IEC 62991

Edition 1.0 2022-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Particular requirements for source switching equipment (SSE)

Exigences particulières relatives au matériel de commutation de source (SSE)

IEC 62991:2022-12(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 62991

Edition 1.0 2022-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Particular requirements for source switching equipment (SSE)

Exigences particulières relatives au matériel de commutation de source (SSE)

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 03.100.70; 27.015; 29.020

ISBN 978-2-8322-6198-9

CONTENTS

FOREWORD 8
INTRODUCTION 10
1 Scope 12
2 Normative references 13
3 Terms and definitions 15
3.1 General definitions 15
3.2 Additional definitions for NC-SSE and SSE control units (controllers) of C-SSE 25
3.3 Additional definitions dedicated to C-SSE 26
4 Classification 27
4.1 According to the method of operation 27
4.2 According to the construction 27
4.3 According to the kind of current 28
4.4 According to the number of switched poles 28
4.5 According to the type of terminals 28
4.6 According to the SSE's intended application 28
4.7 According to coupling method 28
4.7.1 SSE with synchronization 28
4.7.2 SSE with interlock 28
4.7.3 SSE with synchronization and interlock 28
4.8 According to the transition type 28
4.9 According to the possibility to select sources 28
4.10 According to the utilization category 28
4.11 According to the possibility to provide an OFF position 28
4.12 According to the method of mounting 29
4.13 According to the protection against external influences 29
4.14 According to functional categories 29
5 Characteristics 31
5.1 General 31
5.2 Type and characteristics of the equipment 32
5.3 Characteristics of NC-SSE 32
5.3.1 General 32
5.3.2 Characteristics of main circuits 32
5.3.3 Utilization categories 35
5.3.4 Characteristics of control circuits, including electrical interlocks 35
5.3.5 Characteristics of auxiliary circuits 37
5.4 Characteristics of C-SSE 37
5.4.1 General 37
5.4.2 Characteristics of main circuits 37
5.4.3 Utilization categories 38
5.4.4 Characteristics of control circuits, including electrical interlocks 38
5.4.5 Characteristics of auxiliary circuits 39
6 Markings and product information 39
7 Standard conditions for operation in service 40
7.1 General 40
7.2 Ambient temperature range in normal use 41

7.3 Relative humidity 41
7.4 Altitude 41
7.5 Conditions of installation 41
7.6 Pollution degree 41
8 Requirements for construction and operation 41
8.1 General 41
8.2 Mechanical design 42
8.2.1 General 42
8.2.2 Constructional requirements 42
8.2.3 Mechanism and operating means 44
8.2.4 Clearances and creepage distances and distances through sealing compound 46
8.2.5 Screws, current-carrying parts and connections 49
8.2.6 Terminals for external conductors 50
8.3 Protection against electric shock 52
8.4 Dielectric properties 52
8.4.1 General 52
8.4.2 Dielectric properties 52
8.5 Temperature-rise 52
8.6 Making and breaking capacity 53
8.7 Performances 54
8.7.1 General 54
8.7.2 Operating conditions 55
8.7.3 Operational performance 57
8.8 Resistance to heat 58
8.9 Resistance of insulating material to abnormal heat and to fire 58
8.10 Resistance to rusting 59
8.11 Coordination with short-circuit protective devices (SCPDs) 59
8.12 EMC 59
8.13 Resistance to abnormal conditions 59
8.14 Components 59
8.14.1 General 59
8.14.2 Fuses 60
8.14.3 Capacitors 60
8.14.4 Resistors 61
8.14.5 Transformers 61
9 Type tests 61
9.1 General requirements 61
9.1.1 Type tests and test sequences 61
9.1.2 Test conditions 61
9.1.3 Test procedure 63
9.2 Tests of indelibility of markings 63
9.3 Tests of the mechanical strength 63
9.3.1 Tests of the resistance to mechanical stresses of insulating means 63
9.3.2 Verification of installation and connections 73
9.3.3 Tests of fixings of covers, cover plates and actuating members 75
9.3.4 Tests of attachment of knobs 76
9.3.5 Tests of covers, cover plates or actuating members – Accessibility to live parts 77

