International Association of Oil & Gas Producers

SPECIFICATION
S-702

August
2020

Supplementary Specification to IEC 62040-5-3 DC Uninterruptible Power Systems (UPS)

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.0	August 2020	Issued for Use

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of DC uninterruptible power systems (UPS) in accordance with IEC 62040-5-3, Uninterruptible power systems (UPS) - Part 5-3: DC output UPS - Performance and test requirements, Edition 1.0, 2016-10 for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting data sheet, quality requirements specification (QRS) and information requirements specification (IRS) as follows.

IOGP S-702: Supplementary Specification to IEC 62040-5-3 DC Uninterruptible Power Systems (UPS)

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEC 62040-5-3, following the IEC 62040-5-3 clause structure. Clauses from IEC 62040-5-3 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEC 62040-5-3 defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-702D: Data Sheet for DC Uninterruptible Power Systems (UPS) (IEC 62040-5-3)

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-702Q: Quality Requirements for DC Uninterruptible Power Systems (UPS) (IEC 62040-5-3)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

IOGP S-702L: Information Requirements for DC Uninterruptible Power Systems (UPS) (IEC 62040-5-3)

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of IEC 62040-5-3 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (data sheet, QRS, IRS);

d) this specification;

e) IEC 62040-5-3.

1 Scope

Add to second paragraph

This specification also specifies the DC UPS manufacturing requirements of the rectifiers and switches, and functional requirements related to measurement, protection and alarms. Packing, handling, preservation and storage requirements are also defined.

2 Normative references

Add to clause

IEC 60076-1, *Power transformers – Part 1: General*

IEC 60076-11, *Power transformers – 11: Dry-type transformers*

IEC 60076-12, *Power transformers – Part 12: Loading guide for dry-type power transformers*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60092 (all parts), *Electrical installations in ships*

IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*

IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 61000-2-4: 2002, *Electromagnetic compatibility (EMC) – 2-4: – Compatibility levels in industrial for low-frequency conducted disturbances*

IEC 61892 (all parts), *Mobile and fixed offshore units – Electrical installations*

IEC 62040-3: 2011, *Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements*

IEC 62040 (all parts except 5-3), *Uninterruptible power systems (UPS)*

IOGP S-560, *Supplementary Requirements to IEC 61439-1 & 2 LV Switchgear & Controlgear*

Replace IEC 62040-1 with

IEC 62040-1:2017, *Uninterruptible power systems (UPS) – Part 1: Safety requirements*

3 Terms and definitions, acronyms and abbreviations

Add new term

3.2.20
supervisory control and data acquisition
SCADA
overall site integrated process automation, control and/or monitoring system

Add new term

3.3.14
soft start
walk-in
function to control the gradual increase of the input a.c. current within a specified time when the UPS starts or restarts

3.7 Acronyms and abbreviations

HMI human machine interface

MCB miniature circuit breaker

MCCB moulded case circuit breaker

MCT multi cable transit

5 Electrical conditions, performance and declared values

5.1 General

5.1.1 DC UPS configuration

In first paragraph, add to list

– operator access or restricted access classification in accordance with IEC 62040-1.

NOTE 1 See IEC 60950-1 for the definition of operator access or restricted access.

5.1.2 Markings and instructions

Add to subclause

Markings and instructions shall be in accordance with IEC 62040-1:2017, Clause 6.

Add to subclause

The nameplate shall include the item serial number, month and year of manufacture.

Add to subclause

Caution, danger and warning labels shall display information in English and another language, if specified.

Add new subclause

5.1.3 Safety

The DC UPS shall comply with the safety requirements in IEC 62040-1.

Add new subclause

5.1.4 Electromagnetic compatibility

The DC UPS shall conform to the electromagnetic emission and immunity levels in IEC 62040-2 for the specified category level.

Add new subclause

5.1.5 Noise

The sound pressure level, measured at a distance of one metre from the DC UPS in any direction, shall not exceed the specified value, at load conditions ranging from no load to the rated load.

Add new subclause

5.1.6 DC UPS design basis

The operational life of the DC UPS and its components at the rated load shall be in accordance with Table 5.

