report shall also be available on the NRA web site.

On their websites, the network operators shall also inform the users about valid standards, bylaws, delivery terms and conditions, and other documents establishing the minimum technical standards for the voltage quality.

All countries shall adopt compulsory individual verification of actual voltage quality at the customer’s connection point, upon the customer complaint or enquiry. After the monitoring the operator shall give the requesting customer the following information:

- monitoring period,
- type of equipment that was used in the monitoring,
- type of voltage disturbances that have been registered,
- analysis of regulated values or limits fulfillment,
- entity responsible for the disturbance,
- deadline by which the detected problem will be resolved.
Customer complaints in general are one of the most important topics of the commercial quality, which is specifically elaborated in Chapter V.4 together with detailed instructions for complaint handling.\(^\text{13}\) Therefore, hereafter only the most important aspects are highlighted.

All countries shall adopt compulsory individual verification of actual voltage quality at the customer’s connection point, upon the customer complaint or enquiry. The study suggests to legally oblige system operators to verify compliance with voltage quality standards (e.g. EN 50160 or national requirements on VQ if adopted) for a period of one week, based on EN 61000-4-30. Necessary measurements may include power frequency, supply voltage variations, rapid voltage changes, flickers, supply voltage unbalance, harmonic and interharmonic voltage and mains signaling voltage.

This obligation should be accompanied by a detailed description of the complaint handling procedure by the network operator so that all relevant information is available to the customer, including the cost of the service (if any) \(^\text{14}\). For the VQ complaint handling procedure it is necessary that the system operators establish and implement a complaints procedure, which shall be:

- effective in the sense that it is really aimed at solving the problem,
- readily assessable meaning that it clearly set out procedures and responsibilities,
- speedy meaning with timescales for each stage of a complaint handling with clear commitments as to response times,
- confidential in the sense of protection of privacy of the individual customer and

\(^\text{13}\) In June 2010 the ERGEG presented *Guidelines of Good Practice (GGP) on Complaint Handling, Collecting and Classification* (Ref: E10-CEM-33-05). In June 2011 the CEER issued Update to Annex 2 of GGP on Customer Complaint Handling, Reporting and Classification - ADR practices: case studies (Ref: C11-RMC-48-03) on country cases regarding Alternative Dispute Resolution (ADR) in the energy sector. Good practices from some EU Member States (Austria, France, Italy, The Netherlands, Poland, Romania, Spain, Sweden, UK) are described in these two documents and therefore not repeated here.

\(^\text{14}\) In Slovenia, for example, a predefined payment is set according to the tariff for supplementary services (charges vary per utility and on average are around 400 € per week). Customers pay only if the measurements are found to be within the limits.

In Portugal, for example, if actual results of individual VQ monitoring reveal that the waveform characteristics are in accordance with national requirements, or if they are not in accordance with national requirements for reasons attributable to the customer, the customer has to pay cost of the service (VQ verifications). The amount that the client has to pay in this situation is limited to a figure established and published each year by the NRA (ERSE). Table 3.9 from 4th Benchmarking Report on Quality of Electricity Supply (page 79), presents the amount published by ESRE for 2007, differentiated per voltage levels of customer connection to the network.
• integrated with the organization’s operation and practices.

System operators shall be required to publish, on the back of all bills, a short description of how to make a VQ complaint. They shall also be required to attempt to resolve all relevant complaints before referring a complaint to the NRA.

It is assumed that the national regulatory authority has been legally assigned a responsibility to deal with unresolved complaints between the customers and the system operators. The system operator must make the customers aware that they have the right to refer an unresolved complaint to the national regulatory authority for resolution. In this sense, the customer shall be provided with the contact details of the NRA should the customer wish to escalate the complaint.

While the decision of the national regulatory authority shall be binding on the system operator, it is not binding on the customer. Therefore, the national regulatory authority’s decision may be appealed to the court, as the customer may bring the issue before the court. In other words, if a customer does not accept the decision of the national regulatory authority, he/she is free to pursue the complaint through the court if he/she so wishes.

System operators shall:

- introduce and keep the book of complaints, preferably in an electronic form,
- accept and register each written complaint, as well as regularly analyze the records in the book of complaints,
- differentiate between VQ enquiries and real complaints,
- in the annual report on the quality of service to the NRA publish the results of measures taken in respect of the complaints handling as well and make them publicly available to the customers on the web pages.

The service providers shall once a year disclose to the national regulatory authority the status of customer complaints regarding the voltage quality in terms of identified conformity or non-compliance. Table VQ.5 (Annex 6) suggests template for publishing data on customers’ complaints related to VQ in one calendar year (used to produce annual reports that are published on the operator web pages and for reporting to the NRA). As given in Chapter IV.2, system operator shall disclose data on consistency of the voltage quality parameters at different levels of observation: supply area of each organizational unit and entire area of supply of the system operator.

It is recommended that the regulator or the system operator keep statistics on complaints and verification results and correlate these with the results from continuous and rolling voltage quality monitoring (when in place). Customers shall have the right to install their own voltage quality recorder instead of asking for it from the distribution company. The voltage quality recorder owned by the customer must comply with technical standards and/or several technical criteria defined by the operator, to be accepted by the system operator. Customers who have customized contractual levels (i.e. power quality contracts) must have a monitoring recorder installed. It can be owned by the customers themselves or by the network operator.
IV.5 REPORTING GUIDELINES FOR BENCHMARKING ON THE ENERGY COMMUNITY LEVEL IN RELATION TO THE VOLTAGE QUALITY

It is recommended to the Energy Community to follow the guidelines and the templates established by the CEER for the purposes of the benchmarking on the quality of electricity supply in all measurable aspects, including on the voltage quality.

The CEER’s benchmarking exercise has been performed five times so far by way of sending questionnaires to the national regulatory authority of each participating country and consequent elaboration of analytical benchmarking reports – the practice which may also be replicated by the Contracting Parties.

The CEER’s questionnaire, in the part related to the voltage quality, aims to collect information about the voltage quality regulation and monitoring in a jurisdiction under the national regulatory authority and, if available, actual voltage quality data. It covers the following topics:

- voltage quality regulation and legislation,
- voltage quality monitoring systems,
- data collection, aggregation and publication form voltage quality monitoring systems,
- voltage quality indicators,
- actual voltage quality data.

This study strongly recommends countries to design data collecting and reporting in a way to allow NRA to provide data to the Energy Community in the scope needed by CEER questionnaire for voltage quality. The parameters of the voltage quality, which are given in this Chapter, fully match the CEER’s benchmarks ensuring thereby full compatibility at the Energy Community level. There are some issues that still has not been solved (e.g. with respect to voltage dips data collecting and reporting - how to treat dips in three-phase systems, the method for the aggregation of multiple events). Countries are strongly encouraged to follow activities and without delay adopt improvements in definitions and classifications recommended by CEER, CENELEC and CIGRE.

While responding to the CEER’s questionnaire the following aspects shall be paid attention:

- Under each of the questions, where applicable, it is necessary to specify the answers for both TSO and DSO (i.e. all network operators).
- Few questions are presented with pre-set answers (e.g., yes/no) which need to be simply marked, but most of them include requests for additional clarification of details. Many questions are presented in “open” format, where the answer needs to be entered in the text-box.
- In order to guarantee comparability of data, it is essential to follow as much as possible recommendations given regarding data. For voltage dips and other voltage quality parameters data shall be provided separately by:
- type of delivery point (HV busbar in substation, HV end-user sites, MV busbar in HV/MV substations, MV end-user sites, LV busbar in MV/LV substations, LV end-user sites) and
- (if possible) separately by type of network/location (cable/urban; mixed/semiurban; overhead/rural).

- Data for voltage dips and swells shall be classified according to EN 50160:2010 tables. If some criteria for aggregation of data are used in country (e.g. all country, per region, per network operator, per voltage level, per network length...), criteria and all other relevant information shall be appropriately described.

- With regard of monitoring VQ parameters in LV network it is important to indicate whether smart meters or other VQ monitoring devices are used.

- With regard of monitoring VQ parameters in network, network operators shall separately document data obtained by way of continuous monitoring, planned (systematic, rolling) monitoring at pre-defined time periods and monitoring upon customers complaints/enquiries. It shall be evident from the replies to the questionnaire whether a permanent voltage quality monitoring system was in place or a number of portable measuring instruments are used to measure voltage quality.

- Network operators shall pay special attention to documenting historical data on the type of actual VQ problems in the country, measures taken in the network to solve VQ problems and costs of such measures.

### IV.6 GUIDELINES FOR DATA COLLECTING AND AUDITING IN RELATION TO THE VOLTAGE QUALITY

Unlike power supply interruptions, which influence large number of customers at the same time, the voltage characteristics falling under the voltage quality area can vary randomly, over time and at specific network points. Therefore the voltage quality level experienced by the customers can not be obtained by use of, for example SCADA system, but it rather needs to be measured at their network connection points by specific voltage quality recorders.

Regarding the required time span of measurements, the distinction has to be made between voltage variations and events. While the voltage variations are continuous phenomena, therefore measurable by a few weeks monitoring period, voltage events occur rarely and therefore require continuous monitoring.

Over the years a growing number of countries have installed systems for monitoring the voltage quality in their transmission and/or distribution networks. Reasons that drive the implementation of these systems vary from country to country which has led to different choices with respect to voltage levels involved in monitoring, type of network points monitored, criteria for the selection of network points to be monitored, number of points monitored, type of monitoring (e.g. continuous, rolling) and disturbances to be monitored. Experience indicates that monitoring the voltage quality at a selection of a (small) number of strategic and/or characteristic points in the networks can be much more efficient and effective than placing voltage quality monitoring instruments at every network point.
Voltage Quality

With respect to criteria for selection of network points to be monitored, the study suggests to monitor voltage disturbances whenever technically and economically feasible. The usual trade-off between the requirements is a system-wide continuous monitoring of the voltage quality (at representative sample of specific points in the network), planned (rolling) monitoring conducted with portable instruments during shorter but predefined periods of time like 1-4 weeks (with an aim to cover all points in some area or at some voltage level within prescribed period, e.g. 2-4 year period) and individual measurements at customer level whenever the problem is detected.

In summary, from the regulatory perspective, data on the voltage quality shall be collected:

- continuously (permanently), at given points in the network, to obtain a general picture of the voltage quality level (at least for voltage events that occur randomly),
- occasionally, at the customer’s connection point, upon the customer complaint, and
- occasionally or continuously, at the customer’s connection points, upon the customer enquiry.

With respect to criteria that should be used for the selection of network points to be continuously monitored study suggest that monitoring shall take place at locations at which a good estimation of voltage quality as experienced by customers can be made. The final goal is to have increasing number of monitoring instruments in LV, MV and HV networks at supply terminals of customers or close to it. The network operators shall decide for themselves which network points need to be monitored for voltage quality, because data from continuous voltage-quality monitoring can provide useful information for the network operator resulting in significant cost savings and information to support investment decisions.

When deciding about the need for compulsory or regulator-controlled monitoring the principle aims should be: to verify compliance with voltage-quality requirements (both overall and for individual customers), to provide information to customers on their actual or expected voltage quality and to obtain information for the setting of appropriate future requirements.

If permanent voltage quality monitoring has not started yet in the country, study suggests adopting Slovenian approach:

- TSO should carry out continuous monitoring at HV connection points and at HV/MV substations,
- DSO should carry out continuous monitoring at HV, MV and LV networks where fixed measuring instruments should be placed at all HV and MV busbars in HV/MV substations and also at various points in the MV and LV network that are considered to be at risk of high levels of voltage quality disturbances such as:
  - industrial MV/LV substations with connected customers with contractual power exceeding 1 MVA,
  - if the LV feeder in a substation is longer than 1 km,
  - network points with non-linear or rapidly variable loads (e.g. sawmills and metallurgy).

Table IV.1 presents criteria used for the selection of network points under continuous and rolling monitoring in EU countries.
Table IV.1 Continuous and rolling monitoring systems in operation in EU countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Criteria for the selection of network points to be monitored</th>
<th>Voltage levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>The choice of network points monitored varies from one year to the next. Point at which measurements have been conducted in the past are excluded until all points are measured at least once.</td>
<td>LV, MV</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>All HV substations, HV and MV end-user sites and all MV busbars in HV/MV substations.</td>
<td>MV, HV</td>
</tr>
<tr>
<td>Cyprus</td>
<td>In the transmission network there is one instrument at the TSO connection point production units, and 15 portable units that are used to measure VQ at the connection points of renewable energy producers and at MV substations.</td>
<td>LV, MV, HV</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Continuously are monitored all transfer points between TS and DS, 110 kV delivery points and HV/MV substations output voltage are continuously monitored and archived, in case the guaranteed parameters exceed 50% of limit values for the given delivery point during the preliminary weekly monitoring (repeated every 2 years). Delivery points in MV and LV networks are monitored in cases of litigations, claims for connection of users with sensitive technologies or according to the experience of the DSO.</td>
<td>LV, MV, HV</td>
</tr>
<tr>
<td>France</td>
<td>Monitoring program includes 12 % of EHV and HV end-user sites, 50 % of MV customers (primarily customers with a subscribed power larger than 250 kVA), several HV/MV substations, and around 250,000 end-user sites in the LV network are equipped by smart meters capable of supply voltage variations monitoring.</td>
<td>LV, MV, HV, EHV</td>
</tr>
<tr>
<td>Greece</td>
<td>Only LV network points are monitored. 57 % end-user points in urban (population density over 1000) interconnected LV networks, 21 % end-user points in rural interconnected networks and 22 % in non-interconnected islands.</td>
<td>LV</td>
</tr>
<tr>
<td>Hungary</td>
<td>Customer connection points in MV and LV networks are chosen at random. Average monitoring duration of network points is about 90 days after which the units are moved to another randomly chosen points in the network (in a way that does not depend on previous events or complaints).</td>
<td>LV, MV</td>
</tr>
<tr>
<td>Italy</td>
<td>23 points are monitored in EHV networks, 142 HV busbars, 400 MV busbars in HV/MV substations (planned to have all MV busbars monitored), 130 MV busbars in MV/LV substations and 70 MV end-user sites. Monitoring in LV networks occurs for customers equipped with smart meters (planned 350,000 LV end-user sites; consultation is currently being conducted by the regulator on the monitoring campaigns).</td>
<td>LV, MV, HV, EHV</td>
</tr>
<tr>
<td>Latvia</td>
<td>20 portable instruments are monitoring VQ at the weakest points in the LV network. The weakest points in the network are defined by the DSO without the use of standardised criteria. Generally they refer to points in the network with long overhead lines (more than 400-500 m) in the LV network, which are located mostly in rural areas.</td>
<td>LV</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>In EHV network all customer connection points are continuously monitored. In HV 20 and in MV and LV networks 60 customer connection points have been randomly selected and continuously monitored.</td>
<td>LV, MV, HV, EHV</td>
</tr>
<tr>
<td>Norway</td>
<td>All network operators are required to carry out continuous monitoring on characteristic areas (based on features such as underground cables/aerial lines, system earthing, extension of the network, type of connected customers, climate conditions) in EHV, HV and MV networks. The network operators decide themselves how many instruments are required to create trustworthy statistics. Each network operator must have at least one instrument installed in each different characteristic area.</td>
<td>MV, HV, EHV</td>
</tr>
<tr>
<td>Portugal</td>
<td>Within every two years each delivery point in the EHV and HV networks must be monitored. Where monitoring is conducted with portable instruments, the duration of the monitoring is four weeks. In MV busbars in all HV/MV substations and in LV busbars in, at least, two MV/LV substations per municipality monitoring is done for every four year period.</td>
<td>LV, MV, HV, EHV</td>
</tr>
<tr>
<td>Romania</td>
<td>22 fixed monitoring instruments in EHV network (TSO) and 130 in HV and MV network (DSO) are used. The network operators decide for themselves which network points need to be monitored for voltage quality (network points include for example representative substations, connection points between the networks of the TSO and DSO, and wind power stations).</td>
<td>LV, MV, HV, EHV</td>
</tr>
<tr>
<td>Slovenia</td>
<td>TSO carries out continuous monitoring at HV connection points and at HV/MV substations. DSO carries out continuous monitoring at MV busbars in HV/MV substations and also at various points that are considered to be at risk of high levels of voltage quality disturbances.</td>
<td>MV, HV, EHV</td>
</tr>
</tbody>
</table>
Measurement and testing of the voltage quality, according to EN 50160, requires specialized apparatus and measuring methods. Regarding standardized methods for measurements of voltage quality the most important norm world wide is the IEC norm 61000-4-30 (Testing and measurement techniques – Power quality measurement methods). The following parameters shall be monitored:

- voltage in three phases,
- frequency,
- total harmonic distortion factor \( \text{THD}_U \),
- voltage unbalance factor, which is a multiple of positive and negative sequence voltage components and
- fast and slow voltage variations.

This type of equipment shall also enable measurement of outages, their frequency and duration. The measured parameters shall be processed and recorded as 10 minute time-segments (1008 segments over 7 days). For each segment the mean value of the measured parameter shall be calculated. After the 7-day recording period, a so-called “ordered diagram” is produced, showing the sum of the duration of a given distortion level in the observed time period.

By continuous monitoring of the voltage quality, the advantages offered by use of wide variety of equipment capable of memorizing recorded information related to the voltage quality may be realized. Some of the categories of such equipment that may be incorporated in the entire monitoring system are:

1. **Digital instruments for fault detection.** They are not intended particularly for the voltage quality monitoring. However, these instruments are typically activated (triggered) when the fault occurs, and they record voltage and current waveforms that describe faults. This makes them valid to describe distortions of effective value, such as voltage sags during faults in electric power system. These instruments may also be used for determining the harmonic levels.

2. **Intelligent relays and other intelligent electronic devices.** Many types of equipment that are being used in substations may act as intelligent electronic devices with the capability of monitoring. Devices such as relays and automatic switches can register disturbances and make information available for the entire monitoring system. These devices may be located both on supply line and substations.

3. **Voltage recording devices.** It is common for these devices to record maximum, minimum and average voltage within specified interval (e.g., 2 hours). With this capability, the device can adequately record the value of voltage sag as well as all other voltage variations and voltage harmonics.

4. **Power monitors.** These instruments are usually placed at the network user’s connection point. Their characteristics usually include recording of waveform for estimation of harmonic distortion level, voltage profile of effective value variation in steady state, voltage sag, etc. Commonly, these instruments do not have the capability to record transients.

5. **Instruments specifically intended for monitoring of the voltage quality.** These instruments are specifically designed to measure complete range of variations of the voltage quality, by monitoring current and voltage in all three phases and in neutral
conductor. They are suitable for installation in substations, supply lines and customer connection points.

Some countries are planning to use smart meters for the monitoring of voltage quality aspects alongside the measurement of the quantities of used electricity. Power quality measurement integrated in “smart” energy meters, presented as a potential benefit by some manufacturers, at present is of a limited use value. Based on the analysis of countries in which smart meters are currently installed, it could be observed that in most of the countries smart meters are able to measure supply voltage variations. This is because the implementation of both continuous voltage measurements and event registration varies greatly between the meters and for most of them no common power quality standard (i.e. EN 50160, IEC 61000-4-30) seem to have been used as a basis\textsuperscript{15}. Therefore, for example, in a regulation related to energy measurement, Norwegian regulatory authority (NVE) did not mentioned voltage quality measurement as a mandatory functionality. It made only minimum requirements for energy meters to include registration of interruptions.

The CEER recommended investigating whether it is feasible to use smart meters for measuring voltage quality parameters in an efficient way in the future. It is important to exploit the capabilities of available and installed smart meters to the extent and benefits possible but also to ensure that voltage-quality monitoring through smart meters does not result in an excessive increase in price of the meters or tariffs for the network users. The European Energy Regulators do not deem necessary monitoring voltage quality through smart meters for all LV users and at all LV locations.

**IV.7 RECOMMENDATIONS ON GRADUAL INTRODUCTION OF REGULATORY INSTRUMENTS IN RELATION TO THE VOLTAGE QUALITY**

**IV.7.1 GUIDELINES FOR GRADUAL DEVELOPMENT OF THE VOLTAGE QUALITY REGULATION**

Although the interest of the national regulatory authorities in the voltage quality has recently increased, due to growing sensitivity of end-user equipment, a comprehensive regulatory approach is still quite rare and based on definition of standards and guidelines for the premium quality contracts.

Relating to the voltage quality standards, EN 50160 is the most commonly used one, although some significant drawbacks concerning its implementation for the regulatory purposes were highlighted already in the CEER’s Third Benchmarking Report on the Quality of Electricity Supply back in 2005.

The most important proposals given by ERGEG for its revising in 2006, which are now already included in some jurisdictional variations of EN 50160 and should be addressed in case of defining a jurisdictional voltage quality standard in any Contracting Party/Observer, are the following (listed in priority order):

\textsuperscript{15} Power Quality Measurement Capabilities of “Smart” Energy Meters, T. Solvang, L. Aleixo, H. Seljeseth, International Conference on Renewable Energies and Power Quality (ICREPQ’10), Granada, Spain, 23\textsuperscript{rd}-25\textsuperscript{th} March, 2010.
1. Measurement rules and definitions of some voltage quality parameters should be better defined, searching for the widest international consensus as possible.

2. Avoid “95%-of-time” clause and avoid long time intervals for averaging measured values.

3. HV and EHV levels should be considered in the renewed standard. HV and EHV networks are by nature meshed, whilst MV and LV ones are radial or radially operated; this difference must be taken into account, as well as the contribution of HV and EHV to disturbances in MV and LV networks.

4. Indicative values given in EN 50160 for voltage events (especially dips and swells) are often too vague and no longer acceptable. As a preliminary step, dips and swells could be classified by severity, in order to distinguish events according to the typical causes that provoke them and the consequences they may lead to.

5. Duties and rights of all the parties should be taken into account; a general framework is proposed to share the responsibility between network companies, equipment manufacturers and final customers. Measurement procedures and tools should also be considered in order to simply obtain a non controversial measure of disturbances, and as far as possible, a meaningful one for detecting responsibilities.

6. Realistic and even differentiated voltage quality levels should be defined according to network characteristics, taking into account different factors (overhead/underground, operational earthing, etc.). Both the classification according to severity and the availability of field data from the monitoring systems recently installed in some countries could be extremely helpful for this purpose.

7. The concept of “power quality contracts” should be developed in order to clarify in which situations it is applicable, as in many cases the improvement of the quality of service requires interventions in the network that are to be made by the network operator. In those situations, a group of customers could benefit from the improvement and the power quality contracts might not be adequate for all.

Setting more restrictive standards than those stated in EN 50160 may entail higher costs for network investments. But whether more restrictive standards than those stated in EN 50160 will entail higher costs or not, depends on the today’s level of quality within each regulatory jurisdiction. On the one side, improving voltage quality levels can lead to a benefit for the economy and the whole society. Reviewing the limits stated in EN 50160 according to ERGEG’s recommendations can drive this improvement especially for the worst-served customers. On the other side, regulators should not allow to deteriorate the actual level of the voltage quality if these – as often happens – are better than those stated in EN 50160.

