



Supplementary Specification to PIP ELSAP04 for AC Uninterruptible Power Supply (UPS) System

NOTE This version (S-734J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-734.

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
1.1	May 2023	Issued for Public Review
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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).

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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 2020).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of uninterruptible power supply (UPS) systems for North American projects in accordance with PIP ELSAP04, Complete Revision September 2020, Technical Correction September 2021, Uninterruptible Power Supply (UPS) System Specification, 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 procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-734: Supplementary Specification to PIP ELSAP04 AC Uninterruptible Power Supply (UPS) System

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to PIP ELSAP04, following the PIP ELSAP04 clause structure. Clauses from PIP ELSAP04 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to PIP ELSAP04 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-734D: Procurement Data Sheet for AC Uninterruptible Power Supply (UPS) System (PIP)

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement 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 procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-734L: Information Requirements for AC Uninterruptible Power Supply (UPS) System (PIP)

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.

IOGP S-734Q: Quality requirements for AC Uninterruptible Power Supply (UPS) System (PIP)

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.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS follows that of PIP ELSAP04 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The procurement 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 (procurement data sheet, IRS, QRS);
- d) this specification;
- e) PIP ELSAP04.

1 Scope

Replace all instances of "PIP ELSAP04-D Data Sheet" with

IOGP S-734D

Justification

The PIP ELSAP04-D data sheet has been replaced because it does not provide sufficient detail for the scope of supply and default selections are not indicated in most instances. It is also not considered essential minimum.

2 References

2.2 Industry Codes and Standards

Add to section

46 CFR 111, Title 46—Shipping, Chapter I—Department of Coast Guard, Subchapter J—Electrical Engineering, Part 111—Electrical Systems—General Requirements.

ABS MODU, Publication Number 6 Part 4

ASCE/SEI 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

CSA C22.1, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations

CSA C22.2 No. 29, Panelboards and enclosed panelboards

CSA C22.2 No. 107.3, Uninterruptible power systems

IEC 60623, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells

IEC 60896-11, Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of tests

IEC 60896-22, Stationary lead-acid batteries – Part 22: Valve regulated types – Requirements

IEC 62040-2, Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements

IEC 62259, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Nickel-cadmium prismatic secondary single cells with partial gas recombination

IEC 62620, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications

IEEE 519, IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

IEEE 1184, IEEE Guide for Batteries for Uninterruptible Power Supply Systems

NFPA 70, National Electrical Code

3 Definitions

electrical control and management system (ECMS): A system that automatically controls the power system through instrumentation and control devices.

emergency shutdown (ESD): An automatic protection system that acts to shut down the plant if it enters a potentially dangerous state.

fire and gas system (FGS): A system that monitors for fire, gas, smoke and heat and initiates actions to suppress and isolate the detected threats while simultaneously generating audio and visual alarms.

process control system (PCS): An overall site integrated process automation, control and/or monitoring system.

safety instrumented system (SIS): A system that is an independent protection layer to shut down a system or a part of it if a hazardous condition is detected.

touch-safe (finger safe): Protected from inadvertent contact by a finger using covers, recessing of terminals or the size of openings.

Note: Touch-safe and similar terms such as finger safe are widely used to describe products but are not defined by industry standards. Touch-safe is generally equivalent to IP 2X or IPXXB per ANSI/IEC 60529 and IEC 61439-1.

4 Requirements

4.1.3

Replace section with

The UPS shall be listed or certified by a nationally recognized testing laboratory (NRTL) for the United States or accredited certification organization (ACO) for Canada.

Note: Applications for this equipment in other countries may have additional requirements for certification (e.g., UL 1778 for US applications).

Justification

This change is to focus on the requirement of certification laboratories or bodies. The specifics are handled by a data sheet selection for the certifying body.

4.1.4

Add new section

4.1.4.1

The operational life of the UPS and its components at the rated load shall be in accordance with Table 3.

