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Bridgend Green Hydrogen

Part IV Schedule 23 Standards

January 2023

Marubeni

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1 Standards

EU DIRECTIVES AND STATUTORY INSTRUMENTS (SI)	
EMC	Electromagnetic Compatibility Directive (EMC) (2014/30/EU).
LVD	Low Voltage Directive (2014/35/EU).
COSHH	The Control of Substances Hazardous to Health Regulations 2002.
DSEAR	The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).
HSAWA	The Health and Safety at Work Act 1974.
WEEE	Waste Electrical and Electronic Equipment Directive (WEEE) (2012/19/EU).
LCHS	UK Low Carbon Hydrogen Standard

INTERNATIONAL AND BRITISH STANDARDS AND GUIDANCES	
STANDARD	DESCRIPTION
ASM	ASM Consortium Guidelines for Effective Operator Display Design
BS 6739	Code of practice for instrumentation in process control systems: installation design and practice
BS 7430	Code of Practice for Earthing
BS 7671:2018 +A1:2020	Requirements for Electrical Installations (IET Wiring Regulations) Latest Edition.
BSEN5839 (EN54)	Fire detection and alarm panel
BS EN 60073	Basic and Safety Principles for Man-Machine interface, Marking and Identification.
BS EN 60079	Explosive atmospheres
BS EN 60204	Safety of machinery. Electrical equipment of machines.
BS EN 60255	Electrical relays - All Parts
BS EN 60269	Low Voltage Fuses.
BS EN 61000	Electromagnetic Compatibility (EMC)
BS EN 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems.
BS EN 61511	Functional safety – Safety instrumented systems for the process industry sector
BS EN 62061	Machinery
EEMUA 191	Alarm Systems A Guide to Design, Management and Procurement
EEMUA 201	Process plant control desks utilising Human-Computer Interfaces
EEMUA 222	Guide to the Application of IEC 61511 to safety instrumented systems in the UK process industries
HSE EH40	Workplace Exposure Limits
HSE OG0086	Cyber Security for Industrial Automation and Control Systems (IACS)
IEC 60417	Graphical Symbols for Use on Equipment
IEC 60529	Degrees of Protection provided by enclosures.
IEC 60654	Parts 1 to 4 Operating Conditions for Industrial Process Measurement and Control Equipment
IEC 61131	Parts 1 to 9 Programmable controllers
IEC 61512	Parts 1 to 4 Batch Control
IEC 62264	Parts 1 to 3 Enterprise-control system integration
IEC 62443	Parts 1 to 4 Industrial Automation and Control Systems Security
IEC 62682	Management of alarms systems for the process industries
ISA 101	Human-Machine Interfaces

ISA S88	Batch Control
ISO 9001	Quality Systems

1.1 Relevant Standards

The codes and standards as Applicable Standards which are mentioned within this document, are to be regarded as non-exhaustive and do not relieve the *Contractor* from its obligation to provide complete and fully functional systems and facilities. The *Contractor* shall observe all the national and international standards which are relevant for completion of its work under the contract.

When a specific topic is not regulated by a national law or standard, the Work shall comply with the standards issued by the following organisations, in order of precedence:

- Association national standards, for example:
 - BSI: British Standards Institution
 - UBC/IBC: Universal/International Building Code
 - ASCE: American Society of Civil Engineers
 - API: American Petroleum Institute (where hydrogen-specific standards do not exist or are not specific enough)
- International standards, for example:
 - CGA: Compressed Gas Association
 - EIGA: European Industrial Gases Association
 - IEC: International Electrotechnical Commission
 - ISO: International Organisation for Standardisation
 - IEEE: Institute of Electrical and Electronic Engineers
- In the absence of any relevant association national standards or international standards, EN European Standards shall be used.