Example: The preparatory work initiated by the Norwegian regulatory authority for the introduction of the voltage quality regulation

In the past Norwegian regulator (NVE) has dedicated considerable resources to the area of voltage quality regulation. NVE has been working closely with the distribution companies in the collection of data on voltage characteristics and in publication of the relevant statistics. Besides, it has provided constant assistance to customers and network companies in order to solve specific voltage quality problems. It has also conducted surveys on the costs incurred by customers for power quality, and has carried out a broad consultation process on the issue.
In Norway, all voltage levels above 1 kV are involved in continuous monitoring. The quality of supply regulation required monitoring systems to be in operation from 1st January 2006. Every network company is obliged to continuously carry out monitoring on characteristic areas of their MV, HV and EHV network. Important elements to consider when dividing the network into different characteristic areas are inter alia underground cables versus aerial lines, system earthing, extension of the network, customer categories connected, climatic differences, short circuit power, etc. The companies must decide by themselves how many instruments are necessary in order to create trustworthy statistics. Each network company must have at least one instrument installed in each different characteristic area.

When developing the Norwegian regulations, NVE noted the importance of compatibility between different regulations and (international) standards. Hence, the Norwegian requirements take into account both emission and immunity levels given in international standards. International standards were however found to be not satisfactory enough to refer to limits, although for measurement methods, relevant standards from CENELEC and IEC are referred to.

The regulations on quality of supply define requirements for (in short):

- a minimum acceptable level of voltage disturbances at the point of connection,
- continuous monitoring of voltage quality,
- registration and reporting of short and long interruptions,
- information to customers about historical power quality levels and future power quality levels to be expected,
- time limits for handling and solving customers’ complaints relating to power quality,
- restoration of supply and rectification of violated limits without undue delay.

Voltage quality regulation is applicable for networks with voltage levels higher than 35 kV.

Based on the practical experience gained, NVE has set standards which in a number of cases are more demanding than the values given in the EN 50160. In other words, the regulator has decided to set limits for voltage disturbances after becoming very familiar with the subject. National research projects had provided several years of continuous monitoring, giving knowledge about actual voltage quality levels, and knowledge about when different voltage disturbances cause problems for end-users (above which level). This information was a good basis for introducing a better and a more detailed public regulation on quality of supply. It was focused on those voltage disturbances that it is possible (easiest) to prevent from exceeding their limits. The previous schemes for continuous monitoring that were achieved through national research projects depended also upon voluntary contributions from Norwegian distribution companies for more than 12 years.

Regarding voltage quality, minimum requirements have been introduced for power frequency, supply voltage variations, voltage swells (exceptions for some causes), voltage dips (exceptions for some causes), rapid voltage changes (exceptions for some causes), flicker, voltage unbalance and harmonics.
Voltage Quality

For certain voltage disturbances NVE has chosen not to introduce standards (i.e. mains signalling voltage, interharmonic voltages, transient overvoltages). The decision not to introduce standards is due to the difficulties in defining binding values and monitoring them, or to the small socio-economic importance of some of these disturbances.

Example: The preparatory work initiated by the Italian regulatory authority for the introduction of the voltage quality regulation.

After years of work devoted primarily to regulation of the commercial quality and the continuity of supply, including extremely long, accidental interruptions (both their duration and number) and, as unique example in Europe, also short interruptions (lasting more than 1 s and less than 3 min), the Italian national regulatory authority's interest has now progressed toward very short interruptions (lasting up to 1 s) and voltage dips.

With the awareness that this new subject presents a higher degree of technical complexity, the same investigation approach that was used for long and short interruptions was applied, comprising the voltage quality measuring campaign and an assessment of customer costs. The main conclusions were that 1) sufficient evidence that supports the introduction of compulsory voltage quality regulation was provided, and 2) the following guidelines for the design of the regulatory instruments were identified:

- the magnitude of the voltage quality costs justifies a regulatory intervention,
- the concentration of the voltage quality costs on sensitive industrial sectors indicates that an individual policy action might be a more sensible decision than a general intervention,
- the regulation has to consider the responsibility of all interested parties, and to account for a trade-off between investments in networks and more expensive equipment and processes with adequate levels of immunity at customers side (the analysis of a small sample of customers confirms that sensitive users are indeed vulnerable to severe voltage events, but sometimes they are also not properly equipped to override the less severe ones), and
- although the existence of an European Technical Standards is important, the regulatory standards should be developed at a national level, and allow for differentiations according to network structures, protection schemes, and characteristics of the industry (a large variance was observed in the measured levels of the voltage quality and, similarly, the costs across different industrial sectors, and even within sectors).

Premium quality contracts are another way of regulation of the voltage quality which is already in use in a few European countries. A good example of such a contract, with relatively high degree of regulation imposed by the national regulatory authority, is provided hereafter.
Example: Premium voltage quality contract regulation in Italy

Distribution companies may enter into the quality contracts with the end customers, wholesale customers and other utilities such as electricity producers, power producers and interconnected distribution companies, in accordance with criteria established by the national regulatory authority.

The subject of the quality contracts cannot be agreement on the quality levels lower than those defined by the national regulatory authority for the customers of larger size nor the quality level lower as recorded at the delivery point the year before.

Revenues of the distribution companies from the quality contracts are excluded from the revenue allowed by the regulation. Revenues of the distribution companies from the quality contracts and possible penalties paid on the basis of such contracts shall be represented by separate accounting.

In the quality contracts, the parties define the quality level that the distribution company is liable to comply with, the premium to be paid by the customer and the compensation to the customer in case of breaching of the provisions hereof by the distribution company, stating the grounds for exclusion. The quality level is expressed as the threshold applied to one or more indicators of the continuity of supply or the voltage quality. With reference to the indicators for which there is no obligation of individual measuring, the parties shall provide the measuring for a period of at least one year before signing of the quality contract. The measurement costs are charged to the party wishing to make use of higher levels of the continuity of service or higher voltage quality, and who is entitled to install its own measuring instrument.

The compensation may be differentiated only in relation to the following:

- duration of the contract, which must not be less than one year and more than four years,
- agreed level of the quality (if longer than one year the level is agreed each year),
- refundability of damage resulting from failure to comply with the agreed level of quality,
- voltage level and any other electrical parameter relating to the supply, including the actual level of the quality recorded at the delivery point and
- electricity consumed or power installed by the customer, as a number of more customers connected to the same MV line or other lines coming from the same HV/MV substation.

The national regulatory authority reserves the right to include the requirements for entering into the quality contracts in case of critical situations for implementation.
End-users and power producers connected to HV and MV networks have the right to supply, install, maintain and manage their own individual recorders of unannounced long, short and transient interruptions and their compliance with EN 50160.

Each distribution company has the responsibility towards end users and power producers connected to HV and MV networks or for wholesale customers that require it, to supply, install and maintain and manage an individual recorder for long, short and transient interruptions without notice compliance with EN 50160. The costs related to the functions not supported by the meter installed at the customer shall be borne by the applicant.

If the customer wishes to install or require from the distribution company to install an individual recorder of the characteristics of the voltage quality different from the long, short and transient interruptions without notice, such recorder must be in accordance with the technical standard EN 50160.

By March 31 of each year, every distribution company shall send a report to the national regulatory authority, relating to the quality contracts and containing the following information for every signed contract or existing in the previous year:

- name of the customer, territory and performed activity,
- voltage level and available power,
- signing date, starting date and duration of contract,
- quality indicators and levels of agreed quality as subject of contract,
- manner of recording,
- amount of paid premiums by the customers and
- amount of paid compensations to the customers.

**IV.7.2 RECOMMENDED ANALYSES**

Setting voltage quality standards requires a correct balance between the different perspectives assumed by customers, system operators and manufacturers of electrical appliances. The role of the National Regulatory Authorities is ensuring an efficient balance of responsibilities of the stakeholders along the following lines: good VQ at the user’s bus is the network operator responsibility, good quality for load current drawn from the bus is the user’s responsibility, developing and supplying equipment with adequate tolerance to power quality and cost-effective power conditioning devices with appropriate technology are the manufacturers’ responsibility. In the ERGEG Conclusions Paper “Towards Voltage Quality Regulation in Europe” (July 2007), European energy regulators expressed concern about the underestimation of benefits of changes in voltage quality standards given by EN 50160, due to non-active participation of an important class of policy actors: customers’ associations.

The results from cost-estimation studies on customer costs due to various voltage quality disturbances are important input when deciding where to focus regulation. Therefore NRAs should perform national cost-estimation studies regarding voltage disturbances.
To design a regulatory framework, it is necessary to understand also the weight of voltage-related costs on the national economy. As published in 4th Benchmarking report on Quality of Electricity Supply (2008), some research projects have been conducted recently in some countries (e.g. Norway\textsuperscript{16}, Sweden\textsuperscript{17} and Italy\textsuperscript{18}), in this direction with the commitment of the regulators or with their cooperation, in order to assess customers’ costs for poor power quality, with special reference to voltage events like short and transient interruptions and voltage dips.

Guidelines were set out by CEER in the domain of nationwide studies on estimation of costs due to voltage quality disturbances, \textit{Guidelines of Good Practice (GGP) on Estimation of Costs due to Electricity Interruptions and Voltage Disturbances}. According to this guideline, based on the practical experience available in some countries, the conclusions on the issue of analyses needed for preparation of the continuity of supply and the voltage quality regulation are as follows:

- The national regulatory authorities shall perform nationwide cost-estimation studies regarding the continuity of supply and the voltage quality;
- A pre-study shall be performed in advance of a main study in order to define the objectives and to clarify country-specific characteristics, budget and consultancy needs, possible funding partners, timeline and possibilities in general for the main study;
- The GGP shall be used as a reference when performing a nationwide cost-estimation study, always taking into account country specific issues and needs;
- Society costs shall be considered in addition to customer costs when doing a cost estimation study, as these can differ significantly;
- Results from cost-estimation studies on customer costs due to the voltage quality are important input on the consequences of various voltage disturbances when deciding where to focus regulation and
- Results and experience from cost-estimation studies shall be disseminated among interested parties.

There are several important recommendations for conducting studies on costs due to the continuity of supply and the voltage quality:

- definition of objectives,
- choice of consultants,
- specification of customer groups,
- choice of cost-estimation method,
- choice of normalization factor and clarification of data needs,
- check for available data and
- choice of method (means by which the survey/case analysis is performed).

\textsuperscript{16} Norway survey on customers’ costs due to interruptions and a few selected voltage disturbances (2002).
\textsuperscript{17} Sweden surveys on customers’ costs due to short interruptions and voltage dips (2003).
\textsuperscript{18} Italy survey on customer costs for “micro-interruptions (very short interruptions (< 1s) and voltage dips)” (2006).
In addition, specifically for case-based voltage quality studies, the following few additional aspects shall be addressed:

- deployment of measurement instruments,
- logging of events and
- analysis of log forms and measurement data.

Relating to methods used for conducting the analysis, a typical structure for a cost-estimation study on the continuity of supply and the voltage quality can be divided into a “survey-based approach”, which typically includes the design of a questionnaire for a large representative sample, and a “case-based approach” which focuses on a few single cases aimed to identify consequences of power supply interruptions or voltage disturbances for these typical cases.

IV.8 GENERAL OVERVIEW OF THE SITUATION IN THE ENERGY COMMUNITY CONTRACTING PARTIES AND OBSERVERS IN RELATION TO THE VOLTAGE QUALITY

The activities towards the introduction of the voltage quality monitoring and regulation have started in the Energy Community Contracting Parties. However, these activities are still in an initial state, so mostly the data are still not available.

The voltage quality regulation and legislation, as well as the voltage quality indicators, exist across the Contracting Parties. However, the voltage quality monitoring systems and the data collecting, aggregating and publishing are not significantly developed. Actual voltage quality data mitigation measures exist in only one place, whereas the studies on estimation of costs due to poor voltage quality are still non-existent.

There is a recognized need to introduce voltage quality requirements into national legal and regulatory frameworks. This relates to definition of procedures and obligations for the establishment of a voltage quality monitoring system, particularly when it comes to provisions which relate to requirements for voltage quality instruments, collection, aggregation and publication of the voltage quality data from such system (see recommendations provided in Chapter IV.2, IV.3 and IV.6 of this study).

The activities towards the implementation of the voltage quality standards have already been undertaken. EN 50160 and other standards have been adopted, with provisions in line with such standards. Although EN 50160 has been implemented, it has been so mainly as a voluntary standard. Where it has been implemented through national legislation and regulation (the general conditions of supply or the grid/network codes), it is made so either through a reference to EN 50160 or by taking over the limits given in EN 50160.

EN 50160 may be considered as the basic instrument for the voltage quality assessment, being applied mainly in LV and MV distribution networks up to 35 kV. It is predominantly used as a standard for supply voltage variations. Somewhere, stricter requirements for supply voltage variations are put in place.

The voltage quality standards that differ from EN 50160, have been introduced for some voltage characteristics, mainly through the national legislation and the network codes.
Different standards are introduced for different reasons: historical, different network characteristics, introducing new stricter limits, etc.

Those regulatory jurisdictions that have not adopted EN 50160 are encouraged to do so. Those ones that have adopted, but have not translated EN 50160 shall make the effort to translate it in order to have precise definitions in a national language and to allow further development of terminology. This also applies to other widespread standards.

Implementation of provisions in the national legislation that are consistent or stricter than EN 50160 and IEC 61000-x-x is recommended. Further improvement of the precision of definitions, limitations and exceptions is welcome. Since the focus has been put so far on the supply voltage variations, it is necessary to extend the activities to encompass all voltage characteristics mentioned in EN 50160. Deviations from EN 50160, IEC 61000-x-x and other standards shall be avoided as much as possible, keeping in mind national specifics.

The voltage quality monitoring systems for continuous voltage quality monitoring shall be installed to provide relevant data on actual voltage quality levels. In some regulatory jurisdictions, direct obligation for TSO/DSO to measure the voltage quality parameters on a continuous basis or at pre-defined intervals has been introduced into national legislation and regulation. However, detailed procedures and obligations for the establishment of a voltage quality monitoring system still remain to be defined.

TSO/DSO shall develop the voltage quality monitoring systems for continuous voltage quality monitoring in their networks. Monitoring shall take place at those locations which enable a good estimation of the voltage quality as experienced by the customers (see recommendations provided in Chapter IV.6 of this study). The data from the continuous voltage quality monitoring may provide useful information for TSO/DSO resulting in significant cost savings and information to support investment decisions. Prior to the implementation it is recommendable to undertake joint activities towards harmonization of the voltage quality parameters to be measured and the measurement methods.

The principle aims of compulsory monitoring shall be the following:

- to verify compliance with the voltage quality requirements (both overall and for individual customers),
- to provide information to the customers on their actual or expected voltage quality and
- to obtain information needed to set appropriate future requirements.

Note: As far as system level permanent/rolling measurements are concerned, compulsory monitoring of voltage quality in the networks is not common. However, we recommend countries to encourage network operators to continuously monitor voltage quality. In some countries initiatives for the monitoring scheme have even been promoted by the Regulatory Authority. For example, in Italy the voltage quality monitoring scheme in all voltage levels was initiated by the regulator (monitoring is done by network operators). In Norway, the Norwegian regulator has introduced a mandatory requirement for each network to monitor voltage quality continuously. In particular, network companies have to indentify a number of representative measurement points. On the other hand, in Hungary, the regulator owns quality recorders that are installed each semester in one of the distribution networks. In other countries network operators promoted the initiative for the monitoring scheme (Czech Republic, France, Latvia, Lithuania, the Netherlands, Romania) with purposes of statistics,
research, network development, information to customers, publication and regulation. The costs of voltage quality monitoring (installation, maintenance and operation) shall be borne by predefined tariffs or paid by TSO/DSO and then recovered via tariffs for network usage to all connected customers.

In majority of regulatory jurisdictions, TSO/DSO is legally obliged to provide individual voltage quality verification upon a request by the network user who experiences the voltage quality problems. However, obligation to provide individual information on the voltage quality is still not legally defined everywhere and remains to be adopted fully.

This obligation should be accompanied by a detailed description of the procedure by the TSO/DSO so that all relevant information about the procedure is available to the customers, including definition and allocation of costs related to the verification (see recommendations provided in Chapters IV.4 and V.4 of this study).

Statistics on the customer complaints and verification results shall be used by the system operators to identify areas needing improvements or at least the ones to be investigated further. Such statistics shall be used for regulatory decisions on the voltage quality. Furthermore, this statistics shall be correlated with results from continuous voltage quality monitoring (if in place). In the verification process, the system operator shall make reasonable efforts to identify the cause of the disturbance.

The responsibility for improving the overall voltage quality and/or rectifying voltage disturbances is shared between the state inspectorate, TSO/DSO, the customers and the national regulatory authority, but not clearly legally defined. The role of the national regulatory authority is mainly limited to approving codes, while the direct authority for the voltage quality regulation is not defined.

In order to regulate the impact that customer installations have on the voltage quality of the transmission and distribution networks, legislation defining emission limits for individual customers has been imposed. Maximum levels of disturbances concerning the voltage quality for the network user installations that are connected to the network are usually defined by the grid/network codes. Penalties for the customers in case of violation of the maximum levels of disturbances, other than disconnection, are not envisaged anywhere.

Emission limits from individual customers are necessary to maintain the voltage disturbance levels within the voltage quality requirements without excessive costs for other customers. The limits on emission shall be reasonable for both TSO/DSO and the customers causing the emission. Introduction of emission limits for individual network users into legislation or regulation shall go hand in hand with the legal establishment of the voltage quality standards that TSO/DSO has to comply with.

In case of violations of emission limits by the network user, mitigation measures shall be coordinated by TSO and DSO. The network user shall pay penalties or be obliged to carry out corrective measure if his installation is the source of voltage disturbances.

The previous recommendations are preconditions for the national regulatory authorities to make efficient decisions in relation to the voltage quality regulation.
The commercial quality relates to the nature and quality of customer service provided to the customers. This includes all transactions between the service providers and the customers, not just those related to the availability of electricity supply and the physical performance of the network. For example, the response time of the service provider to specific customer request or the execution time for customer related and standardized processes.

The objectives of the recommendations and guidelines which are given hereafter on the commercial quality are the following:

- to protect the rights of the (final) customers by use of the guaranteed and the overall standards of the commercial quality within the distribution services, metering arrangements and supply of electricity, as well as by use of "on request" or "automatic" compensation for the customers in case of non-compliance attributable to the service provider;
- to ensure fair and consistent record of the service providers performance as required by the customers and measured by reliable, comparable and verifiable parameters of the commercial quality;
- to allow provision of adequate information from the service providers to the national regulatory authority as well as to the customers on the timeliness of performance of their requests;
- to enable benchmarking of the parameters of the commercial quality between the regulatory jurisdictions in the Energy Community in a manner which is compatible and comparable to the CEER's one in the European Union; and
- to implement the complaint handling procedure for empowerment of the customers.

V.1 PARAMETERS OF THE COMMERCIAL QUALITY

V.1.1 CONNECTION TO THE NETWORK

V.1.1.1 TIME, NEEDED TO RESPOND TO CUSTOMER’S CLAIM FOR NETWORK CONNECTION (1)

It is the time which elapses from the date of receipt of the complete written customer’s claim for network connection (CCfNC) until the date of dispatch of the written response of DSO, if no intervention is necessary in the public network (if such intervention is necessary then despite the DSO’s obligation to answer, such case is not taken into account here).

The average performance "time, needed to respond to customer’s claim for network connection” is calculated as follows:

$$T_{response\,CCfNC} = \frac{\sum_{i=1}^{No_{response\,CCfNC}} T_{response\,CCfNC\,i}}{No_{response\,CCfNC}} [days],$$

where is
average performance time needed to respond to the customer’s claim for network connection (CCfNC), expressed in days;

time needed to elaborate and dispatch the written response to the "i-th" customer’s claim for network connection (CCfNC) (to the new user or the existing one to increase connecting power), expressed in days; and

number of all written responses to complete customers’ claims for network connection (CCfNC) (of new users or the existing ones for increasing the connecting power).

The relative fulfillment is calculated as the ratio between the number of all written responses in due time (i.e., within the period set in the standard) and the number of all submitted claims for network connection.

Alternatively, this parameter may be related to the issuance of the consent for connection (CfC) and defined as the time which elapses from the date of receipt of a customer’s complete written claim for the consent for connection or to increase connecting power until the date of issuance of the consent for connection, issued by DSO:

\[
T_{response \, CfC} = \frac{\sum_{i=1}^{N_{responses \, CfC}} T_{response \, CfC \, i}}{N_{responses \, CfC}} \quad [days],
\]

where is

average performance time needed to respond to the customer’s claim for network connection by issuing the consent for connection (CfC), expressed in days;

time needed to issue the consent for connection (CfC) to the "i-th" new user or the existing one to increase connecting power, expressed in days; and

number of all written responses to the customers’ claims for issuance of the consent for connection (CfC) to new customers or to the existing ones for increasing the connecting power.

The relative fulfillment is calculated as the ratio between the number of all written responses in due time (i.e., within the period set in the standard) and the number of all submitted claims for the consent for connection.

**Note 1:** This time shall not be longer than 30 days if the consent for connection is to be issued within the short-term proceedings, and 60 days on the basis of normal proceedings (criteria for the type of proceedings do not depend only on the connection complexity, but also on the number of customers which should be included in the proceedings).

**Note 2:** The reporting on the issuance of the consent for connection within the short-term proceedings and on the issuance of that consent within normal proceedings is performed separately for each of them. However, a common parameter for both proceedings shall be calculated.

**Note 3:** If the claim is dismissed within 30 or 60 days, it is considered that due to external causes the consent for connection is not given in the guaranteed period.
V.1.1.2 TIME, NEEDED TO ISSUE A COST ESTIMATE FOR SIMPLE WORKS (2)

It is the time which elapses from the date of receipt of the customer’s written claim for network connection and the date of dispatch of the written response of DSO including a cost estimate for works, if the connection can be executed by simple works.

Simple works are the intervention by DSO in the network in favor of the customer, which is made on the connection equipment in a simple case. Simple works comprise all works performed by DSO in line with its activity at LV delivery/withdrawal point and control devices, such as replacement of meter, construction of new LV connection etc.

Alternatively, this parameter may be directly related to a request for issuance of a cost estimate for simple works, if it is introduced in practice. In such case, it is the time which elapses from the date of receipt of the customer’s written request for issuance of a cost estimate (CE) for simple works until the date of dispatch of such estimate, prepared by DSO.