Add new table

Table 5 – DC UPS operational life

Components	Minimum operation life (years)
Rectifier unit / DC power module	20
Cooling fans	5
DC Capacitors	10

Add new subclause

5.1.7 Availability

Irrespective of its configuration, the DC UPS shall achieve reliability integrity level 1 (RIL 1) in accordance with IEC 62040-3, Table K.1.

5.2 DC UPS input specification

5.2.1 Conditions for normal mode operation

Add to beginning of list item f)

"for public low voltage networks,"

Add new list item h) after NOTE 3

h) for industrial networks, total harmonic distortion of voltage ≤ 8 % as per class 1 compatibility levels, with a maximum level of individual harmonic voltages in accordance with IEC 61000-2-4, Table 2, Table 3 and Table 4. Refer to IEC 61892-1 for offshore installations.

5.3 DC UPS output specification

5.3.4 Performance classification

Add to subclause

The DC UPS shall comply with the requirement of the specified performance-based classification code.

5.6 Communication circuits

Add to subclause

The DC UPS shall be provided with communication hardware compliant with the specified interface media and protocol.

Add to subclause

Cable distance limitations for the selected protocol shall be specified.

Add to subclause

A list of mapping addresses of the data communication and signalling circuits intended to be exchanged with the information technology equipment (e.g. SCADA system, local area networks or telecommunication networks) shall be provided.

Add new clause

7 Constructional requirements

7.1 General

7.1.1

The design of the DC UPS shall minimize the mean time to repair by using self-diagnostics, comprehensive alarm descriptions and easy accessibility to components and circuits.

7.1.2

Components, printed circuit boards, connectors and terminals and the associated locations of these items shall be identified with labels in accordance with IEC 62040-1.

7.1.3

Components requiring periodic replacement shall be listed in the spare parts list with the recommended replacement frequency.

7.1.4

An obsolescence management plan in accordance with an industry recognized system (e.g. IEC 62402) shall be provided for all DC UPS assembly components.

7.1.5

An installation manual, maintenance manual, operational manual and manufacturing record book shall be provided with the equipment.

7.1.6

The DC distribution board, if integral to the DC UPS, shall be in accordance with IOGP S-560.

7.2 Enclosure

7.2.1

The DC UPS shall be installed in steel cabinet enclosures that are:

– floor mounted, free-standing and self-supporting; or

– wall mounted.

7.2.2

The enclosure shall have a minimum degree of protection of IP31 in accordance with IEC 60529.

7.2.3

The battery bank shall be integrated in the DC UPS cabinets or placed separately, as specified.

7.2.4

Undrilled removable gland plates or multi cable transits (MCT) shall be used for cable entry.

7.2.5

Gland plates for single core cable entries shall be of non-magnetic material.

7.3 Accessibility and maintenance safety

7.3.1

Access for operation and maintenance shall be from the front only.

7.3.2

The location and grouping of components and auxiliary equipment shall permit identification and access for operational, maintenance and repair purposes, without interruption of supply to the load.

7.3.3

Protection devices that malfunction due to vibration or impact and cause the DC UPS to trip shall not be mounted on the door.

7.3.4

Live components and parts accessible with the compartment door open shall be protected by enclosures, barriers or shrouds to a degree of protection of at least IP2X.

7.3.5

Document holders shall be provided inside the enclosure, if specified.

7.4 Components

7.4.1

Main circuit switches, miniature circuit breakers (MCBs) and moulded case circuit breakers (MCCBs) shall have a facility for padlocking in the open position.

7.4.2

Mechanical type main circuit switches shall be in accordance with IEC 60947-3.

7.4.3

Main circuit switches shall comply with utilization category AC22 and DC22 for AC and DC switches respectively in accordance with IEC 60947-3.

7.4.4

Main circuit breakers and isolation switches shall be manually operated and air-break type for uninterrupted duty.

7.4.5

MCBs and MCCBs shall comply with IEC 60947-2.

7.4.6

Contactors shall be rated for uninterrupted duty in accordance with IEC 60947-4-1.

7.4.7

Contactors shall comply with utilization category of AC-1 and DC-1 for AC and DC contactors respectively in accordance with IEC 60947-4-1.

