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Smart community infrastructure — Electric power infrastructure — Measurement methods for the quality of thermal power infrastructure and requirements for plant operations and management

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*, Subcommittee SC 1, *Smart community infrastructures*.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes methods for measuring the quality of thermal power infrastructure (QTPI) during the operational phase as well as the requirements for operations and management activities for the purpose of maintaining and improving the QTPI in the medium and long term in order to realize the objectives of the 3E+S (energy security, environmental conservation, economic efficiency, safety) energy policy. The 3E+S energy policy is a framework established to ensure QTPI during its operational phase.

Considering the importance of a sufficient and stable electric power supply to the economy, standard of living and day-to-day needs, electric power shortages or frequent power outages are serious risks to society. Maintaining and improving the QTPI is an important concern for all regions, particularly for regions in the process of rapid economic growth. A sufficient and stable electric power supply can be achieved by establishing thermal power infrastructure as planned and operating this effectively throughout its life cycle.

Reducing the environmental impacts associated with thermal power infrastructure, such as greenhouse gas (GHG) emissions, is a global issue and reduction of the impacts is a goal of this document. Minimizing the impacts needs to take into account the social costs of the environmental impact, the costs required for environmental protection measures and the effectiveness of these measures.

From these viewpoints, it is expected that efforts to maintain and improve the QTPI by applying appropriate operations and management will make society more sustainable. This document is intended to contribute to the Sustainable Development Goals outlined by the United Nations, specifically goal 7 (affordable and clean energy), goal 11 (sustainable cities and communities), goal 13 (climate action), goal 14 (life below water) and goal 15 (life on land).

Smart community infrastructure — Electric power infrastructure — Measurement methods for the quality of thermal power infrastructure and requirements for plant operations and management

1 Scope

This document specifies methods for measuring the quality of thermal power infrastructure (QTPI) during the operational phase and requirements for operations and management activities.

It is intended for use by electric power providers, including public utilities and independent power producers (hereinafter collectively referred to as power plant operators), as well as relevant stakeholders that intend to maintain and improve QTPI.

NOTE The selection and importance of evaluation indicators resulting from the implementation of this document can vary depending on the characteristics of the power plant operator.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
thermal power infrastructure
unit (3.2) or *plant* (3.3) generating electric power utilizing oil, gas, coal or biomass as fuel

3.2
unit
assembly of equipment required for operating one generator

Note 1 to entry: This could include, for example, a generator, turbine, boiler and balance of plant.

Note 2 to entry: When unit means a definite magnitude of quantity used as a standard of measurement, the term "unit of measure" is used in this document.

3.3
plant
entire premises including *units* (3.2) and the common facilities, land and buildings relating to the units

3.4
gross maximum capacity
GMC
maximum output power that a *unit* (3.2) can generate in a specific period

3.5
net maximum capacity
NMC
output power calculated by subtracting the power of the auxiliary systems used by the *unit* (3.2) from the *GMC* (3.4)

Note 1 to entry: Depending on the objective of using NMC, either of the following two calculation methods can be applied.

a) Plant NMC: the output power calculated by subtracting the *total internal consumption of the plant* (3.6) from *the plant* (3.3) GMC.

b) Unit NMC: the output power calculated by subtracting the power consumption of the auxiliary systems for the particular unit from the unit GMC.

3.6
total internal consumption of the plant
summation of the power consumption of the auxiliary systems and general power consumption within the *plant* (3.3)

Note 1 to entry: General power consumption includes energy consumption of administration offices such as lighting and air conditioning.