Justification

PIP ELSAP04 does not address the design life. Table 3 aligns with IOGP S-701.

Add new Table 3

Table 3. Operating Life of the UPS and its Components

Components	Minimum Operation Life (Years)
Rectifier unit, inverter unit and static switch unit	20
Cooling fans	5
AC and DC capacitors	7
Input and output isolation transformer	20
Bypass transformer	20

Justification

PIP ELSAP04 does not address design life. Table 3 aligns with IOGP S-701.

Add new section

4.1.4.2

The UPS shall have a reliability integrity level 1 (RIL-1) in accordance with IEC 62040-3, Annex K.

Justification

PIP ELSAP04 does not address the UPS reliability and integrity. Reliability reflects the quality of the equipment and software used. Integrity reflects the performance and behavior of the system in case of a component failure.

Add new section

4.1.4.3

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

Justification

An obsolescence management plan helps ensuring the availability of components or spares in the market for main equipment during its service life. Unforeseen obsolescence could involve higher costs by means of engaging alternate resources to resolve crises. This situation could place the reliability and operation of critical systems at risk. Hence having an obsolescence management plan in place reduces the risk of obsolescence issues and/or reduces the impact when an item becomes obsolete.

4.1.5

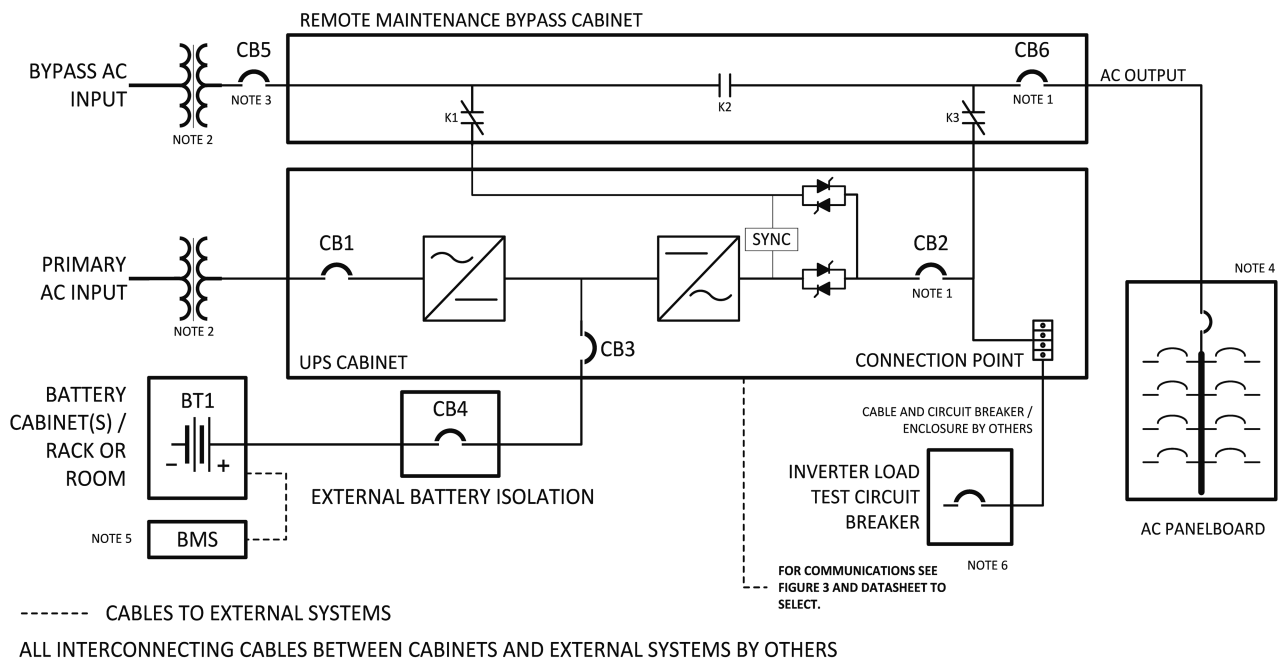
Replace first sentence with

Typical UPS configurations are shown in Figure 1 and Figure 2.