7.4.8

Transformers and reactors used for input isolation shall be air-cooled type in accordance with IEC 60076, parts 1, 11 and 12.

7.4.9

Transformers shall be in accordance with IEC 60076-11.

7.4.10

Transformers shall have copper or aluminium windings.

7.4.11

Transformers shall have a high grade silicon steel core.

7.4.12

Transformers shall be an air-cooled type design.

7.4.13

The transformer insulation material shall have thermal class 180 (H) rating in accordance with IEC 60085.

7.4.14

The DC UPS shall display the single line diagram and status indication, as specified.

7.5 Internal wiring & terminals

7.5.1

Insulation material of internal wires shall be zero halogen, flame retardant and have a low smoke index.

7.5.2

Wiring shall be labelled with alphanumeric characters located adjacent to the terminals.

7.5.3

Wiring for external connections shall be routed to individual terminals on an accessible terminal block.

7.5.4

The separation distance between the gland plate and the connection terminals within the cabinet shall permit stress free orientation of the cable cores and avoid mechanical stress on the connection terminals.

7.6 Earthing

7.6.1

A main protective earthing arrangement shall be provided inside the enclosure in close proximity to the cable entry location.

NOTE The main protective earthing arrangement can be a copper bar, conductor or terminal, as appropriate.

7.6.2

The cubicle shall be bonded to the main protective earthing arrangement in accordance with IEC 62040-1.

7.6.3

All exposed, non-current carrying parts of the DC UPS inclusive of the enclosure, components and doors shall be bonded to earth.

7.6.4

The gland plates or MCTs shall be earthed to the main protective earthing arrangement.

7.7 Ventilation

7.7.1

The cooling system design of the DC UPS shall be convection cooling or fan assisted forced air cooling.

7.7.2

Cooling fans shall be installed with a redundant (N+1) configuration.

7.7.3

Fans shall be equipped with monitoring facilities to provide an alarm in the event of a fan failure.

7.7.4

Cooling air filters shall be replaceable while the DC UPS remains in service.

7.7.5

Cooling fans shall be replaceable while the DC UPS remains in service, if specified.

7.7.6

If a cooling fan is out of service, the DC UPS shall continue to deliver the rated load without maximum continuous temperature of components exceeding the designed limits.

7.8 Additional requirements for offshore (fixed and floating) installations

7.8.1

For offshore installations, the DC UPS and associated equipment and components shall be in accordance with the general requirements of IEC 62040 (all parts) and:

– the requirements of IEC 61892 (all parts) for mobile and fixed units; or

– the requirements of IEC 60092 (all parts except 301, 305, 306, 501, 502 and 503) for electrical installations in ships.

7.8.2

If the requirements according to the International Maritime Organization (IMO), International Association of Classification Societies Ltd. (IACS) or other applicable classification societies contradicts or conflicts with the requirements of the IEC standards, the more stringent shall be applied.

7.9 Battery isolator box

7.9.1

The battery isolator box shall be suitable for wall, frame or pedestal mounting.

7.9.2

The battery isolator shall be lockable in the open position using padlocks.

7.9.3

The battery isolator box design shall be in accordance with the location of installation and the environmental conditions specified.

7.9.4

The battery isolator box with closed door shall have a minimum degree of protection of IP31 in accordance with IEC 60529.

7.9.5

The battery isolator box enclosure type shall depend on the area classification assigned to its specified location of installation.

7.9.6

The battery isolator box enclosure shall have undrilled, removable gland plates.

7.9.7

The battery isolator shall be a switch fuse unit or MCCB.

7.9.8

The battery isolator shall be selected for rated DC voltage and DC current rating.

7.9.9

The auxiliary supply for the MCCB control element (under voltage coil or shunt trip coil) shall be nominally rated equal to the battery bank voltage.

7.9.10

Potential free status contacts of the battery isolator shall be wired to the terminals, if specified.

8 Functional requirements

8.1 Charger

8.1.1 Charger components

8.1.1.1

The charger unit of the DC UPS shall have an input transformer to galvanically isolate the AC and DC sections.