The average performance “time, needed to issue a cost estimate for simple works” is calculated as follows:

$$T_{\text{issue \ CE}} = \frac{\sum_{i=1}^{N_{\text{issue \ CE}}} T_{\text{issue \ CE}\ i}}{N_{\text{issue \ CE}}} \ [\text{days}],$$

where is
- $T_{\text{issue \ CE}}$ average performance time needed to issue a cost estimate (CE) for simple works, expressed in days;
- $T_{\text{issue \ CE}\ i}$ time needed to issue a cost estimate (CE) for simple works within the “i-th” customer's request, expressed in days; and
- $N_{\text{issue \ CE}}$ number of all issued cost estimates (CE) for realization of simple works.

The relative fulfillment is calculated as the ratio between the number of all issued cost estimates in due time (i.e., within the period set in the standard) and the number of all submitted claims for the cost estimate, only for simple works.

Note 1: Request for issuance of a cost estimate must be made in writing or in another way which allows a systemic registration of the date/time of receipt of the request (e.g., call center).

Note 2: This parameter is monitored only for those services for which DSO does not publish the Price List.

V.1.1.3 TIME, NEEDED TO CONNECT NEW CUSTOMER TO THE NETWORK (3)

It is the time which elapses from the date of receipt of the new customer’s complete written claim for network connection until the date when the new customer (NC) is connected to the network, if no intervention is required in the network.

The average performance "time, needed to connect new customer to the network" is calculated as follows:
where is

\[ T_{\text{connect NC}} \] average performance time needed to connect new customer (NC) to the network, expressed in days;

\[ T_{\text{connect NC i}} \] time needed to connect the "i-th" new customer (NC) (or to increase connecting power of the existing one), expressed in days; and

\[ N_{\text{connected NC}} \] number of all connected new customers (NC) or the existing customers to whom connecting power was increased.

The relative fulfillment is calculated as the ratio between the number of all connected new customers in due time (i.e., within the period set in the standard) and the number of all submitted claims for network connection.

Note: The date of receipt of the new customer’s complete written claim for network connection can be either the same moment as the one under V.1.1.1. or the one related to the signature of the contract. It is up to the national regulatory authority to decide what time duration will be monitored, i.e. which duration is more critical for monitoring in its jurisdiction.

Alternatively, this parameter may be directly related to a request to sign the contract on connection, if it is introduced in practice. In such case, it is the time which elapses from the date of receipt of the customer’s complete written claim for issuance of the contract on connection (CoC) until the date of issuance of the contract on connection signed by DSO:

\[ T_{\text{issue CoC}} = \frac{\sum_{i=1}^{N_{\text{issued CoC}}} T_{\text{issue CoC i}}}{N_{\text{issued CoC}}} \text{[days]}, \]

where is

\[ T_{\text{issue CoC}} \] average performance time needed to issue the contract on connection (CoC) (to connect new user to the network), expressed in days;

\[ T_{\text{issue CoC i}} \] time needed to issue the contract on connection (CoC) to the "i-th" new user or existing user to increase connecting power, expressed in days; and

\[ N_{\text{issued CoC}} \] number of all issued contracts on connection (CoC) to new customers or to the existing ones for increasing the connecting power.

The relative fulfillment is calculated as the ratio between the number of all issued contracts on connection in due time (i.e., within the period set in the standard) and the number of all submitted claims for issuance of the contract on connection.

Note: Only the duration of the procedure, to which DSO has an impact, is considered.
V.1.1.4  TIME, NEEDED FOR DISCONNECTION UPON CUSTOMER’S REQUEST (4)

It is the time which elapses from the date of receipt of customer’s complete written request for disconnection (de-activation) from the electricity network until the date of customer’s physical disconnection.

The average performance "time, needed for disconnection upon customer’s request" is calculated as follows:

\[ T_{\text{disconnect}} = \frac{\sum_{i=1}^{N_{\text{disconnections}}} T_{\text{disconnect} \ i}}{N_{\text{disconnections}}} \text{[days]}, \]

where is

- \( T_{\text{disconnect}} \) average performance time needed to disconnect a customer from the electricity network upon his own request, expressed in days;
- \( T_{\text{disconnect} \ i} \) time needed for disconnection (de-activation of a connection) from the electricity network of the "i-th" customer, expressed in days; and
- \( N_{\text{disconnections}} \) number of all disconnections performed upon customers’ requests.

The relative fulfillment is calculated as the ratio between the number of all disconnections performed upon customers’ requests in due time (i.e., within the period set in the standard) and the number of all submitted requests for disconnection or de-activation.

V.1.2  CUSTOMER CARE

V.1.2.1  PROPORTION OF PUNCTUALLY HELD APPOINTMENTS WITH CUSTOMERS (5)

The basis for calculation of this indicator is in advance prescribed or agreed time interval (period of hours) in which the provider’s representative warrants a visit at the customer’s site.

The proportion of punctually held appointments with customers is the proportion of cases in which the personnel of the provider appear at the customer’s site within the time range previously agreed with the customer. It is calculated as follows:

\[ \text{Proportion of punctual appointments} = \frac{N_{\text{comp. appointments}}}{N_{\text{appointments}}} \times 100 \% \],

where is

- Proportion of punctual appointments proportion of appointments which the provider’s representative performed within guaranteed time as determined by guaranteed standard for the commercial quality, expressed in percentages;
- \( N_{\text{comp. appointments}} \) number of punctual appointments, for which there is a justified complaint of the customer; and
- \( N_{\text{appointments}} \) number of all appointments made.
Note: The maximum time interval of the appointment shall be defined by the provisions of the minimum standards for the quality of supply.

V.1.2.2 TIME, NEEDED TO RESPOND TO CUSTOMER’S WRITTEN COMPLAINTS AND ENQUIRIES (6)

It is the time needed to respond to customer’s written complaint or enquiry (CWCE), and shall be counted in days from the date of registration of the customer’s written complaint or enquiry (the date of receipt of the letter) until the date of dispatch of the written response to the intervention (including on-site measurement and investigation only).

The average performance “time, needed to respond to customer’s written complaints and enquiries” is calculated as follows:

\[
T_{response \ CWCE} = \frac{\sum_{i=1}^{No_{responses \ CWCE}} T_{response \ CWCE \ i}}{No_{responses \ CWCE}} \text{[days]},
\]

where is

\(T_{response \ CWCE}\) average performance time needed to respond to customer’s written complaints and enquiries (CWCE), expressed in days;

\(T_{response \ CWCE \ i}\) time needed for the "i-th" response to customer’s written complaint or enquiry (CWCE) (from the date of receipt of the customer’s complaint or enquiry until the date of dispatch of the response to it), expressed in days; and

\(No_{responses \ CWCE}\) number of all written responses to customers’ written complaints and enquiries (CWCE) that were sent.

The relative fulfillment is calculated as the ratio between the number of all written responses to customers’ written complaints or enquiries in due time (i.e., within the period set in the standard) and the number of all submitted written complaints and enquiries.

Note 1: In relation to answers to the letters containing any combination of customers’ written complaints or requests, the longest period of time shall be considered (the time needed for the last answer, if given more than one answer), whereas the letter shall be considered as only one.

Note 2: Complaints which are dealt with in other indicators of the commercial quality do not count in this indicator.

The average performance “time, needed to respond to customer’s written complaints and enquiries” may be subdivided into two different parts which can be calculated separately:

a) Time, needed for answering the voltage complaint

- It is the time which elapses from the date of receipt of the voltage complaint until the date of dispatch of the answer to it, also including on-site measurement and investigation;

- The relative fulfillment is calculated as the ratio between the number of all written answers to customers’ written voltage complaints in due time (i.e., within the
period set in the standard) and the number of all submitted written voltage complaints;

b) Time, needed for answering the interruption complaint

- It is the time from the date of receipt of the interruption complaint until the date of dispatch of the answer to it, also including history and justification of interruptions;
- The relative fulfillment is calculated as the ratio between the number of all written answers to customers’ written interruptions complaints in due time (i.e., within the period set in the standard) and the number of all submitted written interruptions complaints.

Previous equation for calculating the average performance “time, needed to respond to customer’s written complaints and enquiries” applies in both of the parts.

V.1.2.3 TIME, NEEDED TO RESPOND TO CUSTOMER’S WRITTEN QUESTIONS IN RELATION TO COSTS AND PAYMENTS (EXCLUDING COST ESTIMATION FOR CONNECTION)

(7)

It is the time needed to respond to customer’s written question (CWQ) in relation to costs and payments (excluding cost estimation for connection), and shall be counted in days from the date of registration of the customer’s written question (the date of receipt of the letter) until the date of dispatch of the written answer to it.

The average performance “time, needed to respond to customer’s written questions in relation to costs and payments” is calculated as follows:

\[
T_{response\ CWQ} = \frac{\sum_{i=1}^{N_{response\ CWQ}} T_{response\ CWQ\ i}}{N_{responses\ CWQ}} \text{[days]},
\]

where is

- \(T_{response\ CWQ}\) average performance time needed to respond to customer’s written questions (CWQ) in relation to costs and payments (excluding cost estimation for connection), expressed in days;
- \(T_{response\ CWQ\ i}\) time needed for the “i-th” response to customer’s written question (CWQ) in relation to costs and payments (excluding cost estimation for connection) (from the date of receipt of the customer’s written question until the date of dispatch of the response to it), expressed in days; and
- \(N_{responses\ CWQ}\) number of all written responses to customers’ written questions (CWQ) in relation to costs and payments (excluding cost estimation for connection) that were sent.

The relative fulfillment is calculated as the ratio between the number of all written responses to customers’ written questions in relation to costs and payments in due time (i.e., within the period set in the standard) and the number of all submitted written questions in relation to costs and payments, excluding cost estimation for connection.
V.1.2.4 TIME, OF HOLDING OF THE CALL IN THE CALL CENTER (8)

It is the holding time of each call of each individual user (including playback information with music and speech, which follows the voice menu selection with usage of functions such as Interactive Voice Response), as long as the call center operator answers to it. It shall be counted in seconds from the time instant of the customer’s call in the call center until the time instant of the call center operator’s answer to the call.

The average performance "time, of holding of the call in the call center" is calculated as follows:

\[ T_{\text{holding call}} = \frac{\sum_{i=1}^{N_{\text{calls}}} T_{\text{holding call } i}}{N_{\text{calls}}} \text{[sec]}, \]

where is

- \( T_{\text{holding call}} \) average performance time of holding of the customer’s call in the call center, expressed in seconds;
- \( T_{\text{holding call } i} \) time of holding of the "i-th" call in the call center, expressed in seconds; and
- \( N_{\text{calls}} \) number of all incoming calls of the customers in the call center.

V.1.2.5 INDICATOR OF THE SERVICE LEVEL OF THE CALL CENTER (9)

The indicator of the service level of the call center is the percentage of incoming calls in the call center which are answered by the call center operator within the time limit set in the standard.

The average value of the indicator of the service level of the call center is calculated as follows:

\[ I_{\text{service level}} = \frac{\sum_{i=1}^{n} I_{\text{calls } (t<tx) } i}{N_{\text{calls}}} \times 100 \% , \]

where is

- \( I_{\text{service level}} \) indicator of the service level of the call center;
- \( t \) real duration of the call retention (real holding time of the call);
- \( tx \) expected duration of the call retention (expected holding time of the call);
- \( n \) maximum number of time units within a time period for which the calculating takes place (in minutes, hours, days, months, quarters);
- \( I_{\text{calls } (t<tx) } i \) number of incoming telephone calls in which the real duration of the call retention is less than the expected duration of the call retention; and
- \( N_{\text{calls}} \) number of all incoming calls of the customers within a time period for which the calculating takes place.
Commercial Quality

Note: If \( tx \) is not determined, the indicator is calculated as the ratio between number of calls to which the call center operator answered and total number of incoming calls requesting communication with the call center operator, independently of the length of the call retention:

\[
I_{\text{service level}} = \frac{No_{\text{calls answered}}}{No_{\text{calls}}} \times 100 \%.
\]

where is

- \( No_{\text{calls answered}} \) number of calls to which the call center operator answered; and
- \( No_{\text{calls}} \) number of all incoming calls requiring communication with the call center operator independently of the length of the call retention.

---

V.1.2.6 TIME, FOR WAITING IN CASE OF PERSONAL VISIT AT THE CUSTOMER CENTER

It is the waiting time in case of personal visit at the customer center (PVCC), as long as the customer center operator speaks with the customer. It shall be counted in minutes from the time moment of the customer’s arrival at the customer center (for customer contact in person) until the time moment of the customer center operator’s speech with the customer.

The average performance "time, for waiting in case of personal visit at the customer center" is calculated as follows:

\[
T_{\text{waiting PVCC}} = \frac{\sum_{i=1}^{N_{\text{PVCC}}} T_{\text{waiting PVCC } i}}{N_{\text{PVCC}}} \text{[min]},
\]

where is

- \( T_{\text{waiting PVCC}} \) average performance time for waiting of the customer in case of personal visit at the customer center (PVCC), expressed in minutes;
- \( T_{\text{waiting PVCC } i} \) time for waiting in case of the "i-th" personal visit at the customer center (PVCC), expressed in minutes; and
- \( N_{\text{PVCC}} \) number of all personal visits at the customer center (PVCC).

The relative fulfillment is calculated as the ratio between the number of customers received in due time (i.e., within the period set in the standard) and the number of all personal visits at the customer center.

---

V.1.3 TECHNICAL SERVICES

V.1.3.1 TIME, NEEDED TO ELIMINATE THE VOLTAGE QUALITY RELATED PROBLEM AFTER ANSWERING TO THE VOLTAGE QUALITY RELATED COMPLAINT

It is the time which elapses from the date of dispatch of the answer to a complaint regarding the voltage quality (VQ) (it relates to the ending moment when calculating the time needed for answering the voltage complaint under V.1.2.2.) until the date of elimination of the voltage quality disturbance. The time moment of the elimination is the date on which the normal
situation in the network is restored (technical review, starting of trial operation, TS tap switch, etc.).

The average performance "time, needed to eliminate the voltage quality related problem after answering to the voltage quality related complaint" is calculated as follows:

\[ T_{elimination\ VQ} = \frac{\sum_{i=1}^{N_{eliminations\ VQ}} T_{elimination\ VQ\ i}}{N_{eliminations\ VQ}} \text{[days]}, \]

where is

- \( T_{elimination\ VQ} \) average performance time needed to eliminate the voltage quality (VQ) disturbance, expressed in days;
- \( T_{elimination\ VQ\ i} \) time needed to solve the "i-th" problem related to the voltage quality (VQ) disturbance (intervention in the network), expressed in days; and
- \( N_{eliminations\ VQ} \) number of all eliminations of the voltage quality (VQ) disturbances.

The relative fulfillment is calculated as the ratio between the number of all eliminated voltage quality disturbances in due time (i.e., within the period set in the standard) and the number of all complaints regarding the voltage quality verified as true by the service provider.

*Note 1*: Parameters shall be monitored separately by voltage levels. A common indicator shall also be calculated which is the average value of all indicators.

*Note 2*: When calculating this indicator, only complaints about the voltage quality disturbances which are officially recorded and resolved during the year are taken into account. Verbal complaints are not taken into account (the complainant shall be explained how to complain). When calculating this indicator, only justified complaints are taken into account.

Previously noted indicator is closely related to another indicator which is also used in relation to elimination of the voltage quality disturbances. It is called the time needed to answer to the complaint related to the voltage quality. In case of complaints about the voltage quality, the resolution is performed in two steps:

1) check on the affected site and answer to the complaint, and
2) solve the problem.

As the second part is previously explained, the first one is the time which elapses from the date of receipt of the written complaint regarding the voltage quality (VQ) until the date of dispatch of written answer to it.

When calculating this indicator for the first part, only complaints which are formally recorded are taken into account. Verbal complaints are not taken into account (the complainant shall be informed on how to complain). When calculating it, justified and unjustified complaints are taken into account.

The average performance “time, needed to answer to the complaint related to the voltage quality” is calculated as follows:
where is

\[ T_{answer\ VQ} = \frac{\sum_{i=1}^{N_{answers\ VQ}} T_{answer\ VQ\ i}}{N_{answers\ VQ}} \text{[days]}, \]

average performance time needed to answer to the complaint related to the voltage quality (VQ), expressed in days;

\[ T_{answer\ VQ\ i} \]
time needed to answer to the "i-th" voltage quality (VQ) complaint (including the measurements on the affected site and search for solutions), expressed in days; and

\[ N_{answers\ VQ} \]
number of all answers given to complaints received in relation to the voltage quality (VQ) disturbances.

The relative fulfillment is calculated as the ratio between the number of all written answers given to written complaints received in relation to the voltage quality disturbances in due time (i.e., within the period set in the standard) and the number of all written complaints regarding the voltage quality verified as true by the service provider.

**V.1.3.2 TIME, NEEDED TO RESTORE SUPPLY FOLLOWING FAILURE OF DSO’S FUSE (12)**

It is the time which elapses from the receipt of customer’s notice of the failure of DSO’s fuse (F) until 1) the starting of its repairing or 2) the restoration of supply.

The average performance "time, needed to restore supply following failure of DSO’s fuse" is calculated as follows (option 2):

\[ T_{restore\ F} = \frac{\sum_{i=1}^{N_{restorations\ F}} T_{restore\ F\ i}}{N_{restorations\ F}} \text{[h]}, \]

where is

\[ T_{restore\ F} \]
average performance time needed to restore supply following failure of DSO’s fuse (F), expressed in hours;

\[ T_{restore\ F\ i} \]
time needed to restore supply following the "i-th" failure of DSO’s fuse (F), expressed in hours; and

\[ N_{restorations\ F} \]
number of all restorations of supply following failure of DSO’s fuses (F).

The relative fulfillment is calculated as the ratio between the number of all restorations of supply following failure of DSO’s fuses performed in due time (i.e., within the period set in the standard) and the number of all customers’ notices of the failure of DSO’s fuse.

*Note 1*: If it turns out that after replacing the fuse the power supply is interrupted again (defect in the customer’s internal installations), further timing of the elimination is not counted.

*Note 2*: If the customer opts for elimination of the fuse’s failure at a later time due to more favorable pricing, the timing of the elimination is not recorded. DSO must keep evidence of such customers’ requests.
V.1.3.3 PROPORTION OF CUSTOMERS TIMELY INFORMED IN ADVANCE OF A PLANNED INTERRUPTION (13)

Most often, DSO is obliged to inform customers of a planned interruption in line with provisions of energy-related laws. Such provisions usually define the minimum time for giving information in advance of a planned interruption, i.e. the minimum time which elapses from the date of dispatch of the advance notice of a planned interruption until the date of beginning of the planned interruption. Means of information depend on the category of customers. Therefore, it is more interesting to identify the proportion of advance notices on planned interruptions (NPI) which are sent earlier than the prescribed minimum time (this excludes notification done through public media and counts only individual notices).

The proportion of notices on planned interruptions which are sent earlier than the prescribed minimum time is calculated as follows:

$$\text{Proportion of NPI sent in time} = \left[ 1 - \frac{\sum_{i=1}^{NoJC} \frac{NoJC_i}{NoPI}}{NoU} \right] \times 100\%,$$

where is

- \(Proportion of NPI sent in time\) proportion of notices on planned interruptions (NPI) which are sent in time, i.e. proportion of customers benefiting from an adequate quality of service information on planned interruptions, expressed as a percentage;
- \(NoJC_i\) number of justified complaints (JC) from customers at the occasion of the "i-th" planned interruption;
- \(NoU_i\) number of all users (U) at the occasion of the "i-th" planned interruption; and
- \(NoPI\) number of all planned interruptions (PI).

The relative fulfillment is calculated as the ratio between the number of customers informed in due time in advance (i.e., within the period set in the standard) and the number of all customers affected by planned interruptions.

V.1.3.4 TIME, NEEDED TO RESTORE SUPPLY IN CASE OF AN UNPLANNED INTERRUPTION (14)

It is the time which elapses from the beginning of an unplanned interruption (UI) until the restoration of supply to the individual customer affected (for every single event).

The average performance "time, needed to restore supply in case of an unplanned interruption" is calculated as follows:

$$T_{\text{restore UI}} = \frac{\sum_{i=1}^{No_{ui}} T_{\text{restore UI i}}}{No_{restorations UI}} [h],$$

where is
Commercial Quality

\( T_{\text{restore UI}} \) average performance time needed to restore supply in case of an unplanned interruption (UI) to the individual customer affected, expressed in hours;

\( T_{\text{restore UI i}} \) time needed to restore supply in case of the "i-th" unplanned interruption (UI) to the individual customer affected, expressed in hours; and

\( N_{\text{restorations UI}} \) number of all restorations of individual customer supplies due to unplanned interruptions (UI).

The relative fulfillment is calculated as the ratio between the number of individual customer supplies restored in due time (i.e., within the period set in the standard) and the total number of restorations (the total number of customers affected by unplanned interruptions).

V.1.4 METERING AND BILLING

V.1.4.1 TIME, NEEDED TO INSPECT THE METER IN CASE OF METER FAILURE (15)

It is the time which is needed to inspect the meter in case of meter failures (MF), and counted in days from the date of receipt of the customer’s notice on the meter problem until the date of inspection of the meter.

The average performance “time, needed to inspect the meter in case of meter failure” is calculated as follows:

\[
T_{\text{inspection MF}} = \frac{\sum_{i=1}^{N_{\text{inspections MF}}} T_{\text{inspection MF i}}}{N_{\text{inspections MF}}} \text{[days]},
\]

where is

\( T_{\text{inspection MF}} \) average performance time needed to inspect the meter in case of meter failure (MF), expressed in days;

\( T_{\text{inspection MF i}} \) time from the date of receipt of the customer’s notice until the date of inspection of the "i-th" meter, expressed in days; and

\( N_{\text{inspections MF}} \) number of all inspections relating to meter failures (MF).

The relative fulfillment is calculated as the ratio between the number of all inspections relating to meter failures performed in due time (i.e., within the period set in the standard) and the number of all customers’ notices on the meter problem.

Note 1: This indicator shall be monitored by voltage levels and categories of consumption.

Note 2: It is necessary to consider the meters, but also control and communication equipment.

V.1.4.2 TIME, FROM THE NOTICE TO PAY UNTIL DISCONNECTION (16)

It is the time which elapses from the date of dispatch of the notice to pay (NtP) (sometimes notice of disconnection, NoD) after missing payments until the date of disconnection of the customer.
The average performance "time, from the notice to pay until disconnection" is calculated as follows:

\[
T_{\text{disconnection NtP}} = \frac{\sum_{i=1}^{No_{\text{disconnections NtP}}} T_{\text{disconnection NtP } i}}{No_{\text{disconnections NtP}}} \text{[days]},
\]

where is
- \(T_{\text{disconnection NtP}}\) average performance time needed to disconnect the customer after dispatching the notice to pay (NtP), expressed in days;
- \(T_{\text{disconnection NtP } i}\) time from the date of dispatch of the "i-th" notice to pay (NtP) until the date of disconnection of the customer, expressed in days; and
- \(No_{\text{disconnections NtP}}\) number of all disconnections of the customers after dispatching the notice to pay (NtP).