1.2 Statutory Regulations / Requirements

All parts of the *Contractor's* responsibilities including design, management, installation, procurement and component supply, testing and commissioning shall comply with the following non-exhaustive list of statutory requirements:

- The Grid Code
- The Distribution Code of Great Britain
- Control of Pollution Act 1974, as amended
- Environment Act 1995, as amended
- Environmental Protection Act 1990
- Gas Act 1986 (as amended by the Gas Act 1995 and incorporating stand-alone provisions of the Utilities Act 2000)
- The Health and Safety at Work Act 1974
- Gas Appliances (Safety) Regulations 1995
- Management of Health and Safety at Work Regulations 1999
- Dangerous Substances and Explosive Atmosphere Regulations 2002
- Gas Safety (Installation and Use) Regulations 1998, as amended
- Gas Safety (Installation and Use) (Amendment) Regulations 2018
- Gas Safety (Management) Regulations 1996
- Gas Safety (Management) Regulations 1996 Safety Case (HSE Guidance)
- Pipelines Safety Regulations 1996
- Pressure Systems Safety Regulations 2000
- The Electricity at Work Regulations 1989
- The Electricity Supply Regulations 1998
- The Electricity Safety, Continuity and Quality Regulations 2002

- The Electrical Equipment (Safety) Regulations 1994
- Provision and Use of Work Equipment Regulations 1998.
- Construction Design and Management (CDM) Regulations 2015
- NG TS 2.10.10 Technical Specifications - GIS and Other Substation Buildings Design
- NG TS2.10.06
- Products certifications according to the national and international standards made by independent accredited laboratories
- All relevant standards referred to in this document

1.3 General Standards

- ISO 9001:2015, Quality management
- ISO 14001:2015, Environmental management
- OHSAS 18001:2007 Occupational Health and Safety Management or ISO 45001: 2018, Occupational health and safety management systems

1.4 System Design and Installation Standards

1.4.1 General

- API 520, Sizing, Selection and Installation of Pressure Relieving Devices in Refineries – Part 1 Sizing and Selection
- API 520, Sizing, Selection and Installation of Pressure Relieving Devices in Refineries – Part 2 Sizing and Selection
- API 521, Pressure-relieving and Depressurising Systems
- API 2000, Venting Atmospheric and Low-Pressure Storage Tanks
- ASME B31.1, Process Piping
- ASME VIII-1/2, Pressure Vessels

1.4.2 Hydrogen / pressurised gases

- LCHS, BEIS UK Low Carbon Hydrogen Standard
- ANSI/AIAA G-095, Guide to Safety of Hydrogen and Hydrogen Systems
- BS EN 437:2003, Test gases. Test pressures. Appliance categories
- CGA G-5.4, Standard for Hydrogen Piping Systems at Consumer Sites.
- CGA PS-21, Position Statement on Adjacent Storage of Compressed Hydrogen and Other Flammable Gases
- EIGA IGC Doc. 04/18, Fire Hazards of Oxygen and Oxygen Enriched Atmospheres
- EIGA IGC Doc 15/06/E. Gaseous Hydrogen Stations (EIGA)
- EIGA IGC Doc 75/01/rev. Determination of Safety Distances (EIGA)
- EIGA IGC Doc 100/03/E, Hydrogen cylinders and transport vessels (EIGA)
- ISO / DIS 26142, Hydrogen detection apparatus – Stationary applications
- ISO 14687:1999, Hydrogen fuel. Product specification
- ISO TR 15916, Basic considerations for the safety of hydrogen systems
- NFPA 55, Compressed Gases and Cryogenic Fluids Code
- NFPA 2, Hydrogen Technologies Code
- PED EU 97/23/EC, Directive of the European Parliament and of the council on the approximation of the states concerning pressure Equipment

1.4.3 Piping / Pipelines

- ASME B31.12:2019, Hydrogen Piping and Pipelines
- EIGA IGC Doc. 13/20, Oxygen Pipeline and Piping Systems

1.4.4 Venting

- CGA G-5.5, Hydrogen Vent Systems
- EN 14994, Gas Explosion Venting Protective Systems.
- EIGA 154/16, Safe Location of Oxygen and Inert Gas Vents