8.1.1.2

The rectifier unit and components on the input side of the DC UPS shall be sized to supply the rated output and simultaneously boost charging the battery at the highest permissible current rating.

8.1.1.3

If a DC UPS system with a bi-directional rectifier is specified, it shall be provided with an online battery capacity discharge test feature by feeding the power back to the power source.

8.1.1.4

The DC UPS shall have an automatic or manual feature to perform on-line battery capacity testing by discharging of the battery into the load.

8.1.1.5

The DC UPS shall integrate with the on-line battery monitoring system to continuously assess individual cell condition of the battery bank, if specified.

8.1.1.6

If an on-line battery monitoring system is specified, the DC UPS shall generate an alarm when the battery parameters are outside the set limits.

8.1.1.7

The total AC ripple at the battery terminals shall not exceed the tolerance limits specified by the battery manufacturer.

8.1.2 Operation

8.1.2.1

The charger unit shall operate according to the constant voltage, current limiting and soft start philosophy.

8.1.2.2

The charger unit shall restart automatically upon restoration of the input power supply following a power interruption.

8.1.2.3

The charger unit shall be rated to recharge the battery to a specified nominal value of AH capacity following a discharge at rated load for the specified autonomy time while simultaneously delivering the rated output.

8.1.2.4

Depending on the type of battery selected for energy storage, the charger unit shall perform battery charging at float, boost and equalization charge, or float and equalization charge.

8.1.2.5

The float or boost charge voltage shall be adjustable while the DC UPS is in operation.

8.1.2.6

Upon restoration of input power supply following a power interruption, the charger unit shall initiate the boost charge cycle if in auto mode.

NOTE Boost charge initiation depends on the state of charge or type of battery selected for energy storage.

8.1.2.7

The duration of the boost charging shall be controlled by:

– automatic timer; or

– feedback of the battery current and voltage indicating that adequate battery charge has been achieved.

8.1.2.8

The charger unit shall revert automatically to float charging upon completion of the boost charging or equalization charging.

8.1.2.9

The charger unit shall have provision for terminating the boost charging using an external signal (e.g. ventilation failure or H_2 detection within the battery room).

8.1.2.10

The charger unit shall have provision for accepting temperature compensation input for batteries, to control the battery charging voltage with an accuracy of ±1 %.

8.1.2.11

The DC UPS shall permit a black start, delivering power to the load at the rated output with only the batteries providing the input power, if specified.

8.1.2.12

The DC UPS shall permit an ESD override feature, if specified.

8.1.2.13

The charger unit shall restrict the battery charging current to a safe value specified by the battery manufacturer, depending on the mode of operation.

8.1.2.14

Manual initiation of float and boost modes of operation on the charger unit shall be provided.

8.1.2.15

The return from boost mode to float mode of operation for the battery shall be automatic.

8.1.2.16

The charger unit shall permit adjustment of output parameters to suit the type of battery selected for energy storage.

8.1.2.17

The DC UPS shall permit parallel operation with more units of the same nominal DC output voltage, irrespective of whether or not its individual input power supplies are synchronized.

8.2 Measurement, Protection and Control

8.2.1 General

8.2.1.1 General

The DC UPS shall be equipped with necessary equipment to provide the required data measurements.

8.2.1.2 General

The DC UPS shall be equipped with necessary equipment to generate the required indications and alarms.

8.2.1.3 General

The DC UPS shall be equipped with necessary equipment to initiate protection measures to mitigate the consequences of internal/external faults and component or control circuit malfunctions.

8.2.2 Indication and Display

8.2.2.1

The UPS shall have a real time interactive operator interface using a microprocessor based human machine interface (HMI) mounted on the front door.

8.2.2.2

The HMI shall indicate DC UPS operation status.

8.2.2.3

The HMI shall accept operational input commands.

8.2.2.4

The HMI shall monitor operating parameters and display alarms, events and fault diagnostics.

8.2.2.5

The following statuses shall be displayed on the HMI or by LED signalling lights located on the DC UPS front panel:

– AC input power supply healthy;

– charger ON (float);

– charger ON (boost);

– battery breaker ON;

– load on battery;

– charger Fault;

– common DC UPS alarm (LED signalling light).

