EEBus Initiative e.V.
Deutz-Mülheimer-Straße 183
51063 Cologne
GERMANY

Rue d'Arlon 25
1050 Brussels
BELGIUM

Phone: +49 221 / 715 938 - 0
Fax: +49 221 / 715 938 - 99

info@eebus.org
www.eebus.org

District court: Cologne
VR 17275

EEBus High-Level Test Specification

Limitation of Power Production

Version 1.0.0

Cologne, 2024-04-30

The EEBus concept was developed as part of E-Energy.

Supported by: Federal Ministry of Economics and Technology on the basis of a decision by the German Bundestag

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1 Introduction

1.1 Motivation

The objective of this document is to provide a basis for interoperability and comparable quality assurance for EEBus member companies and organizations regarding the various components used to meet the high-level requirements described in [LPP1.0.0].

Due to independent implementations of different vendors which lead to a high degree of complexity, the avoidance of implementation and interpretation errors is the goal for an interoperable system. Therefore, the technical specification for Limitation of Power Production defines a generic framework for interoperable technology-independent implementations. To verify the desired interoperable behaviour between various applications, hardware and software components, the test specification is necessary.

This test specification defines a test suite of abstract test cases being relevant in order to ensure defined behaviour and to derive an agreed and common set of specific conformance tests.

The conformance tests described in this document are generic to apply to different implementations and therefore increase their ability of interoperability. Implementers should gain confidence that each implementation conforms the test specification.

1.2 Structure

Following objectives are identified in the scope of the test specification document:

- Specification of abstract test cases in agreement with the respective requirements
- Defined set of abstract test cases
- Standardized procedures within the abstract test cases
- Forming basic internals (due to black box testing) of each test in a defined test description

1.3 Limitations

Considering that it is impossible to define an exhaustive test suite due to independent implementations within different hardware approaches, these tests do not include the assessment of performance nor robustness or reliability of an implementation. The test specification itself cannot guarantee conformance to the technical specification since it detects errors rather than their absence. Hence, no guarantee of interoperability is given if the implementation is only conforming the test specification. It also focuses on the correct behavior rather than the verification of messages generated by a device under test (DUT). Due to this limitation, only limited tests are defined in this test specification to verify that a DUT message complies with the limits defined in [LPP1.0.0].

In addition, no measurement requirements are specified for checking the Active Power Production Limit and Failsafe Production Power Limit to be maintained during test executions. A test engineer may still use appropriate measuring equipment to verify conformance to these limits.

1.4 Contact information

Questions regarding the conformance process that are not addressed by this document should be directed to: info@eebus.org.

2 Scope

The purpose of the EEBus test specification for the technical specification of the Use Case "Limitation of Power Production" (short name: LPP) is to verify the conformance to section 2 of [LPP1.0.0].

This document focuses on defining a conformance test suite which is then used as a necessary requirement for interoperability tests when dealing with projects using the EEBus technical specification for the Use Case "Limitation of Power Production".

Furthermore, this document mainly refers to the testing of the Controllable System and only covers rudimentary functional testing of the Energy Guard.

2.1 Overview

This document contains scope, referenced documents, abstract test cases (such as conformance or scenario) and test procedures for a Device Under Test (DUT) implementing the LPP according to the following document which define the Limitation of Power Production and its underlying resources as defined in:

- EEBus_UC_TS_LimitationOfPowerProduction_V1.0.0 ([LPP1.0.0])

It provides a detailed description of each test, including as applicable, identification number(s) (ID) and used configurations.

In chapter 3, referenced documents are provided.

A detailed terms and abbreviations description can be found in chapter 4.

Chapter 5 defines the requirements which serve as the foundation on which the abstract test cases are based on.

In chapter 6, a framework for the abstract test cases and their execution is described. The sections contain general information and descriptions as well as the data sets to be used.

The chapters 7 and 8 contain the high-level abstract test cases for both Energy Guard and Controllable System which describe the step-by-step actions, expected results and any special conditions necessary for testing.
Due to different approaches while using [LPP1.0.0] the abstract test cases are defined to be applicable for any specific implementation.

3 References

The following documents include essential guidelines and requirements which, through reference in this text, constitute guidelines and requirements of this document. In case of dated references, subsequent amendments to, or revisions of, any of these publications do not apply. Latest issue of undated references shall be used unless otherwise agreed.

3.1 EEBUS documents

[LPP1.0.0]	EEBus_UC_TS_LimitationOfPowerProduction_V1.0.0.pdf
[ParameterSheet]	EEBus_LPP_ParameterSheet_V1.0.0.xlsx

3.2 Normative references

[RFC2119]	IETF RFC 2119: 1997, Key words for use in RFCs to indicate requirement levels (please see section 4.1 for details)

4 Terms, definitions and abbreviations

4.1 Terms and definitions

Within the scope of this document terms and definitions given in [LPP1.0.0] and the following apply.

As a source of common terminology for use in standardization please see the following databases of ISO, IEC and ISTQB:

- ISO Online Browsing Platform (OBP): https://www.iso.org/obp/ui
- IEC Electropedia: https://www.electropedia.org/
- ISTQB Glossary: https://glossary.istqb.org/en/search/

NOTE 1 Hyperlinks included in this document are subject to its validity at the time of publication, hence no guarantee can be given by the EEBus Initiative e.V. for its long-term validity.

4.1.1 Abstract Test Case

A test case without specific (implementation level) values for input data and expected results.

4.1.2 Black Box Testing

Black Box Testing is a software testing method in which the behaviour of a DUT is tested without having knowledge of internal code structure, implementation details and internal paths. This method mainly focuses on input and output of software applications.

4.1.3 Device Under Test (DUT)

A Device Under Test is a single component, an assembly or an appliance that is undergoing testing.

4.1.4 Expected result

The observable presumed behaviour of the DUT based on its test step.

4.1.5 LPP Instances

The LPP instances describe the possibility of implementing the Use Case in different constellations.

LPP instance 1: The power production limit is first sent from the EG (e.g., Control-Box) to the Customer Energy Manager (CEM). The CEM then tries to control its connected appliances to achieve this limit at the grid connection point.

LPP instance 2: The energy guard (located on a CEM) sends a dedicated power production limit to an appliance.

NOTE 2 For further information regarding the LPP instances please refer to section 6.9 and [LPP1.0.0] section 2.4.

4.1.6 MAY

Verbal form (as defined in [RFC2119]) used to indicate a course of action permissible and optional within the limits of the Use Case ([LPP1.0.0]).

4.1.7 Negative testing

Negative testing is a testing method which checks whether the application reacts as expected to an input or an operation that does not meet application requirements, e.g. by correctly rejecting invalid or improper data sets as an input.

NOTE 3 During test execution, values may be used (e.g. positive APPL values) that may violate the requirements defined in [LPP1.0.0].

4.1.8 Positive testing

Determines that the DUT works as expected by providing valid data sets as an input.

NOTE 4 This type of test behaviour is primarily defined in this document.
NOTE 5 During test execution, values may be used (e.g. positive APPL values) that may violate the requirements defined in [LPP1.0.0].

4.1.9 Pre-condition

The test steps needed to define a stable state of a test item and its environment prior to the test case execution.

4.1.10 SHALL

Verbal form (as defined in [RFC2119]) used to indicate requirements strictly to be followed in order to conform to the standard.

4.1.11 SHOULD

Verbal form (as defined in [RFC2119]) used to indicate that among several possibilities one is recommended as particularly suitable, or that a certain course of action is preferred but not necessarily required.

4.1.12 Specific Test Case

Within this document specific test cases are derived from abstract test cases by adding defined data sets.

4.1.13 Test suite

A set of test cases to be executed in a specific test run.

4.1.14 Verdict

Test verdicts are used to indicate the consequence/outcome of the execution of a test case. Possible outcome statements are "passed", "failed" or "not applicable" as defined in section 6.10.

4.2 Abbreviations

For the present document following abbreviations apply.

Term/ Abbreviation	Description
ACK	Acknowledgement
APPL	Active Power Production Limit
ATC	Abstract Test Case
CEM	Customer Energy Manager
CS	Controllable System
DUT	Device Under Test
EG	Energy Guard
FPAPL	Failsafe Production Active Power Limit
LPP	Limitation of Power Production
MFSDM	Maximum Failsafe Duration Minimum
NACK	Negative Acknowledgement
NT	Negative Testing
PFPAPL	Pre-Configured Failsafe Production Active Power Limit
PFSDM	Pre-Configured Failsafe Duration Minimum
PT	Positive Testing
Ref No	Reference Number
STC	Specific Test Case
TC	Test Case
TestSpec	Test Specification
UC	Use Case

Table 1: Abbreviations

5 Requirements

5.1 Mapping of requirements

Within this document, unique identifiers are used primarily for each mandatory requirement extracted from [LPP1.0.0] allowing full traceability and easier management. Related recommended or optional requirements are provided with a sub-requirement ID following design guidelines of [LPP1.0.0]. In addition, markers used in [LPP1.0.0] are provided as well as the corresponding sections to ensure a quick search in the Use Case.

The short form of the identifier is as follows:

[LPP-TS-xxx/y]

Definition:

- "LPP" represents the use case abbreviation of the technical specification [LPP1.0.0];
- "TS" stands for Test Specification;
- "xxx" represents the unique number for the individual requirement; and
- "y" symbolizes a unique number and is only used for sub-requirements.

The notation of the Use Case references as well as an example is given below.

Ref No: marker, section(s)

Example:

Ref No: [LPP-022], 2.1, 2.2, 2.6.2.1 and 2.7.1

5.2 Requirements and definitions extracted from [LPP1.0.0]

[LPP-TS-001] The APPL SHALL always be lower than or equal to zero as defined in [LPP1.0.0], Ref No: [LPP-001], 2.8.1.

[LPP-TS-001/1] A limit MAY have a duration that states the time the limit is valid for as defined in [LPP1.0.0], Ref No: [LPP-004], 2.6.1.1.

[LPP-TS-001/2] The EG MAY activate or deactivate the limit as defined in [LPP1.0.0], Ref No: [LPP-008], 2.6.1.1.

[LPP-TS-002] The CS SHALL confirm an accepted APPL with an ACK as defined in [LPP1.0.0], Ref No: [LPP-002/1], 2.2 and 2.6.1.1.

[LPP-TS-003] The CS SHALL confirm an accepted FPAPL with an ACK as defined in [LPP1.0.0], Ref No: [LPP-002/2], 2.6.2.1.

[LPP-TS-004] If the APPL value cannot be applied by the CS, the EG SHALL be informed with a NACK as defined in [LPP1.0.0], Ref No: [LPP-003/1], 2.2 and 2.6.1.1.

[LPP-TS-005] Write commands on the FPAPL or Failsafe Duration Minimum, that are not accepted by the CS SHALL be declined with a NACK as defined in [LPP1.0.0], Ref No: [LPP-003/2], 2.2 and 2.6.2.1.

[LPP-TS-006] The heartbeat of the EG SHALL be sent at least every 60 seconds as defined in [LPP1.0.0], Ref No: [LPP-005] and [LPP-031], 2.1 and 2.6.3.1.

[LPP-TS-007] The heartbeat of the CS SHALL be sent at least every 60 seconds as defined in [LPP1.0.0], Ref No: [LPP-006] and [LPP-032], 2.1 and 2.6.3.1.

[LPP-TS-008] If the CS has a duration set on the APPL it SHALL deactivate the limit as soon as the duration expires (reaches the value "0s") as defined in [LPP1.0.0], Ref No: [LPP-007], 2.6.1.1.

[LPP-TS-008/1] The CS MAY remove the duration as soon as the duration is expired as defined in [LPP1.0.0], 2.6.1.1.

[LPP-TS-009] The CS SHALL set the APPL to "activated" or "deactivated" according to its state as defined in [LPP1.0.0], Ref No: [LPP-009], 2.6.1.1.

[LPP-TS-009/1] If in state "limited" the APPL SHALL be activated as defined in [LPP1.0.0], Ref No: [LPP-009/1], 2.3.2.

[LPP-TS-009/2] After a (re)start the APPL SHALL be deactivated by the CS as defined in [LPP1.0.0], Ref No: [LPP-009/2], 2.3.2.

[LPP-TS-009/3] If in state "init", "unlimited/controlled", "failsafe state" or "unlimited/autonomous" the APPL SHALL be deactivated by the CS as defined in [LPP1.0.0], Ref No: [LPP-009/2], 2.3.2.

[LPP-TS-010] The CS SHALL NOT produce more than the according nominal maximum value as defined in [LPP1.0.0], 2.2.

[LPP-TS-010/1] In case the CS is not located on a CEM, it SHOULD inform the EG about its Power Production Nominal Max as defined in [LPP1.0.0], Ref No: [LPP-041], 2.2.

[LPP-TS-010/2] The Power Production Nominal Max SHOULD be supported if the CS is not located on a CEM as defined in [LPP1.0.0], 2.6.4.1.

[LPP-TS-010/3] In case the CS is located on a CEM, it SHOULD inform the EG about its Contractual Production Nominal Max as defined in [LPP1.0.0], Ref No: [LPP-042], 2.2.

[LPP-TS-010/4] The Contractual Production Nominal Max SHOULD be supported if the CS is located on a CEM as defined in [LPP1.0.0], 2.6.4.1.

[LPP-TS-011] A default value for the FPAPL SHALL be configured as defined in [LPP1.0.0], Ref No: [LPP-021/1], 2.2 and 2.6.2.1.

[LPP-TS-011/1] The FPAPL value MAY be changed by the EG as defined in [LPP1.0.0], Ref No: [LPP-021/2], 2.6.2.1.

[LPP-TS-011/2] As soon as the EG changes the FPAPL value in the CS, the value of the CS SHOULD NOT be configurable via user interface anymore (or at least a clear indication should be given that changing the value could possibly violate contractual agreements with the energy supplier) as defined in [LPP1.0.0], 2.6.2.1.

[LPP-TS-012] The CS SHALL remain in the "failsafe state" for at least the duration specified in the configuration value Failsafe Duration Minimum unless another rule permits or requires leaving this state as defined in [LPP1.0.0], 2.1.

[LPP-TS-013] The Failsafe Duration Minimum SHALL be pre-configured by the vendor of the CS in the range of 2 hours to 24 hours as defined in [LPP1.0.0], Ref No: [LPP-022/1], 2.6.2.1.