Justification

Figure 1 as shown in PIP ELSAP04 has been replaced. The data sheet shown in PIP ELSAP04 required several clarifications. PIP ELSAP04 also does not include a figure showing the topology for duplicated and paralleled UPS systems even though this is addressed. Therefore Figure 2 has been added to provide further information.

Replace Figure 1 with



NOTE This figure is used to assist with the specification of the UPS and associated equipment. Refer to the manufacturer's literature for specific components and configuration.

NOTE 1 Circuit breaker located in UPS (CB2) and/or bypass cabinet (CB6).

NOTE 2 Optional isolation transformer(s) located external or internal to associated cabinet.

NOTE 3 CB5 located external or internal to bypass cabinet.

NOTE 4 Panelboard optional, see data sheet.

NOTE 5 BMS Battery monitoring/management system. See Figure 3 for details.

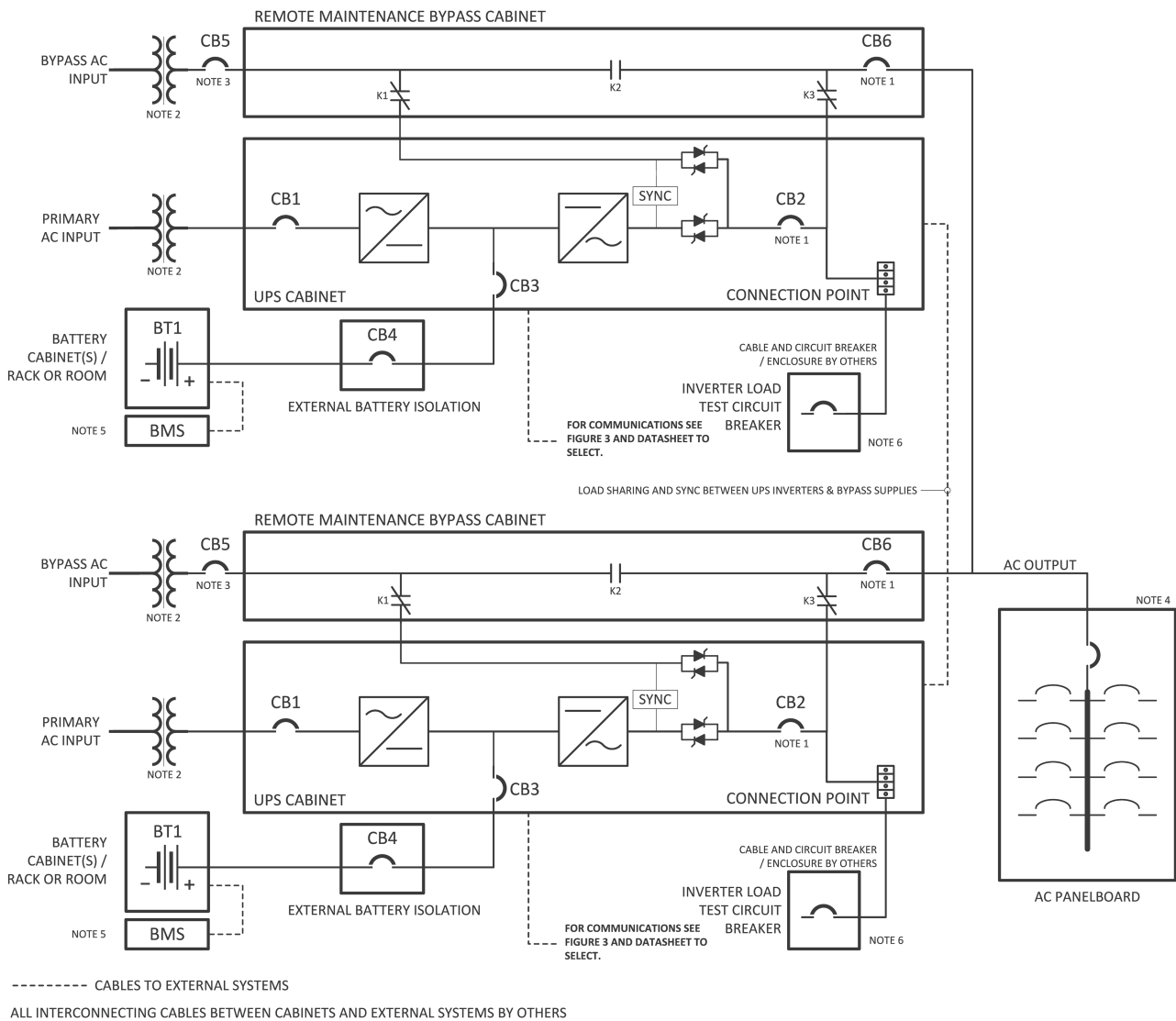
NOTE 6 Test CB located and supplied by others and external to UPS. Terminals to land test cable(s) provided by the supplier and located in the UPS cabinet.