8.2.2.6

This HMI display shall have a mimic diagram representing the power flow path, as a single line diagram of the DC UPS and status of components.

8.2.2.7

Failure of the HMI display or indicating equipment on the DC UPS shall not compromise the operation of the DC UPS.

8.2.2.8

The HMI shall have password protected multiple levels of access:

– for viewing by the operator;

– for settings by trained operating personnel;

– for service by the manufacturer's personnel.

8.2.2.9

The HMI shall have storage for retaining:

– historical data;

– event/alarm logging with time and date stamping;

– historical trending for assisting troubleshooting and failure analysis.

8.2.2.10

The DC UPS shall have communication facilities as specified for remote monitoring and interface.

8.2.2.11

Software and hardware shall be provided for monitoring, review and control of settings on the DC UPS, on-line or off-line, if specified.

8.2.3 Measurements

The following measurement data shall be displayed on the HMI or by discrete measuring or display instruments located on the front panel of the DC UPS:

– DC UPS input voltage per phase;

– DC UPS input current per phase;

– DC output voltage;

– DC output current;

– battery voltage;

– battery current (charging);

– battery current (discharging);

– remaining autonomy time of the battery (percentage or minutes).

8.2.4 Alarms and protection

8.2.4.1

The alarm and protection functions shall be identified on the operator interface HMI by indicators with a first failure feature.

8.2.4.2

Alarm and trip functions shall be provided in accordance with Table 6 as a minimum.

Add new table

Table 6 – Minimum alarm and trip functions

Trouble description	Alarm	Charger trip
AC Input power supply - undervoltage	✓	Off [a] [b]
Charger failure	✓	✓
DC output overvoltage	✓	✓
DC output undervoltage	✓	
Battery discharging	✓	
Battery breaker off / battery disconnected	✓	
Battery temperature high (VRLA batteries only)	✓	
DC earth leakage detection	✓	
Cooling fan failure	✓	
[a] In case the AC input power supply falls below allowable limits, the rectifier shall shut down. [b] When the AC input power supply resumes and remains within allowable limits, the rectifier shall start automatically and no reset is required.		

8.2.4.3

Alarms associated with trip functions shall be reset manually, locally or remotely, except for the AC input power supply alarm (see Table 6).

8.2.4.4

The DC UPS shall have two programmable output relays, with two potential free contacts per relay, a normally open contact and a normally closed contact, wired to a terminal block for remote interface.

8.2.4.5

Alarms and changes in operation modes shall be time stamped and stored chronologically in a non-volatile memory of the HMI in a “first in – first out” rolling manner.

8.2.5 Controls

8.2.5.1

The settings and threshold limits of specific parameters shall be adjustable on-line without requiring the outage of the DC UPS.

8.2.5.2

The charger unit shall permit battery boost charge operation for vented batteries and partial gas recombination nickel-cadmium (NiCd) batteries, in manual and automatic modes.

8.2.5.3

After a period of battery discharge, if the boost-charge cycle is in auto mode, boost charging shall be initiated and continue until the batteries are fully recharged.

NOTE Boost charge initiation depends on the state of charge or type of battery selected for energy storage.

8.2.5.4

The internal control supply of the DC UPS shall be available as long provided any of the power sources to the DC UPS are present.

8.2.5.5

The following controls (push buttons, switches and analog/digital settings) shall be provided on the DC UPS:

– AC input power supply circuit breaker;

– charger float voltage adjustment;

– charger boost voltage adjustment;

– charger boost current adjustment;

– charger output current limit adjustment;

– auto/manual mode selection;

– float control;

– boost control;

– lamp test control;

– battery breaker control;

– output circuit breaker.

NOTE The controls listed above will vary in accordance with the project requirements and type of battery selected.

Add new clause

9 Packing, handling, preservation and storage

The DC UPS and associated equipment and components shall be packed to protect against damage during transportation.