[LPP-TS-013/1] The value MAY be changed by the EG as defined in [LPP1.0.0], Ref No: [LPP-022/2], 2.6.2.1.

[LPP-TS-013/2] As soon as the EG changes the Failsafe Duration Minimum value in the CS, the value of the CS SHOULD NOT be configurable via user interface anymore (or at least a clear indication should be given that changing the value could possibly violate contractual agreements with the energy supplier) as defined in [LPP1.0.0], 2.6.2.1.

[LPP-TS-014] The maximum value for the Failsafe Duration Minimum of the CS is defined as the maximum value the CS accepts as write command from the EG. This maximum value SHALL be in the range of the pre-configured value and 24 hours as defined in [LPP1.0.0], 2.6.2.1.

[LPP-TS-015] The EG SHALL choose a value for the Failsafe Duration Minimum between 2 hours and 24 hours as defined in [LPP1.0.0], Ref No: [LPP-022/3], 2.6.2.1.

[LPP-TS-015/1] The CS MAY reject a write command of the EG on the Failsafe Duration Minimum if the submitted value is greater than the maximum value for the Failsafe Duration Minimum of the CS as defined in [LPP1.0.0], Ref No: [LPP-022/4], 2.6.2.1.

[LPP-TS-016] If the CS rejects the write command on the Failsafe Duration Minimum by the EG when the submitted value is greater than the maximum value of the CS, it SHALL afterwards change the Failsafe Duration Minimum to the maximum value of the CS as defined in [LPP1.0.0], Ref No: [LPP-022/5], 2.6.2.1.

[LPP-TS-017] After a restart the CS SHALL begin with a limited production stated in the FPAPL as defined in [LPP1.0.0], Ref No: [LPP-901/1], 2.2 and 2.3.2.

[LPP-TS-017/1] If the CS is located on a CEM it MAY exceed the FPAPL while specific conditions prevent keeping the limit as defined in [LPP1.0.0], Ref No: [LPP-901/2], 2.2:

- Legal or regulatory specifications; and
- Uncontrolled energy producers prevent achieving the limit.

[LPP-TS-018] If the CS receives a heartbeat from the EG and a following activated power limit which is not accepted in state "init", the CS SHALL switch into state "unlimited/controlled" as defined in [LPP1.0.0], Ref No: [LPP-902], 2.2 and 2.3.3.

[LPP-TS-019] If there was no change of the FPAPL by the EG before restart or if the earlier written data was lost during restart, the CS SHALL use its initially pre-configured FPAPL value as defined in [LPP1.0.0], Ref No: [LPP-903], 2.2 and 2.3.3.

[LPP-TS-020] If the CS receives an EG heartbeat and a following activated power limit which is accepted in state "init", the CS SHALL switch into state "limited" as defined in [LPP1.0.0], Ref No: [LPP-904], 2.2 and 2.3.3.

[LPP-TS-021] If the CS receives an EG heartbeat and a following deactivated power limit in state "init", the CS SHALL switch into state "unlimited/controlled" as defined in [LPP1.0.0], Ref No: [LPP-905], 2.2 and 2.3.3.

[LPP-TS-022] If in state "init" or "failsafe state" the CS MAY switch into "unlimited/autonomous" state for conditions defined in [LPP1.0.0], 2.2 and 2.3.3.

[LPP-TS-022/1] If the CS does not receive any Heartbeat or receives a heartbeat but no following write on the APPL from the EG within 120 seconds since entering the state "init", the CS MAY switch into state "unlimited/autonomous" as defined in [LPP1.0.0], Ref No: [LPP-906], 2.2 and 2.3.3.

[LPP-TS-022/2] The CS MAY leave the "failsafe state" and switch into "unlimited/autonomous" state if the EG Heartbeat is received again, but no write command on the APPL is received within 120s as defined in [LPP1.0.0], Ref No: [LPP-921], 2.2 and 2.3.3.

[LPP-TS-022/3] The CS MAY leave the "failsafe state" after expiry of the Failsafe Duration Minimum and switch into "unlimited/autonomous" state as defined in [LPP1.0.0], Ref No: [LPP-922], 2.2 and 2.3.3.

[LPP-TS-022/4] If the CS is located on a CEM it MAY exceed the FPAPL, but only if and just as long as one of these conditions prevent keeping the FPAPL as defined in [LPP1.0.0], 2.2:

- Legal or regulatory specifications; and
- Uncontrolled energy producers prevent achieving the limit.

[LPP-TS-022/5] If the CS is not located on a CEM it MAY exceed the FPAPL, but only if and just as long as one of these conditions prevent keeping the FPAPL as defined in [LPP1.0.0], 2.2:

- Legal or regulatory specifications.

[LPP-TS-023] If the CS rejects the write command on the APPL, the CS SHALL stay in its state if it was in "unlimited/controlled" state before as defined in [LPP1.0.0], Ref No: [LPP-907/1], 2.2.

[LPP-TS-024] If the CS rejects the write command on the APPL, the CS SHALL stay in its state if it was in "limited" state before as defined in [LPP1.0.0], Ref No: [LPP-907/2], 2.2.

[LPP-TS-025] If in state "limited" the CS SHALL switch into state "unlimited/controlled" after the duration of an APPL has expired as defined in [LPP1.0.0], Ref No: [LPP-908], 2.2 and 2.3.3.

NOTE 6 Heartbeat received in time, Ref No: [LPP-914/1].

[LPP-TS-026] If in state "limited" the CS SHALL switch into state "unlimited/controlled" after receiving the deactivation of the APPL as defined in [LPP1.0.0], Ref No: [LPP-909], 2.2 and 2.3.3.

NOTE 7 Heartbeat received in time, Ref No: [LPP-914/1].

[LPP-TS-027] If in state "unlimited/controlled" the CS SHALL switch into state "limited" after receiving an activated APPL that can be applied as defined in [LPP1.0.0], Ref No: [LPP-910], 2.2 and 2.3.3.

NOTE 8 Heartbeat received in time, Ref No: [LPP-914/1].

[LPP-TS-028] If in state "unlimited/controlled" the CS SHALL switch into state "failsafe state" after not receiving an EG heartbeat within 120 seconds as defined in [LPP1.0.0], Ref No: [LPP-911], 2.2 and 2.3.3.

[LPP-TS-029] If in state "limited" the CS SHALL switch into state "failsafe state" after not receiving an EG heartbeat within 120 seconds as defined in [LPP1.0.0], Ref No: [LPP-912], 2.2 and 2.3.3.

[LPP-TS-030] After initial connection or restoration of communication, the EG SHALL send a heartbeat and a following APPL within 60 seconds to the CS after having determined that the communication is possible again as defined in [LPP1.0.0], Ref No: [LPP-913], 2.2.

[LPP-TS-031] If in state "failsafe state" or "unlimited/autonomous" the CS SHALL switch into state "unlimited/controlled" after receiving a heartbeat and a following APPL that cannot be applied as defined in [LPP1.0.0], Ref No: [LPP-918], 2.2 and 2.3.3.

[LPP-TS-032] If in state "failsafe state" or "unlimited/autonomous" the CS SHALL switch into state "limited" after receiving an EG heartbeat and a following activated APPL that can be applied as defined in [LPP1.0.0], Ref No: [LPP-919], 2.2 and 2.3.3.

[LPP-TS-033] If in state "failsafe state" or "unlimited/autonomous" the CS SHALL switch into state "unlimited/controlled" after receiving a heartbeat and a following deactivated APPL as defined in [LPP1.0.0], Ref No: [LPP-920], 2.2 and 2.3.3.

[LPP-TS-034] If the CS is on a CEM, the CEM SHALL manage its connected devices in a way that the received limit is kept (and not limit its own production) as defined in [LPP1.0.0], 2.2.

[LPP-TS-035] Upon receival of the APPL the CS SHALL evaluate its ability or inability to apply the limit as defined in [LPP1.0.0], 2.2.

[LPP-TS-035/1] An APPL higher than 0W SHALL be rejected by the CS as defined in [LPP1.0.0], 2.2.

[LPP-TS-035/2] If the CS is located on a CEM, the CS SHALL apply the APPL unless the rejection of the APPL is required by one of the following conditions as defined in [LPP1.0.0], 2.2:

- legal or regulatory specifications; and
- uncontrolled energy producers prevent achieving the limit.

[LPP-TS-035/3] If the CS is not located on a CEM, the CS SHALL apply the APPL unless the rejection of the APPL is required by one of the following conditions as defined in [LPP1.0.0], 2.2:

- legal or regulatory specifications.

[LPP-TS-035/4] If the absolute value of a limit is too large to be stored by the CS, the CS MAY alter the value to the most negative possible value (corresponding to the highest possible absolute value) as defined in [LPP1.0.0], 2.2.

[LPP-TS-036] In state "init", "failsafe state" or "unlimited/autonomous", only after a heartbeat from the EG, a following received write command within 60 seconds on the APPL SHALL be evaluated by the CS as defined in [LPP1.0.0], 2.2.

[LPP-TS-037] In state "init", "failsafe state" or "unlimited/autonomous", only after a heartbeat and a write command from the EG within 60 seconds on the APPL, commands on any other data point defined in this Use Case SHALL be evaluated by the CS as defined in [LPP1.0.0], 2.2.

[LPP-TS-038] The FPAPL, Power Production Nominal Max and Contractual Production Nominal Max SHALL always be greater than or equal to zero as defined in [LPP1.0.0], Ref No: [LPP-010], 2.8.1.

[LPP-TS-039] The Power Production Nominal Max value SHALL NOT be supported if the CS is a CEM as defined in [LPP1.0.0], 2.6.4.1.

[LPP-TS-040] The Contractual Production Nominal Max value SHALL NOT be supported if the CS is not a CEM as defined in [LPP1.0.0], 2.6.4.1.

[LPP-TS-041] The data point Failsafe Duration Minimum of this Use Case SHALL be the same as for the Use Case "Limitation of Power Production" as defined in [LPP1.0.0], 2.7.1.

NOTE 9 Meaning that if both Use Cases are supported as Actor CS on the same appliance, the data point is provided only once and is used for both Use Case instances.

[LPP-TS-042] In case of an implementation of this Use Case on an Inverter, the Use Case "Monitoring of Inverter" SHALL be considered as defined in [LPP1.0.0], 2.7.4.

[LPP-TS-042/1] The rules regarding the resource hierarchy of the Inverter SHALL be followed as defined in [LPP1.0.0], 2.7.4.

[LPP-TS-043] The EG SHOULD support both "Monitoring of Grid Connection Point" and "Monitoring of Power Consumption" Use Cases (as Actor Monitoring Appliance) as defined in [LPP1.0.0], 2.2.

[LPP-TS-043/1] The EG SHOULD monitor the actual power production of the CS as defined in [LPP1.0.0], 2.2.

[LPP-TS-043/2] The CS SHOULD provide its actual power production as defined in [LPP1.0.0], 2.2.

[LPP-TS-043/3] If the CS is located on a CEM, the Use Case "Monitoring of Grid Connection Point" SHALL be used for providing its actual power production as defined in [LPP1.0.0], 2.2.

[LPP-TS-043/4] If the CS is not located on a CEM, the Use Case "Monitoring of Power Consumption" SHALL be used for providing its actual power production as defined in [LPP1.0.0], 2.2.

[LPP-TS-044] The CS SHOULD store changed FPAPL and Failsafe Duration Minimum values persistently as defined in [LPP1.0.0], 2.6.2.1.

[LPP-TS-045] If in state "limited" the CS MAY deactivate the APPL and switch into state "unlimited/controlled" if and only if one of the following conditions permit interrupting the state "limited" as defined in [LPP1.0.0], Ref No: [LPP-923], 2.2.

The CS is located on a CEM:

- Legal or regulatory specifications
- Uncontrolled energy producers prevent achieving the limit

The CS is not located on a CEM:

- Legal or regulatory specifications

NOTE 10 This requirement relates to [LPP-TS-025] and [LPP-TS-026].

[LPP-TS-046] An EG should be aware of the possibility of its write commands being rejected (due to a timing problem or permitted reasons for rejection). Appropriate reactions on those NACK messages should be implemented (e.g. retry at a later time or change the chosen value).

350

6 Test suite conventions

6.1 General information

This chapter defines all conventions that are relevant for conformance tests of DUTs implementing [LPP1.0.0].

6.2 Conceptual test process

Figure 1 illustrates the conceptual test process to provide an overview and understanding of the test infrastructure elements required to perform tests regarding the Limitation of Power Production Use Case. It represents a simplification of the structural relationships of the components and can be thought of conceptually as a set of interacting process steps. Each step corresponds to a particular aspect of functionality in the test system. The explanation of the conceptual test process elements, e.g. the [ParameterSheet] as a base document for the specific test cases, can be found in the following sections.

