



Generic Panel specification

Electrical, Instrumentation and Telecom systems

MIVSP platform locations



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Table of contents

1.	Introduction.....	4
1.1.	General.....	4
1.2.	DEFINITION OF TERMS.....	5
2.	DETAILS OF THE SCOPE OF WORK.....	6
3.	LAWS, REGULATIONS, CODES, STANDARDS AND AUTHORITIES	6
3.1.	FOREWORD.....	6
3.2.	CONFLICTS.....	6
3.3.	CERTIFYING AUTHORITIES.....	6
3.4.	ELECTRICAL STANDARDS.....	6
3.4.1.	INTERNATIONAL STANDARDS.....	6
	NEN-EN-IEC 61439 Low voltage switchgear and control gear assemblies.....	6
3.4.2.	NATIONAL STANDARDS.....	7
4.	GENERAL REQUIREMENTS	8
4.1.	GENERAL.....	8
4.2.	SUBSTITUTION AND MODIFICATIONS.....	8
4.3.	ADDITIONAL WORK.....	8
4.4.	DRAWINGS AND SPECIFICATIONS.....	8
4.5.	MATERIAL, WORKMANSHIP AND SUITABILITY.....	8
4.6.	WORK UNDER SPECIAL CONDITIONS.....	9
4.7.	CERTIFICATION.....	9
5.	DESIGN REQUIREMENTS	10
5.1.	GENERAL DESIGN REQUIREMENTS.....	10
6.	SPECIFIC DESIGN REQUIREMENTS.....	12
6.1.	GENERAL.....	12
6.2.	PANEL REQUIREMENTS.....	12
6.3.	CIRCUIT BREAKERS.....	14
6.4.	AUXILIARY RELAYS.....	14
6.5.	POWER SUPPLY MODULES.....	15
6.6.	DC / DC CONVERTERS.....	15
6.7.	WIRING CHANNEL.....	15
6.8.	INTERNAL PANEL WIRING	16
6.9.	INTERNAL WIRING COLOURS.....	17
6.10.	WIRE IDENTIFICATION	17
6.11.	TERMINALS.....	18
6.12.	TERMINAL STRIPS.....	19
6.13.	EXTERNAL CABLE TERMINATIONS.....	19
6.14.	EARTHING	20
6.15.	COMPONENTS AND PARTS	21
7.	TAGGING AND IDENTIFICATION.....	22
7.1.	TAGGING AND IDENTIFICATION FOR PANELS.....	22
7.2.	TAGGING AND IDENTIFICATION FOR OUTDOOR EQUIPMENT.....	23
8.	RELEVANT DOCUMENTS SUPPLIED BY RWS.....	24
9.	VENDOR DOCUMENTS REQUIRED.....	24
9.1.	DRAWING REQUIREMENTS	24
9.2.	DRAWING NUMBERS	24
9.3.	SHEET NUMBERS.....	24
9.4.	MODIFICATIONS.....	25
9.5.	DOCUMENTATION	25
9.5.1.	GENERAL.....	25

10. REPRESENTATIVES, SITE VISITS, INSPECTION AND TESTING.....

10.1. Test Reports

11. PREPARATION FOR SHIPMENT.....

11.1. MATERIAL RECEIPT AND STORAGE.....

12. MECHANICAL COMPLETION / COMMISSIONING

12.1. COMMISSIONING

12.2. START-UP ASSISTANCE.....

13. ABBREVIATIONS.....

29

30

31

31

33

33

34

35

1. Introduction

1.1. General

This electrical, instrumentation and telecom systems panel specification covers the minimum requirements for the design, construction and testing of sensing and communication systems panels and related equipment, to be installed on the TenneT Offshore Substation (OSS).

On the offshore substations (OSS) the sensing and communication system panels of Rijkswaterstaat (RWS) will be installed. The panels contain the indoor units of the sensor- and communication systems, which can be found in [Bijlage 3] and [Bijlage 4]

All items of the Work and their combination into a complete installation shall meet all the requirements as described in this document.

Detailed information, responsibilities and requirements are described in this specification.

This specification is a detailed part of a particular installation and shall be read in conjunction with the other appendices.

Note : All deviations from this standard specification and items not relevant for the applicable panels to be listed, other RWS Contractor “ fit for purpose “ materials and solutions are subject to RWS approval.

The design and construction of the sensing and communication systems panels shall be so that continuity of production shall be ensured and be as safely as possible at all times.

1.2. DEFINITION OF TERMS

In this document the following terms and respective definitions are used. These definitions shall apply throughout this document.

RWS	Rijkswaterstaat or its appointed representative(s).
RWS Contractor	The company to whom the Purchase Order (P.O.) is awarded.
RWS Vendor(s)	Other party(s) from which RWS receives sensor- and communication equipment
The Work	All work to be done by Vendor in accordance with the Purchase Order.
TenneT	The Dutch grid operator from which the offshore substations are
Tenderer	The company accepting the request for tender
TenneT Contractor	The company responsible for the construction of the platform and / or WTG
T-IV RWS	Technisch Installatie Verantwoordelijke RWS, Technical Installation Responsible Owner of the panels.