Annex A
(informative)
DC UPS configurations

Replace Figure A.1 with

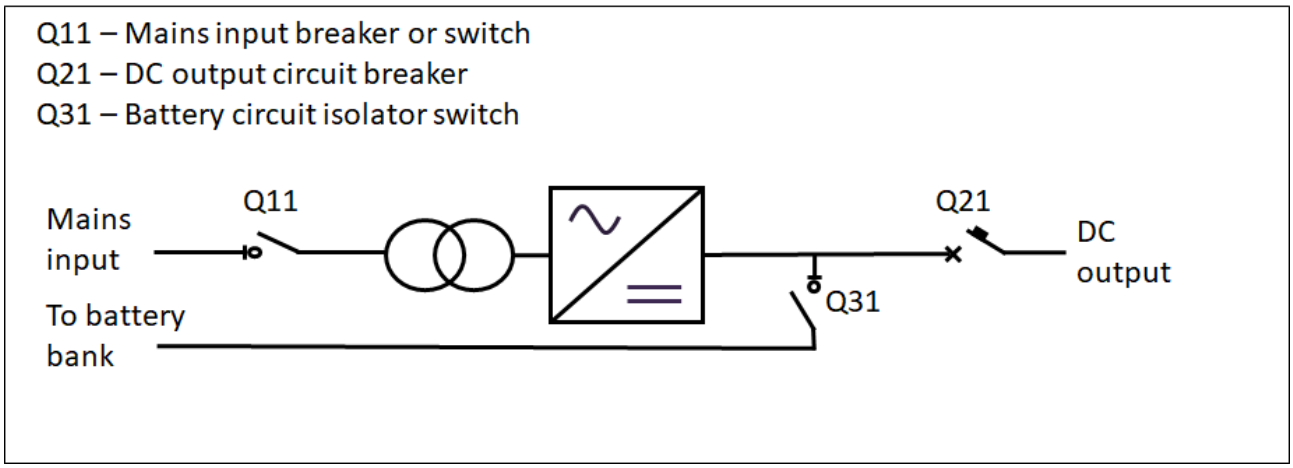

Figure A.1 – Simplified single DC UPS

Replace Figure A.3 with

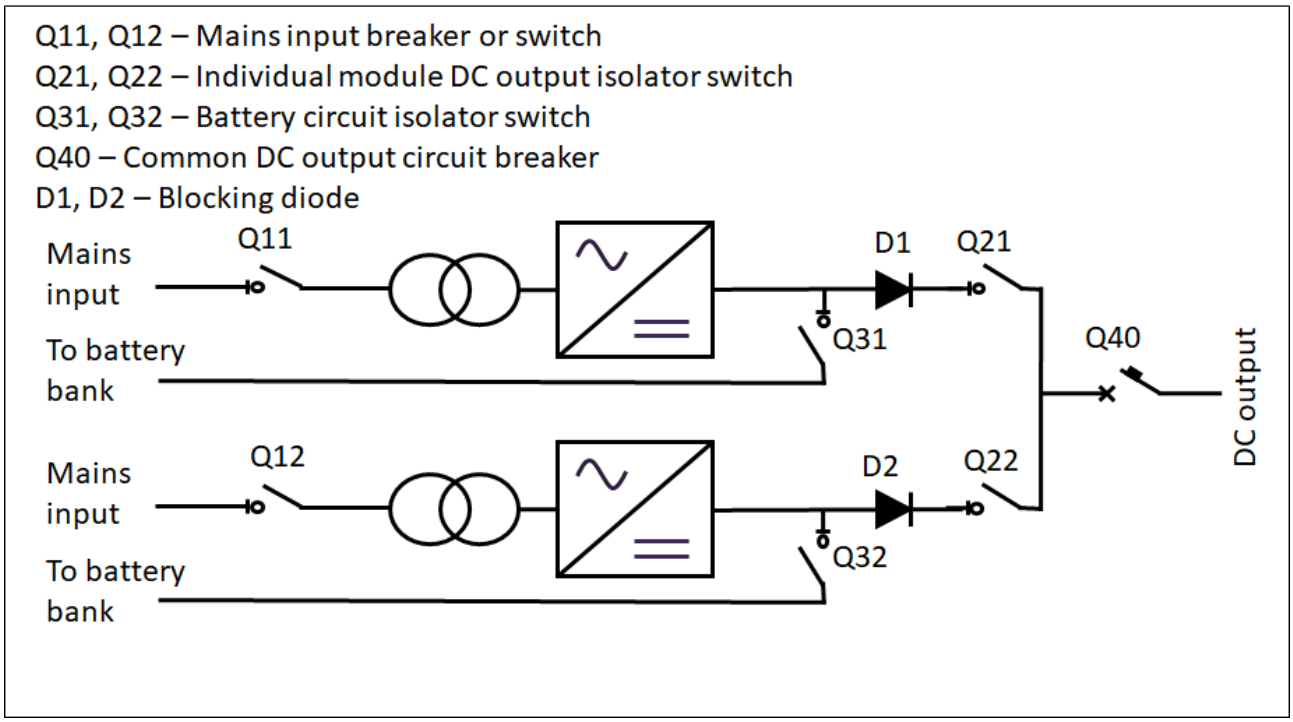

Figure A.3 – Simplified parallel DC UPS with common output bus