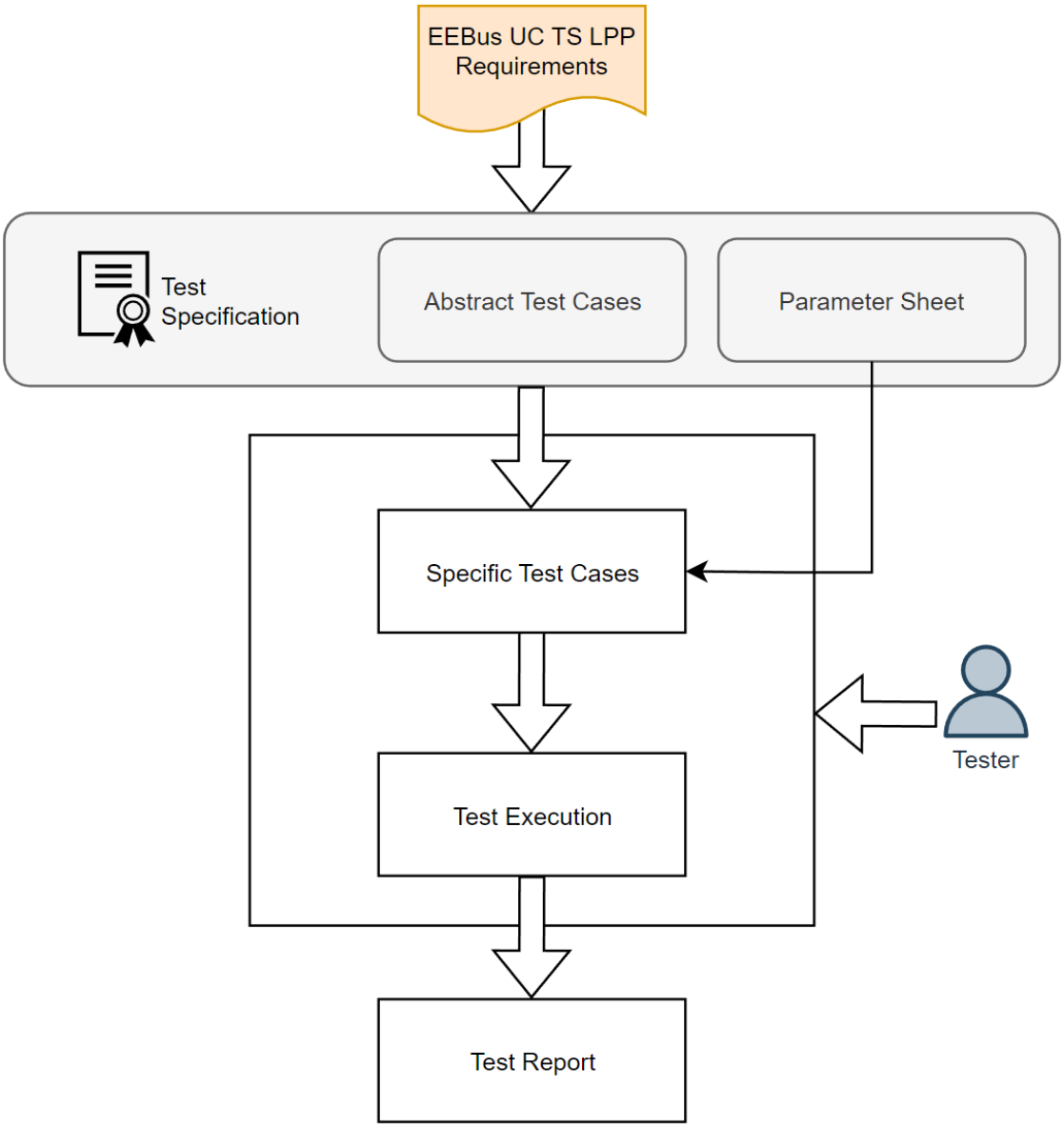

Figure 1: Conceptual test process

6.2.1 Test specification

This document defines ATCs derived from requirements extracted from [LPP1.0.0] (see section 5).

6.2.1.1 Parameter sheet – specific test cases

The [ParameterSheet] "Specific Test Cases" worksheet, provided in a separate document, is intended to support the test engineer in creating STCs derived from ATCs. Furthermore, it contains all device specific information of the manufacturer.

Cells that need to be filled in by the manufacturer/test engineer are highlighted with a white background whereas fields with a grey background should not be filled in manually. Each value entered in the corresponding cell above the table for the STCs, is completed in the STCs by automatic filling using a formula.

NOTE 11 Due to different values used in different test steps for the same parameter in one STC, some test cases are listed in two lines and marked with a suffixed STC ID, e.g. 1.1 and 1.2.

NOTE 12 For more information on using the [ParameterSheet], see the "Legend" worksheet.

6.2.1.2 Parameter sheet – optional support

In the second worksheet "Optional Support" of the [ParameterSheet], additional information is provided for the ATCs marked as optional in section 6.13, which become mandatory in case of implementation. At the same time, testing of these ATCs is made visible here for the test report.

6.2.2 Specific test cases

Due to the necessary variation of test input data (see section 6.11), ATCs need to be transferred to specific test cases. These data sets are manufacturer dependent as applications (thus the DUT) can be different in many details, e.g. devices may vary in their applicable power range. Specific test cases based on the ATCs are derived by using test input values of the [ParameterSheet]. Thus, test input values shall be defined in the [ParameterSheet] by the test engineer.

NOTE 13 For more information on using the [ParameterSheet], see the "Legend" worksheet.

6.2.3 Test execution

After the STCs were created, entry conditions for the test execution are met and the test execution phase begins. Tests shall be conducted as per the defined test cases. This step involves comparing actual results with expected results.

As described in section 1.3, it is not specified how a test engineer can verify both the limits and the states a DUT is in during test execution. Therefore, the manufacturer must ensure, e.g. via debug outputs or a graphical interface, that the required information is made available to the test engineer.

6.2.4 Test report

A test report is a document containing information about the performed tests and collected metrics like failed or passed test cases, test case coverage, detected bugs, spent time and results of the test runs. This report may contain manufacturer-specific information and is subject to the manufacturer.

6.3 Test suite identifiers

6.3.1 Abstract test case identifier

According to the naming convention defined by ETSI TS 102 869-3 V1.5.1 (European Telecommunications Standards Institute – https://www.etsi.org/), this convention is followed and applied to ATCs as shown in Table 2.

Element	Naming convention	Prefix	Example identifier
Abstract test case name	The identifier begins with ATC. It is mandatory to use underscores as separators within an identifier.	ATC	ATC_INS1_PT_Transition1_001

Table 2: Naming convention for abstract test case names

The identifier of the ATC is built according to Table 3 within this document.

ATC identifier: <prefix>_<con>_<tot>_<ctx>_<xxx>

Identifier	Value	Description
<prefix>		see Table 2
<con>		Use Case constellation (see section 4.1.5 and 6.9)
	INS1	LPP instance 1 (see section 6.9)
	INS2	LPP instance 2 (see section 6.9)
	COM	Common
<tot>		Type of testing
	PT	Positive testing
	NT	Negative testing
<ctx>		Context
	{name}	e.g. name of transition
<xxx>		Number
	{nnn}	Unique number from 001 to 999

Table 3: Naming convention for abstract test case identifiers

6.3.2 Test configuration identifier

The short form of the test configuration is as follows:

<prefix>_<actor>_<config>

Examples:

EG: CF_EG_ManualExecution

CS: CF_CS_UnlCntrl

425 The identifier is built according to Table 4.

Identifier	Value	Description
<prefix>		Test configuration
	CF	Configuration
<actor>		Actor
	CS	Controllable System
	EG	Energy Guard
<config>		Test configuration
	{name}	CS: state the CS is in, e.g. unlimited/controlled EG: e.g. ManualExecution

426 *Table 4: Naming convention for test configurations*

427 Test configurations are defined in section 6.5.

428

429 ### 6.3.3 Timeout identifier

430 The specific timeout identifier within this document is defined as follows:

431 [E-DT<y>] or [<x>:E-DT<y>]

432 Examples:

433 With prefix: [1:E-DT60]
434 Without prefix: [E-DT120]
435 [E-DT0*]

436 Since various timeouts need to be considered an identifier is built according to Table 5.

Identifier	Value	Description
<x>		Test step number (optional)
	{N}	This number indicates a previous test step (not the current test step where the timeout identifier is used). The completion timeout ("E") of the current test step refers to the end of test step {N}.
E		Execution: The timeout refers exclusively to the "Execution" instructions.
DT		Delta-time
<y>		The number indicates the completion time in seconds since the previous test step.
	{N}	Timeout in seconds, e.g. 60.
	0*	The corresponding step must be completed "as soon as possible". *[1] The step is associated with a duration of 0 seconds. *[1]: Typically, timeouts like [E-DT0*] are limited indirectly by one or more further timeouts.

437 *Table 5: Naming convention for timeouts*

438 As shown in Table 5, timeouts can be used across test steps. Therefore, it is possible to mark them
439 with an optional prefixed number indicating after which test step the timeout started. For timeouts
440 that only affect the current test step, the prefixed numbering is omitted. For an example, see section
441 6.4.1.

6.4 Abstract test case description

The template for an abstract test case (ATC) is given below.

ATC ID	The ATC ID is a unique identifier for an ATC according to its definition in chapter 6.3.1.
Description	A brief description of the test objective is given here in accordance with the Use Case.
Referenced Requirement(s)	The referenced requirement(s) refers to requirements stated in section 5.2 of this document. The requirements are referenced according to the format defined in 5.1.
Pre-condition	The pre-condition provides a short description of the state the DUT is in before the actual ATC is executed. This may contain a test configuration which is referenced according to the format defined in section 6.5. Test step 1 is executed immediately after the pre-condition has been fulfilled.
Test variation	Due to variations within the data sets in section 6.11 the ATC defines the number of STCs. In addition, possible message combinations (see section 6.11.4) and the data to be used for STCs (see section 6.11) are listed here. Detailed information about deriving STCs can be found in section 6.8.
Execution	This element describes the test steps dealing with the actions to be performed and what is observed or measured during execution. The steps are performed within a certain time, unless otherwise described. There is no delay between the individual steps intended.
Expected result	Describes the observable expected results of the test steps during and after the Execution. For the execution of the STCs, it is mandatory to be able to clearly identify these states in detail. The overall verdict is only 'passed' if there is no failed result for an intermediate test or test step.

Table 6: Abstract test case description template

6.4.1 Abstract test case example

For clarification, individual components of an ATC are explained in more detail in the following example.

ATC ID	ATC_COM_PT_CSExample_004
Description	This test shall ensure that the CS persistently stores the FPAPL and Failsafe Duration Minimum values.
Referenced Requirement(s)	[LPP-TS-011/1], [LPP-TS-013/1], [LPP-TS-044]
Test variation	The variation of the data sets result into a sum of 2 test executions with 1 actor being tested. Message combinations (any): MSG_03, MSG_07, MSG_12, MSG_16

	APPL values (all): APPL_02, APPL_03 FPAPL values (all): FPAPL_03 Failsafe Duration Minimum values (all): FPAPL_DUR_02 *1	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60] *2	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG FPAPL write command. [E-DT0*] *3	The CS receives and accepts the write command.
5.	Send an EG heartbeat. [3:E-DT60] *4	The CS receives the heartbeat.
6.	Send an EG Failsafe Duration Minimum write command. [E-DT60]	The CS receives and accepts the write command.

Table 7: Abstract test case example

*1: The ATC shall be executed with both APPL values since it is marked with (all). One of the message combinations (any) can be freely selected for sending the APPL commands. If more than one FPAPL or Failsafe Duration Minimum values were specified, also marked with an (all), this abstract test case would have to be executed with all values equally as a specific test case.

*2: This timeout is used across multiple test steps. After test step 1, test steps 2 and 3 must be performed within the specified duration. The delta time since end of test step 1 is less than 60 seconds.

*3: This test step execution is to be completed as soon as possible after the previous one. According to test step 5, the duration to execute test step 4 must not violate the timeout specified for test step 5. In addition, the test step must be executed in time to prevent interruption by other timers such as the Failsafe Duration Minimum.

*4: The delta time since end of test step 3 execution is less than 60 seconds.

6.5 Test configurations

The test configuration reflects fixed conditions including "Limitation of Power Production" Use Case states in which the CS can be as well as a defined EG behaviour before and during an ATC execution. In order to implement ATCs from a defined behaviour, these configurations are used as pre-conditions.

Within a configuration used in the pre-condition of an ATC, starting the corresponding timeouts must also be considered. The maximum possible time must be available for each configuration of the

respective actor. It does not matter whether this is achieved via debug interface, exact logging or triggering a message by the tester.

6.5.1 Behaviour of the DUT

The configuration of a test object determines the start condition and the immediate start of test step 1. The configuration must not be delayed in such a way that the timeouts defined in the test steps are violated.

The rationale is that a configuration may be associated with a state "A" of an actor and a timer defined in [LPP1.0.0]. This means that it can be defined in [LPP1.0.0] that a certain actor (DUT) starts a timer as soon as it reaches the "A" state and that the actor either switches to the "B" state as soon as the timer ends or that it switches to another state "C" if, for example, it receives a command before the timer ends.

Typically, two test cases are defined in a test specification that cover such transitions: a test case that verifies the change to state "C" by a command before the timer ends; another test case that verifies the change to state "B" as soon as the timer ends. The execution of these test cases depends on the control of the timer. This means that the configuration of the DUT for such test cases corresponds to state "A" with a just initialised timer and that the execution of test step 1 starts immediately. In practice, there may be a certain delay between the configuration and the actual execution of test step 1. However, these delays must be short enough to allow a reliable verification of the time-controlled conditions and behaviour.

6.5.2 Behaviour of the tester

The configuration of the tester must support the test of the DUT. This includes taking the configuration of the DUT into account, particularly with regard to the DUT's timers. In general, the configuration of the tester is defined in such a way that it is fully functional in accordance with [LPP1.0.0]. However, the execution of the tests allows two test paradigms:

1. Full-featured actor as tester
2. Simplified actor as tester

In the first paradigm, the tester is or behaves like a fully functional implementation of the actor as specified in [LPP1.0.0]. The configuration of the tester must therefore be applied as specified in the test specification.

In the second paradigm, the simplified tester focuses on the verification of the expected results described. In addition, it performs the necessary actions required to maintain the connection and the execution of the test steps.

NOTE 14 Test paradigm 1 might detect invalid behaviour of a DUT by detecting invalid messages that are not explicitly described in a test step. This behaviour should be logged as an error for later verification.

6.5.3 Energy Guard

Within this document different roles an EG is used in while performing the described abstract test cases is covered. The actor EG can either be used as the tester or the DUT. Depending on the corresponding test configuration a set of components and interactions for the EG are defined.

Valid test configurations for the EG within this document are shown in Table 8.

Configuration	Description for the EG *1	Description for the EG as simplified tester *2
CF_EG_ManualExecution	No initial EG conditions need to be considered for the execution of the ATC. If an EG action is required, it is described within the test steps.	Same as in the description for the EG.
CF_EG_Reboot	Ensure that the EG has already been connected to the CS. Disconnect the EG from the CS for 120 seconds and reboot the EG. The reconnection steps are described within the test steps.	Not applicable
CF_EG_ConnectionEstablished	The EG is already connected to the CS. Necessary steps for establishing, as well as maintaining the connection (e.g. sending heartbeats) during test execution are not explicitly described in the test steps.	Same as in the description for the EG.
CF_EG_ConnectionLoss	The EG was connected, but has lost the connection to the CS. If an EG action is required, it is described within the test steps.	Same as in the description for the EG.

Table 8: EG test configurations

***1**: Applies for the EG as DUT or for a fully-featured EG as tester, see section 6.5.2.

***2**: Applies for the EG as simplified tester, see section 6.5.2.

6.5.4 Controllable System

These test configurations reflect fixed conditions, according to [LPP1.0.0], which the CS has in each state.

Valid test configurations for the CS as the tester and the DUT within this document are shown below.