The relative fulfillment is calculated as the ratio between the number of all disconnections after the minimum due time and the number of all disconnections subsequent to the notice to pay.

Note: This indicator shall be monitored by voltage levels and categories of consumption.

\[\text{V.1.4.3 \hspace{1cm} TIME, NEEDED TO RESTORE SUPPLY FOLLOWING DISCONNECTION DUE TO NON-PAYMENT (17)}\]

It is the time which elapses from the date on which all conditions for reconnection of the customer are fulfilled (paid-on debt, including costs of disconnection and reconnection, signed contracts on network access and supply) until the date of actual restoration of supply to the customer following disconnection due to non-payment (DdtNP).

The average performance "time, needed to restore supply following disconnection due to non-payment" is calculated as follows:

\[
T_{\text{restoration DdtNP}} = \frac{\sum_{i=1}^{No_{\text{restorations DdtNP}}} T_{\text{restoration DdtNP } i}}{No_{\text{restorations DdtNP}}} \text{[days]},
\]

where is
- \(T_{\text{restoration DdtNP}}\) average performance time needed to restore supply following disconnection due to non-payment, expressed in days;
- \(T_{\text{restoration DdtNP } i}\) time from having fulfilled conditions for the "i-th" reconnection until the actual restoration of supply following disconnection due to non-payment (DdtNP), expressed in days; and
- \(No_{\text{restorations DdtNP}}\) number of all restorations of supply following disconnection due to non-payment (DdtNP).

The relative fulfillment is calculated as the ratio between the number of all restorations of supply following disconnection due to non-payment performed in due time (i.e., subsequent
to payment of the debts and within the limit specified in the standard) and the number of all customers who paid-on their debts and were reconnected.

### V.1.4.4 NUMBER OF REGULAR METER READINGS IN ONE YEAR BY THE DESIGNATED COMPANY (18)

The average number of actually performed meter readings (MR) in one year by the designated metering operator (readings by the customer are excluded) is calculated as follows:

$$\text{Average } No_{MR} = \frac{No_{MR}}{No_M} \times \text{No / year},$$

where is

- $\text{Average } No_{MR}$: average number of actually performed meter readings (MR) in one year by the designated metering operator;
- $No_{MR}$: number of all actually performed regular meter readings (MR) in one year; and
- $No_M$: number of all meters (M).

The relative fulfillment is calculated as the ratio between the number of customers with at least the minimum yearly meter readings performed and the number of customers subject to requirements on meter readings.

**Note 1:** Meter reading is performed in different ways and with varying frequency. It is expected that the designated metering operator will regularly read meters, because the charging on the basis of estimates represents the most frequent cause of complaints. Solution to this problem is to use the system for a remote reading of metering devices.

**Note 2:** The customer, who has not allowed reading of the meter located at inaccessible measuring point, is not entitled to compensation. The designated metering operator shall keep exhibits.

### V.1.5 CONSISTENCY LEVEL OF THE COMMERCIAL QUALITY

The respective percentage of the commercial services which are performed in line with the minimum standards for the commercial quality is calculated by using individual parameters of the commercial quality as follows:

$$\text{Consistency level of } CQ \times 100 \% = \frac{No_{consistent \ services \ CQ}}{No_{all \ services \ CQ}},$$

where is

- $\text{Consistency level of } CQ$: share of the commercial services rendered in line with the minimum standards for the commercial quality;
- $No_{consistent \ services \ CQ}$: number of the commercial services which are performed in line with the minimum standards for the commercial quality; and
- $No_{all \ services \ CQ}$: number of all commercial services provided.
The share of the commercial services rendered in line with the minimum standards for the commercial quality is calculated by using the following parameters of the commercial quality:

- Time, needed to respond to customer’s claim for network connection (1);
- Time, needed to issue a cost estimate for simple works (2);
- Time, needed to connect new customer to the network (3);
- Time, needed for disconnection upon customer’s request (4);
- Time, needed to respond to customer’s written complaints and enquiries (6);
- Time, needed to respond to customer’s written questions in relation to costs and payments (excluding cost estimation for connection) (7);
- Time, needed to eliminate the voltage quality related problem after answering to the voltage quality related complaint (11);
- Time, needed to restore supply following failure of DSO’s fuse (12);
- Time, needed to restore supply in case of an unplanned interruption (14);
- Time, needed to inspect the meter in case of meter failure (15); and
- Time, needed to restore supply following disconnection due to non-payment (17).

The consistency level shall be automatically calculated in the Web-based application on the basis of entry or import of necessary input data which are semantically related to each individual service.

V.2 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO THE NATIONAL REGULATORY AUTHORITIES ON THE COMMERCIAL QUALITY

The Web-based application for the commercial quality shall enable the service provider to report on:

- the general data, and
- the parameters of the commercial quality.

The national regulatory authority shall establish a set of mandatory general data. The Web-based application for the commercial quality shall enable the reporting on the general data in relation to each individual service provider.

The general data to be reported on shall include the following:

- number of all connected customers (network users) and delivery/withdrawal points by voltage levels and customer groups or categories;
- number of newly connected delivery/withdrawal points of customers by voltage levels;
- number of disconnected delivery/withdrawal points of customers by voltage levels;
- number of customers supplied with electricity within the universal service; and
- number of customers supplied with electricity within the supply of last resort and duration of such supply.

The Web-based application for the reporting on the commercial quality may contain further details in relation to previous general data.
Commercial Quality

The service providers shall report on the following parameters of the commercial quality (the ones noted previously in this Chapter together with definitions needed for their calculation) in the Web-based application for the commercial quality:

**Connection to the network**

1) Time, needed to respond to customer’s claim for network connection;
2) Time, needed to issue a cost estimate for simple works;
3) Time, needed to connect new customer to the network;
4) Time, needed for disconnection upon customer’s request;

**Customer care**

5) Proportion of punctually held appointments with customers;
6) Time, needed to respond to customer’s written complaints and enquiries;
7) Time, needed to respond to customer’s written questions in relation to costs and payments (excluding cost estimation for connection);
8) Time, of holding of the call in the call center;
9) Indicator of the service level of the call center;
10) Time, for waiting in case of personal visit at the customer center;

**Technical services**

11) Time, needed to eliminate the voltage quality related problem after answering to the voltage quality related complaint;
12) Time, needed to restore supply following failure of DSO’s fuse;
13) Proportion of customers timely informed in advance of a planned interruption;
14) Time, needed to restore supply in case of an unplanned interruption;

**Metering and billing**

15) Time, needed to inspect the meter in case of meter failure;
16) Time, from the notice to pay until disconnection;
17) Time, needed to restore supply following disconnection due to non-payment; and
18) Number of regular meter readings in one year by the designated company.

The service providers shall also provide other details than the parameters of the commercial quality:

- Input data, underlying the calculation of the parameters of the commercial services;
- Input data, underlying the calculation of the relative fulfillment, i.e. the share of customers who receive an appropriate level of the quality of each individual commercial service; and
- Number and amount of paid compensations due to non-compliance with the guaranteed standards for individual services.
The service providers shall keep and maintain all input data underlying calculation of the parameters of the commercial quality for a minimum period of three regulatory frameworks or at least 10 years. For the duration of this period, the service providers are obliged to keep and maintain all available documentation about the customers’ complaints.

The Web-based application for the reporting on the commercial quality may contain further details in relation to previous parameters and input data.

The annual reports to the national regulatory authority shall be presented on behalf of the service providers under the signature of nominated individuals.

In their annual reports to the national regulatory authority, the service providers shall disclose all data on the commercial quality for the previous year. The reporting shall be made before 15 February in the current year for the previous calendar year.

The service providers shall also report annually to the national regulatory authority on the number of justified and unjustified customer complaints which relate to non-compliance of the commercial quality with the guaranteed standards for the commercial quality.

The causes of failure to meet the guaranteed and the overall standards of the commercial quality are classified as follows:

- **Force Majeure**, understood as acts of public authorities, acts of exceptional nature for which a state of disaster was declared by a competent authority, strikes, and failure to obtain authorization documents;
- Causes attributable to the customer or third party, such as the non-presence of the customer on a date agreed with the service provider to carry out inspections necessary to effectuate the required performance or execution of benefit, or damage or obstructions caused by third parties;
- Causes attributable to the service provider, defined as all other causes which are not indicated in previous two bullets.

The service provider shall document the cause of non-compliance in order to effectuate the cause of failure to meet the guaranteed and the overall standards of the commercial quality.

The service providers shall keep records for all parameters whose values have exceeded the value set by the minimum standards for the commercial quality and which the service providers have identified as the **Force Majeure** or external cause (having same definitions throughout all three quality dimensions).

The service providers shall notify causes and documents for each such incident in the appropriate form within the Web-based application.

V.3 GUIDELINES FOR SERVICE PROVIDERS REPORTING TO CUSTOMERS ON THE COMMERCIAL QUALITY

The service providers shall be obliged to inform customers on the level of the commercial quality in such a way that once a year (or half-yearly, should the service providers be exposed to a stricter regime) they attach a note to the bill and publish on their web pages:

- values of the parameters relating to the guaranteed and the overall standards for the commercial quality which are either laid down by the national regulatory authority or written down in the general conditions for electricity supply, and
actually attained values of the parameters relating to the guaranteed and the overall standards for the commercial quality.

Notification under the first indent above shall be made as soon as there are data available in line with the bylaws governing the matter in question. Notification under the second indent above shall be made within 15 days after the service providers report on the same data to the national regulatory authority.

Apart from annual (or half-yearly) reporting, the service providers shall introduce and implement a work management system for automatic generation of notices on individual defaults towards customers (including compensation payments) as well as for wide reporting purposes. This means that the service providers shall notify their customers of compensation and refund arrangements that apply if the commercial quality standards are not met.

The work management systems shall be designed to capture the time of initiation of all customers' requests and the time of completion of the same in the context of the commercial quality. The response times to complete each activity shall be measured in each individual case and the management reports shall be issued monthly to line managers to monitor the delivery of the commercial services.

The work management systems shall automatically compare the actual response time for each commercial service against the target service levels and shall automatically generate a default if the response time exceeds the target service delivery.

All defaults shall be screened to filter out any cases where the service provider is not responsible for the failure to meet the target. Compensation payments shall be automatically issued to the customers in respect of all remaining defaults, accompanied with adequate notification.

V.4 RECOMMENDATIONS FOR COMPLAINT HANDLING PROCEDURES IN RELATION TO THE COMMERCIAL QUALITY

In June 2010 the ERGEG presented Guidelines of Good Practice (GGP) on Complaint Handling, Collecting and Classification (Ref: E10-CEM-33-05). In June 2011 the CEER issued Update to Annex 2 of GGP on Customer Complaint Handling, Reporting and Classification - ADR practices: case studies (Ref: C11-RMC-48-03) on country cases regarding Alternative Dispute Resolution (ADR) in the energy sector.

Good practices from some EU Member States (Austria, France, Italy, The Netherlands, Poland, Romania, Spain, Sweden, UK) are described in these two documents and therefore not repeated here. Instead, the most appropriate recommendations for the Energy Community are provided in this subchapter after noting the following main ERGEG’s (and CEER’s) recommendations on complaint handling:

- The customers should be provided, on their bills, with the contact details of the service provider’s customer service;
- The customers should be provided by the service provider with the relevant contact information of the relevant third party body;
- To submit a complaint, a wide range of channels should be available;
- Statutory complaint handling standards determined at national level and common to the service providers should be in place;

- Redress schemes should be in place to allow compensation in defined cases;

- The service providers should follow the Alternative Dispute Settlement body recommendations;

- When the national regulatory authority deems it appropriate to receive data on complaints, the service provider should give the national regulatory authority access to these data;

- A single point of contact should deliver free information and advice on consumer issues;

- Before submitting a complaint to a third party body, the customer should first contact the service provider;

- In order for the customer to get in contact with a third party body, a wide range of channels should be available;

- Alternative Dispute Resolution/Settlement should be made available for all household customers, preferably without charge or inexpensively as possible;

- Complaint handling standards should be determined at national level for third party bodies;

- The customer whose complaint has been settled in its favor by the Alternative Dispute Resolution/Settlement body, should be allowed a fair compensation from the service provider;

- When the national regulatory authority deems it appropriate to collect data on complaints, the third party body should provide it;

- Third party bodies could provide and publish reports on complaints they have received.

The service providers shall in their customer centers introduce and keep the book of complaints, preferably in an electronic form, so those customers who are dissatisfied with a particular service are enabled to complain by describing their findings which shall be recorded in the book. The service providers must accept and register each written complaint, as well as regularly analyze the records in the book of complaints.

The service providers shall differentiate between customers’ information queries and real complaints. They shall set the targets for replying (such as to issue the responses to 95% of queries within two working days or to resolve at least 92% of complaints within 5 working days; they shall also set the maximum timeline for a reply, i.e. 15 working days after the date of reception of the complaint). They shall attach a copy of relevant documents to the reply to the customer.

There are two options in relation to the cost of the complaint: 1) the service providers must consider customers’ complaints free of charge regardless of the outcome of the case (the preferable option); or 2) the cost of the complaint is €25, which will be refunded by the service provider (as the opposing party), if the case is settled in favor of the customer.
Further on, the service providers shall establish and implement a complaints procedure. The complaints procedure shall be:

- effective, aimed at solving the problem and providing at the very least a satisfactory explanation, an apology or some form of redress as appropriate;
- readily assessable, with clearly set out procedures and responsibilities;
- speedy, with time limits for dealing with complaints;
- confidential, with the privacy of the individual customer protected; and
- integrated with the organization’s operation and practices.

The complaints procedure shall pay particular attention to the following four elements:

- contacting the service provider with a complaint;
- procedure for escalating a complaint;
- timescales for each stage of a complaint; and
- compensation payment or redress.

In particular, the complaints procedure shall include the following:

- details of how to contact the service provider to make a complaint, including any special arrangements for vulnerable customers;
- the procedure for escalating a complaint if the customer remains dissatisfied, including a named individual or job title with overall responsibility and contact details for each stage of the process;
- timescales for each stage of a complaint handling and investigation with clear commitments as to response times and details of any guaranteed standards and compensation payments for failure to respond within the set time;
- details of how the national regulatory authority can assist in resolving a complaint which the service provider has not resolved to the customer’s satisfaction and how the national regulatory authority can be contacted (the preferable option is that its contact details shall appear here only as a point of reference for an unresolved complaint at the end of the escalation process);
- the arrangements for making compensation payment to the customer following a failure by the service provider to meet a guaranteed standard – including details when such payment may be due and the time limit in which the customer should receive payment; and
- commitment to making payment to the customer within a certain period, where the national regulatory authority has issued a direction for compensation or redress.

The procedure shall have clearly described steps, at least as the following:

- step 1 – complaint of the customer by phone call, letter or e-mail as well as physical claim to the customer service representative in the service provider’s customer center;
step 2 – complaint of the customer in writing to the complaints facilitator of the service provider if the customer is not satisfied with the answer of the customer service representative; and

step 3 – referral of the matter by the customer for a decision to the customer care team of the national regulatory authority by using a complaint form if the customer is not satisfied with the proposal of the complaints facilitator.

The service providers must close a complaint by finding a solution within 2 months (or in the administration time limit) unless a technical procedure that requires an extended time period for addressing the complaint is necessary. In addition, the complaint must be closed by the service provider in writing and the customer shall be provided with the contact details of the national regulatory authority should the customer wish to escalate the complaint. All service providers shall be required to publish, on the back of all bills, a short description of how to make a complaint.

Staff in the customer centre and local management shall be empowered to resolve complaints promptly. The complaints facilitator shall produce a monthly management report to monitor both the volume of complaints received and the response performance in relation to these complaints. The service provider shall be required to attempt to resolve all relevant complaints before referring a complaint to the national regulatory authority.

It is assumed above that the national regulatory authority has been legally assigned a responsibility to deal with unresolved complaints between the customers and the service providers. In its Guidelines of Good Practice (GGP) on Complaint Handling, Collecting and Classification the ERGEG also proposed a consumer complaint classification system (consisting mainly of sections relating to billing, network tariffs, contracts and commercial quality, markets and competitions, connections and disconnections, meter services, technical quality, outages and voltage quality).

Therefore, having completed the complaints procedure with the service provider, the customer may refer complaints to the national regulatory authority (step 3 above). The service provider must make the customers aware that they have the right to refer an unresolved complaint to the national regulatory authority for resolution.

According to the current EU practices, the responsibility for out-of-court dispute resolution is split between various authorities:

- the national regulatory authority or the complaint boards linked to the national regulatory authority (Austria, Ireland, Luxembourg, Malta, Portugal, Romania),
- the consumer protection authorities or the complaint boards under the consumer protection authorities (Estonia, Finland, Hungary, Poland, Spain),
- the private complaint board, approved by consumer affairs Minister (Denmark),
- shared between the consumer protection authority, the national regulatory authority and the State Energy Inspectorate (Lithuania),

---

shared between the national regulatory authority and the consumer protection authority (Latvia),

the national regulatory authority guarantees the procedure between the customer and the service provider (Italy),

the independent ombudsmen or the complaint boards (Belgium, France, Greece, The Netherlands, Sweden, United Kingdom),

about to establish the energy related Alternative Dispute Resolution scheme (Germany), and

the pilot project for the energy related Alternative Dispute Resolution scheme (Czech Republic).

Once a complaint is referred to the national regulatory authority, the authority shall forward the complaint to the relevant service provider for a report to be completed. This report shall be sent then to the customer for a comment before issuing any decision. The national regulatory authority may request further information from the customer or the service provider until enough information has been received or engage an external expert if lacking specific expertise in order to issue a decision in relation to the complaint.

Being so, the national regulatory authority may provide a binding decision for non-compliance, as well as impose a fine, and oblige the service provider to correct the failure. It may also put in place a resolution for the customer. The complaints section of the customer care team of the national regulatory authority\(^\text{20}\) may be financed by a specific fund fed by penalties paid by the service providers when they do not meet the performance standards set in the regulation of the commercial quality. In addition, its other activities may include regulation and a price comparison tool.

The national regulatory authority shall act as third party body and resolve complaints according to a procedure set out in the general administrative procedure law, hence the procedure is compulsory. On the basis of the procedure, the national regulatory authority shall be obliged to resolve the complaint within the maximum number of days/months set as the administration time limit.

While the decision of the national regulatory authority shall be binding on the service provider, it is not binding on the customer. Therefore, the national regulatory authority's decision may be appealed to the court, as the customer may bring the issue before the court. In other words, if a customer does not accept the decision of the national regulatory authority, he/she is free to pursue the complaint through the court if he/she so wishes.

The template for the service provider reporting on the complaints handling to the national regulatory authority is given hereafter.

---

\(^{20}\) Experience of AEEG Italy as given in the ERGEG's Guidelines of Good Practice (GGP) on Complaint Handling, Collecting and Classification (Ref: E10-CEM-33-05) reveals some data on number of staff engaged in complaints section of the customer protection unit of the national regulatory authority, number of complaints handled on average, costs, etc.
Table V.1 - The template for the service provider reporting on the complaints handling to the national regulatory authority

**DSO related complaints (related to faulty meters, connection costs, emergencies, planned outages, delays in getting connected, etc.)**

<table>
<thead>
<tr>
<th>Main categories</th>
<th>Subcategories</th>
<th>Total number of complaints received</th>
<th>Total number of complaints referred directly to DSO</th>
<th>Total number of complaints resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network related complaints</td>
<td>Meter reading / Estimated meter reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meter function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time switch fault</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meter installation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality of supply / Interruption to supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damage to property</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Siteworks charges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiplier problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network related performance standards</td>
<td>Guaranteed standard</td>
<td>Complaints received</td>
<td>Compensation payment made</td>
<td>Complaints resolved</td>
</tr>
<tr>
<td></td>
<td>Guaranteed standard 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>…</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guaranteed standard n</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Supplier related complaints (related to changing supplier, closing account, costs included in the bill, etc.)**

<table>
<thead>
<tr>
<th>Main categories</th>
<th>Subcategories</th>
<th>Total number of complaints received</th>
<th>Total number of complaints escalated to the 2nd stage</th>
<th>Total number of complaints resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billing</td>
<td>Bill clarity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bill frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payment</td>
<td>Payment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct debits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missing payments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tariffs / Price</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refunds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing / Sales / Customer service</td>
<td>Marketing practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sales staff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sign up process</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Website</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit control</td>
<td>Credit control (correspondence, procedures)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>De-energization / Locking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Debt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepayment metering</td>
<td>Ease of use of the system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to top up facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Account issues</td>
<td>General usage complaint – too high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change of address or tenancy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Account details incorrect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Landlord/tenant problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Account incorrectly opened or closed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Guaranteed standard name</td>
<td>Complaints received</td>
<td>Compensation payment made</td>
<td>Complaints resolved</td>
</tr>
<tr>
<td>Supply related performance standards</td>
<td>Guaranteed standard 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>…</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guaranteed standard n</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The subcategories are given as a guide only. They may be changed to suit a service provider's own requirements.*
Where the national regulatory authority is investigating a customer complaint, the service provider must refrain from taking follow up action in relation to any monies that are the subject of dispute. No such action shall take place prior to the national regulatory authority issuing its final decision on the complaint. This does not mean that the service provider cannot follow up additional monies accrued before or after the bill in dispute which remain unpaid. In the event that a particular customer seeks to use the complaints handling procedure to avoid bill payment, the national regulatory authority shall address this on a case by case basis.

In its annual report on the quality of electricity supply to the national regulatory authority the service provider shall publish the results of measures taken in respect of the complaints handling as well and make them publicly available to the customers on its web pages. The national regulatory authority shall publish a ranking of the service providers (per category) on the basis of complaints received. The national regulatory authority shall, in its annual report towards the Parliament, include a section which relates to data on the complaints handling.

V.5 REPORTING GUIDELINES FOR BENCHMARKING ON THE ENERGY COMMUNITY LEVEL IN RELATION TO THE COMMERCIAL QUALITY

It is recommended to the Energy Community to follow the guidelines and the templates established by the CEER for the purposes of the benchmarking on the quality of electricity supply in all measurable aspects, including on the commercial quality.

So far, the CEER’s benchmarking exercise has been performed 5 times by way of sending questionnaires to the national regulatory authority of each participating country and consequent elaboration of analytical benchmarking reports – the practice which may also be replicated by the Contracting Parties.

The CEER’s questionnaire, in the part related to the commercial quality, consists of a spreadsheet together with a legend (MS Excel file) plus, in a separate document, explanations, definitions and instructions to the responding national regulatory authority on how to fill the template in.

The parameters of the commercial quality, which are given previously in this Chapter, fully match the CEER’s benchmarks ensuring thereby full compatibility at the Energy Community level.