1.4.5 Earthing Standards

- IEEE Std. 80-2000, IEEE Guide for Safety in AC Substation Grounding
- IEEE 142-2007 IEEE Recommended Practice for Grounding of Industrial and Commercial Power System
- BS EN 50522 Earthing of Power Installations exceeding 1kV A.C.
- BS EN 61936-1, Power installations exceeding 1 kV a.c. – Part 1: Common rules
- BS EN 60999 (all parts), Connecting devices. Electrical copper conductors. Safety requirements for screw-type and screwless-type clamping units.
- BS EN 60071-1, Insulation co-ordination - Part 1: Definitions, principles and rules
- BS EN 60664-1, Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
- BS EN 61557-8, Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring, or monitoring of protective measures - Part 8: Insulation monitoring devices for IT systems.
- UL 1053 Standard for Ground-Fault Sensing and Relaying Equipment
- IEEE 81- IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Grounding System
- BS 7430, Code of Practice for Protective Earthing of Electrical Systems
- ENA ER S34, A Guide for Assessing the Rise of Earth
- ENA ER S36, Identification and Recording of 'Hot Sites'- Joint
- ENA TS 41-24, Guidelines for the Design, Installation, Testing and Maintenance of Main Earthing Systems in Substations
- ENA TS 43-94, Earth Rods and Their Connectors
- IEC/TS 60479-1 Effects of current on human beings and livestock - Part 1: General aspects

1.4.6 Overvoltage and Lightning Protection

- BS EN 62305 SER, Protection against lightning - ALL PARTS
- BS EN 60099-4, Surge arresters – Part 4: Metal-oxide surge arrestors without gaps for a.c. systems
- BS EN 60099-5, Surge arresters – Part 5: Selection and application recommendations
- BS EN 61643-11, Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods.
- BS EN 62561 (all parts), Lightning Protection System Components (LPSC).
- IEC/TS 60479-1 Effects of current on human beings and livestock - Part 1: General aspects

1.5 Primary System Components

1.5.1 PEM Electrolysers

- BS ISO 22734-1, Hydrogen generators using water electrolysis — Industrial, commercial, and residential applications

1.5.2 Power Transformers

- BS EN 60076, Power transformers (parts as relevant)
- BS EN 61378-1, Converter transformers - Transformers for industrial applications
- BS EN 60296, Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear

- BS EN 60422, Mineral insulating oils in electrical equipment - Supervision and maintenance guidance
- BS EN 60599, Mineral oil-filled electrical equipment in service – Guidance on the interpretation of dissolved and free gases analysis
- BS EN 60270, High-voltage test techniques - Partial discharge measurements
- BS EN 60156, Insulating liquids - Determination of the breakdown voltage at power frequency - Test method

1.5.3 Cables, Connectors, Switchgear and Control gear - General

- BS EN 60204. Safety of Machinery - Electrical Requirements of Machines
- BS EN 60445. Basic and Safety Principles for Man-machine Interface, Marking and Identification of Equipment Terminals and Conductor Terminations
- BS EN 60044. Instrument Transformers (CTs)
- BS EN 61869. Instrument Transformers (VTs)
- BS EN 55014. EMC Requirements
- BS EN 61000. EMC
- BS EN 60255. Measuring Relays and Protection Equipment. Common Requirements
- BS 5467. Electric Cables. Thermosetting Insulated, Armoured Cables for Voltages of 600/1000V and 1900/3300V
- BS 6004. Electric cables. PVC Insulated and Thermoplastic Sheathed Cables, Non-armoured, for Voltages Up to and Including 450/750V
- BS 6622. Specification of Cables with Extruded Cross-linked Polyethylene or Ethylene Propylene Rubber Insulation for Rated Voltages from 3.8/6.6kV up to 19/33kV
- BS 6724. Electric cables. Thermosetting Insulated Armoured Cables for Voltages of 600/1000V and 1900/3300V
- BS 7211. Electric cables. Thermosetting Insulated and Thermoplastic Sheathed Cables, Non-armoured, for Voltages Up to and Including 450/750V
- BS 7870. LV and HV Polymeric Insulated Cables for Use by Distribution and Generation Utilities
- BS EN 50525. Electric Cables. Low Voltage Energy Cables of Rated Voltages up to and Including 450/750V
- BS EN 61537. Cable Management – Cable Tray Systems and Cable Ladder Systems
- BS EN 50085. Cable Trunking Systems and Cable Ducting Systems for Electrical Installations (all parts)
- BS 7671. Requirements for Electrical Installations
- BS EN 61869, Instrument Transformers (parts as relevant)
- BS EN 60287-1, Electric cables - Calculation of the current rating
- BS EN 60228, Conductors of insulated cables
- BS EN 60332-1-2, Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame
- BS EN 61034 (all parts), Measurement of smoke density of cables burning under defined conditions
- BS EN 60068-2-78, Environmental testing – Part 2-78: Tests. Test Cab: Damp heat, steady state
- BS EN 60754-1, Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
- BS EN 60811-100, Electric and optical fibre cables - Test methods for non-metallic materials - Part 100: General
- BS EN 62444, Cable glands for electrical installations
- BS EN 60216-1, Electrical insulating materials - Thermal endurance properties - Part 1: Ageing procedures and evaluation of test results