Figure 1. Single UPS

Justification

Figure 1 has been replaced to more closely align to an Industrial UPS.

Add new Figure 2



NOTE This figure is used to assist with the specification of the UPS and associated equipment. Refer to the manufacturer's literature for specific components and configuration.

NOTE 1 Circuit breaker located in UPS (CB2) and/or bypass cabinet (CB6).

NOTE 2 Optional isolation transformer(s) located external or internal to associated cabinet.

NOTE 3 CB5 located external or internal to bypass cabinet.

NOTE 4 Panelboard optional, see data sheet.

NOTE 5 BMS Battery monitoring/management system. See Figure 3 for details.

NOTE 6 Test CB located and supplied by others and external to UPS. Terminals to land test cable(s) provided by the supplier and located in the UPS cabinet.

Figure 2. Duplicate (Paralleled) UPS

Justification

This figure has been added to provide details on duplicate and paralleled UPS systems topology that is not covered by PIP ELSAP04.

4.1.20

Replace section with

A ground bus shall be provided inside each cabinet and inside the remote maintenance bypass switch (RMBS) enclosure.

Justification

Proper grounding is typically provided in each cabinet. Grounding is provided to conform to electrical safety requirements as defined the referenced standards. Ground bus material is included in the data sheet selection.

Add new section

4.1.24

If a distribution panelboard is specified, the UPS and panelboard incorporating the main and branch circuit breakers shall provide a selective coordinated system (i.e., fully coordinated system) with the UPS inverter and bypass source.

Justification

Distribution panelboards are not covered in PIP ELSAP04. If specified in IOGP S-734D, panelboards are to be incorporated into the UPS system design. A properly coordinated system minimizes the impact of a load-side fault on the panelboard when the panelboard is supplied either by the UPS inverter or bypass sources.

Add new section

4.1.25

Equipment and wiring methods external to the UPS shall be in accordance with the applicable installation codes and regulations.

Justification

This requirement clarifies that equipment, wiring and installation methods external to the UPS are not covered by the NEMA, UL and IEC standards associated with the UPS but are covered by applicable codes and standards as specified.

Add new section

4.1.26

If specified, UPS assemblies to be installed on floating offshore installations in United States Coast Guard (USCG) and American Bureau of Shipping (ABS) jurisdictions shall comply with 46 CFR 111 and ABS MODU Publication Number 6 Part 4, respectively.

Note: Additional guidance and information for USCG and ABS requirements for UPS installed on floating facilities in US territorial waters can be found in API RP 14F / API RP FZ.

Justification

Floating marine/offshore installations can require additional measures to ensure compliance with ABS/USCG regulatory requirements.

4.2 Site Conditions

4.2.5

Replace section with

The UPS shall be designed for an electrically unclassified area.

Justification

This requirement brings terminology consistency by changing "non-hazardous" to "unclassified".