While responding to the CEER’s questionnaire the following aspects shall be paid attention:

- The commercial quality refers mainly to services rendered to LV end-user customers. However, as MV or HV data might be available in some Contracting Parties, the supply of such answers is also welcome, by inserting additional lines in the MS Excel file for MV or HV data, as appropriate;

- The actual performance levels of the commercial quality (total number of performances/cases/complaints, percentage fulfillment of the standard, average duration of performances) as well as the requirements (quantity and measurement unit, percentage fulfillment of the standard) applied as the overall standards or as the guaranteed standards or as the other available requirements or as the performances only being monitored are requested in the questionnaire;
The commercial quality indices and standards are grouped in four categories (connection to the network, customer care, technical services, and metering and billing) according to the types of activity monitored and the number of indices. Questions in each category are limited, referring mainly to the most widely used standards and indices;

- The terms used in the questionnaires do not limit the option of filling in data or giving answers derived from a different kind of the commercial quality measurement or calculation method of the same or similar requirement/index/indicator. If the actually used commercial quality indicators/standards are similar to those listed but not exactly the same formula (e.g., a different starting time or a different ending time), such differences shall be specified.

### V.6 GUIDELINES FOR DATA COLLECTING AND AUDITING IN RELATION TO THE COMMERCIAL QUALITY

#### V.6.1 RECOMMENDATIONS FOR DATA COLLECTING

The national regulatory authority shall focus on the commercial quality in such a manner that it can observe, quantify and verify related indicators. The use of the regulatory instruments is constrained by the availability of a uniform (across service providers) and reliable (verifiable) set of measures of the quality indicators which describe the commercial quality.

When such measures are not available, the national regulatory authority shall give precedence to data collecting, by introducing binding instructions for the service providers to follow. The introduction of instructions and guidance on data collecting is a necessary precondition for any regulatory intervention.

Instructions and guidance shall ensure that measuring, registration and reporting requirements are consistent with the purposes of the regulatory framework. Instructions enable the national regulatory authority to control the process of data collecting. They promote credibility and fairness with respect to the regulatory framework.

In order to propose viable measuring protocols, the national regulatory authority shall acquire a fairly good knowledge of several organizational and technical aspects of the electricity distribution and supply businesses (metering included). It shall be noted that the service providers may need a couple of years to adopt and adjust to the requirements.

#### V.6.2 GUIDELINES FOR INTRODUCING VERIFIABLE DATA COLLECTING PROCEDURES

The regulatory instructions shall be designed in such a manner to gather reliable information on the performance of the service providers.

The procedures for verifiable data collecting, as well as for measuring performance and data reporting to the national regulatory authority shall be defined clearly and in the same way for all service providers. They shall be consistent with the regulatory instruments in use.

All measured indicators may be published and some of them may be subject to regulation, most likely in the form of the minimum quality standards.
The service provider must recognize the type of data, the sources and locations of data for their collecting and reporting purposes. These may be source documents, computer records, automatic recording systems or other appropriate arrangements. Where practicable, these details shall be defined through the use of standard forms, prompts on screen, etc.

The data collecting procedures, which incorporate flowcharts, shall make it clear which staff have which responsibilities for data recording. The responsibilities for data recording shall be defined in the data collecting procedures (including its entry onto any form of computer system) at each stage such as the starting and ending times.

The data collecting procedures shall be provided to all relevant staff, together with record forms and any other material they may need. The content and format of data to be recorded shall be clearly defined, ideally in a handbook or manual. Where there is a risk of inconsistent recording, copies of agreed definitions and instructions shall be issued.

Methods and responsibilities for reviewing and approving raw data, if any, shall be defined. Requirements to keep copies of recorded raw data, if any, shall also be defined. In most cases, the indicator that describes the commercial quality is the time between the lodging of the customer's request and the actual provision of the service (the "waiting time"). Thus, the national regulatory authority shall introduce an obligation for the service providers to register at least the following for all requests received:

- the type of the commercial service requested;
- the category of end-user requesting the commercial service (if the national regulatory authority plans to apply the minimum quality standard with compensation payments that are differentiated per customer type);
- the customer's identification data;
- the time of receipt of the request for the commercial service; and
- the time of providing the commercial service.

The most common indicator of the commercial quality – the waiting time – is derived from the last two items in the register, in more details:

- the time of receipt of the customers' written questions, complaints, claims or requests shall be either the date of receipt of an electronic mail (the date of arrival in the service provider's inbox) or the date of stamping of incoming mail;
- the time of response/answer to the customers' written questions, complaints, claims or requests shall be either the date of dispatch of an electronic mail to electronic address of the recipient or the date of stamping of outgoing mail.

The register may take different forms, but it shall basically result with a chronological list of the commercial services requested by the customers and performed by the service provider during a specified period of time (generally a year).

When the commercial service is regulated, a performance standard shall be set by the national regulatory authority, including a set of exemptions from the obligation to pay a financial penalty (a fine) when the performance standard is not met. The service provider shall not be responsible for failing to meet the performance standard in situations of Force Majeure or when the service provider can prove external cause (third-party responsibility).
The information regarding exemptions shall be recorded in the register. For each of the requested commercial services that are subject to regulation, the service provider shall indicate:

- the cause, among those set out in the regulation (including those leading to an exemption), of any failure to respect the performance standard stipulated for the service requested, or
- the reason and date of any failure to respect the requirement to follow up the request for the commercial service, if this was the case.

In addition, the service provider's work may require other types of intervention performed under the responsibility of the customer or other parties. For instance, it may be necessary to obtain authorizations to perform any works needed to connect a new customer. The time needed for obtaining authorizations and/or for the customers to complete their share of works shall be recorded in the register. For this reason, the service provider shall keep track of:

- the dates of submission of requests for authorizations and the dates on which these are obtained; and
- the date of notification of the completion of works for which the customer is responsible.

These time periods shall not be counted as time taken to complete the requested commercial service.

Sometimes, the quality indicator of certain commercial services (mainly regular transactions) is not the waiting time but rather the accuracy of the service or, more generically, customer satisfaction.

A typical case of accuracy regards the number of meter readings in a year: the measured indicator is the number of readings. When this commercial service is regulated the service provider shall register the readings made in an appropriate form.

Customer satisfaction is the quality indicator that is mostly used to regulate the performance of call centers or customer centers. The quality indicators for customer satisfaction are often scaled indications of satisfaction with respect to the politeness of staff, their willingness to help, the accuracy and usefulness of the information given, and so on.

### V.6.3 Guidelines for Auditing Data Collecting Procedures

Data provided by the service providers on the commercial quality (as well as the measurement systems in the continuity of supply data validations) shall be subject to auditing procedures. Audits may be carried out by the national regulatory authority, consultants, or even by the service providers themselves, according to rules set by the national regulatory authority.

It is very important to conduct regularly and often such periodical audits, especially in the first years. The frequency of audits may then be relaxed over time. If audits are to be performed, the national regulatory authority shall indicate when (within a given timeframe) the service providers concerned can expect the appointed auditors to undertake an audit.

The commercial quality data auditing shall concern:
for the system operators, the performance of delivery service;

for the suppliers, the performance of commercial sales.

All commercial quality services that require or not an appointment with the customer shall be subjects of performance monitoring.

Audits shall focus on the correctness of the measures and on the compliance with the rules for registration and reporting, by having the following two key objectives:

- to verify that the service providers are correctly applying the instructions and guidance for the collecting and reporting the commercial quality data, and

- to verify that the service providers meet specific minimum levels of accuracy while performing these tasks (minimum levels of accuracy shall be defined by the national regulatory authority, with actions to be taken in case of inaccuracy).

The national regulatory authority shall require that internal and/or external audits are performed with a given periodicity (e.g., once per year):

- Internal audits
  - these shall be performed by trained staff of the service provider who have no role in performing any of the data collecting and reporting functions (including the measuring one);
  - the responsible person shall ensure that internal audits of the operation of the guaranteed standards are conducted regularly by trained staff who have no role in performing any of the collecting and reporting functions;
  - the audit schedule or plan shall be maintained which ensures that all aspects of the commercial quality are audited across all departments of the service provider;
  - the frequency of such audits shall be determined by the results of previous audits and the significance of the individual aspect, however, in any event all aspects shall be audited at least once per year;
  - the audits shall examine systems, documentation, equipment and activities and shall evaluate their effectiveness in providing appropriate data and reports;
  - the audits shall confirm that the national regulatory authority’s guidance and proposals on the best practice have been incorporated into the service provider’s documented procedures and that its performance has been in accordance with these – checklists may be used to identify key elements of the activity being audited, findings must be documented;
  - the management responsible for the audited department shall review the audit results and agree actions and timetables to correct any non-conformance, including annual reporting to the national regulatory authority on the conclusions and actions taken (these reports shall be submitted to the national regulatory authority at the same time as the service provider’s performance returns for the financial year);
the management shall use internal audit reports when reviewing the continuing effectiveness of the monitoring of the commercial quality;

- **External audits**
  - these may be conducted by a designated department of the national regulatory authority or by independent consultants on behalf of the national regulatory authority (to whom they must report);
  - the service provider shall commission an annual independent external audit to: 1) confirm that the national regulatory authority’s guidance and proposals on the best practice have been included in the service provider’s documentation and implemented in its working procedures, and 2) audit its reporting systems;
  - compliance with the relevant parts of the ISO 9000 series may be acceptable for demonstrating that the service provider met the requirements;
  - the service provider shall supply copies of the audit report(s) to the national regulatory authority together with the service provider’s conclusions about content and proposals for any corrective actions;
  - independent external auditors used to perform the requirements shall be registered assessors or lead assessors with the appropriate institution for quality assurance or be employed as auditors by companies who have achieved national accreditation as a certification body.

When designing an audit procedure, the national regulatory authority shall define the following three fundamental elements:

- instructions for the service providers to ensure the traceability of all reported data;
- indicators of accuracy and minimum acceptable levels of these indicators; and
- corrective actions to be taken in case of non-compliance with the minimum levels (and possibly, associated financial penalties).

Without prejudice to the right of the national regulatory authority to initiate proceedings against the service provider and to impose penalties for failing to fulfill obligations, the data auditing shall be carried out in accordance with a prescribed methodology. Therefore, the national regulatory authority shall define the process, the timetable, and the focus of the auditing procedure.

The auditing procedure shall have at least the following evaluation steps:

1. **Planning**
   - Choice of the service provider/IT system/district to be audited;
   - Preparation of the check-list, according to specific situations;

2. **Formal decision**
   - Regulatory order issued by the national regulatory authority and published at its internet website without names of the selected service providers;
3. One week in advance: announcement
   - The service provider informed about the documentation it has to make ready and the date/place of the audit;

4. During the audit:
   A. Filling in the check-list regarding the service provider’s business administration, customer handling procedures, IT system, etc.;
   B. Checking random sampling records;
   C. Drafting final minutes of the audit operation;

5. After the audit:
   - Drafting of the report of the audit and communicating it to the service provider;
   - Final decision on approval or rejection based on the audit results.

Under the third step above, the national regulatory authority shall inform the service provider, through a letter sent from their offices by fax or electronically, about the date of the commercial quality data auditing with a notice of not less than 3 working days in advance.

The notice shall indicate:
- the commercial quality services to be inspected;
- the year to be covered by the audit; and
- the provinces to be covered by the audit, if the service provider provides the service in more than a single province.

The service provider shall, within one business day following the receipt of the letter communication, based on the information contained in that letter, advise the national regulatory authority on the execution of the data auditing by fax or electronic mail to which it attaches all necessary documentation.

In connection with the audit, the service provider shall allow an access to physical and/or electronic records to enable the commercial quality data auditing. The records shall be extracted by simple random sampling and organized in a manner prescribed by the national regulatory authority.

The service provider who does not allow an access and/or does not organize data in a prescribed manner within a maximum time fixed at 4 hours after the start of the audit, shall inform the national regulatory authority about reasons related to the failure to deliver these within 15 calendar days from the completion date of the audit, supported by adequate documentation.

The data provided in an organized form during the audit must be consistent with the relevant data previously reported to the national regulatory authority by the service provider. In case of any discrepancies, the service provider shall provide to the auditors a documented motivation of such discrepancies. In absence of such motivation, the value used for the calculation of penalties shall be the higher one between that reported to the national regulatory authority and that provided by the service provider in the audit.
The national regulatory authority shall indicate validation elements of the commercial quality (such as the ones noted in the Table below), without which the performance of the activity is considered invalid. If the validation elements do not reveal the traceability code or if this code does not match the one on the lists provided by the service provider, the related services are classified as invalid.

<table>
<thead>
<tr>
<th>Table V.2</th>
<th>Example of validation items for the different performing types of the commercial quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements essential for validation</td>
<td></td>
</tr>
<tr>
<td>Requests for quotation</td>
<td>Copies of quotations</td>
</tr>
<tr>
<td>Services subject to on request and automatic compensation, other than the request for quotation</td>
<td>Copies of the forms certifying the provision of the service</td>
</tr>
<tr>
<td>Requests for execution of works</td>
<td>Copies of the forms certifying the provision of the service</td>
</tr>
<tr>
<td>Requests for verification of metering or supply voltage</td>
<td>Copies of the reports of the audits</td>
</tr>
<tr>
<td>Written complaints or written requests for information (inquiries)</td>
<td>Copies of the reasoned responses</td>
</tr>
<tr>
<td>Requests for correction of billing</td>
<td>Copies of documents showing the correct copies of the notices of rejection or correction</td>
</tr>
<tr>
<td>Written complaints or written requests for information (inquiries)</td>
<td>Copies of the reasoned responses</td>
</tr>
</tbody>
</table>

Each provision of the commercial service which is classified as valid shall be subject to verification of compliance by one or more of the following criteria:

- correspondence;
- completeness;
- correctness of compensation;
- documentation of the causes;
- accuracy of the time.

The provision of the commercial services at a quality level that does not meet even one of the previous criteria shall be classified as “how not to comply”.

At the end of each audit, the performance of the commercial services shall be analyzed and penalty for the underperformance determined in accordance with a statistical methodology.

---

V.6.4 GUIDELINES FOR AUDITING REPORTS BY SERVICE PROVIDERS TO NATIONAL REGULATORY AUTHORITIES

The reports for the national regulatory authority shall be audited having in mind primarily data on breaches. Data on breaches shall be recorded in accordance with process routes,
responsibilities and methods defined in the collecting and reporting procedures. Breaches shall be recorded in such a way as to allow audits and reviews to be conducted.

The collecting and reporting procedures shall cover:

- how breaches will be identified;
- who shall be responsible for recording and review of apparent breaches;
- the specific data which should be entered;
- the procedures for reviewing these data; and
- definitions and guaranteed standards.

The recording, reporting and reviewing of breaches shall be monitored by means of planned and recorded reviews.

The review of breaches of the guaranteed standards shall consider the following questions:

- Was the data comprehensive and correctly recorded?
- Are there any inconsistencies in the data recorded?
- Was the breach allocated to the correct guaranteed standard?
- Are there any exemptions which would apply? If so, were these properly applied?
- What is the necessary follow-up action?

The results of the review shall be documented.

Where an apparent breach is not confirmed because of the existence of a specific exemption, the nature of the exemption and the name of the person authorizing it shall be recorded in accordance with defined responsibilities.

### V.6.5 RECOMMENDATIONS FOR AUDITING DIGITAL REGISTERS, SOFTWARE AND SYSTEMS

Document control principles shall apply to computer systems, software and computer-based records. These shall normally include the use of backups and passwords and other arrangements to ensure the integrity and availability of computerized records and documents.

The responsible person for the reporting shall have overall responsibility for identifying the records needed for the operation of the monitoring system and the periods for which they shall be retained. System records shall be maintained, either in a documentary form or on computer, to demonstrate accurate recording of data and the effective operation of the monitoring system.

System records shall be stored and maintained in such a way as to:

- provide for ready access and retrieval;
- ensure minimal deterioration or damage; and
- prevent loss.
Records of all types shall be held for defined minimum periods. After the minimum retention period these records shall be reviewed against stated criteria before disposal, archiving or further retention.

Computer systems used to support the collecting and collating of data shall be identified in the data collecting procedures. The computer systems shall be reviewed by suitably qualified personnel before they are brought into use and whenever changes are made, to ensure their systems provide the correct results. These shall be made both initially and after any changes to the systems.

If any of the computer systems is found to produce erroneous results, the validity of previous data shall be considered. Appropriate action must be taken to correct the error – the action shall be recorded and the national regulatory authority shall be advised of the nature of the error and its effects. Test and control software and hardware shall be subject to appropriate backups and access controls.

**V.7 RECOMMENDATIONS ON GRADUAL INTRODUCTION OF REGULATORY INSTRUMENTS IN RELATION TO THE COMMERCIAL QUALITY**

**V.7.1 GUIDELINES FOR GRADUAL DEVELOPMENT OF THE COMMERCIAL QUALITY REGULATION**

The quality of service regulation currently tends to focus on regulating outputs, namely the measured values (indicators) of those quality dimensions that are most important to customers. Behind the outputs generated by the service provider, there is a process made up of decisions on investment, network planning and operation, maintenance programs and asset management to which the quality of service regulation shall focus more in the future.

However, in the beginning a good understanding of the "output regulation" is an essential step before starting on more innovative paths. Major guidelines are recapitulated hereafter:

- The regulatory scheme shall be assessed with respect to: 1) its effects on the commercial quality, and 2) its costs and benefits for the service providers and the customers;
- The regulatory scheme must be built upon a relatively small number of the quality of service indicators;
- The regulatory schemes may differ significantly in different jurisdictions, adjusting the regulation to specific industrial and institutional factors of the jurisdiction in question;
- Different policy decisions shall be all equally valid, as long as the effects of the regulation, in terms of quality improvements versus incurred costs, are satisfactory;
- The regulatory scheme shall apply a gradual approach to the implementation process, allowing the national regulatory authority to begin with one – the most critical – aspect of the quality and then enlarge the scope of the regulation only when visible results have been captured and before possible side-effects appear;
The quality of service regulation shall be subject to periodic evaluation and revision, allowing the national regulatory authority to learn from practical results and to enlarge and adapt the scope and structure of the regulation over time;

Periodic review shall give the service providers the necessary amount of time to make investment decisions under stable regulatory conditions;

The regulatory instruments must be fair and simple to implement. Clear rules on data measurements and collecting have a fundamental role in ensuring fairness;

The four regulatory instruments may be employed alone, or in combination with one another, in all three areas of the quality of service (though the premium quality contracts are not found in the regulation of the commercial quality);

Collecting reliable data on the actual quality level supplied by the service providers and making them available shall be the first objective pursued by the national regulatory authority, allowing publication of data on actual service provider performance and use of cross-service provider comparisons;

Behind publication of data, there shall always be a process of data collecting according to the regulatory instructions and guidance, ensuring necessary accuracy and reliability of published data;

The national regulatory authority shall further be concerned with a group of customers which receives unacceptably low quality levels, leading to protection of the worst-served customers by use of the minimum quality standards;

The national regulatory authority shall also be concerned with the average quality level supplied by the service provider. Reward and penalty schemes respond well to the objective of inducing the service provider to deliver, on average, an efficient quality level;

The national regulatory authority shall be concerned with the needs of customers with higher than average valuation of quality, leading to creation of mechanisms that will give these customers the opportunity to individually negotiate higher service levels with the service provider (premium quality contracts).

Relating to the regulatory instruments in the regulation of the commercial quality, the following shall be kept in mind:

- the regulatory instructions on data collecting and reporting, together with the minimum quality standards, have been employed for quite some time;
- the reward and penalty schemes have been employed in the commercial quality since relatively recently and for very specific aspects (in particular, the quality of call centers), and their use is, to date, not widespread;
- the premium quality contracts have not been employed in the commercial quality;
- although it is not very common yet, a few commercial services may be offered in a competitive environment (e.g., metering related).

Publication of reliable data on the service provider's performance is a simple, yet powerful regulatory instrument. The minimum quality standards, together with data publication, shall
be the preferred and most widely employed instruments for the regulation of the commercial quality.

For this reason, especially at the beginning, the national regulatory authority shall focus on designing and implementing the minimum quality standards for those commercial services that are the most important to the customers, instead of dealing with the complexities of the reward and penalty scheme.

Even these relatively simple regulatory instruments require time to be designed, as they demand continuous work of the national regulatory authority and the service providers. Moreover, these must be revised and adjusted periodically. From experience, it takes at least one to two years' work to introduce the regulation of the commercial quality.

When it comes to design of the guaranteed standards and the overall standards, the national regulatory authority shall make a number of decisions regarding regulated services, performance standards, compensation payments and exemptions.

Of all the commercial transactions occurring between the customers and the service providers, only a small number are normally subject to regulation. The national regulatory authority shall select and focus on those commercial services that are the most important for the customers.

There is no fixed rule for deciding whether to apply a guaranteed standard or an overall standard. However, a guaranteed standard refers to the level of quality of each transaction, and thereby implies stricter control with respect to the service provider's performance. As the service provider's performance improves over time, the number of the overall standards gradually drops and the number of the guaranteed standards increases.

The national regulatory authority shall decide on:

- the amount of the compensation, and
- the method of payment.

The compensation shall be a fixed sum, differentiated according to customer category (household/non-household) and/or voltage level of the connection (LV/MV).

The exemptions from compensation payments can be numerous and complex. The definition of Force Majeure is a sensitive issue, and it may differ across jurisdictions. External cause (third-party actions) can be another cause of exemption from compensation payment, if it can be proved. Customers themselves can also prevent the service provider from meeting the required level of the commercial quality.

The method of compensation payments may be of two types: 1) automatic, or 2) on the customer's request ("on request"). Automatic compensation payments do not depend on the customer intervention and shall be straightforward if the register is up to date and accurate. Under an on request compensation scheme, the customers must contact the service provider in order to receive the compensation.

If possible, the national regulatory authority shall avoid on request compensation payment because experience shows that it weakens the power of the regulatory instrument: not all affected customers request compensation, and service providers might try to discourage customer actions with exaggerated response delays or burdensome legal procedures. On
request compensation payments shall only be implemented when direct monitoring of individual transaction is not possible.

The national regulatory authority shall oblige the service providers to ensure that their customers are fully informed of their rights under the guaranteed standard. The service providers shall inform the customers of those situations where automatic payment will be made for breaches of the guaranteed standard, and the procedures which the customers need to follow in cases where a claim for compensation is necessary (e.g., by letter, by means of hand-outs and posters at customer centers, by posting them on the relevant website).

The national regulatory authority shall progressively modify and then remove the guaranteed standards and the overall standards where it considered competition to be sufficiently strong to ensure satisfactory performance of the commercial services.

For most guaranteed standards the compensation payment shall be automatic, whereas in the case of the commercial services for which it is more difficult to identify who did not receive the required quality level, the compensation payments are paid on request.