2. DETAILS OF THE SCOPE OF WORK

The general scope of work and requirements are described in [bijlage 7]. Details of the scope of work and requirements are described in this document.

3. LAWS, REGULATIONS, CODES, STANDARDS AND AUTHORITIES

3.1. FOREWORD

All equipment shall be certified by a European authorized certifying body in accordance with IEC standards.

All equipment shall conform to the European health, safety and environmental protection standards and therefore have a CE certification mark.

All equipment and materials shall comply with the statutory requirements of the Electromagnetic Compatibility (EMC) directives and shall be.

RWS Contractor shall be able to handover the declarations of conformity to the above mentioned standards of their purchased goods to RWS.

RWS Contractor shall handover (non)dual use statements of their purchased goods to RWS.

3.2. CONFLICTS

In any case of conflict between the requirements stated in local law, all codes, standards and regulations, as listed in this standard specification, RWS shall be notified of this conflict in writing immediately. Work shall only proceed after receipt of a written clarification from RWS. These points are not allowed to delay the delivery. In case of interpretation conflicts, the requirements in this specification shall prevail.

3.3. CERTIFYING AUTHORITIES

DNV GL is the Notified Body and Certifying Authority appointed by TenneT to ensure the offshore substations comply with Dutch Law and Regulations.

RWS Technical Installation Manager (T-IV) is responsible to ensure sensing and communication system panels and equipment of RWS comply with Dutch Law and Regulations.

3.4. ELECTRICAL STANDARDS

3.4.1. INTERNATIONAL STANDARDS

NEN-EN-IEC 61000 Electromagnetic compatibility

NEN-EN-IEC 61439 Low voltage switchgear and control gear assemblies



3.4.2. NATIONAL STANDARDS

NEN 1010	Safety regulations for low voltage installations
NEN 3140	Safety regulations for work at low voltage installations

4. GENERAL REQUIREMENTS

4.1. GENERAL

This technical document covers the minimum general requirements for the design, delivery, construction, installation and testing of the Work.

4.2. SUBSTITUTION AND MODIFICATIONS

The RWS Contractor shall make no substitution of materials or modifications to details without the prior approval of RWS.

Should RWS Contractor desire to make any substitutions or modifications, he shall submit his request to RWS, stating the reason whilst demonstrating the adequacy of the proposed substitution or modifications.

4.3. ADDITIONAL WORK

Any additional work, not provided for in the specifications and referenced documents, shall be subject to RWS approval before any work may start.

4.4. DRAWINGS AND SPECIFICATIONS

The Work shall in every respect be in accordance with the specifications and referenced documents.

Installation drawings for construction by or to the RWS Contractor shall be the most up-to-date issues, but it is the RWS Contractor's responsibility to ensure it is in possession of the latest issue. RWS Contractor shall scrutinize all documents for any error, discrepancy, omission or conflict in the installation drawings, specifications and the physical conditions on the site.

The RWS Contractor shall mark-up the Electrical Drawing Package, indicating the as-built conditions, and make a final as-built Electrical Drawing package. During the project the RWS Contractor shall keep an up to date record of all changes in the Work and indicate these changes on the relevant drawings (of the Electrical Drawing Package). RWS shall have access to these documents at all times. RWS Contractor shall produce as much detail drawings as can be regarded practicable to clarify specific installation details. These drawings require RWS approval. These drawings shall be returned to the RWS representative after completion and are intellectual property of RWS.

4.5. MATERIAL, WORKMANSHIP AND SUITABILITY

The equipment and materials shall be in accordance with the requirements stated in [bijlage 3] and [bijlage 4, appendix 4.6] and prior to purchase RWS approval is required. Deviations shall be highlighted to RWS and agreed upon in writing.

Selection of materials and equipment shall be as standardized as can be considered reasonable and practical, this to limit RWS spare parts for all platforms, WTG's and other installations.

Where specific manufacturers are mentioned in the specification documents or drawings without any reference to an alternative manufacturer, only that particular make or catalogue number, etc., will be acceptable.

The RWS Contractor shall be responsible for furnishing all material and equipment necessary to complete the Work in accordance with the specifications and drawings.

The RWS Contractor shall furnish and install all material and equipment which is not specifically mentioned or shown, but which is necessary for a complete and workmanlike installation.

RWS Contractor shall carry out all installation work with skilled personnel with experience in this form of installation. RWS Contractor shall provide competent technical supervision. The completed installation shall be of the highest grade and carried out in accordance with relevant rules and regulations herein specified and executed to the satisfaction of RWS.