Add new section

4.2.6

If a seismic design is specified, the UPS shall comply with ASCE/SEI 7-16.

Justification

This seismic requirement is not covered by PIP ELSAP04 and is needed for critical equipment such as UPS systems.

4.3 Electrical Characteristics

Table 1. Electrical Characteristics

Add row 6. to section A.

	Ferroresonant	Pulse-Width Modulated (PWM)
A. Input		
6. AC input supply voltage total harmonic distortion (THDv)	≤ 8% as per IEEE 519	≤ 8% as per IEEE 519

Justification

Input harmonic limits are not specifically included or referenced in PIP ELSAP04 and are used to establish the maximum total harmonic voltage distortion limit that the UPS feeds back into the connected input.

In section D, replace rows 9. and 10. with

	Ferroresonant	Pulse-Width Modulated (PWM)
D. Output		
9. Overload (inverter only, without transfer to bypass)	a. 100% continuously b. 125% for 10 minutes c. 150% for 1 minute d. 200% for 100 milliseconds	a. 100% continuously b. 125% for 10 minutes c. 150% for 1 minute d. 200% for 100 milliseconds
10. Overload/fault-clearing current capability on bypass source, including static transfer switch	a. 100% continuously b. 125% for 10 minutes c. 150% for 1 minute d. 200% for 100 milliseconds e. 1000% for 50 milliseconds	a. 100% continuously b. 125% for 10 minutes c. 150% for 1 minute d. 200% for 100 milliseconds e. 1000% for 50 milliseconds

Justification

These alternate values better align with IOGP S-701, the essential minimum and the supplier's standard offerings.

4.5 Input Isolation and Bypass Isolation Transformers

4.5.6

Delete section 4.5.6

Justification

The manufacturer typically considers harmonics while designing the integral input isolation transformer of the UPS. This requirement has been transferred to the data sheet as this statement is redundant and provides no further useful information.

4.6 Rectifier/Charger

4.6.1 General

Replace list section 12. with

12. Input transient protection shall be in accordance with IEC 62040-2, Category C2 and C3 UPS.

Justification

This requirement clarifies the input overvoltage and EMC immunity standard as per IEC 62040-2. As per IEC 62040-2, Table 6, Category 2 and Category 3 are equivalent for UPS applications. All performance and testing (routine and type) is as per NEMA PE-1 and IEC 62040-3 which reference IEC 62040-2.

4.9 Internal Manual Bypass Switch (MBS)

Delete section 4.9

Justification

These requirements for the internal maintenance bypass switch are deleted for safety to ensure that there are no internal power sources inside UPS cabinets during maintenance.

4.10 Remote Maintenance Bypass Switch (RMBS)

4.10.1

Replace first sentence with

A remote maintenance bypass switch shall be provided.

Justification

The maintenance bypass switch for supply isolation ensures safety for maintenance personnel during the AC UPS maintenance.

Add new section

4.10.5

The RMBS shall have a three-position switch to select between normal, test and bypass modes, with the ability to be locked in the bypass position.

Justification

The three-position switch with the capability to be locked in the bypass position provides isolation for the safety of personnel performing maintenance on the UPS.

4.11 Inverter Test Load Connection

4.11.1

Replace section with

If test load terminals are specified, they shall be rated for the full load rating of the UPS at the inverter output.

Justification

Customer load test terminals are provided to allow safe isolation of the inverter output for test purposes. This can include readily accessible customer terminals provided by the supplier and cabling to an external standalone circuit breaker or disconnect. The cabling, circuit breaker or disconnect is provided by entities other than the UPS supplier. The terminals are sized to permit full load testing of the UPS.

4.11.2

Delete section 4.11.2

Justification

The circuit breaker is external to the UPS and supplied by entities other than the UPS supplier.

4.11.3

Delete section 4.11.3

Justification

The circuit breaker is external to the UPS and supplied by entities other than the UPS supplier.