9.3.6 Tests of covers, cover plates or actuating members – Accessibility to non-earthed metal parts separated from live parts 78
9.3.7 Tests of covers, cover plates or actuating members – Accessibility to insulating parts, earthed metal parts, the live parts of SELV ≤ 25 V AC or metal parts separated from live parts 78
9.3.8 Tests of covers, cover plates or actuating members – Application of gauges 78
9.3.9 Tests of grooves, holes and reverse tapers 80
9.4 Measurements of clearances and creepage distances 81
9.5 Test of reliability of screws, current-carrying parts and connections 82
9.6 Test of reliability of screw-type terminals for external copper conductors 82
9.7 Tests for the protection against electric shock 84
9.8 Tests of dielectric properties 86
9.8.1 General 86
9.8.2 Tests of the resistance to humidity 87
9.8.3 Tests of the insulation resistance of the main circuits 87
9.8.4 Tests of the dielectric strength of main circuits 88
9.8.5 Tests of the insulation resistance and dielectric strength of other circuits 90
9.8.6 Verification of impulse withstand voltages (across clearances and through solid insulations) 91
9.9 Tests of temperature-rise 92
9.9.1 General 92
9.9.2 Test setup 92
9.9.3 Test procedure 94
9.10 Tests of making and breaking capacity 94
9.11 Verification of performances 95
9.11.1 General 95
9.11.2 Verification of interlocking function 95
9.11.3 Verification of controls, sequences and limits of operations 98
9.11.4 Verification of the operational performance capability 102
9.12 Tests of heat resistance 103
9.12.1 Basic heating test 103
9.12.2 Ball-pressure test on parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position 104
9.12.3 Ball-pressure test on parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position 104
9.13 Tests of the resistance of insulating material to abnormal heat and to fire 104
9.14 Resistance to rusting 106
9.15 Tests of coordination with short-circuit protective devices (SCPDs) 107
9.15.1 General 107
9.15.2 Test conditions 107
9.15.3 Tests of coordination between the SSE and the SCPDs 112
9.16 EMC tests 113
9.16.1 General 113
9.16.2 Electromagnetic emission 113
9.16.3 Electromagnetic immunity 113
9.17 Tests under abnormal conditions 117
9.17.1 General 117
9.17.2 Tests under fault conditions 119
9.17.3 Overload tests 121

9.18 Tests of components 121
Annex A (informative) Examples of possible use of SSE 125
A.1 General concept of prosumer's low-voltage electrical installation 125
A.2 Examples of SSE use 128
Annex B (informative) Correspondence between ISO and AWG copper conductors 133
Annex C (normative) Determination of clearances and creepage distances 134
C.1 General 134
C.2 Orientation and location of a creepage distance 134
C.3 Creepage distances where more than one material is used 134
C.4 Creepage distances split by floating conductive part 134
C.5 Measurement of creepage distances and clearances 134
Annex D (normative) Test sequences and number of specimens 137
Annex E (normative) Arrangement for the detection of the emission of ionized gases during short-circuit tests 139
Bibliography 142

Figure 1 – Energy efficiency management system (EEMS) 10
Figure 2 – Principle of management of two sources with source switching equipment (SSE) 11
Figure 3 – Example of A-SSE 30
Figure 4 – Example of R-SSE 31
Figure 5 – Example of M-SSE 31
Figure 6 – Pendulum impact test apparatus 65
Figure 7 – Pendulum impact test apparatus (striking element) 66
Figure 8 – Mounting support of specimens 67
Figure 9 – Mounting block for a flush type SSE 68
Figure 10 – Example of mounting support of panel board type SSE 69
Figure 11 – Example of mounting support for a rear fixed SSE 70
Figure 12 – Application of forces on a rail-mounted SSE 72
Figure 13 – Determination of the direction of the forces to be applied 74
Figure 14 – Direction for the conductor pull of 30 N for 1 min 75
Figure 15 – Gauge (thickness: about 2 mm) for the verification of the outline of covers, cover plates or actuating members 78
Figure 16 – Example of application of the gauge of Figure 15 on covers fixed without screws on a mounting surface or supporting surface 79
Figure 17 – Examples of applications of the gauge of Figure 15 80
Figure 18 – Gauge for verification of grooves, holes and reverse tapers 81
Figure 19 – Sketch showing the direction of application of the gauge of Figure 18 81
Figure 20 – Jointed test finger (test probe B according to IEC 61032:1997) 85
Figure 21 – Test pin for checking the protection against electric shock 86
Figure 22 – Actuator test force 97
Figure 23 – Test circuit for connection to source 1 and source 2 99
Figure 24 – Ball-pressure test apparatus 104
Figure 25 – Diagrammatic representation 105
Figure 26 – Typical diagram for all coordination tests 108