Configuration	LPP state for the CS *1	Behaviour of the CS as tester *2
CF_CS_Init	Init	Unless otherwise specified in the ATC, send heartbeats at least every 60 seconds after communication with the DUT has been enabled. Verify received heartbeats and write commands as specified in the ATC.

CF_CS_Reset_Init	Init after a factory reset	Not applicable
CF_CS_FS	Failsafe state	Unless otherwise specified in the ATC, send heartbeats at least every 60 seconds after communication with the DUT has been enabled. Verify received heartbeats and write commands as specified in the ATC.
CF_CS_Limited_w_dur	Limited with duration The duration shall be set to APPL_DUR_01 if this state is used in the pre-condition.	Not applicable
CF_CS_Limited_wo_dur	Limited without duration	Not applicable
CF_CS_UnlCntrl	Unlimited/controlled	Unless otherwise specified in the ATC, send heartbeats at least every 60 seconds after communication with the DUT has been enabled. Verify received heartbeats and write commands as specified in the ATC.
CF_CS_UnlAuto	Unlimited/autonomous	Unless otherwise specified in the ATC, send heartbeats at least every 60 seconds after communication with the DUT has been enabled. Verify received heartbeats and write commands as specified in the ATC.

Table 9: CS test configurations

***[1]**: Applies for the CS as DUT or for a fully-featured CS as tester, see section 6.5.2.

***[2]**: Applies for the CS as simplified tester, see section 6.5.2.

6.6 Timeouts and timings

For the scope of this document internal timings of any DUT cannot be tested explicitly in black box testing since they are not accessible by the tester. Therefore, only timeouts from the tester's perspective can be accurately measured and are considered in this document. All timeouts are defined according to its identifier in section 6.3.3.

In order to gain a common understanding of how to handle timeouts during test execution, it is formally defined as follows:

- The corresponding timeout starts after the previous test step execution or the test step execution specified in the timeout identifier prefix.
- If the test step(s) end within the appropriate time and it corresponds to the expected result, the test continues. *[1]
- In case the test step(s) do not end by the time defined by the corresponding timeout value, the test verdict is set to 'false'.

*[1]: This formal definition assumes that the duration of the determination of a test result does not delay the execution of the next test step. In fact, for most test steps, it is acceptable to record relevant time-stamped data and determine the test result of each test step later during test execution or even after all test steps have been executed. Such "delayed" test step verification is NOT possible in any of the following cases:

- The next test step execution depends on a previous test result.
  Examples:
  - Depending on a test result, the next test step is either test step x or test step y.
  - The next test step contains a conditional statement that depends on a previous test result.
- Executing the next test step without considering the current test result would endanger any device.
  Both the manufacturer of a DUT and the test engineer are responsible for disclosing such constraints of their equipment prior to test execution. The test engineer is then responsible for taking these constraints into account during test execution.

Regardless of immediate or delayed test step verification, the first test step that deviates from the expected result is considered as last test step executed. I.e. even if some further test steps have been executed, they are considered not to have been executed.

6.7 Test case execution

Within this document each test case executes a specific test behaviour and verifies the behaviour of the DUT according to its message-based response at any point in time. To ensure interoperability, each test case starts and ends in a defined and recoverable state of both the tester and the DUT. Therefore, the following steps are defined.

- *Pre-condition:* The tester and the DUT should be set to a configuration that allows communication between the two devices.
  If a pre-condition has been defined, both the tester and the DUT initialize to a known and stable state. This means that tester and DUT must be in a valid configuration before the test execution is performed.
- *Test behaviour during test execution:* In order to achieve the test objective, the test behaviour describes the necessary test steps during the test execution. At the end of each test step, the result is evaluated and a test verdict is assigned (see section 6.6 for further details, especially regarding the results of the delayed test steps). The actions to be performed are explained below.
  a. Relevant timeouts must be initialized on both tester and DUT sides.
  b. Send messages to the DUT.
  c. Receive and verify the response of the DUT.
  d. Stop timeouts.
  e. Assign a test verdict for the test behaviour.

6.8 Test case variation

Some ATCs (see chapters 7 and 8) specify for the "test variation" row one or more data sets that can or have to be used to derive STCs. For an example, see section 6.4.1.

The following keywords define how many of the listed data sets have to be used: *[1]

1. (all): If a data set is extended with "(all)" in the ATC, all possible values shall be used per STC. This extension is decisive for the number of STCs to be derived.
2. (any): If a data set is extended with "(any)" in the ATC, at least one of the possible values shall be used for all STCs.

*[1]: The information in the test case variation does not refer to heartbeats.

6.9 LPP instances

The Use Case [LPP1.0.0] defines two instances for its application. Since slightly different rules apply to these instances, ATCs are defined which carry an appropriate label in the identifier (see section 6.3.1).

LPP instance 1: The power production limit is first sent from the EG (e.g., Control-Box) to the Customer Energy Manager (CEM). The CEM then tries to control its connected appliances to achieve this limit at the grid connection point.

LPP instance 2: The EG (located on a CEM) sends a dedicated power production limit to an appliance.

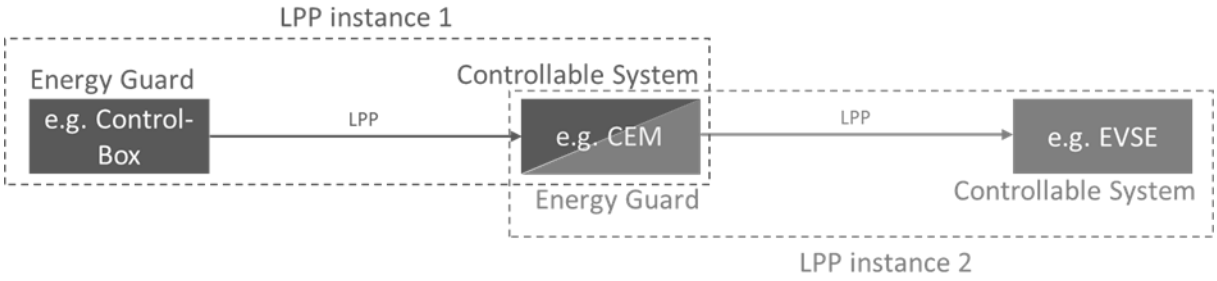

Figure 2: Example for two instances of LPP Use Case

6.10 Test verdict

The test verdicts defined in this document are listed in Table 10.

Verdict statement	Definition
passed	This verdict statement shall be used when the DUT shows the correct behaviour with respect to the relevant requirements.
failed	This verdict statement shall be used when the DUT shows the wrong behaviour with respect to the relevant requirements.
not applicable	This verdict statement shall be used when the test case is not relevant to the DUT to be tested.

Table 10: Test verdicts

An overview of the test case coverage regarding its verdict can be found in section 6.13.

6.11 Data sets

The data sets defined in this section contain various values for the [LPP1.0.0] scenarios 1 and 2 as well as possible combinations in which these values can be sent or received. In order to ensure the greatest possible test coverage, the ATCs define which values and combinations have to be used (see section 6.8).

6.11.1 Message handling

With reference to section 6.7, messages are either sent by the tester and received by the DUT or vice versa. Due to the defined roles within [LPP1.0.0], the following two message handling rules emerge depending on the type of DUT.

1. *CS as DUT:* The tester (EG) sends a message to the DUT and expects the corresponding response message from the DUT as described in section 6.7 step 2.
2. *EG as DUT:* After receiving a write command, the tester sends a response message to the DUT, from which conclusions can be drawn about the correct initial message sent by the DUT. The tester must be able to process the (received) message and create a valid response in order to make valid test verdict assignments as described in section 6.7 step 2.

Notifications such as heartbeats are excluded from the behavior described above and are handled in the test steps of the abstract test cases as specified.

6.11.2 Active Power Production Limit

With respect to the Active Power Production Limit, test cases ensure that the set limit is held by the DUT or that the state has changed, provided that the duration has expired, or the DUT receives a deactivation command.

According to [LPP-TS-001], valid APPL values are less than or equal to zero.

If the CS is not located on a CEM, the manufacturer needs to specify the power range [$APPL_{min}$, $APPL_{max}$] in which the DUT can be operated.

If the CS is located on a CEM, the manufacturer needs to specify the power range [$APPL_{min}$, $APPL_{max}$] in which the system representing the house can be operated.

NOTE 15 The indices "min" and "max" are to be understood in a mathematical sense. Since valid APPL values are zero or negative, the relation of the absolute values is $|APPL_{min}| > |APPL_{max}|$.

To ensure conformance to the Use Case specification while using the auxiliary value

$$delta = 0.05 * (APPL_{max} - APPL_{min})$$

the following Active Power Production Limit values shall be used as a variation of that specified range to derive STCs:

- APPL_01: The value shall be either
  - $APPL_{max}$ + delta, provided that the result is negative, or
  - 0 otherwise

  (a value above the maximum of the specified range).
- APPL_02: The value shall be $APPL_{max}$ - delta (a value within the specified range, close to $APPL_{max}$).
- APPL_03: Within the specified range a value between APPL_04 and APPL_02 shall be freely selected.
- APPL_04: The value shall be $APPL_{min}$ + delta (a value within the specified range, close to $APPL_{min}$).
- APPL_05: The value shall be $APPL_{min}$ - delta (a value below the specified range).
- APPL_06: The value shall be plus 1000W (i.e. an invalid value).

Within the test variation of an ATC, the following statement can be found: "APPL values:". A more detailed description of how to understand this statement can be found in section 6.8. For an example, see section 6.4.1.

6.11.3 Active Power Production Limit duration

The Active Power Production Limit duration states that the DUT maintains the limited state in which the (activated) APPL is held until the duration expires provided that the state is not left due to other circumstances. By setting this parameter, STCs validate whether a state change of the DUT is performed.

In correspondence to the identified set of relevant message combinations the duration parameter is defined as follows:

- APPL_DUR_01: The duration parameter shall be set to 60 seconds.
- APPL_DUR_02: The duration parameter shall be deleted.

Within the test variation of an ATC, the following statement can be found: "APPL duration values:". A more detailed description of how to understand this statement can be found in section 6.8. For an example, see section 6.4.1.

6.11.4 Active Power Production Limit message combinations

Since the server is required to perform different state changes while receiving Active Power Production Limit commands as a single value or as message pairs including de-/activation and duration parameters, the test specification details possible variations.

Each message combination reflects only a particular facet of the APPL (e.g., only the value of the limit or only the "activated" state) or combinations thereof with particular values (e.g., the value of the limit along with its "activated" state).

NOTE 16 Some communication protocols may allow the transmission of particular attributes, e.g. the duration of the APPL, while other protocols only allow the transmission of the APPL

including all attributes. The message combinations defined in this section should be considered independent of the capabilities of the communication protocol. This means that the respective communication protocol must be applied in such a way that the expected result of a message defined in this section is achieved.

Valid APPL messages are defined in Table 11.

Combination	Message
MSG_01	value
MSG_02	activated
MSG_03	deactivated
MSG_04	**delete** duration
MSG_05	duration
MSG_06	value **and** activated
MSG_07	value **and** deactivated
MSG_08	value **and** delete/unset duration
MSG_09	value **and** duration
MSG_10	activated **and** delete/unset duration
MSG_11	activated **and** duration
MSG_12	deactivated **and** delete/unset duration
MSG_13	deactivated **and** duration
MSG_14	value **and** activated **and** delete/unset duration
MSG_15	value **and** activated **and** duration
MSG_16	value **and** deactivated **and** delete/unset duration
MSG_17	value **and** deactivated **and** duration

Table 11: Active Power Production Limit configurations

Within the test variation of an abstract test case, the following statement can be found: "Message combinations:". A more detailed description of how to understand this statement can be found in section 6.8. For an example, see section 6.4.1.

6.11.5 Failsafe Production Active Power Limit

With respect to the Failsafe Production Active Power Limit, STCs are used to verify that the DUT is in a configuration where it must keep the limit.

According to [LPP-TS-038], valid FPAPL values are greater than or equal to zero.

The manufacturer needs to specify the power range [$FPAPL_{min}$, $FPAPL_{max}$] in which the DUT can be operated.

NOTE 17 The indices "min" and "max" are to be understood in a mathematical sense. Since valid FPAPL values are zero or positive, the relation of the absolute values is $|FPAPL_{min}| < |FPAPL_{max}|$.

To ensure conformance to [LPP1.0.0] while using the auxiliary value

$$delta = 0.05 * (FPAPL_{max} - FPAPL_{min})$$

the following Failsafe Production Active Power Limit values shall be used for the specific test cases:

- FPAPL_01: The value shall be either
  - $FPAPL_{min}$ - delta, provided that the result is positive, or
  - 0 otherwise

  (a value below the minimum of the specified range).
- FPAPL_02: The value shall be $FPAPL_{min}$ + delta (a value above the minimum of the specified range).
- FPAPL_03: Within the specified range a value between FPAPL_02 and FPAPL_04 shall be freely selected.
- FPAPL_04: The value shall be $FPAPL_{max}$ - delta (a value below the maximum of the specified range).
- FPAPL_05: The value shall be $FPAPL_{max}$ + delta (a value above the maximum of the specified range).
- FPAPL_06: The value shall be minus 1000W (i.e. an invalid value).

Within the test variation of an ATC, the following statement can be found: "FPAPL values:". A more detailed description of how to understand this statement can be found in section 6.8. For an example, see section 6.4.1.

6.11.6 Pre-Configured Failsafe Production Active Power Limit

This value describes the FPAPL preset set by the test engineer, e.g. via control element of the DUT, or stored in the software of the DUT as a default value by the manufacturer.
The Pre-Configured Failsafe Production Active Power Limit PFPAPL shall be provided in the [ParameterSheet] equivalent to the other parameters.

NOTE 18 Due to the black box test paradigm in this document, it is not defined how to ensure that a corresponding preset is set on the DUT side for a given test case execution.

6.11.7 Failsafe Duration Minimum

A Failsafe Duration Minimum states that the DUT maintains the failsafe state in which the FPAPL is held until the duration expires provided that the state is not left due to other circumstances. By setting this parameter, specific test cases validate whether a state change of the DUT is performed.

Due to different inert DUTs and therefore different duration parameters the manufacturer needs to specify both the pre-configured value for the Failsafe Duration Minimum (PFSDM) as well as the internal value for the maximum Failsafe Duration Minimum (MFSDM) their DUT can process. According to [LPP1.0.0], the MFSDM shall be in the range of 2 to 24 hours. These values need to be provided in the [ParameterSheet] by the manufacturer. This is necessary because the abstract test cases only consider internal status changes and communication. By providing the values in the [ParameterSheet], the test engineer is able to execute specific test cases.