4.11.4

Replace section with

Terminals used for the test load connection shall be clearly identified in the UPS.

Justification

Test load terminals need to be clearly identified for safe customer connections.

4.13 Batteries

4.13.1

Delete section 4.13.1

Justification

These references have been deleted as IOGP S-734D now provides information to completely specify the batteries.

4.13.2

Delete section 4.13.2

Justification

Batteries are specified in detail in the data sheet.

4.13.3

Add to section

If batteries are specified, hardware and accessories applicable to the battery technology selected shall be provided (e.g., insulated inter-cell connectors, flame arrestor type vent plugs with dust caps and racks with provisions for grounding).

Justification

This requirement clarifies the scope to include battery hardware, connectors and accessories when batteries are provided as PIP ELSAP04 does not address these items directly but through the deleted battery specifications and data sheets.

4.14 Enclosures

4.14.12

Delete "to less than 2% by volume in accordance with IEEE 484"

Justification

The hydrogen concentration of 2% in IEEE 484 conflicts with that of 1% in API RP 500 and API RP 505. The purchaser has to determine the H₂ concentration using the appropriate standard/practice.

4.15 Circuit Breakers and Switches

4.15.1

Replace "the one-line diagram" with

Figure 1, Figure 2 or the purchaser's diagram

Justification

Figure 1, Figure 2 or the purchaser's diagram provides details regarding the circuit breakers for the charger input and inverter/UPS output.

4.16 Fuses

4.16.1

Replace "finger safe, with an open fuse indication light" with

touch-safe (finger safe)

Justification

This requirement provides increased electrical safety for persons troubleshooting inside the UPS enclosure. An indicator light is not considered essential minimum.

4.16.3

Replace section with

Exposed energized terminals of low-voltage components (e.g., fuse holders and fuse blocks) with a line-to-ground voltage greater than or equal to 50 V shall be provided as touch-safe (finger safe) or covered by an insulating barrier to provide protection from incidental contact.

Justification

This requirement provides increased electrical safety for personnel troubleshooting inside the UPS enclosure.

4.17 Wiring and Terminals

4.17.1

Replace section with

Exposed energized terminals of low-voltage components (e.g., relays, power terminal blocks and alarm terminal blocks) with a line-to-ground voltage greater than or equal 50 V shall be provided as touch-safe (finger safe) or covered by an insulating barrier to provide protection from incidental contact.

Justification

This requirement provides increased electrical safety for personnel troubleshooting inside the UPS enclosure.

4.18 UPS Controls, Monitoring, and Communications

4.18.3 Measurement

4.18.3.3

Delete list item c.

Justification

The display of frequency is not considered essential minimum because issues with power system frequency indicate global issues with the power system which have to be addressed elsewhere.

Delete list item e.

Justification

The display of bypass AC current for each phase is not considered essential minimum because it adds significant complexity to the bypass cabinet with the addition of current transformers and associated wiring with additional inputs and programming for the UPS displays.

4.18.4 Protection and Alarms

4.18.4.6

Delete list item 3. of list section j.

Justification

This option is not considered essential minimum. This is an issue external to the UPS and has to be addressed at the power supply system feeding the UPS input.

4.18.4.7

Delete section 4.18.4.7

Justification

The provision of an audible alarm is not considered essential minimum and, as specified, is alarmed through communications and hardwired alarms.