3.7
equivalent unit derated hours
EUNDH
value calculated by dividing the product of the derated output power amount and the derated output power time by the *NMC* (3.5)

3.8
available hours
AH
time during which the *unit* (3.2) is available for service

3.9
period hours
PH
time the *unit* (3.2) was intended to operate excluding unintended shutdown time resulting from natural disasters

3.10
service hours
SH
time that the *unit* (3.2) is electrically connected to an electric power grid and generating electric power

3.11
equivalent availability factor excluding seasonal deratings
EAF, XS
portion of a given operating period in which a generating *unit* (3.2) is available without any outage

3.12
heat rate
HR
value calculated by dividing the fuel input to the *unit* (3.2) by the generated power

3.13
forced outage hours
FOH
time that a *unit* (3.2) did not operate due to forced outages

3.14
forced outage rate
FOR
rate that a *unit* (3.2) was not available due to forced outages

3.15
ability to adjust power supply to demand
ability of a *unit* (3.2) to adjust its output power according to changes in demand

3.16
restricted time of the ability to adjust power supply to demand
time that the ability to adjust output power according to changes in demand is restricted

Note 1 to entry: The total time of the following are included.

a) The time that the use of auto frequency control (AFC) or load frequency control (LFC) was restricted due to unplanned causes.

b) The time that the output power of the *unit* (3.2) was constant due to unplanned causes.

Note 2 to entry: AFC is defined as the adjustment of output power using AFC devices to maintain the frequency of the electric system within a standard value.

Note 3 to entry: LFC is defined as detecting frequency variations and interconnected power variations caused by load variations and controlling the output power to maintain the frequency and power flow within standard values during normal operation.

3.17
emission rate
emissions of a given pollutant per *unit* (3.2) of output power over a given time period

EXAMPLE The value calculated by dividing the annual emissions by the annual power generation.

Note 1 to entry: Emission rate (of stacks) generally refers to SO_X, NO_X, CO_2 and particulate matter (PM) that are emitted from a unit.

3.18
industrial safety accident rate
number of people who became unable to work, the number of people whose work was restricted and the number of fatalities due to an accident per 200 000 or 1 000 000 man-hours worked

4 Evaluation indicators for the QTPI during the operational phase

4.1 QTPI

QTPI is an indication of the degree to which thermal power infrastructure consistently meets or exceeds requirements or expectations regarding:

— initial operation capability;

— supply stability;

— reliability;

— environmental and social considerations;

— safety;

— life cycle cost (LCC).

NOTE 1 The 3E+S is used to represent QTPI: energy security, environmental conservation, economic efficiency and safety.

NOTE 2 The three sub-elements of energy security which are specific to thermal power infrastructure are:

— initial operation capability;

— supply stability;

— reliability.

NOTE 3 Environmental and social considerations are both used to indicate general aspects of the quality of infrastructure.