To ensure conformance to [LPP1.0.0], the following Failsafe Duration Minimum values shall be used for the specific test cases:

- FPAPL_DUR_01: The value shall be set to 1 hour 54 minutes.
- FPAPL_DUR_02: A value greater than PFSDM and less than MFSDM shall be chosen if PFSDM is less than MFSDM. Otherwise MFSDM shall be chosen.
- FPAPL_DUR_03: The value shall be set to 1.05 * MFSDM (5% above the MFSDM).

Within the test variation of an abstract test case, the following statement can be found: "Failsafe Duration Minimum values:". A more detailed description of how to understand this statement can be found in section 6.8. For an example, see section 6.4.1.

6.11.8 Startup duration

Due to the different startup times, a manufacturer needs to provide its specific time in the [ParameterSheet] up to which its device can establish communication.

- StartUpDur_EG: The duration from power on to configuration CF_EG_ConnectionEstablished.
- StartUpDur_CS: The duration from power on to configuration CF_CS_Init.

6.12 Requirement coverage

Table 12 provides an overview of the requirements covered in the test cases and the requirements that are e.g. out of scope according to the conventions defined in this document or cannot be tested in black box tests.

Requirement ID	Comment/ATC ID(s)
[LPP-TS-001]	ATC_COM_PT_EGMessages_001, ATC_COM_PT_EGMessages_003, ATC_COM_PT_CSConnection_007, ATC_COM_PT_CSConnection_008
[LPP-TS-001/1]	ATC_COM_PT_CSTransition6_001
[LPP-TS-001/2]	ATC_COM_PT_EGMessages_003, ATC_COM_PT_CSLimited_002
[LPP-TS-002]	ATC_COM_PT_EGMessages_003, ATC_COM_PT_CSLimited_002
[LPP-TS-003]	ATC_COM_PT_EGMessages_004, ATC_COM_PT_CSConnection_002
[LPP-TS-004]	ATC_COM_NT_CSConnection_001
[LPP-TS-005]	ATC_COM_PT_CSConnection_003, ATC_COM_PT_CSConnection_004
[LPP-TS-006]	ATC_COM_PT_EGHeartbeat_001
[LPP-TS-007]	ATC_COM_PT_CSHeartbeat_001
[LPP-TS-008]	ATC_COM_PT_CSTransition6_001
[LPP-TS-008/1]	ATC_COM_PT_CSTransition6_001
[LPP-TS-009]	ATC_COM_NT_CSUnlCntrl_001, ATC_COM_PT_CSFS_003
[LPP-TS-009/1]	ATC_COM_NT_CSLimited_001
[LPP-TS-009/2]	ATC_COM_PT_CSInit_002

[LPP-TS-009/3]	ATC_COM_PT_CSInit_001, ATC_COM_PT_CSInit_002, ATC_COM_NT_CSUnlCntrl_001, ATC_COM_PT_CSFS_003, ATC_COM_PT_CSUnlAuto_002
[LPP-TS-010]	ATC_COM_PT_CSUnlAuto_002
[LPP-TS-010/1]	ATC_COM_PT_CSUnlCntrl_003
[LPP-TS-010/2]	ATC_COM_PT_CSUnlCntrl_003
[LPP-TS-010/3]	ATC_COM_PT_CSUnlCntrl_002
[LPP-TS-010/4]	ATC_COM_PT_CSUnlCntrl_002
[LPP-TS-011]	ATC_COM_PT_CSInit_001, ATC_COM_PT_CSInit_002
[LPP-TS-011/1]	ATC_COM_PT_EGMessages_004, ATC_COM_PT_CSInit_003
[LPP-TS-011/2]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-012]	ATC_COM_PT_CSFS_002, ATC_COM_PT_CSTransition10_001
[LPP-TS-013]	ATC_COM_PT_CSInit_002, ATC_COM_PT_CSFS_002
[LPP-TS-013/1]	ATC_COM_PT_EGMessages_004, ATC_COM_PT_CSInit_003
[LPP-TS-013/2]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-014]	ATC_COM_PT_CSConnection_005
[LPP-TS-015]	ATC_COM_PT_CSConnection_005
[LPP-TS-015/1]	ATC_COM_PT_CSConnection_005, ATC_COM_PT_CSConnection_008
[LPP-TS-016]	ATC_COM_PT_CSConnection_005, ATC_COM_PT_CSConnection_008
[LPP-TS-017]	ATC_COM_PT_CSInit_001
[LPP-TS-017/1]	Out of scope (The test specification does not check the quality of the data.)
[LPP-TS-018]	ATC_COM_PT_CSConnection_003, ATC_COM_PT_CSTransition1_001
[LPP-TS-019]	ATC_COM_PT_CSInit_001
[LPP-TS-020]	ATC_COM_PT_CSTransition2_001
[LPP-TS-021]	ATC_COM_PT_CSTransition1_002
[LPP-TS-022]	ATC_COM_PT_CSTransition3_001, ATC_COM_PT_CSTransition3_002, ATC_COM_PT_CSTransition10_001, ATC_COM_PT_CSTransition10_002
[LPP-TS-022/1]	ATC_COM_PT_CSTransition3_001, ATC_COM_PT_CSTransition3_002
[LPP-TS-022/2]	ATC_COM_PT_CSTransition10_002
[LPP-TS-022/3]	ATC_COM_PT_CSTransition10_001
[LPP-TS-022/4]	Out of scope (The test specification does not check the quality of the data.)
[LPP-TS-022/5]	Out of scope (The test specification does not check the quality of the data.)
[LPP-TS-023]	ATC_COM_NT_CSUnlCntrl_001
[LPP-TS-024]	ATC_COM_NT_CSLimited_001

[LPP-TS-025]	ATC_COM_PT_CSTransition6_001
[LPP-TS-026]	ATC_COM_PT_CSTransition6_002
[LPP-TS-027]	ATC_COM_PT_CSTransition4_001
[LPP-TS-028]	ATC_COM_PT_CSTransition5_001
[LPP-TS-029]	ATC_COM_PT_CSTransition7_001
[LPP-TS-030]	ATC_COM_PT_EGConnection_001, ATC_COM_PT_EGConnection_002, ATC_COM_PT_EGConnection_003
[LPP-TS-031]	ATC_COM_PT_CSTransition8_001, ATC_COM_PT_CSTransition11_001
[LPP-TS-032]	ATC_COM_PT_CSTransition9_001, ATC_COM_PT_CSTransition12_001
[LPP-TS-033]	ATC_COM_PT_CSFS_001, ATC_COM_NT_CSUnlAuto_001, ATC_COM_PT_CSTransition8_002, ATC_COM_PT_CSTransition11_002
[LPP-TS-034]	Out of scope (The test specification does not check the quality of the data.)
[LPP-TS-035]	ATC_COM_PT_CSConnection_007, ATC_INS1_PT_CSTransition1_001, ATC_INS2_PT_CSTransition1_001
[LPP-TS-035/1]	ATC_COM_NT_CSLimited_001, ATC_COM_PT_CSTransition1_001, ATC_COM_PT_CSTransition8_001, ATC_COM_PT_CSTransition11_001
[LPP-TS-035/2]	ATC_INS1_PT_CSTransition1_001
[LPP-TS-035/3]	ATC_INS2_PT_CSTransition1_001
[LPP-TS-035/4]	ATC_COM_PT_CSConnection_006, ATC_COM_PT_CSConnection_007
[LPP-TS-036]	ATC_COM_NT_CSConnection_001, ATC_COM_PT_CSConnection_002, ATC_COM_PT_CSFS_001, ATC_COM_NT_CSUnlAuto_001
[LPP-TS-037]	ATC_COM_PT_CSConnection_002, ATC_COM_PT_CSConnection_004, ATC_COM_PT_CSFS_001, ATC_COM_NT_CSUnlAuto_001
[LPP-TS-038]	ATC_COM_PT_CSConnection_002, ATC_COM_PT_CSConnection_003, ATC_COM_PT_CSConnection_008, ATC_COM_PT_CSUnlAuto_002
[LPP-TS-039]	ATC_COM_PT_CSUnlCntrl_002
[LPP-TS-040]	ATC_COM_PT_CSUnlCntrl_003
[LPP-TS-041]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-042]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-042/1]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-043]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)

[LPP-TS-043/1]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-043/2]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-043/3]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-043/4]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-044]	ATC_COM_PT_CSInit_003
[LPP-TS-045]	Out of scope (requirements refer to local regulations, external standards, internal conditions, etc.)
[LPP-TS-046]	ATC_COM_PT_EGMessages_002, ATC_COM_PT_CSConnection_009

Table 12: Requirement coverage

6.13 Test case coverage

The resulting test case coverage depending on the DUT (test scope) with reference to verdicts is summarized in Table 13. It defines the relevance of conformity of respective DUTs for this document, based upon the type of the DUT (EG or CS).

The following symbols are used in Table 13:

- "m" represents the mandatory test scope for a specific DUT – the item SHALL be implemented;
- "r" marks recommended test cases – this includes the functional standard which SHOULD be applied; and
- "o" represents the optional test scope – manufacturer MAY decide to implement the item;
- "—" indicates that the test case is not applicable for the DUT.

ATC ID	DUT which is covered in the ATC	
	EG	CS
ATC_COM_PT_EGHeartbeat_001	m	—
ATC_COM_PT_EGConnection_001	m	—
ATC_COM_PT_EGConnection_002	m	—
ATC_COM_PT_EGConnection_003	r *[3]	—
ATC_COM_PT_EGMessages_001	m	—
ATC_COM_PT_EGMessages_002	r	—
ATC_COM_PT_EGMessages_003	r	—
ATC_COM_PT_EGMessages_004	r	—
ATC_COM_PT_CSHeartbeat_001	—	m
ATC_COM_NT_CSConnection_001	—	m
ATC_COM_PT_CSConnection_002	—	m
ATC_COM_PT_CSConnection_003	—	m
ATC_COM_PT_CSConnection_004	—	m
ATC_COM_PT_CSConnection_005	—	m
ATC_COM_PT_CSConnection_006	—	o
ATC_COM_PT_CSConnection_007	—	m
ATC_COM_PT_CSConnection_008	—	m

ATC_COM_PT_CSConnection_009	—	r *3
ATC_COM_PT_CSInit_001	—	m
ATC_COM_PT_CSInit_002	—	m
ATC_COM_PT_CSInit_003	—	r
ATC_COM_NT_CSLimited_001	—	m
ATC_COM_PT_CSLimited_002	—	m
ATC_COM_NT_CSUnlCntrl_001	—	m
ATC_COM_PT_CSUnlCntrl_002	—	r *4
ATC_COM_PT_CSUnlCntrl_003	—	r *4
ATC_COM_PT_CSFS_001	—	m
ATC_COM_PT_CSFS_002	—	m
ATC_COM_PT_CSFS_003	—	m
ATC_COM_NT_CSUnlAuto_001	—	o/m *1
ATC_COM_PT_CSUnlAuto_002	—	o
ATC_COM_PT_CSTransition1_001	—	m
ATC_COM_PT_CSTransition1_002	—	m
ATC_COM_PT_CSTransition2_001	—	m
ATC_COM_PT_CSTransition3_001	—	o/m *1
ATC_COM_PT_CSTransition3_002	—	o/m *1
ATC_COM_PT_CSTransition4_001	—	m
ATC_COM_PT_CSTransition5_001	—	m
ATC_COM_PT_CSTransition6_001	—	m
ATC_COM_PT_CSTransition6_002	—	m
ATC_COM_PT_CSTransition7_001	—	m
ATC_COM_PT_CSTransition8_001	—	m
ATC_COM_PT_CSTransition8_002	—	m
ATC_COM_PT_CSTransition9_001	—	m
ATC_COM_PT_CSTransition10_001	—	o/m *1
ATC_COM_PT_CSTransition10_002	—	o/m *1
ATC_COM_PT_CSTransition11_001	—	o/m *1
ATC_COM_PT_CSTransition11_002	—	o/m *1
ATC_COM_PT_CSTransition12_001	—	o/m *1
ATC_INS1_PT_CSTransition1_001	—	o *2
ATC_INS2_PT_CSTransition1_001	—	o *2

Table 13: Test case coverage of verdict statements

*1: The referenced version [LPP1.0.0] of the Use Case "Limitation of Power Production" describes rules when the state "unlimited/autonomous" can be accessed by a CS. These rules are designed to allow delayed access to this state. Theoretically, this delay can be infinite, leading to the possibility of not implementing this state at all. Although this is a very unlikely (and not recommended) option for implementation, test cases with the "unlimited/autonomous" state are usually marked as optional. However, as soon as implementations of a CS include the "unlimited/autonomous" state, the correspondingly marked abstract test cases become "mandatory".

*2: The manufacturer must specify conditions on how the test case can be tested (e.g. via debug interface). If the write command is rejected, this may only be done for the reasons mentioned. The rationale needs to be documented in the [ParameterSheet].

*3: If the device is black start capable, the corresponding ATC is "mandatory".

784 *[4]: If the CS is a CEM, test case ATC_COM_PT_CSUnlCntrl_002 is "mandatory" and test case
785 ATC_COM_PT_CSUnlCntrl_003 is not executed. Otherwise, test case ATC_COM_PT_CSUnlCntrl_003
786 is "mandatory" and test case ATC_COM_PT_CSUnlCntrl_002 is not executed.

787

7 Abstract test cases for EG

7.1 General information

In this chapter, all abstract test cases for the Use Case "Limitation of Power Production" conformance test are specified covering the LPP requirements as defined in [LPP1.0.0] and summarized in chapter 5.2 of this document. Within this chapter, the EG is the DUT.

7.2 Common abstract test cases

7.2.1 Heartbeat

Table 14 shows the test case description for ATC_COM_PT_EGHeartbeat_001.

ATC ID		ATC_COM_PT_EGHeartbeat_001
Description		This test shall ensure that the EG sends its heartbeats regularly. The interval between 2 consecutive heartbeats shall not exceed 60 seconds.
Referenced Requirement(s)		[LPP-TS-006]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	Count 5 heartbeats sent by the EG.	The longest period between 2 consecutive heartbeats does not exceed 60 seconds.

Table 14: ATC_COM_PT_EGHeartbeat_001

7.2.2 Connection

Table 15 shows the test case description for ATC_COM_PT_EGConnection_001.