4.18.7 Communications

4.18.7.2

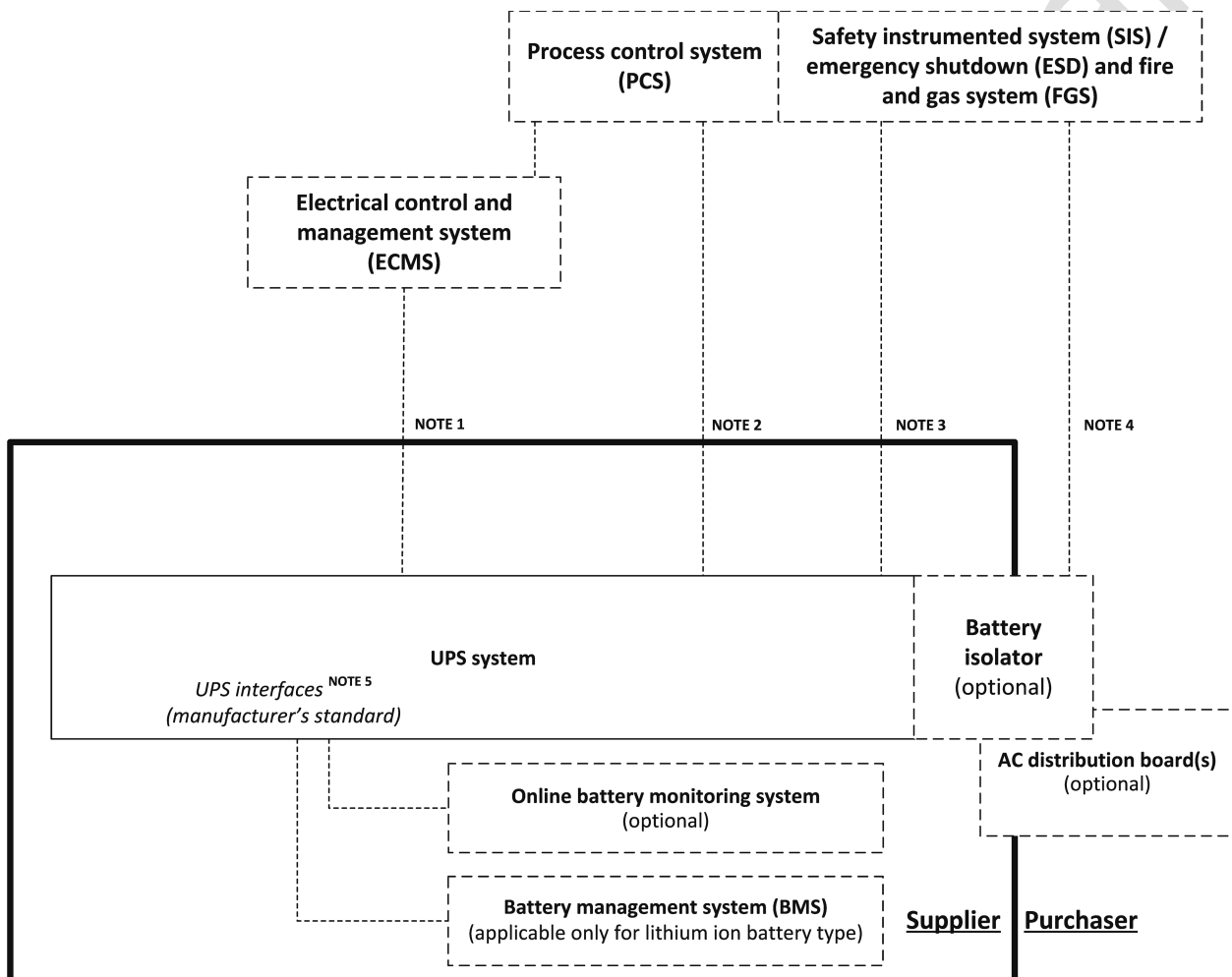
Replace section with

Figure 3 shall be used to reference additional details on UPS interfaces and interconnections.

Justification

This requirement provides clarity on the UPS interface and communications options.

Add new Figure 3



NOTE 1 Network connectivity interface for time synchronization, remote access and configuration.

NOTE 2 Direct interface for critical / safety critical status and alarms to PCS where ECMS is not present. Independent to emergency shutdown system trip.

NOTE 3 Direct interface for emergency shutdown trip and fire and gas system function (example: boost charge inhibit) / trip.

NOTE 4 Direct interface for emergency shutdown and fire and gas system trips.