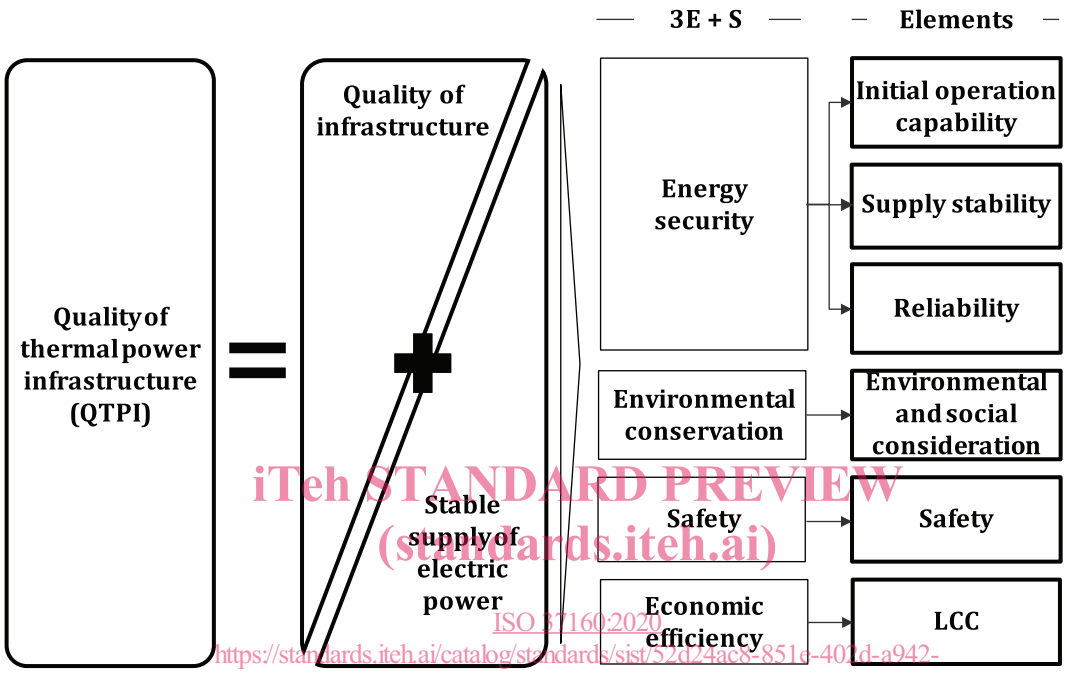

Figure 1 — Elements of the QTPI

4.2 Elements of the QTPI

4.2.1 General

Power plant operators shall consider the elements listed from 4.2.2 to 4.2.7 in order to maintain and continuously improve the QTPI during the operational phase. See Figure 1.

4.2.2 Initial operation capability

Initial operation capability means the ability to begin operation of thermal power infrastructure as planned and scheduled in accordance with relevant specifications and unit-specific conditions.

4.2.3 Supply stability

Supply stability means the ability of thermal power infrastructure to consistently supply electric power when required.

4.2.4 Reliability (reliable operation and fast recovery)

Reliable operation means to minimize internal forced outages of thermal power infrastructure as much as is practical and to safely deactivate the infrastructure without damaging the equipment.

Fast recovery means to recover from a forced outage as soon as is practical.

NOTE Internal forced outage refers to a shutdown or output power suppression that is within the control of the power plant. They can be caused by external and internal incidents, excluding shutting down or limiting output power due to events such as planned maintenance.

4.2.5 Environmental and social considerations

Environmental and social considerations means the consideration given to the prevention or control of environmental impacts attributable to the thermal power infrastructure and to the need to coexist with the local community.

NOTE 1 The factors that need to be considered from the viewpoint of reducing adverse environmental impacts can include, but are not limited to, the control of air pollutants, waste water, effluents, noise, other waste and GHG emissions.

NOTE 2 The factors that need to be considered from the viewpoint of addressing social aspects can include, but are not limited to, community engagement, operational transparency and public disclosure. For details of social considerations refer to ISO 26000.

4.2.6 Safety

Safety means the ability to prevent injury to humans.

4.2.7 LCC

LCC in the context of thermal power infrastructure means the summation of the costs incurred throughout the life cycle of the thermal power infrastructure, provided that it satisfies all requirements of the QTPI elements specified above.

Note that LCC can generally be classified into engineering, procurement and construction (EPC) costs, operating and maintenance costs and demolition costs, including disposal costs. In the case of a thermal power infrastructure, fuel costs typically account for a large portion of operating costs. The LCC also includes other costs such as costs caused by forced outages or the costs associated with compensation or penalties incurred as a result of failing to meet requirements for emissions or pollutants.

4.2.8 Performance indicators and evaluation of the QTPI

Power plant operators shall collect the data required for evaluation by evaluators as specified in Table 1 to Table 10. Evaluators may include stakeholders such as insurance underwriters, governments, power providers, NGOs and environmental organizations. Evaluators may utilize the indicators shown in 4.3 for appropriate measurement of the QTPI during the operational phase of the thermal power infrastructure. The evaluation methods and formulas shall be reviewed, as appropriate, so that evaluations can accommodate relevant changes in requirements or circumstances.

4.3 Evaluation indicators

4.3.1 Supply stability

4.3.1.1 Availability

Table 1 shows the evaluation method, formula, evaluation period, unit of measure and scope required to assess, at planned intervals, operation and maintenance capability of the thermal power infrastructure and the quality of unit.