ATC ID		ATC_COM_PT_EGConnection_001
Description		This test shall ensure that the EG sends its heartbeat followed by an APPL command after the EG has rebooted.
Referenced Requirement(s)		[LPP-TS-030]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested. For test step 2: Message combinations (any): MSG_14, MSG_15, MSG_16, MSG_17
Pre-condition		CF_EG_Reboot, CF_CS_FS
Execution		**Expected result**
1.	Wait for the reboot to be completed.	Reboot completed within StartUpDur_EG.
2.	Wait for the EG to send at least one heartbeat and a following APPL write command in time. [E-DT60]	The CS receives at least one EG heartbeat and a following APPL write command within 60 seconds.

Table 15: ATC_COM_PT_EGConnection_001

802 Table 16 shows the test case description for ATC_COM_PT_EGConnection_002.

ATC ID	ATC_COM_PT_EGConnection_002	
Description	This test shall ensure that the EG sends its heartbeat followed by an APPL command after restoring the connection to the CS.	
Referenced Requirement(s)	[LPP-TS-030]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 1: Message combinations (any): MSG_14, MSG_15, MSG_16, MSG_17	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Restore the communication between EG and CS and wait for the EG to send at least one heartbeat and a following APPL write command in time.	The CS receives at least one EG heartbeat and a following APPL write command within 60 seconds after the communication is restored.

803 *Table 16: ATC_COM_PT_EGConnection_002*

804 Table 17 shows the test case description for ATC_COM_PT_EGConnection_003. *[1]

ATC ID	ATC_COM_PT_EGConnection_003	
Description	This test shall ensure that the EG automatically reconnects after a black start.	
Referenced Requirement(s)	[LPP-TS-030]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl	
Execution		**Expected result**
1.	Switch off the power supply to both the tester and the DUT.	Both devices turn off.
2.	Wait for a 90 seconds interval.	
3.	Switch on the power supply to both the tester and the DUT.	Both devices turn on.
4.	Wait for the tester to be in CF_CS_Init configuration and for the EG to be in CF_EG_ConnectionEstablished. Maximum waiting time for this test step equals the larger value of StartUpDur_EG and StartUpDur_CS.	
5.	Wait for the EG to send at least one heartbeat and a following APPL write command in time. [E-DT60]	The CS receives at least one EG heartbeat and a following APPL write command within 60 seconds.

805 *Table 17: ATC_COM_PT_EGConnection_003*

806 *[1]: If a test implementation is used as a tester instead of a real device, it is permissible to simulate
807 the black start behaviour of the tester in relation to the DUT (as with a real device).

808

7.2.3 Messages

Table 18 shows the test case description for ATC_COM_PT_EGMessages_001.

ATC ID	ATC_COM_PT_EGMessages_001	
Description	This test shall ensure that the EG causes the CS to change its current state from unlimited/controlled to limited without a duration due to an external stimulus.	
Referenced Requirement(s)	[LPP-TS-001]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 1: Message combinations (any): MSG_14 APPL values (all): APPL_02, APPL_03, APPL_04	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl	
Execution		**Expected result**
1.	Set an external stimulus signalling the EG to send an activated APPL write command to the CS and wait for the EG to send the activated APPL write command.	The EG is able to send an activated APPL write command. The CS receives and accepts the write command.

Table 18: ATC_COM_PT_EGMessages_001

Table 19 shows the test case description for ATC_COM_PT_EGMessages_002.

ATC ID	ATC_COM_PT_EGMessages_002	
Description	This test shall ensure that the EG resends its messages when receiving a NACK from the CS after the EG has rebooted.	
Referenced Requirement(s)	[LPP-TS-046]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test steps 3 and 4: Message combinations (any): MSG_14 APPL values (all): APPL_02, APPL_03, APPL_04	
Pre-condition	CF_EG_Reboot, CF_CS_UnlAuto	
Execution		**Expected result**
1.	Wait for the reboot to be completed.	Reboot completed within StartUpDur_EG.
2.	Wait for the EG to send at least one heartbeat. [E-DT60]	The CS receives at least one heartbeat. The connection is maintained. *[3]
3.	The CS should intentionally reject the next APPL write command. Wait for the EG to send an activated APPL write command and reject it on the CS side. [1:E-DT120] *[1]	The EG sends the activated write command in time and receives a corresponding NACK from the CS.
4.	Wait for the EG to send at least one heartbeat and a following APPL write command in time.	The CS receives at least one EG heartbeat and a following APPL write command within 60 seconds.

	[E-DT60] *2	

Table 19: ATC_COM_PT_EGMessages_002

*1: The timeout for a resend within 120 seconds is to be considered best practice.

*2: The timeout of 60 seconds within which the EG sends both messages is considered best practice.

*3: Necessary steps to maintain the connection (e.g. sending heartbeats) during test execution are not explicitly described in the subsequent test steps.

Table 20 shows the test case description for ATC_COM_PT_EGMessages_003.

ATC ID		ATC_COM_PT_EGMessages_003
Description		This test shall ensure that the EG sends valid messages over an extended period of time. The tester (CS) is able to switch its internal states immediately according to received write commands.
Referenced Requirement(s)		[LPP-TS-001], [LPP-TS-001/2], [LPP-TS-002]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	25 iterations of the following sequence: 1. Initiate an activated APPL write command with a duration and wait for the EG to send the command. 2. Initiate a deactivated APPL write command and wait for the EG to send the command.	The CS receives and accepts each write command. *1

Table 20: ATC_COM_PT_EGMessages_003

*1: The tester (CS) rejects invalid received messages.

Table 21 shows the test case description for ATC_COM_PT_EGMessages_004.

ATC ID		ATC_COM_PT_EGMessages_004
Description		This test shall ensure that the EG sends valid messages over an extended period of time. The tester (CS) is able to switch its internal states immediately according to received write commands.
Referenced Requirement(s)		[LPP-TS-003], [LPP-TS-011/1], [LPP-TS-013/1]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	5 iterations of the following sequence: 1. Initiate an FPAPL write command and wait for the EG to send the command.	The CS receives and accepts each write command. *1

	2. Initiate a Failsafe Duration Minimum write command and wait for the EG to send the command.	

Table 21: ATC_COM_PT_EGMessages_004

*[1]: The tester (CS) rejects invalid received messages.

8 Abstract test cases for CS

8.1 General information

In this chapter, all abstract test cases for the Use Case "Limitation of Power Production" conformance test are specified covering the LPP requirements as defined in [LPP1.0.0] and summarized in chapter 5.2 of this document. Within this chapter, the CS is the DUT.

Section 8.2 details abstract test case descriptions in which there is no distinction between the instances.
Section 8.3 details abstract test case descriptions in which the DUT operates in LPP instance 1.
Section 8.4 details abstract test case descriptions in which the DUT operates in LPP instance 2.

NOTE 19 For further information regarding the LPP instances please refer to section 6.9 within this document and to section 2.4 of [LPP1.0.0].

8.2 Common abstract test cases

8.2.1 Heartbeat

Table 22 shows the test case description for ATC_COM_PT_CSHeartbeat_001.

ATC ID	ATC_COM_PT_CSHeartbeat_001	
Description	This test shall ensure that the CS sends its heartbeats regularly. The interval between 2 consecutive heartbeats shall not exceed 60 seconds.	
Referenced Requirement(s)	[LPP-TS-007]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl	
Execution		**Expected result**
1.	Count 5 heartbeats sent by the CS.	The longest period between 2 consecutive heartbeats does not exceed 60 seconds.

Table 22: ATC_COM_PT_CSHeartbeat_001

8.2.2 Connection

Table 23 shows the test case description for ATC_COM_NT_CSConnection_001.

ATC ID	ATC_COM_NT_CSConnection_001
Description	This test shall ensure that the CS does not evaluate APPL write commands until it first receives an EG heartbeat after the connection is established.
Referenced Requirement(s)	[LPP-TS-004], [LPP-TS-036]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test steps 2 and 4: Message combinations (any): MSG_16 APPL values (all): APPL_03

Pre-condition		CF_EG_ManualExecution, CF_CS_Init
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG APPL deactivation write command. [E-DT60]	The CS receives and rejects the write command.
3.	Send an EG heartbeat.	The CS receives the heartbeat.
4.	Send an EG APPL deactivation write command. [2:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

844 *Table 23: ATC_COM_NT_CSConnection_001*

845 Table 24 shows the test case description for ATC_COM_PT_CSConnection_002.

ATC ID		ATC_COM_PT_CSConnection_002
Description		This test shall ensure that the CS does not evaluate write commands to any data point (FPAPL) until it first receives an EG heartbeat and a following APPL write command after the connection is established.
Referenced Requirement(s)		[LPP-TS-003], [LPP-TS-036], [LPP-TS-037], [LPP-TS-038]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested. For test step 4: Message combinations (any): MSG_16 APPL values (all): APPL_03 For test steps 3 and 5: FPAPL values (all): FPAPL_03
Pre-condition		CF_EG_ManualExecution, CF_CS_Init
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG FPAPL write command.	The CS receives and rejects the write command.
4.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
5.	Send an EG FPAPL write command.	The CS receives and accepts the write command.

846 *Table 24: ATC_COM_PT_CSConnection_002*

847 Table 25 shows the test case description for ATC_COM_PT_CSConnection_003.

ATC ID	ATC_COM_PT_CSConnection_003

Description	This test shall ensure that the CS only accepts APPL values smaller than or equal to zero and FPAPL values greater than or equal to zero.
Referenced Requirement(s)	[LPP-TS-005], [LPP-TS-018], [LPP-TS-038]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_14, MSG_16 APPL values (all): APPL_06 For test step 4: FPAPL values (all): FPAPL_06 For test step 5: FPAPL values (all): FPAPL_03
Pre-condition	CF_EG_ManualExecution, CF_CS_Init

Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL write command with a positive value. [1:E-DT60]	The CS receives and rejects the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG FPAPL write command with a negative value.	The CS receives and rejects the write command. The EG receives a NACK from the CS.
5.	Send an EG FPAPL write command. [3:E-DT60]	The CS receives and accepts the write command.

Table 25: ATC_COM_PT_CSConnection_003

Table 26 shows the test case description for ATC_COM_PT_CSConnection_004.

ATC ID	ATC_COM_PT_CSConnection_004
Description	This test shall ensure that the CS does not evaluate write commands to any data point (Failsafe Duration Minimum) until it first receives an EG heartbeat and a following APPL write command after the connection is established.
Referenced Requirement(s)	[LPP-TS-005], [LPP-TS-037]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 4: Message combinations (any): MSG_16 APPL values (all): APPL_03 For test step 3: Failsafe Duration Minimum values (all): FPAPL_DUR_02
Pre-condition	CF_EG_ManualExecution, CF_CS_Init

Execution	**Expected result**

1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG Failsafe Duration Minimum write command.	The CS receives and rejects the write command. The EG receives a NACK from the CS.
4.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 26: ATC_COM_PT_CSConnection_004

Table 27 shows the test case description for ATC_COM_PT_CSConnection_005.

ATC ID	ATC_COM_PT_CSConnection_005	
Description	This test shall ensure that the CS evaluates write commands to the Failsafe Duration Minimum if the submitted value is greater than the maximum value of the CS.	
Referenced Requirement(s)	[LPP-TS-014], [LPP-TS-015], [LPP-TS-015/1], [LPP-TS-016]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_16 APPL values (all): APPL_03 For test step 4: Failsafe Duration Minimum values (all): FPAPL_DUR_03	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG Failsafe Duration Minimum write command.	The CS receives and accepts or rejects the write command.
5.	Check the Failsafe Duration Minimum value of the CS.	The CS changed the Failsafe Duration Minimum. • The CS received and accepted the write command. The CS changed its Failsafe Duration

		Minimum value according to the value sent. OR • The CS received and rejected the write command. The CS changed its Failsafe Duration Minimum value to its MFSDM.

852 *Table 27: ATC_COM_PT_CSConnection_005*

853 Table 28 shows the test case description for ATC_COM_PT_CSConnection_006.

ATC ID		ATC_COM_PT_CSConnection_006
Description		This test shall ensure that the CS accepts APPL write commands with a larger value than the possible maximum production and alters the value accordingly.
Referenced Requirement(s)		[LPP-TS-035/4]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_14 APPL values (all): APPL_05 APPL duration values (all): APPL_DUR_02
Pre-condition		CF_EG_ManualExecution, CF_CS_Init
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL activation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_wo_dur.
4.	Check the APPL value of the CS.	The CS changes its APPL value according to the value sent.

854 *Table 28: ATC_COM_PT_CSConnection_006*

855 Table 29 shows the test case description for ATC_COM_PT_CSConnection_007.

ATC ID	ATC_COM_PT_CSConnection_007
Description	This test shall ensure that the CS correctly evaluates APPL write commands.
Referenced Requirement(s)	[LPP-TS-001], [LPP-TS-035], [LPP-TS-035/4]
Test variation	The variation of the data sets result into a sum of 5 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_16 APPL values (all): APPL_03

	For test step 4: Message combinations (any): MSG_14 APPL values (all): APPL_01, APPL_02, APPL_03, APPL_04, APPL_05	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG APPL activation write command. [2:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_wo_dur. For APPL_01: The CS changes its production to 0 and the APPL value according to the value sent. For APPL_02: The CS changes its APPL value according to the value sent. For APPL_03: The CS changes its APPL value according to the value sent. For APPL_04: The CS changes its APPL value according to the value sent. For APPL_05: The CS changes its APPL value according to the value sent.

Table 29: ATC_COM_PT_CSConnection_007

Table 30 shows the test case description for ATC_COM_PT_CSConnection_008.

ATC ID	ATC_COM_PT_CSConnection_008
Description	This test shall ensure that the CS correctly evaluates FPAPL and Failsafe Duration Minimum write commands.
Referenced Requirement(s)	[LPP-TS-001], [LPP-TS-015/1], [LPP-TS-016], [LPP-TS-038]
Test variation	The variation of the data sets result into a sum of 7 test executions with 1 actor being tested. For test step 1: FPAPL values (all): FPAPL_01, FPAPL_02, FPAPL_03, FPAPL_04, FPAPL_05 For test step 2: Failsafe Duration Minimum values (all): FPAPL_DUR_01, FPAPL_DUR_02, FPAPL_DUR_03
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl

Execution		Expected result
1.	Send an EG FPAPL write command.	The CS receives and accepts the write command. The CS changes its FPAPL value according to the value sent.
2.	Send an EG Failsafe Duration Minimum write command.	For FPAPL_DUR_01: The CS receives and rejects the write command. For FPAPL_DUR_02: The CS receives and accepts the write command. The CS changes its Failsafe Duration Minimum value according to the value sent. For FPAPL_DUR_03: • The CS receives and accepts the write command. The CS changes its Failsafe Duration Minimum value according to the value sent. OR • The CS receives and rejects the write command. The CS changes its Failsafe Duration Minimum value to its MFSDM.