1.5.4 Cables, Connectors, Switchgear and Control gear - Low voltage

- BS EN 61557-12, Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V d.c. Equipment for testing, measuring or monitoring of protective measures. Power metering and monitoring devices (PMD)
- BS EN 60364 (all parts), Low-Voltage electrical installations (for topics not included in National Electrical Standards)
- BS EN 61439 (all parts), Low-voltage switchgear and control gear assemblies
- BS EN 60947, Low-voltage switchgear and control gear (parts as relevant)
- BS EN 60269 (all parts), Low-voltage fuses
- BS EN 60227 (all parts) Polyvinyl chloride insulated cables of rated voltages up to and including 450/750V
- BS EN 60245 (all parts), Rubber insulated cables - Rated voltages up to and including 450/750V
- BS EN 62852, Connectors for photovoltaic systems. Safety requirements and tests
- BS EN 60189-1, Low frequency cables and wires with PVC insulation and PVC sheath – Part 1: General test and measuring methods
- TUV 2 Pfg 1169 08. Requirements for cables
- BS EN 60898-1, Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations - Part 1: Circuit-breakers for a.c. operation
- BS EN 60715 Dimensions of low-voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations
- BS 2692. Fuses for Voltages Exceeding 1000V AC Expulsion Fuses
- BS EN 60947. Specification for Low Voltage Switchgear and Controlgear
- BS EN 61439. LV Switchgear and Controlgear Assemblies
- BS 88. Cartridge Fuses for Voltages up to and Including 1000V AC and 1500V DC
- BS EN 60051. Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories
- BS EN 60529. Specification for Degrees of Protection Provided by Enclosures (IP code)
- ENA 37-1. 400V AC Switchgear, Controlgear and Fusegear
- ENA TS 50-18. Design and Application of Ancillary Electrical Equipment
- BS 6231. Single core Polyvinyl Chloride (PVC) insulated flexible cables - 600/1000V
- BS 5499. Safety Signs. Code of Practice

1.5.5 Cables, Connectors, Switchgear and Control gear - High voltage

- BS EN 62271, High-voltage switchgear and control gear (parts below as relevant)
- -1, Common specifications for alternating current switchgear and control gear
- -100, Alternating current circuit-breakers
- -110, Inductive load switching
- -200, AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
- -202, High-voltage/ low-voltage prefabricated Substation
- BS EN 60502, SER Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2 \text{ kV}$) up to 30 kV ($U_m = 36 \text{ kV}$) – ALL PARTS

1.5.6 Cables, Connectors, Switchgear and Control gear - Cable containment, trenches and ducting

- BS EN 60364-5 (all sections), Selection and erection of electrical equipment
- BS EN 61386-24, Conduit systems for cable management - Part 24: Particular requirements - Conduit systems buried underground
- BS EN 61386-21, Conduit systems for cable management - Part 21: Particular requirements - Rigid conduit systems

- BS EN 61084 (all parts), Cable trunking and ducting systems for electrical installations

1.5.7 Cables, Connectors, Switchgear and Control gear - Cable jointing and terminations

- BS EN 61442, Test methods for accessories for power cables
- BS EN 61238-1, Compression and mechanical connectors for power cables
- BS EN 61914, Cable cleats for electrical installations
- BS EN 60947-7-2, Low voltage switchgear and control gear – part 7-2: Ancillary equipment – Protective conductor terminal block for copper conductors
- BS EN 60502, Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV)

1.6 Control and Instrument System

EU DIRECTIVES AND STATUTORY INSTRUMENTS (SI)	
EMC	Electromagnetic Compatibility Directive (EMC) (2014/30/EU).
LVD	Low Voltage Directive (2014/35/EU).
COSHH	The Control of Substances Hazardous to Health Regulations 2002.
DSEAR	The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).
HSAWA	The Health and Safety at Work Act 1974.
WEEE	Waste Electrical and Electronic Equipment Directive (WEEE) (2012/19/EU).