Customer contracts (network use and/or supply contracts) must clearly state that the performance standards apply. The service providers must note:

- the commercial services provided and the service quality levels offered, and
- the compensation payment and the refund arrangements which apply if the service quality levels are not met.

All service providers shall have a number of set commercial service guarantees. These guarantees are an indication of a service provider’s commitment to customer service and shall have a small financial penalty associated with them should they not be met.

The examples of the guaranteed standards and the overall standards for the regulation of the commercial quality in the EU are given hereafter.

Table V.3 The examples of the guaranteed standards and the overall standards for the regulation of the commercial quality in the EU

<table>
<thead>
<tr>
<th>Connection to the network</th>
<th>Example 1. The service provider shall respond to all customer letters within 10 working days.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Example 2. The customer shall receive a reply within 5 working days, except where immediate action is required. Interim replies will indicate when a full reply may be expected. Planned performance level is 90%.</td>
</tr>
<tr>
<td></td>
<td>Example 3. Customer with correspondence requesting connection of premises likely to use less than 4,000 kWh per year shall receive a reply in 5 working days (unless the request comes via supplier). Planned performance level is 90%.</td>
</tr>
<tr>
<td></td>
<td>Example 4. Upon sending by the customer to the service provider of a completed application form and certain information, such as a site map, the service provider shall send to the customer a connection cost quotation within 7 working days when no visit to the site is required or 15 working days when a visit to the site is required. Connections to larger developments or connections over 100 kW or MV connections can require considerable planning input; however, the service provider shall provide a quotation within 90 working days. Compensation payment in case of failing to meet the quotation deadlines is €65 in case of a household customer or €130 in case of a large non-household customer.</td>
</tr>
</tbody>
</table>
2 Time, needed to issue a cost estimate for simple works

Example 1. DSO shall either provide an estimate to the customer within 5 working days if there is no need for significant additional work in order to establish the connection or provide such an estimate within 15 working days if significant work is required ("significant additional work" refers to a connection requiring work in addition to the provision of a service line and a DSO's fuse).

Example 2. The customer shall receive a cost estimate for simple works within 5 working days, and 15 working days for significant works. Automatic compensation payment is €40 for household and non-household customers.

Example 3. DSO shall provide written information within 8 days in cases not requiring network intervention, and within 30 days in cases requiring network intervention.

Example 4.

LV
For load capacity up to 15 kW and where network expansion is not needed, DSO shall give the technical-economic conditions in writing within 5 working days.

For any connection that does not require the installation of a transformer, DSO shall give the technical-economic conditions in writing within 5 working days.

For any connection that requires the installation of a transformer, auxiliary works service – 10 days, permanent service with MV/LV transformer – 20 working days, permanent service with HV/MV transformer – 30 days.

MV
For nominal voltage up to 60 kV – 40 days.

For higher voltages – 60 days.

3 Time, needed to connect new customer to the network

Example 1. DSO shall connect new tariff premises to the electricity distribution system within 30 working days (households) and 40 working days (non-households).

Example 2. For provision of supply and meter, DSO shall arrange and keep an appointment within 2 working days for household customers and 4 working days for non-household customers. Compensation payment is €20 (households) / €100 (non-households).

Example 3. DSO shall connect the customer within 8 working days (unless different agreements are reached).

Example 4. DSO shall connect 90% of the customers within 7 days and 100% within 8 days.

Example 5.

LV
When network expansion is not necessary – 5 working days.

When LV network expansion is necessary – 30 working days.

When installation of a transformer is necessary – 60 working days.

When installation of more than one transformer is necessary – 80 working days.

MV
Mains connection to a single customer with a nominal supply voltage up to 66 kV – 80 working days.

HV – deadlines to be determined in each case according to the complexity of the work.

Example 6. In the event of connecting a new place of consumption or expansion of capacity – unless otherwise agreed – the service provider shall connect the place of consumption within 8 working days after connection is ordered, the contract is concluded and the technical and financial conditions for connection are met. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.
**Example 7.** The meter installation and connection guarantee applies where there is an existing supply of electricity at the customer’s premises. The service provider shall have the customer’s meter installed within 3 working days for household customers or 5 working days for non-household customers. New connections require a valid completion certificate. More complex or multiple metering requirements shall be arranged by agreement. Compensation payment in case of failing to meet this guarantee is €50.

**Example 8.** The service provider shall, provided the customer has applied and paid for the connection at least 10 weeks prior to the completion of his or her electrical installation, complete the new connection within 2 weeks of receipt of the completion certificate. Compensation payment in case of failing to meet this connection guarantee is €65. This guarantee is subject to the conditions in the letter of quotation having been met (e.g., wayleaves, certificate, underground service duct ready) and there being no significant network reinforcement involved. In the case of housing schemes, where the certificates have been submitted by the builder, the service provider shall connect the customer within two weeks from the date of application.

### 4 Time, needed for disconnection upon customer’s request

**Example 1.** DSO shall visit to move the meter, when asked to do so by the customer, and change meters when necessary on change of tariff, within 10 working days of a household customer’s request, in all cases.

**Example 2.** DSO shall visit to reposition the meter, when asked to do so by the customer within 15 working days following acceptance and payment of quote. DSO shall change meters when necessary on change of tariff within 10 working days of a household customer’s request, in all cases.

### Customer care

**5 Proportion of punctually held appointments with customers**

See under 10.

**6 Time, needed to respond to customer’s written complaints and enquiries**

**Example 1.** The service provider shall answer within 15 days.

**Example 2.** DSO shall answer to at least 90% of household customers within 7 days, and to 100% within 8 days. DSO shall answer to at least 90% of non-household customers within 25 days, and 100% within 30 days.

**Example 3.** DSO shall answer to at least 90% of customers within 12 days, and 100% within 15 days.

**Example 4.** The service provider shall provide written information within 8 days in cases that do not require intervention on the network and within 30 days in cases that require intervention on the network if connection has not been established during that time. If it is not possible to give a substantial reply during such a period, the service provider shall proceed in accordance with the Commercial Code. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

**Example 5.** When the supplier needs to be provided with technical data by DSO in order to respond to the customer’s complaint, DSO must respond to the supplier’s request within 15 working days. If DSO does not comply with this deadline, it must pay compensation.

### 7 Time, needed to respond to customer’s written questions in relation to costs and payments (excluding cost estimation for connection)

**Example 1.** A substantive reply shall be provided and agreed refunds shall be paid within 5 working days. Compensation payment is €20.

**Example 2.** In the event of any written communication requiring an answer concerning electricity supply, the service provider shall reply within the number of days defined in the Commercial Code calculated from receipt or delivery of the inquiry. For instance: agreement on payment by installments – within 15 days, change in the method of payment – within 15 days, modification of partial consumption – within 15 days. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

**Example 3.** The service provider shall repay excess payment – in the same way as the method of
payment by the customer – within 8 days after establishing that the complaint about an error in invoicing was justified. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 4. Where agreed that the customer is entitled to receive a refund for any reason connected with his electricity connection, the service provider shall make the refund within 5 working days of agreeing the amount to be repaid. Compensation payment in case of failing to meet this guarantee is €35.

Example 5. If the customer achieves complaint resolution through the use of the national regulatory authority’s services which involves a monetary payment, the service provider shall honor the financial settlement arrangements within 10 working days of the acceptance of the proposed resolution. Compensation payment in case of failing to meet this guarantee is €130.

Example 6. When the service provider fails to make the payment or when (in the case of certain guaranteed standards) the service provider has received a valid claim, the service provider shall send to the customer a check within 10 working days. Compensation payment in case of failing to do this is an additional €35.

8 Time, of holding of the call in the call center

Example 1. 80% of calls must be answered within 30 seconds (call answering rate).

Example 2. 85% of calls must be answered within 20 seconds (call answering rate). Less than 5% of calls may be dropped (call abandonment rate; where the customer has terminated the call without waiting for a response).

Example 3. All calls to call center must be answered within 30 seconds. Planned performance level is 90%.

9 Indicator of the service level of the call center

See under 8.

10 Time, for waiting in case of personal visit at the customer center

Example 1. Where DSO informs a customer that it wishes to visit the customer’s premises, or where a customer asks DSO to visit his/her premises, DSO must, within a reasonable period from the applicable date, offer a scheduled appointment. It must be: during a specified period up to 13:00 (the starting time of this period should also be notified to the customer) on a specified day; during a specified period after 12:00 noon (the limits of this period must be notified to the customer) on a specified day; or during a specified period not exceeding two hours in length on a specified day.

Example 2. Where required, appointment shall be made on a morning or afternoon basis, or as a timed appointment if requested by the customer. Failure to give 24 hours’ notice of inability to attend may attract a compensation payment of €10. Planned performance level is 95%.

Example 3. Upon a customer’s request for a timed appointment, the service provider’s representative shall arrive on the date and within the timeframe agreed upon. The time frame cannot be longer than 4 hours.

Example 4. The service providers must offer and keep a timed appointment, or offer and keep a timed appointment where requested by the customer, otherwise a €20 payment must be made for household and non-household customers.

Example 5. The service provider’s representative shall turn up within the period and at the location agreed on the customer’s request. The agreed period may not be longer than 4 hours. If necessary, the customer and the service provider’s representatives shall agree the time in advance in a form that corresponds to the customer’s request. Compensation payment: for households automatic the fee for on-site visit but at least €20 and on request the fee for on-site visit but at least €40; for LV non-households automatic the fee for on-site visit but at least €40 and on request the fee for on-site visit but at least €70; for MV customer automatic €100 and on request €200.

Example 6. In case of a need to visit the customer’s premises at the customer’s request, the service provider shall offer to the customer either a morning appointment (up to 1pm) or an afternoon appointment (after 1pm). The service provider shall visit as agreed or contact the customer on the day before the appointment should a problem arise. Compensation payment in case of failing to meet this
Example 7. At least 85% of visiting customers shall have waiting time up to 20 minutes in customer center. At least 85% of phone calls shall have waiting time up to 60 seconds in call center.

Technical services

11 Time, needed to eliminate the voltage quality related problem after answering to the voltage quality related complaint

Example 1. All voltage faults shall be corrected within 6 months.

Example 2. If a customer reports that he believes that the supply is or has been outside the permitted voltage range, or if the customer reports an event which might reasonably lead DSO to believe that this is the case, DSO must either: (where a visit is deemed necessary) make an offer to visit the customer's premises during a specified time within 7 working days; or (where no such visit is deemed necessary) provide a written explanation within 5 working days of receipt of the customer's report.

Example 3. DSO shall contact the customer within 10 working days with a proposal to adjust the voltage or else DSO shall propose a date for installing a measuring device in which case measuring shall begin within 5 days and DSO shall inform the customer about the outcomes within 15 days after completion of the measuring.

Example 4. DSO shall visit customer's premises within 7 working days or dispatch a substantive explanation of the probable reason for the complaint within 5 working days, otherwise a €20 payment must be made for household and non-household customers.

Example 5. In case of complaints concerning voltage, the service provider shall contact the customer within 10 working days with the proposal on improving voltage or for the purpose of making an appointment to prepare on-site measurement. The service provider shall start measurements within additional 5 working days, and shall inform the customer about the results of such measurements within 15 working days after the measurements are completed. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 6. The service provider shall supply electricity at the connection point of the place of consumption within a range of ±7.5% (at points of branching off: ±8/-7%) of nominal capacity in 95% of the values averaged for any 10 minutes during any day in the course of measurements taken from one week under normal operating conditions. All the 10-minute average values of the one-week measurements must be within +10/-15% of the nominal value. The rate of the largest increase in voltage may not exceed 115% of nominal capacity on an average of 1 minute. In case of failure to meet this requirement, the customer shall be entitled to penalty once within 12 months. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 7. In case of a concern about the level of electricity voltage supplied, the service provider shall contact the customer within 10 working days either to tell about the voltage improvement proposals or to arrange to visit the customer to carry out an investigation of the complaint. Where an investigation is required the service provider shall contact the customer within a further 10 working days to advise the customer of the outcome. Compensation payment in case of failing to contact the customer within the guaranteed timeframe is €35.

Example 8. Where a problem with the customer’s voltage quality has been identified, the service provider shall resolve that problem within 12 weeks, except in those cases where significant network reinforcement work is required. Compensation payment in case of failing to honor this guarantee is €50.

12 Time, needed to restore supply following failure of DSO's fuse

Example 1. Where DSO is notified by a telephone call of an actual or apparent operation of its fuse so as to disconnect the supply, and the notification is received during working hours, an appropriate person must be sent to replace or reinstate the fuse and restore supply within 3 hours on working days and within 4 hours on any other day.

Example 2. Where DSO is notified by a telephone call of an actual or apparent operation of its fuse so as to disconnect the supply, and the notification is received during working hours, an appropriate person must be sent to replace or reinstate the fuse and restore supply within 3 hours on weekdays.
between (at least) 7am to 7pm and within 4 hours at weekends between (at least) 9am to 5pm. The working hours are between 7am and 7pm on working days and between 9am and 5pm on any other day. Where DSO is notified outside these hours, it must take the required action as though it received the notice the following day at the start of working hours. Compensation payment €20 for household and non-household customers.

Example 3. In case that the main fuse has failed the customer shall contact the service provider immediately. The service provider shall call on the customer, free of charge, within 3 hours if the customer calls the service provider anytime between 8.30 am and 11.00 pm. Calls after 11.00 pm shall receive attention before 11.30 am the following morning. Compensation payment in case of failure to meet these deadlines is €35.

Example 1. DSO shall give customers at least 2 days’ advance notice in writing, when it discontinues supply for an authorized purpose, stating the day of the interruption. If DSO fails to give the required notice, or if supply is interrupted on a day different from that notified, it must, on receipt of a qualifying claim, make a payment to the customer. Claims must be made within 1 month of the day on which the interruption occurred.

Example 2. Customers must be given at least 5 days’ advance notice in writing. Compensation payment is €20 (households) and €40 (non-households).

Example 3. Customers must be given at least 4 days’ advance notice in writing for planned interruptions shorter than 4 hours and at least 8 days for interruptions longer than 4 hours.

Example 4. Customers must be given at least 2 days’ advance notice in writing; otherwise a €20 compensation payment must be made for household and non-household customers.

Example 5. The service provider shall notify customers about an interruption in electricity supply accompanied by planned intervention in accordance with the character of the customer in the manner required by the Commercial Code. Notification on planned intervention that is shorter than 4 hours shall be given 4 days and on interventions longer than 4 hours, 8 days prior to the interruption in supply. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 6. If an interruption due to works on the distribution network is necessary to improve the supply or to connect new customers, the service provider shall give to the customer at least 2 days notice unless the customer agrees otherwise. If the service provider fails to do this, household customers may claim €35, while non-household customers may claim €130. To claim the compensation payment under this guarantee, the customer shall contact the service provider within one month of the planned supply interruption. Very short supply interruptions, and interruptions arising from network faults and third party actions, are exempt from this guarantee.

Example 1. Minimum percentage of supplies to be connected, following faults, within 3 hours shall vary, among service providers, between 85% and 95%. All supplies shall be reconnected, following faults, within 18 hours.

Example 2. DSOs shall restore household customers’ supplies within 18 hours following unplanned interruptions. Failure to do so shall result in a compensation payment of €50 for household and €100 for non-household customers for the first 18 hours plus €25 for each additional 12 hours. There shall be no cap on the amount of compensation.

Example 3. (Multiple interruptions) If 4 or more interruptions each lasting 3 or more hours occur in any single year (1 April – 31 March), a €50 compensation payment must be made for household and non-household customers.

Example 4. (Category 1 severe weather conditions) Supplies must be restored within 24 hours, otherwise a compensation payment must be made on receipt of a claim from a customer in amount of €25 for household and non-household customers, plus €25 for each further 12 hours up to a cap of €200 per customer.

Example 5. (Category 2 severe weather conditions) Supplies must be restored within 48 hours, otherwise a compensation payment must be made on receipt of a claim from a customer in amount of €25 for household and non-household customers, plus €25 for each further 12 hours up to a cap of
Commercial Quality

$200 per customer.

Example 6. (Category 3 severe weather conditions) Supplies must be restored within the period calculated using the following formula:

$$48 \times \left( \frac{\text{total number of customers interrupted}}{\text{category 3 threshold number of customers}} \right)^2,$$

otherwise a compensation payment must be made on receipt of a claim from a customer in amount of €25 for household and non-household customers, plus €25 for each further 12 hours up to a cap of €200 per customer.

Example 7. (Highlands and Islands) Supply must be restored within 18 hours, otherwise a compensation payment must be made on receipt of a claim from a customer in amount of €50 for household customers and €100 for non-household customers, plus €25 for each further 12 hours.

Example 8. If a customer reports that he has no electricity supply although electricity is supplied in his vicinity, in order to eliminate the failure, the service provider shall start to repair the failure on site:

- in the residential area of a settlement with more than 50,000 inhabitants, within 4 hours on working days, and within 6 hours on weekends or holidays,
- in the residential area of a settlement with a population between 5,000 and 50,000, within 6 hours on working days and within 8 hours on weekends or holidays,
- in the residential areas of settlements with less than 5,000 inhabitants, within 8 hours on working days, and within 12 hours on weekends or holidays,
- in non-residential areas, within 12 hours,

calculated from the time of receiving the report. If the failure is reported after 8:00 p.m., guaranteed repair shall start between 7 and 10 hours, and in non-residential areas, between 7 and 11 hours. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 9. In the event of a network failure on the LV and MV network arising on the service provider’s equipment affecting several places of consumption, electricity supply must be restored within 12 hours in case of a single failure and within 18 hours in the case of multiple failures calculated from receipt of the notification by the service provider. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

Example 10. In case of faults in the electricity networks and supply lost, the service provider shall restore the supply within less than 4 hours after being notified of the fault in 95% of cases. Compensation payment: if the customer is without power for 24 hours after the service provider was notified of the fault, he or she may claim €65 (households) or €130 (non-households). The customer may claim an extra €35 for every additional 12 hours being without power. In exceptional cases (such as storms or extensive disruption to electricity supplies), this guarantee is not offered. To claim compensation payment under this guarantee, the customer shall contact the service provider within one month of the supply failure.

Metering and billing

Example 1. Where a service provider is notified by a household customer that it considers that an appropriate meter is or may have been operating outside the margins of error, or that there are circumstances which might reasonably have been caused by the meter operating outside the margins of error, DSO must visit the customer’s premises within 7 working days or provide an explanation of the probable reason for the complaint within 5 working days.

Example 2. In the event that a service provider is informed by a household customer who receives its supply through a prepayment meter that the pre-payment meter is not operating so as to permit the customer’s premises to be supplied, or if the service provider otherwise becomes aware of circumstances suggesting that it is not operating, an appropriate person must visit the premises where the pre-payment meter is installed in order to repair or replace it, within 3 hours on a working day or...
within 4 hours on any other day. Compensation payment is €20.

*Example 3.* Upon the request of the customer the service provider must arrange for the meter to be examined, by simple means (such as counting the revolutions) within 15 days. The service provider must replace the defected, inaccurate, non-functioning meter within 8 days.

*Example 4.* Service provider must visit the customer’s premises within 7 working days or provide a substantive reply within 5 working days. Compensation payment is €20.

*Example 5.* On a customer’s request, the service provider shall arrange for investigating and checking consumption meters on the site using simple means, inspection, checking the number of rotations, etc. within 15 days. The service provider shall replace consumption meters with errors or those that are inaccurate or are stopped within 8 days. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

### 16 Time, from the notice to pay until disconnection

*Example 1.* TSO or DSO shall, upon supplier’s request, and unless dealing with a vulnerable customer to whom electricity delivery must not be suspended according to other special regulations, suspend the delivery of electricity which suspension may not be initiated on a Friday, Saturday or Sunday or on a national holiday or the day before a national holiday.

*Example 2.* The service provider shall pay a penalty for unlawful disconnection. Compensation payment: for households automatic the fee for on-site visit but at least €20 and on request the fee for on-site visit but at least €40; for LV non-households automatic the fee for on-site visit but at least €40 and on request the fee for on site visit but at least €70; for MV customer automatic €100 and on request €200.

### 17 Time, needed to restore supply following disconnection due to non-payment

*Example 1.* If the final customer has settled all his debts to the supplier, the supplier shall undertake measures for the purpose of re-establishing supply to that final customer within 24 hours, and therefore without delay submit the request to TSO or DSO for the re-establishment of the electricity supply. TSO or DSO shall fulfill the supplier’s request in connection with the above without delay.

*Example 2.* All customers who have been disconnected for non-payment shall be reconnected before the end of the working day after they have paid the bill, or made arrangements to pay.

*Example 3.* DSO shall reconnect the customers on the day following the full and credible settlement of the debt, interests and all costs concerning the collection of the payment, in case of the existence of a valid contract.

*Example 4.* The service provider shall reconnect customers on the date after credible payment of tariffs, late charges and costs related to collection in full if an effective agreement exists. Compensation payment: for households automatic €10 and on request €20; for LV non-households automatic €20 and on request €40; for MV customer automatic €50 and on request €100.

### 18 Number of regular meter readings in one year by the designated company

*Example 1.* A firm meter reading for all household and non-household customers shall be obtained at least once a year.

Certain general exemptions may be applied to previous guaranteed and overall standards:

- if the customer informs DSO before the guaranteed standard contravention time that he does not want DSO to take any action or any further action;
- if the customer agrees that action already taken by DSO meets the requirement of the guaranteed standard (but where DSO has promised to take further action, that action must be taken without undue delay if this exemption is to be invoked);
- if, in order to meet the guaranteed standard, information is required to be given by the customer to DSO and the customer either sends the information to an address or calls a number other than the one which DSO has indicated, or (in the case of
investigating voltage complaints) calls with the information at a time outside reasonable hours as notified by DSO;

- it was not reasonably practicable for DSO to have complied with the requirements because of certain circumstances (severe weather; industrial action by DSO’s employees; an action or default by someone other than DSO’s employee, agent or officer or a person acting on behalf of the agent; an inability to gain necessary access to relevant premises; the likelihood that DSO would break the law if he complied; the effects of an event for which emergency regulations have been made; or other exceptional circumstances beyond the control of DSO), and DSO had in each case taken all reasonable steps both to prevent the circumstances from occurring and from having that effect;

- it was reasonable for DSO to regard information from the customer as being frivolous or vexatious; and

- the customer had either committed an offence under the Electricity/Energy Law or had failed to pay charges due after receiving a disconnection notice.

The reward and penalty schemes modify the service provider’s revenues (e.g., maximum penalty 1% and maximum reward 0.25% of the allowed revenue) according to its actual performance as measured against performance standards set by the national regulatory authority. These schemes are more difficult to design than the guaranteed standards and the overall standards, and require considerable work in the implementation phase.

The use of this regulatory instrument is not widespread in the regulation of the commercial quality. The minimum quality standards seem to be a sufficient and effective means to improve the commercial quality of commercial transactions.