858 *Table 30: ATC_COM_PT_CSConnection_008*

859 Table 31 shows the test case description for ATC_COM_PT_CSConnection_009. *[1]

ATC ID	ATC_COM_PT_CSConnection_009
Description	This test shall ensure that the CS automatically reconnects after a black start.
Referenced Requirement(s)	[LPP-TS-046]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 6 and 8: Message combinations (any): MSG_16 APPL values (all): APPL_03
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl

Execution		Expected result
1.	Switch off the power supply to both the tester and the DUT.	Both devices turn off.
2.	Wait for a 90 seconds interval.	
3.	Switch on the power supply to both the tester and the DUT.	Both devices turn on.
4.	Wait for the tester to be in CF_EG_ConnectionEstablished	If StartUpDur_EG is longer than 120 seconds after the CS reached CF_CS_Init, the CS may change its configuration to CF_CS_UnlAuto.

	configuration and for the CS to be at least in CF_CS_Init. Maximum waiting time for this test step equals the larger value of StartUpDur_EG and StartUpDur_CS.	
5.	Send an EG heartbeat.	The CS receives the heartbeat.
6.	Send an EG APPL deactivation write command. [4:E-DT60]	• The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl. OR • The CS receives and rejects the write command. *[2]
7.	Send an EG heartbeat. *[3]	The CS receives the heartbeat.
8.	Send an EG APPL deactivation write command. *[3] [6:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 31: ATC_COM_PT_CSConnection_009

*[1]: If a test implementation is used as a tester instead of a real device, it is permissible to simulate the black start behaviour of the tester in relation to the DUT (as with a real device).

*[2]: According to [LPP1.0.0] it depends on the timing to which configuration the CS would change. This is not verified in this test step.

*[3]: Only execute test steps 7 and 8 if the write command from test step 6 was rejected by the CS.

8.2.3 Init

Table 32 shows the test case description for ATC_COM_PT_CSInit_001.

ATC ID	ATC_COM_PT_CSInit_001	
Description	This test shall ensure that the CS starts with a limited power production stated in the FPAPL and a deactivated APPL after a factory reset.	
Referenced Requirement(s)	[LPP-TS-009/3], [LPP-TS-011], [LPP-TS-017], [LPP-TS-019]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ManualExecution, CF_CS_Reset_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Check the FPAPL parameter of the CS.	The CS limits its power production with its PFPAPL.
3.	Check if the APPL of the CS is activated or deactivated. [1:E-DT120]	The APPL of the CS is deactivated.

Table 32: ATC_COM_PT_CSInit_001

Table 33 shows the test case description for ATC_COM_PT_CSInit_002.

ATC ID		ATC_COM_PT_CSInit_002
Description		This test shall ensure that the CS starts with default parameters after a factory reset.
Referenced Requirement(s)		[LPP-TS-009/2], [LPP-TS-009/3], [LPP-TS-011], [LPP-TS-013]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ManualExecution, CF_CS_Reset_Init
Execution		**Expected result**
1.	Reset the CS.	The CS reboots.
2.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
3.	Send an EG heartbeat. [E-DT60]	The CS receives the heartbeat.
4.	Check if the APPL of the CS is activated or deactivated.	The APPL of the CS is deactivated.
5.	Check the PFPAPL value of the CS.	The PFPAPL value is equal to the specified value in the [ParameterSheet].
6.	Check the PFSDM value of the CS. [2:E-DT120]	The PFSDM value is equal to the specified value in the [ParameterSheet].

Table 33: ATC_COM_PT_CSInit_002

Table 34 shows the test case description for ATC_COM_PT_CSInit_003.

ATC ID		ATC_COM_PT_CSInit_003
Description		This test shall ensure that the CS persistently stores the FPAPL and Failsafe Duration Minimum values.
Referenced Requirement(s)		[LPP-TS-011/1], [LPP-TS-013/1], [LPP-TS-044]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested. For test steps 3 and 10: Message combinations (any): MSG_16 APPL values (all): APPL_03 For test step 4: FPAPL values (all): FPAPL_03 For test step 6: Failsafe Duration Minimum values (all): FPAPL_DUR_02
Pre-condition		CF_EG_ManualExecution, CF_CS_Init
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.

3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG FPAPL write command. [E-DT0*]	The CS receives and accepts the write command.
5.	Send an EG heartbeat. [3:E-DT60]	The CS receives the heartbeat.
6.	Send an EG Failsafe Duration Minimum write command. [E-DT0*]	The CS receives and accepts the write command.
7.	Send an EG heartbeat. [5:E-DT60]	The CS receives the heartbeat.
8.	Reboot the CS and wait until it's able to exchange messages.	The CS restarts in configuration CF_CS_Init.
9.	Send an EG heartbeat.	The CS receives the heartbeat.
10.	Send an EG APPL deactivation write command. [9:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
11.	Check the FPAPL parameter of the CS.	The CS changed the FPAPL to the value sent in test step 4.
12.	Check the Failsafe Duration Minimum parameter of the CS.	The CS changed the Failsafe Duration Minimum to the value sent in test step 6.

Table 34: ATC_COM_PT_CSInit_003

8.2.4 Limited

Table 35 shows the test case description for ATC_COM_NT_CSLimited_001.

ATC ID	ATC_COM_NT_CSLimited_001	
Description	This test shall ensure that the CS is limited with an activated APPL and maintains its state after rejecting invalid APPL commands.	
Referenced Requirement(s)	[LPP-TS-009/1], [LPP-TS-024], [LPP-TS-035/1]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 2: Message combinations (any): MSG_01, MSG_06, MSG_08, MSG_14, MSG_15, MSG_16, MSG_17 APPL values (all): APPL_06	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_Limited_wo_dur	
Execution		**Expected result**
1.	Check if the APPL of the CS is activated or deactivated.	The APPL of the CS is activated.
2.	Send an EG APPL write command with a positive value.	The CS receives and rejects the write command. The CS stays in CF_CS_Limited_wo_dur.

Table 35: ATC_COM_NT_CSLimited_001

Table 36 shows the test case description for ATC_COM_PT_CSLimited_002.

ATC ID	ATC_COM_PT_CSLimited_002	
Description	This test shall ensure that the CS maintains its state and accepts APPL write commands even if heartbeats from the EG are absent.	
Referenced Requirement(s)	[LPP-TS-001/2], [LPP-TS-002]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test steps 3 and 6: Message combinations (any): MSG_14 APPL values (all): APPL_03 APPL duration values (all): APPL_DUR_02	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL activation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_wo_dur.
4.	Send an EG heartbeat. [E-DT60]	The CS receives the heartbeat.
5.	Wait for a 90 second interval.	
6.	Send an EG APPL activation write command. [E-DT0*]	The CS receives and accepts the write command.
7.	Send an EG heartbeat. [5:E-DT30]	The CS receives the heartbeat. The CS stays in CF_CS_Limited_wo_dur.

Table 36: ATC_COM_PT_CSLimited_002

8.2.5 Unlimited/controlled

Table 37 shows the test case description for ATC_COM_NT_CSUnlCntrl_001.

ATC ID	ATC_COM_NT_CSUnlCntrl_001
Description	This test shall ensure that the CS maintains its state after rejecting invalid APPL commands.
Referenced Requirement(s)	[LPP-TS-009], [LPP-TS-009/3], [LPP-TS-023]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 2: Message combinations (any): MSG_06, MSG_14 APPL values (all): APPL_06

Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	Check if the APPL of the CS is activated or deactivated.	The APPL of the CS is deactivated.
2.	Send an EG APPL write command with a positive value.	The CS receives and rejects the write command. The CS stays in CF_CS_UnlCntrl.

Table 37: ATC_COM_NT_CSUnlCntrl_001

Table 38 shows the test case description for ATC_COM_PT_CSUnlCntrl_002.

ATC ID		ATC_COM_PT_CSUnlCntrl_002
Description		This test shall ensure that the CS supports and provides the Contractual Production Nominal Max value, as it is an actor of type CEM.
Referenced Requirement(s)		[LPP-TS-010/3], [LPP-TS-010/4], [LPP-TS-039]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	Check the Power Production Nominal Max value of the CS.	The Power Production Nominal Max value is not supported.
2.	Check the Contractual Production Nominal Max value of the CS.	The Contractual Production Nominal Max value is supported and provided.

Table 38: ATC_COM_PT_CSUnlCntrl_002

Table 39 shows the test case description for ATC_COM_PT_CSUnlCntrl_003.

ATC ID		ATC_COM_PT_CSUnlCntrl_003
Description		This test shall ensure that the CS supports and provides the Power Production Nominal Max value, as it is not an actor of type CEM.
Referenced Requirement(s)		[LPP-TS-010/1], [LPP-TS-010/2], [LPP-TS-040]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	Check the Contractual Production Nominal Max value of the CS.	The Contractual Production Nominal Max value is not supported.
2.	Check the Power Production Nominal Max value of the CS.	The Power Production Nominal Max value is supported and provided.

Table 39: ATC_COM_PT_CSUnlCntrl_003

8.2.6 Failsafe state

Table 40 shows the test case description for ATC_COM_PT_CSFS_001.

ATC ID	ATC_COM_PT_CSFS_001

Description	This test shall ensure that the CS does not evaluate write commands to any data point until it first receives an EG heartbeat and a following APPL write command within 60 seconds.
Referenced Requirement(s)	[LPP-TS-033], [LPP-TS-036], [LPP-TS-037]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test steps 4 and 8: Message combinations (any): MSG_07, MSG_16 APPL values (all): APPL_03 For test steps 5 and 10: FPAPL values (all): FPAPL_03 For test step 6: Failsafe Duration Minimum values (any): FPAPL_DUR_02
Pre-condition	CF_EG_ManualExecution, CF_CS_FS

Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Wait for a 90 second interval.	
4.	Send an EG APPL deactivation write command. [E-DT0*]	The CS receives and rejects the write command. The CS stays in CF_CS_FS.
5.	Send an EG FPAPL write command. [E-DT0*]	The CS receives and rejects the write command. The CS stays in CF_CS_FS.
6.	Send an EG Failsafe Duration Minimum write command.	The CS receives and rejects the write command. The CS stays in CF_CS_FS.
7.	Send an EG heartbeat. [E-DT0*]	The CS receives the heartbeat.
8.	Send an EG APPL deactivation write command. [E-DT0*]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
9.	Send an EG heartbeat. [7:E-DT60]	The CS receives the heartbeat.
10.	Send an EG FPAPL write command. [E-DT120]	The CS receives and accepts the write command.

Table 40: ATC_COM_PT_CSFS_001

Table 41 shows the test case description for ATC_COM_PT_CSFS_002.

ATC ID	ATC_COM_PT_CSFS_002
Description	This test shall ensure that the CS remains in failsafe state for the Failsafe Duration Minimum.

Referenced Requirement(s)	[LPP-TS-012], [LPP-TS-013]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Wait until the Failsafe Duration Minimum expires.	The CS changes its configuration to CF_CS_UnlAuto or stays in CF_CS_FS after the duration expires.

Table 41: ATC_COM_PT_CSFS_002

Table 42 shows the test case description for ATC_COM_PT_CSFS_003.

ATC ID	ATC_COM_PT_CSFS_003	
Description	This test shall ensure that the CS rejects Failsafe Duration Minimum write commands in failsafe state.	
Referenced Requirement(s)	[LPP-TS-009], [LPP-TS-009/3]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 4: Failsafe Duration Minimum values (any): FPAPL_DUR_02	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Check if the APPL of the CS is activated or deactivated.	The APPL of the CS is deactivated.
3.	Send an EG heartbeat.	The CS receives the heartbeat.
4.	Send an EG Failsafe Duration Minimum write command. [3:E-DT60]	The CS receives and rejects the write command. The CS stays in CF_CS_FS.

Table 42: ATC_COM_PT_CSFS_003

8.2.7 Unlimited/autonomous

Table 43 shows the test case description for ATC_COM_NT_CSUnlAuto_001.

ATC ID	ATC_COM_NT_CSUnlAuto_001
Description	This test shall ensure that the CS does not evaluate write commands to any data point until it first receives an EG heartbeat and a following APPL write command within 60 seconds.
Referenced Requirement(s)	[LPP-TS-033], [LPP-TS-036], [LPP-TS-037]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test steps 4 and 7: Message combinations (any): MSG_03, MSG_16 APPL values (all): APPL_03

	For test steps 5 and 9: FPAPL values (all): FPAPL_03	
Pre-condition	CF_EG_ManualExecution, CF_CS_UnlAuto	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Wait for a 90 second interval.	
4.	Send an EG APPL deactivation write command. [E-DT0*]	The CS receives and rejects the write command. The CS stays in CF_CS_UnlAuto.
5.	Send an EG FPAPL write command. [E-DT0*]	The CS receives and rejects the write command.
6.	Send an EG heartbeat. [E-DT0*]	The CS receives the heartbeat.
7.	Send an EG APPL deactivation write command. [E-DT0*]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
8.	Send an EG heartbeat. [6:E-DT60]	The CS receives the heartbeat.
9.	Send an EG FPAPL write command. [E-DT120]	The CS receives and accepts the write command.

Table 43: ATC_COM_NT_CSUnlAuto_001

Table 44 shows the test case description for ATC_COM_PT_CSUnlAuto_002.

ATC ID	ATC_COM_PT_CSUnlAuto_002	
Description	This test shall ensure that the CS does not produce (or allow production) higher than the according nominal maximum value. The APPL is deactivated in CF_CS_UnlAuto.	
Referenced Requirement(s)	[LPP-TS-009/3], [LPP-TS-010], [LPP-TS-038]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_UnlAuto	
Execution		**Expected result**
1.	Compare the actual power production with the pre-configured nominal max parameter. *[1]	The actual power production is less than or equal to the nominal max.
2.	Check if the APPL of the CS is activated or deactivated.	The APPL of the CS is deactivated.