NOTE 5 Supplier standard interface for synchronization and load sharing between UPSs (applicable for parallel systems), UPS battery monitoring system and battery management system where applicable.

Figure 3. Communications Block Diagram

Justification

This figure provides further details of the communication and interconnection options selectable on the data sheet.

4.19 Tagging and Nameplates

4.19.3

4.19.3.4

Delete section 4.19.3.4

Justification

This option is not considered essential minimum. The UPS does not require the addition of the short circuit current on the nameplate.

4.19.3.7

Delete section 4.19.3.7

Justification

This option is not considered essential minimum. The KVA rating of the UPS is already part of the nameplate requirement.

Add to section

4.19.8

Compartments with an external voltage source shall have a caution label fitted on the doors.

Justification

This requirement provides increased electrical safety by notifying workers of the location of multiple sources of power.

4.20 Inspection and Testing

4.20.3

Replace section with

Type testing shall be performed in accordance with IEC 62040-3, Table 5.

Justification

Type testing is now covered in IEC 62040-3.

4.20.4

Delete section 4.20.4

Justification

Testing is now covered in IEC 62040-3.

4.20.5

Delete section 4.20.5

Justification

Testing is now covered in IEC 62040-3.

4.20.6

Delete section 4.20.6

Justification

Testing is now covered in IEC 62040-3.

4.20.7

Delete section 4.20.7

Justification

Testing is now covered in IEC 62040-3.

4.20.8

Delete section 4.20.8

Justification

Testing is now covered in IEC 62040-3.

Add new section

4.20.9

Routine testing shall be performed in accordance with IEC 62040-3, Table 5.

Justification

Routine testing in IEC 62040-3 covers the testing required for the AC UPS system and associated equipment.

Add new section

4.20.10

If burn-in testing is specified, a continuous operation at full rated capacity burn-in test shall be completed.

Justification

This requirement ensures proper operation of critical UPS equipment and identifies heat related failure modes.

Add new section

4.20.11

Communication interfaces shall be tested to verify the physical hardware media and associated software protocols.

Justification

This requirement verifies UPS communication interface prior to shipment.

Add new section

4.20.12

For duplicate paralleled UPSs, equal load sharing shall be verified in accordance with IEC 62040-3:2021, Section 6.4.2.6.

Justification

IEC 62040-3:2021 refers to this as a type test and verifies the ability of paralleled UPSs to load share. This requirement provides evidence of equal load sharing between each duplicate (paralleled) UPS unit.

4.22 Documentation

4.22.3

Delete section 4.22.3

Justification

The requirements for documentation are defined in IOGP S-734L.

4.22.4

Delete section 4.22.4

Justification

The requirements for documentation are defined in IOGP S-734L.

4.22.5

Delete section 4.22.5

Justification

The requirements for documentation are defined in IOGP S-734L.

4.22.6

Delete Section 4.22.6

Justification

The requirements for documentation are defined in IOGP S-734L.

4.22.7

Delete section 4.22.7

Justification

The requirements for documentation are defined in IOGP S-734L.

Table 2. Documentation Requirements

Delete Table 2

Justification

The requirements for documentation are defined in IOGP S-734L.

4.23 Conflict Resolution

Delete section 4.23

Justification

Conflict resolution (order of precedence) is covered in the Introduction section of this specification.

Add Bibliography

Bibliography

- [1] API Recommended Practice 14F, *Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1, and Division 2 Locations*
- [2] API Recommended Practice 14FZ, *Recommended Practice for Design, Installation and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations*
- [3] API Recommended Practice 500, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*
- [4] API Recommended Practice 505, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*
- [5] IEC 62402, *Obsolescence management*
- [6] IEEE 485, *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications*
- [7] IEEE 1115, *IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications*
- [8] IOGP S-701, *Supplementary Specification to IEC 62040-3 for AC Uninterruptible Power Systems (UPS)*
- [9] ISO 9001, *Quality management systems — Requirements*
- [10] ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*

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