INTERNATIONAL AND BRITISH STANDARDS AND GUIDANCES	
STANDARD	DESCRIPTION
BS 6739	Code of practice for instrumentation in process control systems: installation design and practice
BS 7430	Code of Practice for Earthing
BS 7671:2018 +A1:2020	Requirements for Electrical Installations (IET Wiring Regulations) Latest Edition.
BS EN 60073	Basic and Safety Principles for Man-Machine interface, Marking and Identification.
BS EN 60079	Explosive atmospheres
BS EN 60204	Safety of machinery. Electrical equipment of machines.

BS EN 60255	Electrical relays - All Parts
BS EN 60269	Low Voltage Fuses.
BS EN 61000	Electromagnetic Compatibility (EMC)
BS EN 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems.
BS EN 61511	Functional safety – Safety instrumented systems for the process industry sector
EEMUA 191	Alarm Systems A Guide to Design, Management and Procurement
EEMUA 201	Process plant control desks utilising Human-Computer Interfaces
EEMUA 222	Guide to the Application of IEC 61511 to safety instrumented systems in the UK process industries
HSE EH40	Workplace Exposure Limits
HSE OG0086	Cyber Security for Industrial Automation and Control Systems (IACS)
IEC 60417	Graphical Symbols for Use on Equipment
IEC 60529	Degrees of Protection provided by enclosures.
IEC 60654	Parts 1 to 4 Operating Conditions for Industrial Process Measurement and Control Equipment
IEC 60839 (all parts)	Alarm and electronic security systems
IEC 61131	Parts 1 to 9 Programmable controllers
IEC 61512	Parts 1 to 4 Batch Control
IEC 62264	Parts 1 to 3 Enterprise-control system integration
IEC 62443	Parts 1 to 4 Industrial Automation and Control Systems Security
IEC 62676-4	Video surveillance systems for use in security applications. Application guidelines
IEC 62682	Management of alarms systems for the process industries
ISA 101	Human-Machine Interfaces
ISA S88	Batch Control
ISO 9001	Quality Systems

ASM Consortium Guidelines for Effective Operator Display Design

1.7 Security System

- IEC 62676-4, Video surveillance systems for use in security applications. Application guidelines
- IEC 60839 (all parts), Alarm and electronic security systems

1.8 Monitoring System

- IEC 61850 (all parts) - Communication networks and systems for power utility automation
- IEC 60870-6-503, Telecontrol equipment and systems - Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations - TASE.2 Services and protocol.
- IEC 61000-6-1, Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
- IEC 61158 (all parts), Industrial communication networks – Fieldbus specifications-
- ISO/IEC 11801, Information technology – Generic cabling for customer premises
- IEC 61784 (all parts), Industrial communication networks – Profiles
- IEC 61918, Industrial communication networks – Installation of communication networks in industrial premises
- IEC 81346 (all parts), Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations
- IEC 60870-5 SER, Telecontrol equipment and systems - Part 5: Transmission protocols - ALL PARTS

1.9 Metering

- IEC 60044. Instrument Transformers (CT's)
- IEC 61869. Instrument Transformers (VT's)
- IEC 62052 (all parts), Electricity metering equipment (AC) - General requirements, tests and test conditions

1.10 Mechanical, Civil and Structural Design Standards

- Eurocodes and the British National Annexes:
 - BS/EN 1990 – Basis of structural design
 - BS/EN 1991 – Action on structures
 - BS/EN 1992 – Design of concrete structures
 - BS/EN 1993 – Design of steel structures
 - BS/EN 1997 – Geotechnical Design
- Building Regulations, Parts A-P Manual of Contract Documents for Highway Works (MCHW).
- Design Manual for Roads and Bridges (DMRB).
- IEC 60826, Design criteria of overhead transmission lines.
- IEC 61773, Overhead lines – testing of foundations for structures.
- IEC 60364-7-704, Low-voltage electrical installations: Construction and demolition sit installations