Table 44: ATC_COM_PT_CSUnlAuto_002

*[1]: The tester (EG) must read out which nominal max parameter is present.

For a DUT of actor type CEM, the parameter is Contractual Production Nominal Max.

For a DUT that is not a CEM type actor, the parameter is Power Production Nominal Max.

905

906 ### 8.2.8 Transition 1

907 Table 45 shows the test case description for ATC_COM_PT_CSTransition1_001.

ATC ID	ATC_COM_PT_CSTransition1_001	
Description	This test shall ensure that the CS changes its state after rejecting an activated APPL with invalid value.	
Referenced Requirement(s)	[LPP-TS-018], [LPP-TS-035/1]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_14 APPL values (all): APPL_06	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL write command with a positive value. [1:E-DT60]	The CS receives and rejects the write command. The CS changes its configuration to CF_CS_UnlCntrl.

908 *Table 45: ATC_COM_PT_CSTransition1_001*

909 Table 46 shows the test case description for ATC_COM_PT_CSTransition1_002.

ATC ID	ATC_COM_PT_CSTransition1_002	
Description	This test shall ensure that the CS changes its state after accepting a deactivated APPL write command.	
Referenced Requirement(s)	[LPP-TS-021]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_16, MSG_17 APPL values (all): APPL_03 APPL duration values (all): APPL_DUR_01	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

910 *Table 46: ATC_COM_PT_CSTransition1_002*

8.2.9 Transition 2

Table 47 shows the test case description for ATC_COM_PT_CSTransition2_001.

ATC ID	ATC_COM_PT_CSTransition2_001	
Description	This test shall ensure that the CS changes its state after accepting an activated APPL command.	
Referenced Requirement(s)	[LPP-TS-020]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_15 APPL values (all): APPL_02, APPL_03, APPL_04 APPL duration values (any): APPL_DUR_01	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL activation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_w_dur.

Table 47: ATC_COM_PT_CSTransition2_001

8.2.10 Transition 3

Table 48 shows the test case description for ATC_COM_PT_CSTransition3_001.

ATC ID	ATC_COM_PT_CSTransition3_001	
Description	This test shall ensure that the CS changes its state after not receiving a heartbeat and a following APPL command.	
Referenced Requirement(s)	[LPP-TS-022], [LPP-TS-022/1]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Wait for configuration change of the CS for 130 seconds.	The CS does not receive a heartbeat and a following APPL write command. The CS changes its configuration to CF_CS_UnlAuto or stays in CF_CS_Init.

Table 48: ATC_COM_PT_CSTransition3_001

919 Table 49 shows the test case description for ATC_COM_PT_CSTransition3_002.

ATC ID	ATC_COM_PT_CSTransition3_002	
Description	This test shall ensure that the CS changes its state after receiving a heartbeat, but no following APPL write command.	
Referenced Requirement(s)	[LPP-TS-022], [LPP-TS-022/1]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Wait for configuration change of the CS for 130 seconds.	The CS does not receive an APPL write command. The CS changes its configuration to CF_CS_UnlAuto or stays in CF_CS_Init.

920 *Table 49: ATC_COM_PT_CSTransition3_002*

921

922 **8.2.11 Transition 4**

923 Table 50 shows the test case description for ATC_COM_PT_CSTransition4_001.

ATC ID	ATC_COM_PT_CSTransition4_001	
Description	This test shall ensure that the CS changes its state after receiving and accepting an APPL command.	
Referenced Requirement(s)	[LPP-TS-027]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 1: Message combinations (any): MSG_15 APPL values (all): APPL_02, APPL_03, APPL_04 APPL duration values (any): APPL_DUR_01	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl	
Execution		**Expected result**
1.	Send an EG APPL activation write command.	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_w_dur.

924 *Table 50: ATC_COM_PT_CSTransition4_001*

925

926 **8.2.12 Transition 5**

927 Table 51 shows the test case description for ATC_COM_PT_CSTransition5_001.

ATC ID		ATC_COM_PT_CSTransition5_001
Description		This test shall ensure that the CS changes its state after not receiving a heartbeat within 120 seconds.
Referenced Requirement(s)		[LPP-TS-028]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_UnlCntrl
Execution		**Expected result**
1.	Simulate an interrupted connection, e.g. by disconnecting the network.	The network connection to the EG is interrupted.
2.	Wait for configuration change of the CS for at least 130 seconds.	The CS changes its configuration to CF_CS_FS within 120 seconds since communication interrupt.

928 *Table 51: ATC_COM_PT_CSTransition5_001*

929

930 **8.2.13 Transition 6**

931 Table 53 shows the test case description for ATC_COM_PT_CSTransition6_001.

ATC ID		ATC_COM_PT_CSTransition6_001
Description		This test shall ensure that the CS changes its state after the APPL duration is expired.
Referenced Requirement(s)		[LPP-TS-001/1], [LPP-TS-008], [LPP-TS-008/1], [LPP-TS-025]
Test variation		No variation of the setup results into 1 test execution with 1 actor being tested. For test step 1: Message combinations (any): MSG_09, MSG_15 APPL values (all): APPL_03 APPL duration values (all): APPL_DUR_01
Pre-condition		CF_EG_ConnectionEstablished, CF_CS_Limited_wo_dur
Execution		**Expected result**
1.	Send an EG APPL duration write command.	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_w_dur.
2.	Wait for the set duration to expire.	The duration is expired. The CS changes its configuration to CF_CS_UnlCntrl.
3.	Optional test step: Check the APPL duration parameter of the CS.	The APPL duration parameter is deleted or has a value of 0 seconds.

932 *Table 52: ATC_COM_PT_CSTransition6_001*

933 Table 53 shows the test case description for ATC_COM_PT_CSTransition6_002.

ATC ID	ATC_COM_PT_CSTransition6_002

Description	This test shall ensure that the CS changes its state after receiving an APPL deactivation command.	
Referenced Requirement(s)	[LPP-TS-026]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 1: Message combinations (any): MSG_07, MSG_16, MSG_17 APPL values (all): APPL_03 APPL duration values (any): APPL_DUR_01	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_Limited_wo_dur	
Execution		**Expected result**
1.	Send an EG APPL deactivation write command.	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 53: ATC_COM_PT_CSTransition6_002

8.2.14 Transition 7

Table 54 shows the test case description for ATC_COM_PT_CSTransition7_001.

ATC ID	ATC_COM_PT_CSTransition7_001	
Description	This test shall ensure that the CS changes its state after not receiving a heartbeat within 120 seconds.	
Referenced Requirement(s)	[LPP-TS-029]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 1: FPAPL values (all): FPAPL_02, FPAPL_03, FPAPL_04	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_Limited_wo_dur	
Execution		**Expected result**
1.	Send an EG FPAPL write command.	The CS receives and accepts the write command.
2.	Simulate an interrupted connection, e.g. by disconnecting the network.	The network connection to the EG is interrupted.
3.	Wait for configuration change of the CS for at least 130 seconds.	After the communication to the EG has been interrupted for 130 seconds, the CS changes its configuration to CF_CS_FS.

Table 54: ATC_COM_PT_CSTransition7_001

8.2.15 Transition 8

Table 55 shows the test case description for ATC_COM_PT_CSTransition8_001.

ATC ID	ATC_COM_PT_CSTransition8_001	
Description	This test shall ensure that the CS changes its state after receiving an APPL command which cannot be applied.	
Referenced Requirement(s)	[LPP-TS-031], [LPP-TS-035/1]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_06, MSG_07, MSG_08, MSG_09, MSG_14, MSG_15, MSG_16, MSG_17 APPL values (all): APPL_06	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL write command with a positive value. [1:E-DT60]	The CS receives and rejects the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 55: ATC_COM_PT_CSTransition8_001

Table 56 shows the test case description for ATC_COM_PT_CSTransition8_002.

ATC ID	ATC_COM_PT_CSTransition8_002	
Description	This test shall ensure that the CS changes its state after receiving an APPL deactivation command.	
Referenced Requirement(s)	[LPP-TS-033]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_16 APPL values (all): APPL_02, APPL_03, APPL_04	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 56: ATC_COM_PT_CSTransition8_002

8.2.16 Transition 9

Table 57 shows the test case description for ATC_COM_PT_CSTransition9_001.

ATC ID	ATC_COM_PT_CSTransition9_001	
Description	This test shall ensure that the CS changes its state after receiving an APPL activation command.	
Referenced Requirement(s)	[LPP-TS-032]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_14 APPL values (all): APPL_02, APPL_03, APPL_04 APPL duration values (all): APPL_DUR_02	
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL activation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_wo_dur.

Table 57: ATC_COM_PT_CSTransition9_001

8.2.17 Transition 10

Table 58 shows the test case description for ATC_COM_PT_CSTransition10_001.

ATC ID	ATC_COM_PT_CSTransition10_001	
Description	This test shall ensure that the CS changes its state after expiry of the Failsafe Duration Minimum.	
Referenced Requirement(s)	[LPP-TS-012], [LPP-TS-022], [LPP-TS-022/3]	
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.	
Pre-condition	CF_EG_ConnectionEstablished, CF_CS_UnlCntrl	
Execution		**Expected result**
1.	Wait for the Failsafe Duration Minimum to expire.	The Failsafe Duration Minimum of the CS expired.
2.	Wait for configuration change of the CS for 130 seconds.	The CS changes its configuration to CF_CS_UnlAuto or stays in CF_CS_FS.

Table 58: ATC_COM_PT_CSTransition10_001

Table 59 shows the test case description for ATC_COM_PT_CSTransition10_002.

ATC ID	ATC_COM_PT_CSTransition10_002

Description	This test shall ensure that the CS changes its state after not receiving an APPL command within 120 seconds.
Referenced Requirement(s)	[LPP-TS-022], [LPP-TS-022/2]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested.
Pre-condition	CF_EG_ConnectionLoss, CF_CS_FS

Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Wait for configuration change of the CS for 130 seconds.	The CS does not receive an APPL write command. The CS changes its configuration to CF_CS_UnlAuto or stays in CF_CS_FS.

Table 59: ATC_COM_PT_CSTransition10_002

8.2.18 Transition 11

Table 60 shows the test case description for ATC_COM_PT_CSTransition11_001.

ATC ID	ATC_COM_PT_CSTransition11_001
Description	This test shall ensure that the CS changes its state after declining an APPL command.
Referenced Requirement(s)	[LPP-TS-031], [LPP-TS-035/1]
Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_14, MSG_15, MSG_16, MSG_17 APPL values (all): APPL_06
Pre-condition	CF_EG_ManualExecution, CF_CS_UnlAuto

Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL write command with a positive value. [1:E-DT60]	The CS receives and rejects the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 60: ATC_COM_PT_CSTransition11_001

Table 61 shows the test case description for ATC_COM_PT_CSTransition11_002.

ATC ID	ATC_COM_PT_CSTransition11_002
Description	This test shall ensure that the CS changes its state after receiving an APPL deactivation command.
Referenced Requirement(s)	[LPP-TS-033]

Test variation	No variation of the setup results into 1 test execution with 1 actor being tested. For test step 3: Message combinations (any): MSG_07, MSG_16 APPL values (all): APPL_03	
Pre-condition	CF_EG_ManualExecution, CF_CS_UnlAuto	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.

Table 61: ATC_COM_PT_CSTransition11_002

8.2.19 Transition 12

Table 62 shows the test case description for ATC_COM_PT_CSTransition12_001.

ATC ID	ATC_COM_PT_CSTransition12_001	
Description	This test shall ensure that the CS changes its state after receiving a heartbeat and a following APPL activation command.	
Referenced Requirement(s)	[LPP-TS-032]	
Test variation	The variation of the data sets result into a sum of 3 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_14 APPL values (all): APPL_02, APPL_03, APPL_04 APPL duration values (all): APPL_DUR_02	
Pre-condition	CF_EG_ManualExecution, CF_CS_UnlAuto	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL activation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_Limited_wo_dur.

Table 62: ATC_COM_PT_CSTransition12_001

8.3 LPP instance 1 (CS located on a CEM) abstract test cases

Table 63 shows the test case description for ATC_INS1_PT_CSTransition1_001.

ATC ID	ATC_INS1_PT_CSTransition1_001
Description	This test shall ensure that the CS receives and accepts the initial APPL deactivation write command and rejects the following APPL write command due to exceptions permitted by [LPP1.0.0].
Referenced Requirement(s)	[LPP-TS-035], [LPP-TS-035/2]
Test variation	The variation of the data sets result into a sum of 2 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_16 APPL values (all): APPL_02, APPL_03 For test step 4: Message combinations (any): MSG_14, MSG_15 APPL values (all): APPL_02, APPL_03 APPL duration values (any): APPL_DUR_01, APPL_DUR_02
Pre-condition	CF_EG_ManualExecution, CF_CS_Init

Execution		Expected result
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG APPL write command. [2:E-DT60]	The CS receives and rejects the write command due to exceptions permitted by [LPP1.0.0].

Table 63: ATC_INS1_PT_CSTransition1_001

8.4 LPP instance 2 (CS not located on a CEM) abstract test cases

Table 64 shows the test case description for ATC_INS2_PT_CSTransition1_001.

ATC ID	ATC_INS2_PT_CSTransition1_001
Description	This test shall ensure that the CS receives and accepts the initial APPL write command and rejects the following APPL write command due to exceptions permitted by [LPP1.0.0].
Referenced Requirement(s)	[LPP-TS-035], [LPP-TS-035/3]
Test variation	The variation of the data sets result into a sum of 2 test executions with 1 actor being tested. For test step 3: Message combinations (any): MSG_16 APPL values (all): APPL_02, APPL_03 For test step 4:

	Message combinations (any): MSG_14, MSG_15 APPL values (all): APPL_02, APPL_03 APPL duration values (any): APPL_DUR_01, APPL_DUR_02	
Pre-condition	CF_EG_ManualExecution, CF_CS_Init	
Execution		**Expected result**
1.	Connect the CS to the EG.	The CS is connected and able to exchange messages.
2.	Send an EG heartbeat.	The CS receives the heartbeat.
3.	Send an EG APPL deactivation write command. [1:E-DT60]	The CS receives and accepts the write command. The CS changes its configuration to CF_CS_UnlCntrl.
4.	Send an EG APPL write command. [2:E-DT60]	The CS receives and rejects the write command due to exceptions permitted by [LPP1.0.0].

Table 64: ATC_INS2_PT_CSTransition1_001