For these reasons the national regulatory authority who approaches the regulation of the commercial quality for the first time shall consider the use of the reward and penalty schemes only after gaining some practical experience with the minimum quality standards.

### V.7.2 RECOMMENDED ANALYSES

#### V.7.2.1 CUSTOMER SATISFACTION SURVEYS

Effective consultation is at the heart of good quality policy development. When designing the regulation of the commercial quality, results from customer satisfaction surveys can make significant contributions to the decision-making process. In particular, the national regulatory authority may use customer satisfaction surveys for three main reasons:

- to acquire information on customer satisfaction with the commercial service provided by the service providers;

- to identify customers' priorities and expectations for improvements in the commercial quality; and

- to estimate customers' willingness to pay (WTP) for improvements in the commercial quality.

Customer satisfaction with the level of the commercial quality offered by the service providers is the simplest information that can be obtained with a survey, and at the lowest
cost. Surveys of this sort shall be carried out by the national regulatory authority or the national body responsible for official statistics on a regular basis (e.g., once a year). In the latter case, the customer satisfaction survey may be incorporated in a broader survey.

The national regulatory authority may implement a customer satisfaction incentive plan, under which the service provider is expected to achieve a targeted level of customer satisfaction, as measured through customer satisfaction survey. The service provider may then be rewarded for exceeding this or penalized for falling short of the targeted level.

The customer target (normally household customers), the sample size and stratification, as well as the method of the interview (mail, telephone or face-to-face) are usually well known in advance and the national regulatory authority shall identify only the issues to be explored. The criteria shall be clear, so that an appropriate questionnaire may be prepared and the details of the ex post analysis defined.

The questionnaire on customer satisfaction shall address both general and more specific issues concerning the level of satisfaction with the commercial quality aspects. Answers to questions asked shall be scaled from "very dissatisfied" to "very satisfied", or similar.

The most important objective of the annual customer survey shall be to gather information on customer satisfaction and priorities. The structure of the survey shall be straightforward. The customers shall be requested to provide an indication of "satisfaction" on a number of aspects of the commercial quality, as well as an indication of their relative "importance". The issues investigated with the survey shall include all four groups of the indicators of the commercial quality. Opinions on other quality dimensions may also be asked.

The analysis of the results shall produce a "satisfaction" score and an "importance" score, in each case as a percentage (where 100% indicates both high satisfaction and high importance), for each item in the questionnaire, per service provider and at national level. In addition, a "satisfaction minus importance" score shall also be derived as a percentage, by subtracting the importance score from the satisfaction score.

Data shall be compared across the service providers and changes over time shall be observed. A list of customer priorities shall be defined based on the "importance" score. A positive "satisfaction minus importance" score is interpreted as over-performance, and a negative one indicates that service provider's performance falls short of customer expectations.

For example, the service provider may be rewarded or penalized €1 million for each percentage point above or below a ±3% dead-band around its historic customer satisfaction of 64%. The service provider may be rewarded up to €10 million through this mechanism, but will not receive a bonus if more than 10% of customers fall in the bottom third of the response categories surveyed. In addition, the service provider may be penalized up to €10 million if performance in any of the survey areas falls below 56%.

In contrast to the previous example, the national regulatory authority may apply an indicator which measures the service provider’s responsiveness to customer telephone inquiries. The benchmark may be set at 80% of calls being answered in 60 seconds, as measured on an annual basis, without dead-band. For each 0.1% change in performance results, the reward or the penalty may increase by €10,000 up to a maximum of €1.5 million.
The following focal points of the customer satisfaction survey shall be recognized (first separately for households and non-households, and then combined):

- (for DSOs) the continuity of supply, the perceived voltage variations, the restoration of the supply and the contact with the customers or providing the customers with information;
- (for suppliers) the billing and invoice layout (especially regarding accuracy, comprehensibility and arrival of invoices), the performance of the customer centers (especially the handling and settlement of customer complaints and the accessibility and operation of the centers) as well as communication with and information to the customers;
- (other issues) the readiness of the customers to change suppliers, the willingness of the customers to pay extra for green energy, the confidence of the customers in accurate metering, the access of the customers to complaint registration, the opinions of the customers on the call centers, etc.

### V.7.2.2 REGULATORY IMPACT ASSESSMENT (RIA)

In all cases where the national regulatory authority proposes to do anything for the purposes of, or in connection with, the carrying out of its functions under the laws and it appears to the national regulatory authority that proposal is "important", the national regulatory authority may carry out and publish the "Regulatory Impact Assessment (RIA)".

The RIA is actually a study of the anticipated effects of the main regulatory policy options. It considers the impact (i.e., benefits and costs) of some of the proposed solutions for those directly affected by it, including the service providers and the customers, and its indirect, potential consequences for the level of competition in the market and for the environment.

### V.7.3 METHODOLOGIES FOR DEFINING TARGET VALUES OF THE COMMERCIAL QUALITY INDICATORS

Performance standards for the commercial quality shall provide the service providers with targets for the time it takes to respond to the customer requests for services such as connections, activations, quotations, and technical checks.

The national regulatory authority may set either on request or automatic refunds for the customers when the service provider fails to meet a time target.

The national regulatory authority shall publish annually the average times taken to provide the services and the maximum time limits. It shall also report the percentage of cases that do not meet the standards. Cases that are not due to the service provider shall be excluded.

The targets shall take into account historic actual performance since this enables the service providers to exceed their targets and earn additional revenues. This is an important condition for any incentive scheme to be effective. Therefore, performance standards for the commercial services shall be chosen by:

- looking at the service provider's performance over time (when available);
- consultation with the service providers and the customers; or
- relying on international experience.
In addition, performance standards shall be revised periodically. The national regulatory authority shall compare the actual, measured performance with the requirements indicated in the regulation. In light of that comparison, a stricter performance standard may be chosen – an overall standard could become a guaranteed standard, or in the case of an overall standard, the national regulatory authority could require full compliance with the performance standard in 100% of the cases.

Following their definitions, performance standards may be checked against the opinion of customers in the customer satisfaction survey (described earlier). A series of questions shall be asked to evaluate customers’ attitudes toward the guaranteed standards and to explore how these could be improved.

The respondents shall answer whether the responding times in the performance standards are "about right" or whether they are "too long". When the response is "too long", the respondents shall be asked what they think would be more appropriate.

The respondents shall also be asked whether they felt that a compensation payment is considered "about right", "too little" or "too much". The respondents shall be asked to indicate, if relevant, a more appropriate compensation.

Finally, the respondents’ attitude towards automatic payment of compensation shall be examined, together with his or her willingness to pay in order to facilitate investment in technology that would make automatic payments possible.

V.8 GENERAL OVERVIEW OF THE SITUATION IN THE ENERGY COMMUNITY CONTRACTING PARTIES AND OBSERVERS IN RELATION TO THE COMMERCIAL QUALITY

The regulation of the commercial quality is still in early stages in the Energy Community Contracting Parties and Observers.

As the commercial quality standards are strongly correlated with the (retail) market model/design and legal framework there is primarily a need to develop further legislation and implement it in practice. This will enable the regulation of the commercial quality to follow in presence of multiple free-market suppliers as well as regulated entities (DSOs and USPs).

When establishing the regulation of the commercial quality, precise definitions of triggers and time intervals for measuring the waiting times are crucial. Furthermore, it is necessary to define entities to which a certain trigger/event/process applies to.

There is an overwhelming use of explicit provisions regarding the commercial quality where a standard is applied to all (100%) cases. Although such provisions are in essence the guaranteed standards, they are in fact the other available requirements because there is no compensation for individual customer and often there is no penalty defined for the service provider. Therefore, the commercial quality in the Contracting Parties and Observers is enforced largely by the other available requirements.

In most such standards, penalties are based either on vague and imprecise general penal provisions or are simply nonexistent (although predefined in primary legislation). Additionally, the other available requirements present in the Contracting Parties and Observers are
usually not influenced by the national regulatory authority, but rather by legislators as these are provisions found in primary legislation or other secondary legislation.

These other available requirements mostly relate to the time needed to connect new customer to the network, followed by the indicators dealing with connection claims and disconnection. Also, complaints handling is very important with a lot of attention paid to it.

Moreover, there is no clear distinction between standards applied to DSOs, suppliers and universal service providers since the national electricity retail markets are still in the early competition development stages. There is no adequate statistical data existing for most of the commercial quality indicators.

Relating to the four groups of the indicators, the following is noticed:

- **Connection to the network**
  - Most of electricity-related legal frameworks encompass the commercial standards regarding connections;
  - Standards and approaches to monitoring connection issues are similar across the Contracting Parties and Observers, which accounts for predominant use of the other available requirements;
  - Due to the current lower levels of the electricity retail market opening and competition, the standards for connection related activities apply solely to DSOs; and
  - Contrary to the EU practice (where an accent has been put on the division between LV and MV customers, stressing the voltage levels that a standard applies to), the Contracting Parties and Observers differentiate connection procedures according to the customer types (households and non-households);

- **Customer care**
  - This is the group of indicators with the least number of standards;
  - For certain indicators, there is no adopted standards which is a direct reflection of the low level of the electricity retail market opening and competition;
  - Direct interaction with the customers is not monitored, there is a lack of call centers (used by DSOs and incumbent suppliers), appointments and visits are not planned/recorded;
  - DSOs and incumbent suppliers have not been focused on the customers, so many customer care indicators are solely statistical information on certain commercial activities;
  - DSOs and incumbent suppliers do not have customer relationship management or any similar system, so there is no possibility to track a specific customer with a specific issue;
  - In such situations, it is virtually impossible to obtain data on the indicators related to customer care;
There is a clear lack of standards related to call centers and recording of visits/appointments, which emphasizes the need to develop technical systems designed for customer care;

- **Technical services**
  - This is the most diverse group within the commercial quality across the Contracting Parties and Observers as different approaches are used at different development stages;
  - Standards here correspond to the duration of contractual period and are tied to technical services offered by DSOs;
  - Standards for the technical services (and the legal framework governing the supply business) must be developed to accommodate scenarios where the customer contacts DSO directly or its supplier for technical services;

- **Billing and metering**
  - This is the only group of the indicators where standards also apply to suppliers in addition to DSOs;
  - The actual standards and ranges used here show that billing and metering shall be further developed in terms of precise definitions of the standards;
  - Standards here depend whether or not the customers must rely on a supplier for billing and metering or may directly communicate or carry out business with DSO or the metering operator.

In general, the commercial quality is in early stages of its implementation across all Contracting Parties and Observers. Therefore, all general recommendations and guidelines provided in this Chapter for developing the regulation of the commercial quality may apply. In addition, the commercial quality shall be considered in a broader perspective having in mind customer protection which is definitely an area that is clearly behind in comparison to customer protection in the EU Member States.
VI  CONCLUSIONS AND RECOMMENDATIONS

The study covers all the aspects of the quality of service regulation, with a special emphasis given to the data collection, reporting and auditing in each of three dimensions of the quality of service, namely the continuity of supply, the voltage quality and the commercial quality.

The main feature of the study is relying on the recently approved Slovene legislative on the quality of service regulation as a good example for significant share of the Energy Community Contracting Parties and Observers regarding current status of the quality of service regulation, as well as service provider’s network structure and operational procedures. While Slovenia certainly is at least one or two steps ahead of the Energy Community Contracting Parties and Observers in the quality of service regulation, her focus still remains on the very basic step – collection and auditing of the quality of service data. Therefore the study uses the Slovenian recently approved legislative as a sort of a checklist for all the necessary activities. Furthermore, the structure and formatting of the study, with main chapters comprising precise instructions written in black and basic explanatory notes written in gray, can serve as a template for drafting similar laws in other jurisdictions.

The introductory section gives an overview of the previous activities in the Energy Community with regard to quality of service regulation, study objectives and an overview of the binding legislation.

The second section provides some common principles of all three dimensions of the quality of service regulation, with definitions of terms and general guidelines for service providers reporting to the national regulatory authorities.

The main part of the study consists of sections III – V, related to three dimensions of the quality of service (the continuity of supply, the voltage quality and the commercial quality). The structure of all chapters is similar and comprises definitions of the quality indicators (parameters), guidelines for the service providers reporting to the national regulatory authorities, guidelines for the service providers reporting to customers, recommendations for complaint handling procedures, reporting guidelines for benchmarking on the Energy Community level, guidelines for data collecting and auditing, recommendations on gradual introduction of the regulatory instruments and finally general overview of the situation in the Energy Community Contracting Parties and Observers.

Most of the examples and more detailed explanations are given in annexes and MS excel tables provided with the study, with the above elaborated intention to keep the main part of the study focused on precise instructions, recommendations and guidelines.

Finally, hereafter, there is a brief overview of key recommendations related to the quality of service regulation given by the Contracting Parties and Observers to the Energy Community, based on the similar list within the study “Assistance to regulators in introducing and improving service quality regulation in the Energy Community”.

Determined key activities at the jurisdictional level are divided according to their importance into three groups:

- **RED** = high priority activity that has to be conducted as soon as possible;
- **ORANGE** = medium priority activity that has to be conducted within a few years; and
- **GREEN** = low priority activity that can be considered on a medium term basis.
Albania

Jurisdictional Specifics
- Ensure there is no more load shedding due to shortages in electricity production/import (planned or unplanned);
- Ensure basic voltage quality standards (deviations from nominal voltages) at all voltage levels;

Legal Framework
- Include QoS as a part of tariff regulation;
- Define customer compensation procedure for breaching legislative or contractual performance standards;

Continuity of Supply
- Set up the register for selected performance indicators and start collecting data (initiated in January 2010);
- Prepare guidelines for CoS monitoring;
- Develop and perform data auditing procedures;
- Define performance standards;

Voltage Quality
- Undertake remedial actions aimed at improving voltage quality (primarily supply voltage variations);
- Adopt a voltage quality regulation based on international standards such as EN 50160 to substitute much more lose supply voltage variation limits currently in place;
- Define priority list of voltage disturbances to be monitored at system level;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

Commercial Quality
- Implement appropriate provisions from the Distribution Code and the Metering Code relating to the commercial quality;
- Introduce compensations to customers for some or all commercial quality indicators;

Bosnia and Herzegovina

Jurisdictional Specifics
- Harmonise the QoS regulation practised by the two entities;

Legal Framework
- Include QoS as a part of tariff regulation;
Conclusions and Recommendations

- Define customer compensation procedure for breaching legislative or contractual performance standards;

**Continuity of Supply**
- Prepare guidelines for CoS monitoring in FBiH;
- Develop and perform data auditing procedures in FBiH;
- Define performance standards;

**Voltage Quality**
- Define priority list of voltage disturbances to be monitored at system level;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Commercial Quality**
- Evaluate commercial quality according to compliance with defined standards and perform benchmarking with neighbouring areas/countries (initiated);
- Introduce compensations to customers for some or all commercial quality indicators;

**Croatia**

**Jurisdictional Specifics**
- Conduct necessary amendments to the primary and secondary legislation to place the regulatory authority in charge of the QoS regulation;

**Legal Framework**
- Include QoS as a part of tariff regulation;
- Define customer compensation procedure for breaching legislative or contractual performance standards;

**Continuity of Supply**
- Include publishing data by voltage levels;
- Prepare guidelines for CoS monitoring;
- Develop and perform data auditing procedures;
- Define performance standards (initiated);

**Voltage Quality**
- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
Introduce premium quality contracts;

**Commercial Quality**

- Focus on setting up of MQS for most commonly used commercial services;
- Introduce compensations to customers for some or all commercial quality indicators;

**The former Yugoslav Republic of Macedonia**

**Legal Framework**

- Strengthen the power of the regulatory authority with regard to the voltage quality regulation;
- Include QoS as a part of tariff regulation;

**Continuity of Supply**

- Prepare guidelines for CoS monitoring (initiated);
- Conduct analyses on the collected data;
- Develop and perform data auditing procedures;
- Define performance standards;

**Voltage Quality**

- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Commercial Quality**

- Start keeping records, develop adequate database and draft reports in accordance with the Rulebook on Conditions for Electricity Supply;
- Introduce compensations to customers for some or all commercial quality indicators;

**Moldova**

Comparing to the current status in other Contracting Parties and Observers to the Energy Community, Moldova seems to be quite advanced in terms of the QoS regulation. Therefore, only a few recommendations are given hereafter.

**Continuity of Supply**

- Develop and perform data auditing procedures;

**Voltage Quality**

- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
Conclusions and Recommendations

- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Montenegro**

**Jurisdictional Specifics**
- Revise types of interruptions by duration (over/under 3 minutes, instead of over/under 30 minutes);

**Legal Framework**
- Include QoS as a part of tariff regulation;

**Continuity of Supply**
- Set up the register and start collecting data on interruptions at all MV levels and for standard types of interruptions;
- Prepare guidelines for CoS monitoring;
- Develop and perform data auditing procedures;
- Define performance standards;

**Voltage Quality**
- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Commercial Quality**
- Introduce compensations to customers for some or all commercial quality indicators;

**Serbia**

**Legal Framework**
- Include QoS as a part of tariff regulation;

**Continuity of Supply**
- Develop and perform data auditing procedures;
- Define performance standards;

**Voltage Quality**
- Investigate if it is possible to increase a percentile of resolved justified complaints related to the voltage quality monitoring;
- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

_Ukraine_

**Legal Framework**
- Include QoS as a part of tariff regulation;
- Implement additional schemes of the QoS regulation (including commercial quality of services, general and guaranteed standards);

**Continuity of Supply**
- Finalise monitoring system and introduce regular audits;
- Define performance standards;

**Voltage Quality**
- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

_UNMIK_

**Legal Framework**
- Establish QoS standards in collaboration with DSO, TSO, PS and MEM (initiated);
- Include QoS as a part of tariff regulation;

**Continuity of Supply**
- Prepare guidelines for CoS monitoring;
- Set up the register and reporting process for selected performance indicators and start collecting data;
- Develop and perform data auditing procedures;
- Define performance standards;

**Voltage Quality**
- Impose obligation for DSO to report the complaints on voltage quality to the regulatory authority;
- Define priority list of voltage disturbances to be monitored;
- Develop a system level voltage quality monitoring scheme and related regulatory instructions and guidance;
Conclusions and Recommendations

- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Commercial Quality**

- Introduce compensations to customers for some or all commercial quality indicators;

**Turkey**

**Legal Framework**

- Include QoS as a part of tariff regulation;

**Continuity of Supply**

- Set up an improved, well functioning data collection system (initiated);
- Prepare guidelines for CoS monitoring;
- Conduct analyses on the existing 5-year data;
- Enhance data auditing mechanism;

**Voltage Quality**

- Complete remote monitoring and control system which is currently in development stage (should be completed by the end of 2012);
- Publish relevant VQ statistics (data on system VQ performance and VQ complaints);
- Define targeted quality levels (VQ standards);
- Introduce premium quality contracts;

**Commercial Quality**

- Introduce compensations to customers for some or all commercial quality indicators;
The suggested way for calculation of the SAIDI, SAIFI, CAIDI, CAIFI and MAIFI indicators is general by means of the duration of the monitoring time interval $T$ and the reporting time in which the time interval $T$ is expressed (e.g. month or year). It enables averaging the value of the indicator over more than one reporting interval, or normalizing the value of the indicator on the level of the reporting interval with the data on the interruptions collected in the monitoring interval shorter than the reporting interval.

**Example 1:** Monitoring interval 3 years and reporting in yearly intervals

The value of $T$ is 3 [years] and the indicators are calculated on the bases of the data on the power supply interruptions during 3 years. The result is average annual value of the indicators.

**Example 2:** Monitoring interval 1 month and results reported normalized on annual values

The value of $T$ is 1/12 [years] and the indicators are calculated every month based on the data on the power supply interruptions during the previous month. The result is 12 times larger and represents the estimation for the annual value based on the monthly data.

**Example 3:** Assessment of the value of the indicator with the data missing for 1 month

The value of $T$ is 11/12 [years] and the indicators are calculated based on the data on the power supply interruptions collected during 11 months. The result is the estimation for the annual value of the indicators.
ANNEX 2: GROUPING OF EVENTS

Grouping of two or more power supply interruptions may be considered only for:

1) long interruptions which
2) affect (fully or partly) the same customers.

The rule of grouping the events is: two power supply interruptions which meet the above two criteria are registered as one event if the time interval between the ending of the first interruption and the beginning of the following interruption is less or equal to three minutes.

In case this time interval is longer than three minutes, or one or both of the interruptions is a short one, or the interruptions do not affect (at least partly) the same customers, they are registered separately.

The rule on grouping the events is further described in the following figure.