Replace Figure A.5 with

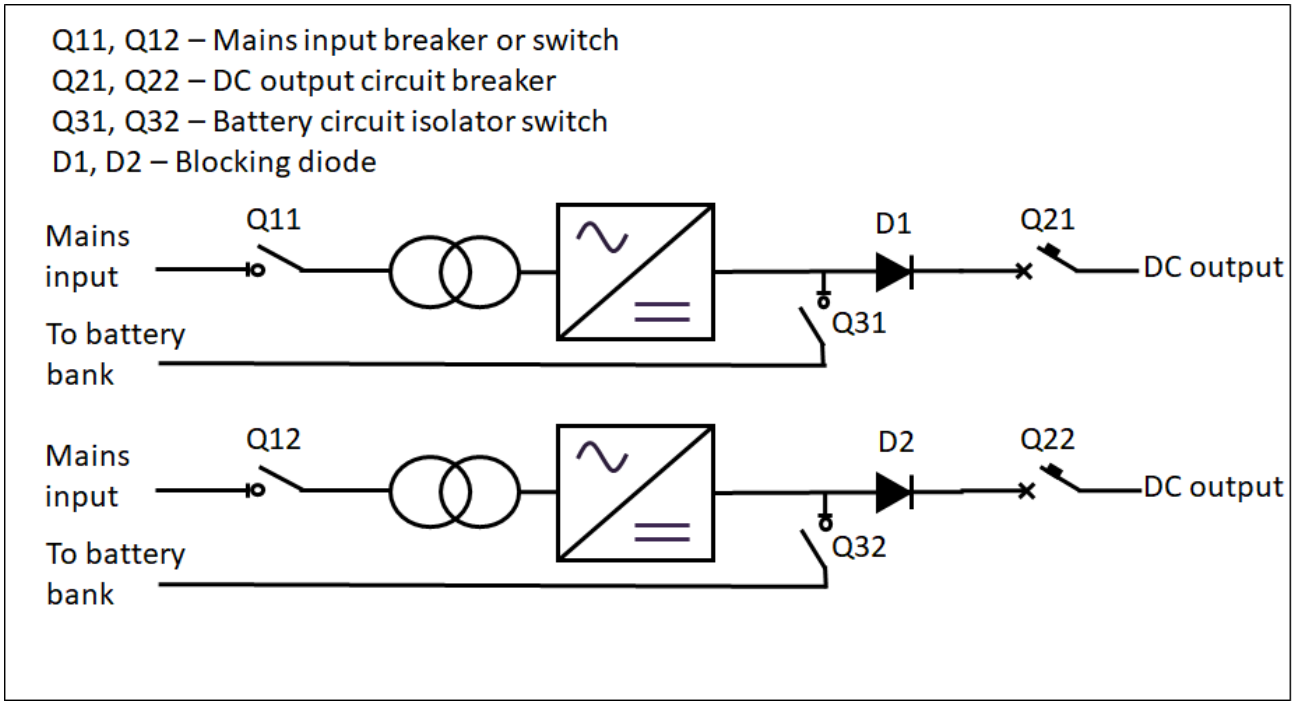

Figure A.5 – Simplified dual DC UPS with independent output bus

Bibliography

Add to bibliography

IEC 62402, *Obsolescence management*

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