Figure 27 – Detail of impedances Z and Z_1 109
Figure 28 – Minimum clearances and creepage distances on printed boards 120
Figure 29 – Surge test – Test circuit 122
Figure 30 – Surge test – Example of a switch to be used in the test circuit 123
Figure A.1 – Example of PEI 126
Figure A.2 – Example of an individual PEI 127
Figure A.3 – Example of a shared PEI with a distribution system within the PEI in parallel to the DSO distribution system 128
Figure A.4 – Example of SSE use in an individual PEI with PV production and storage on the DC side 129
Figure A.5 – Example of SSE use in an individual PEI with PV production and storage on the AC side 130
Figure A.6 – Example of SSE use for power backup with storage or a generating set 131
Figure A.7 – Example of SSE use for power backup with storage only 132
Figure C.1 – Example 1 135
Figure C.2 – Example 2 135
Figure C.3 – Example 3 135
Figure C.4 – Example 4 135
Figure C.5 – Example 5 136
Figure C.6 – Example 6 136
Figure C.7 – Example 7 136
Figure E.1 – Test arrangement 140
Figure E.2 – Grid 141
Figure E.3 – Grid circuit 141

Table 1 – Source switching functional categories 29
Table 2 – Preferred values of rated voltages 33
Table 3 – Rated impulse voltage as a function of the nominal voltage of the installation 34
Table 4 – Utilization categories 35
Table 5 – Requirements and position for markings and other product information 39
Table 6 – Cross-sectional areas (S) of test copper conductors corresponding to the rated currents 43
Table 7 – Minimum clearances and creepage distances 47
Table 8 – Connectable cross-sections of copper conductors for screw-type terminals 50
Table 9 – Temperature-rise values 53
Table 10 – Making and breaking conditions for tests of making and breaking capacities 54
Table 11 – OFF-time durations for the verification of making and breaking capacities for utilization categories 54
Table 12 – Making and breaking conditions for the operational performance 58
Table 13 – Number of operations for operational performance 58
Table 14 – Capacitors 61
Table 15 – Tightening torque for the verification of the mechanical strength of screw-type terminals 62
Table 16 – Height of fall for impact test 71

Table 17 – Forces to be applied to covers, cover plates or actuating members whose fixing is not dependent on screws 76
Table 18 – Test values for pulling out test 83
Table 19 – Test voltage, points of application and minimum values of insulating resistance for the verification of dielectric strength 89
Table 20 – Test voltages of auxiliary circuits 90
Table 21 – Test voltage for verification of impulse withstand voltage 92
Table 22 – Temperature-rise test currents and cross-sectional areas of copper conductors 93
Table 23 – Actuator test force 97
Table 24 – Minimum values of I^2t and I_p 110
Table 25 – Power factors for short-circuit tests 111
Table 26 – Immunity tests (overview) 114
Table 27 – Performance criteria 114
Table 28 – Voltage dip test values 115
Table 29 – Short-interruption test values 115
Table 30 – Surge test voltages 115
Table 31 – Fast transient test values 116
Table 32 – Permissible temperature rise values 118
Table B.1 – Correspondence between ISO and AWG copper conductors 133
Table D.1 – Test sequences and number of specimens for tests 138

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

PARTICULAR REQUIREMENTS FOR SOURCE SWITCHING EQUIPMENT (SSE)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62991 has been prepared by subcommittee 23K: Electrical Energy Efficiency products, of IEC technical committee 23: Electrical accessories. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
23K/78/FDIS	23K/79/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

In this document, the following print types are used:

– *conformity statements: in italic type*.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The optimization of electrical energy usage can be facilitated by appropriate design and installation considerations. An electrical installation can provide the required level of service and safety for the lowest level of electrical consumption.

This is considered by designers as a general requirement of their design procedures to establish the best use of electrical energy.

The optimization of the use of electricity is based on energy efficiency management taking into consideration the price of electricity, electrical consumption of the loads and real-time adaptation, as described in Figure 1, which is reproduced from IEC 60364-8-1:2019, Figure 1.