![Figure CoS.1: Grouping of the events](image)

If $(t3-t2) > 3\text{min}$ there are two events
If $(t3-t2) \leq 3\text{min}$ there is an event
### ANNEX 3: EXAMPLE OF TEMPLATE FOR REGISTERING POWER SUPPLY INTERRUPTION DATA

**Table CoS.1:** Example of template for registering unplanned power supply interruptions

<table>
<thead>
<tr>
<th>Intermuption No.</th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>20</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>From Date and Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To Date and Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration t &gt; 3 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration t ≤ 3 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Long Interruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Short Interruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Affected Customers</strong></td>
<td>Name of Switchyard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Affected Customers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Origin and Cause</strong></td>
<td>External Cause</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Force Majeure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal Cause</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Origin of Failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network Element in Failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cause and Elaboration of Force Majeure</strong></td>
<td>Cause of Interruption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Figure 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Figure 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table CoS.2:** Example of template for registering planned power supply interruptions

<table>
<thead>
<tr>
<th>Intermuption No.</th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>20</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>From Date and Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To Date and Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration t &gt; 3 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Duration t ≤ 3 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Long Interruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Short Interruptions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Affected Customers</strong></td>
<td>Name of Switchyard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Affected Customers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Origin and Cause</strong></td>
<td>Origin of Failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network Element in Failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cause of Interruption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## ANNEX 4: EXAMPLE OF REPORT ON THE CONTINUITY OF SUPPLY INDICATORS

### Table CoS.3: Example of report on the continuity of supply indicators on the DSO level by PTS / PS

<table>
<thead>
<tr>
<th>No.</th>
<th>NAME OF PTS / PS</th>
<th>UNPLANNED INTERRUPTIONS</th>
<th>PLANNED INTERRUPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>INTERNAL CAUSE</td>
<td>EXTERNAL CAUSE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAIFI</td>
<td>SAIDI</td>
</tr>
<tr>
<td>1.</td>
<td>PTS ŠENTJUR</td>
<td>0.094497</td>
<td>2.638679</td>
</tr>
<tr>
<td>2.</td>
<td>PTS LAŠKO-DES</td>
<td>0.002468</td>
<td>0.023055</td>
</tr>
<tr>
<td>3.</td>
<td>PS LAŠKO</td>
<td>0.017154</td>
<td>1.309786</td>
</tr>
<tr>
<td>4.</td>
<td>PTS ROGASKA SLATINA</td>
<td>0.078462</td>
<td>2.242205</td>
</tr>
<tr>
<td>5.</td>
<td>PS PODPLAT</td>
<td>0.025571</td>
<td>0.626695</td>
</tr>
<tr>
<td>6.</td>
<td>PS LIBOJE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>PTS MOZIRJE</td>
<td>0.022768</td>
<td>0.6396</td>
</tr>
<tr>
<td>8.</td>
<td>PS NAZARJE</td>
<td>0.034454</td>
<td>0.598755</td>
</tr>
<tr>
<td>9.</td>
<td>PS LJUBNO</td>
<td>0.014637</td>
<td>0.386688</td>
</tr>
<tr>
<td>10.</td>
<td>PTS PODLOG</td>
<td>0.094008</td>
<td>2.966377</td>
</tr>
<tr>
<td>11.</td>
<td>PTS LAVA</td>
<td>0.024301</td>
<td>0.322906</td>
</tr>
<tr>
<td>12.</td>
<td>PTS SELCE</td>
<td>0.003647</td>
<td>0.116064</td>
</tr>
<tr>
<td>13.</td>
<td>PTS TRNOVLJE</td>
<td>0.095255</td>
<td>1.821969</td>
</tr>
<tr>
<td>14.</td>
<td>PTS SL. GRADEC</td>
<td>0.038449</td>
<td>1.793275</td>
</tr>
<tr>
<td>15.</td>
<td>PTS RAVNE</td>
<td>0.062835</td>
<td>4.269612</td>
</tr>
<tr>
<td>16.</td>
<td>PS MEŽICA</td>
<td>0.005981</td>
<td>0.331505</td>
</tr>
<tr>
<td>17.</td>
<td>PTS VUZENICA</td>
<td>0.01248</td>
<td>0.641066</td>
</tr>
<tr>
<td>18.</td>
<td>PS RADLJE</td>
<td>0.002401</td>
<td>0.154516</td>
</tr>
<tr>
<td>19.</td>
<td>PTS DRAVOGRAD</td>
<td>0.024319</td>
<td>0.457439</td>
</tr>
<tr>
<td>20.</td>
<td>PTS VELENJE</td>
<td>0.230699</td>
<td>3.957557</td>
</tr>
<tr>
<td>21.</td>
<td>PTS SEVNICA</td>
<td>0.032352</td>
<td>0.784486</td>
</tr>
<tr>
<td>22.</td>
<td>PS MOKRONOG</td>
<td>0.03006</td>
<td>0.373222</td>
</tr>
<tr>
<td>23.</td>
<td>PS PLANINA</td>
<td>0.018473</td>
<td>0.639942</td>
</tr>
<tr>
<td>24.</td>
<td>PTS BREŽICE</td>
<td>0.087313</td>
<td>1.058614</td>
</tr>
<tr>
<td>25.</td>
<td>PS PODGRAČENO</td>
<td>0.005767</td>
<td>0.0346</td>
</tr>
<tr>
<td>26.</td>
<td>PTS KRŠKO</td>
<td>0.028345</td>
<td>0.422036</td>
</tr>
<tr>
<td>27.</td>
<td>PTS BRESTANICA</td>
<td>0.010861</td>
<td>0.345832</td>
</tr>
<tr>
<td>28.</td>
<td>PS PODSREDA</td>
<td>0.0108</td>
<td>0.121612</td>
</tr>
<tr>
<td>29.</td>
<td>PTS TREBNIJE – F.eeder Mrina</td>
<td>0.006029</td>
<td>0.520611</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>1.094332</td>
<td>29.59872</td>
</tr>
</tbody>
</table>
ANNEX 5: EXAMPLE OF CALCULATION OF INDICES FOR AUDITING THE CONTINUITY OF SUPPLY DATA IN ITALY

ACCURACY INDEX

The \( IA \) accuracy index estimates the completeness and accuracy of records of interruptions without notice originating in the MV network. It is expressed as percentage (%), with a value between 0% (minimum accuracy) and 100% (maximum accuracy), and calculated as:

\[
IA = \left( 1 - \frac{\sum_{i=1}^{10} P_i \times N_i}{N_{camp}} \right) \times 100 \%
\]

where:

- \( i \) is an index whose value varies from 1 to 10 and expresses the various types of missing or inaccurate data as indicated in the table below;
- \( P_i \) is the weight given to each type of missing or inaccurate data as indicated in the table below;
- \( N_i \) is the number of interruptions without notice originating in the MV network found to be recorded incompletely or inaccurately during the audit;
- \( N_{camp} \) is the number of interruptions without notice originating in the MV network checked on a sample basis during the audit.

When the record of a given interruption shows more than one type of incomplete or inaccurate data, the record is classified on the basis of the more serious error (i.e. that with the larger weighting \( P_i \)).

Table CoS.4: Types of missing or inaccurate data

<table>
<thead>
<tr>
<th>( i )</th>
<th>Type of missing or inaccurate data (interruptions without notice originating in the MV network)</th>
<th>( P_i )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unrecorded interruptions</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Interruptions recorded with error as to start time of more than 30 minutes</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>Interruptions recorded with error as to start time of between 15 minutes and less than or equal to 30 minutes</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>Interruptions recorded with error as to start time of more than 5 minutes and less than or equal to 15 minutes</td>
<td>0.1</td>
</tr>
<tr>
<td>5</td>
<td>Interruptions recorded with error as to start time of more than 1 minute and less than or equal to 5 minutes</td>
<td>0.05</td>
</tr>
<tr>
<td>6</td>
<td>Interruptions recorded with error as to start time of 1 minute</td>
<td>0.01</td>
</tr>
<tr>
<td>(i)</td>
<td>Type of missing or inaccurate data (interruptions without notice originating in the MV network)</td>
<td>(P_i)</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>7</td>
<td>Interruptions recorded with error as to end time of more than 10 minutes</td>
<td>0.3</td>
</tr>
<tr>
<td>8</td>
<td>Interruptions recorded with error as to end time of between 1 minute and 10 minutes</td>
<td>0.01</td>
</tr>
<tr>
<td>9</td>
<td>Interruptions recorded in an incomplete or inaccurate manner for which it was not possible to verify the duration of the interruption, the number of customers affected or the cause of the interruption</td>
<td>0.3</td>
</tr>
<tr>
<td>10</td>
<td>Interruptions recorded inaccurately for other reasons (e.g. two interruptions erroneously recorded as a single interruption with an accurate total duration, extra interruptions recorded)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**PRECISION INDEX**

The \(IP\) precision index estimates the total estimated approximation of the data provided on long interruptions without notice originating in MV distribution networks.

It may have a positive or a negative value. It is equal to 0 for maximum precision. Positive \(IP\) values indicate that in the sample of interruptions checked during the audit the value calculated by the distribution company has been approximated at a lower value than that found during the audit. Conversely, negative precision index values indicate that the figure calculated by the distribution company has been approximated at a higher value than that found during the audit.

\(IP\) is calculated as follows:

\[ IP = \frac{D_{ver} - D_{eserc}}{D_{ver}} \times 100\% \]

where:

- \(D_{ver}\) is the total duration of interruptions per LV customer with regard solely to interruptions originating in the MV network examined during the audit, calculated on the basis of the effective duration of the interruption and number of customers affected as ascertained in the audit;
- \(D_{eserc}\) is the indicator of total duration of interruptions per LV customer with regard solely to interruptions originating in the MV network examined during the technical inspection as calculated by the distribution company.

**CORRECTNESS INDEX**

The \(IC\) exactness index estimates the degree to which the distribution company has correctly used causes and origins of interruptions, with the following ones excluded for the purposes of the economic compensation of interruptions without notice:
those originating in the national transmission grid or the HV distribution network;

those due to force majeure or external causes (interruptions due to third parties, customers or other distribution companies).

IC has a value of between 0 and 100%. A value of 0 indicates total lack of correctness in the attribution of the cause of Force Majeure and external causes, and of the origins of interruptions regarding the TSO and the HV network. A value of 100% indicates maximum correctness in specifying the causes and origins of interruptions.

IC is calculated as follows:

\[
IC = \frac{D_{escl}}{D_{escl} + D_A + D_B + D_C + D_D} \times 100 \%
\]

where:

- \( D_{escl} \) is the duration of interruptions by customer for long interruptions without notice examined during the audit correctly attributed by the distribution company to force majeure or external causes or originating in the NTG or HV network;
- \( D_A \) is the duration of interruptions by customer for long interruptions without notice originating in the MV or LV networks and examined during the audit that have been attributed to force majeure by the distribution company but which should in fact have been attributed to other causes;
- \( D_B \) is the duration of interruptions by customer for long interruptions without notice originating in the MV or LV networks and examined during the audit that have been attributed by the distribution company to external causes but which should in fact have been attributed to other causes;
- \( D_C \) is the duration of interruptions by customer for long interruptions without notice due to any cause and examined during the audit that have been identified by the distribution company as originating in the TSO network but which should in fact have been attributed to the MV network;
- \( D_D \) is the duration of interruptions by customer for long interruptions without notice due to any cause and examined during the audit that have been identified by the distribution company as originating in the HV network but which should in fact have been attributed to the MV network.

In calculating IC, the value of the duration of interruptions per customer is based on the effective values verified during the audit of the duration of interruptions and the number of customers involved. In this way the correctness index is independent of the precision index.

IC is conventionally set at 100% in cases in which there are no interruptions (or no interruptions were found) whose origin was attributed to the TSO network or the HV network or whose cause was attributed to force majeure or external causes.
ANNEX 6: EXAMPLES OF CALCULATION AND REPORTING ON VOLTAGE QUALITY PARAMETERS AND INDICATORS

In what follows example is given describing calculation of voltage quality indicators for the supply area of one system operator in which network there are 44 points with continuous monitoring of VQ:

- 8 points (VQ recorders) in HV network,
- 29 points (VQ recorders) in MV network and
- 7 points (VQ recorders) in LV network.

Tables VQ.1, VQ.2 and VQ.3 contain data on voltage disturbances observed in one calendar year for HV, MV and LV points respectively, differentiated per voltage disturbances monitored (i.e. supply voltage variation, harmonic distortion, flickers, voltage unbalance, mains signaling voltages and power frequency). For one calendar year and each point in the network the following data are the results of analysis of measured values provided by the operator:

- the number of weeks under continuous monitoring,
- number of weeks in which voltage limits have been exceeded, differentiated per observed voltage disturbance (see Note 1),
- overall number of weeks in which at least one voltage limits have been exceeded (see Note 1),
- overall number of weeks in which neither one voltage limit have been exceeded,
- overall number of weeks with unreliable or missing data (measured values).

During one week in the calendar year several disturbances of different type can occur. In this case the summation of weeks (with voltage limits exceeded) over all disturbances will result in a number higher than the total number of weeks in which the monitoring is carried out (see for example data in the first raw of Table VQ.1; during one week in the calendar year flickers and supply voltage variation exceeded limits). However, this should be taken into account when determining the total number of weeks with at least one voltage disturbance exceeding limit. In the summation, weeks with several disturbances exceeding limits, shall only be used once.

Overall indicator of the voltage quality at HV level:

\[
I_{VQ-HV} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{nconsistent weeks } i}}{\sum_{i=1}^{n} No_{\text{weeks measured } i}} \right) \times 100\% = \left( 1 - \frac{405}{413} \right) \times 100\% = 1.94\%
\]
Overall indicator of the voltage quality at MV level:

\[
I_{\text{VQ-MV}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{679}{1362} \right) \times 100 \% = 50.15 \%
\]

Overall indicator of the voltage quality at LV level:

\[
I_{\text{VQ-LV}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{262}{365} \right) \times 100 \% = 28.22 \%
\]

Overall indicator of the voltage quality in the supply area (all voltage levels)

\[
I_{\text{VQ}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{405 + 679 + 262}{413 + 1362 + 365} \right) \times 100 \% = \left( 1 - \frac{1346}{2140} \right) \times 100 \% = 37.10 \%
\]

Indicator of the supply voltage variations (SVV) at HV level:

\[
I_{\text{VQ-HV-SVV}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{1}{413} \right) \times 100 \% = 99.76 \%
\]

Indicator of the supply voltage variations (SVV) at MV level:

\[
I_{\text{VQ-MV-SVV}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{1}{1362} \right) \times 100 \% = 99.93 \%
\]

Indicator of the supply voltage variations (SVV) at LV level:

\[
I_{\text{VQ-LV-SVV}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{4}{365} \right) \times 100 \% = 98.90 \%
\]

Indicator of the harmonic distortions (H) at HV level:

\[
I_{\text{VQ-HV-H}} = \left( 1 - \frac{\sum_{i=1}^{n} No_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} No_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{413} \right) \times 100 \% = 100 \%
\]
Indicator of the harmonic distortions (H) at MV level:

\[ I_{VQ-MV-H} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{0}{1362} \right) \times 100\% = 100\% \]

Indicator of the harmonic distortions (H) at LV level:

\[ I_{VQ-LV-H} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{32}{365} \right) \times 100\% = 91.23\% \]

Indicator of the flickers (FL) at HV level:

\[ I_{VQ-HV-FL} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{405}{413} \right) \times 100\% = 1.94\% \]

Indicator of the flickers (FL) at MV level:

\[ I_{VQ-MV-FL} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{675}{1362} \right) \times 100\% = 50.44\% \]

Indicator of the flickers (FL) at LV level:

\[ I_{VQ-LV-FL} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{248}{365} \right) \times 100\% = 32.05\% \]

Indicator of the voltage unbalance (VU) at HV level:

\[ I_{VQ-HV-VU} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{0}{413} \right) \times 100\% = 100\% \]

Indicator of the voltage unbalance (VU) at MV level:

\[ I_{VQ-MV-VU} = \left( 1 - \frac{\sum_{i=1}^{n} N_{0_{\text{inconsistent weeks, } i}}}{\sum_{i=1}^{n} N_{0_{\text{weeks measured, } i}}} \right) \times 100\% = \left( 1 - \frac{0}{1362} \right) \times 100\% = 100\% \]
Indicator of the voltage unbalance (VU) at LV level:

\[ I_{\text{VQ-LV-VU}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{158}{365} \right) \times 100 \% = 56.71\% \]

Indicator of the mains signaling voltages (MSV) at HV level:

\[ I_{\text{VQ-HV-MSV}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{413} \right) \times 100 \% = 100\% \]

Indicator of the mains signaling voltages (MSV) at MV level:

\[ I_{\text{VQ-MV-MSV}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{1362} \right) \times 100 \% = 100\% \]

Indicator of the mains signaling voltages (MSV) at LV level:

\[ I_{\text{VQ-LV-MSV}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{365} \right) \times 100 \% = 100\% \]

Indicator of the power frequency (PF) at HV level:

\[ I_{\text{VQ-HV-PF}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{413} \right) \times 100 \% = 100\% \]

Indicator of the power frequency (PF) at MV level:

\[ I_{\text{VQ-MV-PF}} = \left( 1 - \frac{\sum_{i=1}^{n} \text{NO}_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} \text{NO}_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{4}{1362} \right) \times 100 \% = 99.71\% \]
Indicator of the power frequency (PF) at LV level:

\[ I_{VQ-LV-PF} = \left( 1 - \frac{\sum_{i=1}^{n} N_{\text{inconsistent weeks i}}}{\sum_{i=1}^{n} N_{\text{weeks measured i}}} \right) \times 100 \% = \left( 1 - \frac{0}{365} \right) \times 100 \% = 100\% \]

Table VQ.1  The template for the service provider reporting on the voltage disturbances in HV network continuous monitoring points

<table>
<thead>
<tr>
<th>HV object (monitoring device)</th>
<th>No. of weeks under continuous monitoring</th>
<th>VQ limits are exceeded (No. of weeks)</th>
<th>Total no. of weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>supply voltage variation</td>
<td>harmonic distortions</td>
<td>flickers</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>413</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table VQ.2  The template for the service provider reporting on the voltage disturbances in MV network continuous monitoring points

<table>
<thead>
<tr>
<th>MV object (monitoring device)</th>
<th>No. of weeks under continuous monitoring</th>
<th>VQ limits are exceeded (No. of weeks)</th>
<th>Total no. of weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>supply voltage variation</td>
<td>harmonic distortions</td>
<td>flickers</td>
</tr>
<tr>
<td>1</td>
<td>39</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>43</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>38</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>38</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>23</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MV object (monitoring device)</td>
<td>No. of weeks under continuous monitoring</td>
<td>VQ limits are exceeded (No. of weeks)</td>
<td>Total no. of weeks</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------</td>
<td>--------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td>supply voltage variation</td>
<td>harmonic distortions</td>
<td>flickers</td>
</tr>
<tr>
<td>29</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1362</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table VQ.3  The template for the service provider reporting on the voltage disturbances in LV network continuous monitoring points

<table>
<thead>
<tr>
<th>LV object (monitoring device)</th>
<th>No. of weeks under continuous monitoring</th>
<th>VQ limits are exceeded (No. of weeks)</th>
<th>Total no. of weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>supply voltage variation</td>
<td>harmonic distortions</td>
<td>flickers</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>4</td>
<td>48</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>8</td>
<td>42</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>2</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>365</td>
<td>4</td>
<td>32</td>
</tr>
</tbody>
</table>
Table VQ.4  The template for the service provider reporting on the voltage disturbances observed by planned (rolling) monitoring

<table>
<thead>
<tr>
<th>Organizational unit supply area¹</th>
<th>supply voltage variation</th>
<th>harmonic distortions</th>
<th>flickers</th>
<th>voltage unbalance</th>
<th>mains signalling voltages</th>
<th>power frequency</th>
<th>No. of measurements being performed with limits exceeded</th>
<th>No. of measurements being performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>1</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>27</td>
</tr>
</tbody>
</table>

¹e.g. HV/MV and MV/MV substations
Table VQ.5  Data on customers’ complaints related to VQ in one calendar year

<table>
<thead>
<tr>
<th>Year</th>
<th>Network operator organizational unit supply area (e.g. supply area of HV/MV and MV/MV substations)</th>
<th>No. of complaints</th>
<th>No. of justified complaints</th>
<th>Justified complaints [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>1</td>
<td>50.0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td>1</td>
<td>50.0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>2</td>
<td>2</td>
<td>100.0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
<td>1</td>
<td>100.0</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>4</td>
<td>2</td>
<td>50.0</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>2</td>
<td>1</td>
<td>50.0</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>3</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>2</td>
<td>1</td>
<td>50.0</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>22</strong></td>
<td><strong>9</strong></td>
<td><strong>40.9</strong></td>
</tr>
</tbody>
</table>

Total number of customers 86,874
Table VQ.6  The template for the service provider reporting on the voltage dips (average number per end-user) according to EN 50160:2010 table

<table>
<thead>
<tr>
<th>Residual voltage $u$ [%]</th>
<th>Duration $t$ [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 \leq t \leq 200$</td>
<td>CELL A1</td>
</tr>
<tr>
<td>$200 &lt; t \leq 500$</td>
<td>CELL A2</td>
</tr>
<tr>
<td>$500 &lt; t \leq 1 000$</td>
<td>CELL A3</td>
</tr>
<tr>
<td>$1 000 &lt; t \leq 5 000$</td>
<td>CELL A4</td>
</tr>
<tr>
<td>$5 000 &lt; t \leq 60 000$</td>
<td>CELL A5</td>
</tr>
<tr>
<td>$90 &gt; u \geq 80$</td>
<td>CELL B1</td>
</tr>
<tr>
<td>$80 &gt; u \geq 70$</td>
<td>CELL B2</td>
</tr>
<tr>
<td>$70 &gt; u \geq 40$</td>
<td>CELL B3</td>
</tr>
<tr>
<td>$40 &gt; u \geq 5$</td>
<td>CELL B4</td>
</tr>
<tr>
<td>$5 &gt; u$</td>
<td>CELL B5</td>
</tr>
</tbody>
</table>

Table VQ.7  The template for the service provider reporting on the voltage dips (95 % percentile of monitored sites) according to EN 50160:2010 table

<table>
<thead>
<tr>
<th>Residual voltage $u$ [%]</th>
<th>Duration $t$ [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 \leq t \leq 200$</td>
<td>CELL A1</td>
</tr>
<tr>
<td>$200 &lt; t \leq 500$</td>
<td>CELL A2</td>
</tr>
<tr>
<td>$500 &lt; t \leq 1 000$</td>
<td>CELL A3</td>
</tr>
<tr>
<td>$1 000 &lt; t \leq 5 000$</td>
<td>CELL A4</td>
</tr>
<tr>
<td>$5 000 &lt; t \leq 60 000$</td>
<td>CELL A5</td>
</tr>
<tr>
<td>$90 &gt; u \geq 80$</td>
<td>CELL B1</td>
</tr>
<tr>
<td>$80 &gt; u \geq 70$</td>
<td>CELL B2</td>
</tr>
<tr>
<td>$70 &gt; u \geq 40$</td>
<td>CELL B3</td>
</tr>
<tr>
<td>$40 &gt; u \geq 5$</td>
<td>CELL B4</td>
</tr>
<tr>
<td>$5 &gt; u$</td>
<td>CELL B5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residual voltage $u$ [%]</th>
<th>Duration $t$ [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 \leq t \leq 200$</td>
<td>CELL C1</td>
</tr>
<tr>
<td>$200 &lt; t \leq 500$</td>
<td>CELL C2</td>
</tr>
<tr>
<td>$500 &lt; t \leq 1 000$</td>
<td>CELL C3</td>
</tr>
<tr>
<td>$1 000 &lt; t \leq 5 000$</td>
<td>CELL C4</td>
</tr>
<tr>
<td>$5 000 &lt; t \leq 60 000$</td>
<td>CELL C5</td>
</tr>
<tr>
<td>$90 &gt; u \geq 80$</td>
<td>CELL D1</td>
</tr>
<tr>
<td>$80 &gt; u \geq 70$</td>
<td>CELL D2</td>
</tr>
<tr>
<td>$70 &gt; u \geq 40$</td>
<td>CELL D3</td>
</tr>
<tr>
<td>$40 &gt; u \geq 5$</td>
<td>CELL D4</td>
</tr>
<tr>
<td>$5 &gt; u$</td>
<td>CELL D5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residual voltage $u$ [%]</th>
<th>Duration $t$ [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 \leq t \leq 200$</td>
<td>CELL X1</td>
</tr>
<tr>
<td>$200 &lt; t \leq 500$</td>
<td>CELL X2</td>
</tr>
<tr>
<td>$500 &lt; t \leq 1 000$</td>
<td>CELL X3</td>
</tr>
<tr>
<td>$1 000 &lt; t \leq 5 000$</td>
<td>CELL X4</td>
</tr>
<tr>
<td>$5 000 &lt; t \leq 60 000$</td>
<td>CELL X5</td>
</tr>
</tbody>
</table>