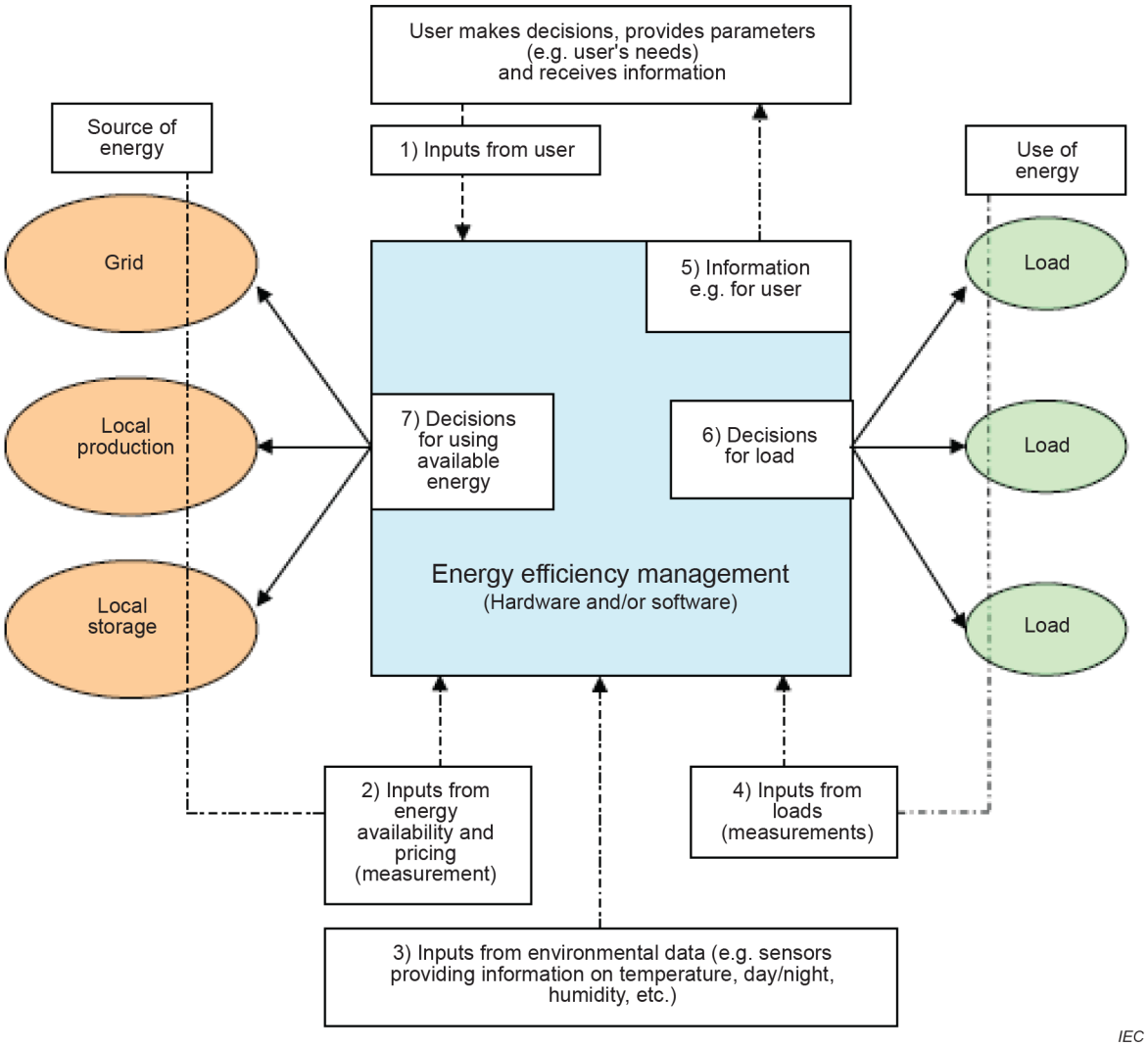

Figure 1 – Energy efficiency management system (EEMS)

This document applies to source switching equipment (SSE), for household and similar uses (see Figure 2).

SSE is intended:

– to make transparent to the end-user the use of energy sources, taking into account local generation or storage;
– to optimize the electrical energy originating either from the grid or from other local sources/storage.

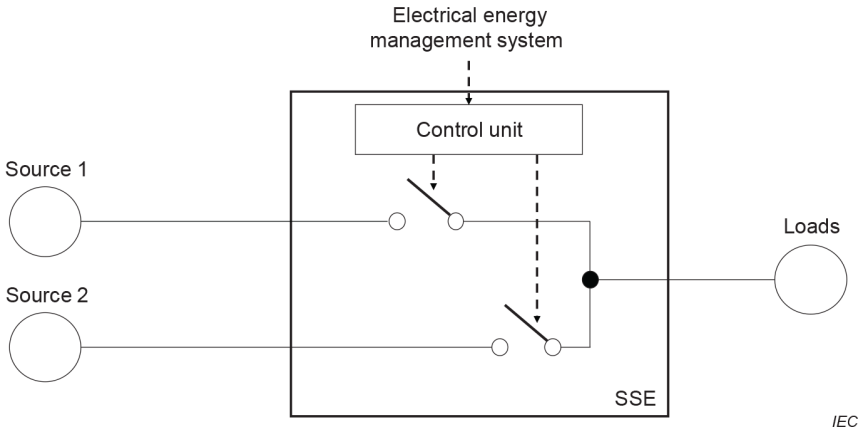

Figure 2 – Principle of management of two sources with source switching equipment (SSE)

NOTE Examples of use of SSE are given Annex A.

As defined by IEC 60364-8-82:2022, the main operating modes of SSE are:

– direct feeding mode: corresponding to the normal source (supply from the grid). Storage units can supply current-using-equipment or be charged by the grid or local power supplies;
– island mode: loads supplied by local energy sources and storage units, disconnected from the grid;
– reverse feeding mode: corresponding to the supply of the grid. Storage units can supply current-using-equipment and/or the grid or be charged by local power supplies.

Transfer from/to the direct feeding mode to island mode and vice versa can be achieved by the operation of the SSE which can be either directly controlled (manually or remotely) or automatically controlled.

Operation of SSE is to occur in safe conditions as described in IEC 60364-8-82:2022.

This document does not cover communication aspects such as protocols and interoperability nor data security or other related aspects.

SSE switching operations are based on similar principles as transfer switching equipment (TSE). For applications with higher currents, for example, for industrial applications, the reader may refer to IEC 60947-6-1.

PARTICULAR REQUIREMENTS FOR SOURCE SWITCHING EQUIPMENT (SSE)

1 Scope

This International Standard applies to source switching equipment, hereafter referred to as SSE, for household and similar uses, primarily intended to be used for energy efficiency (EE) purposes with local production and/or storage of energy.

SSE is intended to be installed in low voltage prosumer electrical installations (PEI) to deliver the electrical energy:

– either to current-using equipment (direct feeding mode or island mode);

– or to the grid (reverse feeding mode).

SSE is intended to select and/or combine two power sources (e.g. selected from among grid, local power source, storage units) within an electrical energy management system (EEMS). SSE can also be used for backup supply.

NOTE 1 "Switching device for islanding" (SDFI) function is under consideration as additional requirements can be necessary. See also Figure 4 of IEC 60364-8-82:2022.

SSE is part of the fixed electrical installation.

This document applies to SSE for operation in AC single or multiphase main circuits with rated voltages not exceeding 440 V AC, frequencies of 50 Hz, 60 Hz or 50/60 Hz and rated currents not exceeding 125 A (40 A for screwless terminals). They are intended to be used in installations with prospective short circuit currents not exceeding 25 000 A. DC operations are not covered by this edition and are kept under consideration for a future revision of this document.

According to this document, SSE can be operated:

– manually (M-SSE), or

– remotely (R-SSE), or

– automatically (A-SSE), or

– a combination of the above methods of operation, e.g. manual and remote.

SSE is used to select two sources sequentially. SSE able to run two (or more) sources in parallel are not covered by this edition and are kept under consideration for a future revision of this product standard.

SSE can be operated with interlocks and/or synchronization.

NOTE 2 In some countries, it is not permitted to have synchronization of local sources with the grid for particular grid conditions, e.g. when fluctuations of the grid voltage or frequency are outside the tolerance limits.

SSE is constructed either as combined SSE (C-SSE, based on dedicated products such as circuit breakers, switches or contactors) or non-combined SSE (NC-SSE).

According to this document, C-SSE is based on switching units of the same type.

SSE is intended for use in circuits where protection against electrical shock and over-current is provided according to installation rules for low voltage electrical installations, unless the SSE already contains such protective function.