Selection of RWS Contractor's electro-technical personnel shall be based on the qualifications as mentioned in NEN 3140. It's RWS's responsibility to audit the RWS Contractor regularly.

Only the best trade practices shall be used for installation works. Where equipment manufacturer recommends special tools or procedures, the RWS Contractor shall conform to such recommendations.

The RWS Contractor provides all tools, installation and testing equipment for its use.

The RWS representative shall approve all materials and methods of installation prior to installation.

Concealed work shall be left open for inspection and testing until approved by the RWS representative.

Any equipment damaged or broken on site shall be replaced or repaired by the RWS Contractor at his own costs.

4.6. WORK UNDER SPECIAL CONDITIONS

Changes to or modification of energized power circuits shall be done only after clearance of the lines and shall be the full responsibility of the RWS Contractor. Certain low voltage circuits may require work to be performed while energized

When work is to be done on part of the main electrical distribution system, which is energized, the RWS Contractor shall be fully responsible for ensuring that it is safe to do so.

4.7. CERTIFICATION

The equipment and systems offered for incorporation into the facilities shall comply with all current regulations pertaining to offshore installations and platforms, and with all requirements applicable to this kind of installations, as appropriate for the proposed use.

5. DESIGN REQUIREMENTS

5.1. GENERAL DESIGN REQUIREMENTS

The cabinets shall be built in accordance with [bijlage 4].

The RWS panel contains the items as described in [bijlage 4, appendix 4.6] and also includes active components such as:

- Power Distribution Unit (PDU - Raritan)
- Smart PDU
- Moxa
- etc.

Design, installation, equipment, material, and performance shall be in accordance with the latest editions (with amendments) of all applicable codes, standards and good engineering practice.

RWS has a system of dedicated tag numbers for each sensor and communication system item used on the project. RWS Contractor's tag numbers shall be in line with this system and are subject to RWS approval.

For the applicable tag numbers of the panels, cables, field equipment etc. see [bijlage 4] and [bijlage 5]. Requirements of the text and tag labels are described in chapter 7.

The equipment shall be treated in all respects to provide lasting durability.

All materials and parts included in the Work shall be new and unused, of current manufacture, of the best quality and free from all defects and imperfections likely to affect their performance.

The design of the equipment, the selection of individual components, as well as the layout and installation of related equipment shall be based on high standards of reliability and availability.

The equipment shall be suitable for continuous operation at the specified voltage and continuous currents.

All bolted connections of antenna brackets and other pedestals/mounting units shall be equipped with offshore quality Nord Lock 254 SMO rings to create a non-loosing connection. Before purchase RWS should give approval.

All connection material shall be suitable for the size and number of conductors.

The selection of auxiliary equipment shall be standardized as far as reasonable practical.

All control systems and auxiliary circuits shall be executed for 24Vdc unless specified otherwise.

The panels and equipment of the sensor- and communication systems will be installed onto TenneT OSS and / or connected Wind Turbine Generators (WTG's). As such, the panels and indoor units (such as S06-RWS-NTP-11) shall be designed and prepared to withstand the following transportation loads:

- vertical acceleration 1.40 g
- horizontal acceleration 0.8 g
- roll $\pm 20^\circ$ with 10 seconds full period
- pitch $\pm 12.5^\circ$ with 10 seconds full period



The vertical accelerations include the static component of 1 g. It should be assumed that the horizontal and vertical accelerations act simultaneously.

6. SPECIFIC DESIGN REQUIREMENTS

6.1. GENERAL

All components and bus bar system (if applicable) shall be capable of withstanding the thermal and dynamic stresses, resulting from the prospective short circuit currents as specified, without the possibility of injury to personnel.

Panel layout shall be well laid out for ease of trouble shooting, testing and shall have good segregation of function and voltage level.

The system shall be designed for a totally floating 24V DC and 48V DC. If for any reason the system requires a connection to earth, RWS Contractor shall include in their scope all necessary DC/DC converters. All external signals to the field shall remain floating at all times. Necessary converters and other switching devices to achieve this goal shall be included in RWS Contractor's scope of supply.

The following features for personal and electrical safety shall be incorporated, if not covered in the NEN1010 or NEN3140 standards:

- The panels shall be designed such, to minimize the risk of short circuits and to ensure personnel and operational safety at all times;
- Exposed parts within panels which have to be accessible during all operation conditions, maintenance, commissioning or inspection shall not be live in the opened position, or shall otherwise, by virtue of the operation of the equipment, be protected to at least IP20;
- Barriers of live parts shall preferably be of rigid transparent insulating material and shall be provided with a warning label;
- Physical distance between intrinsically and non- intrinsically safe equipment shall be 70mm as a minimum. In case separation by distance is not possible a metal separation plate shall be installed to with a height of 70mm minimum.

Unless specified otherwise, electrical control circuits shall be designed for fail safe action on loss of power supply. Alarms and shutdown actions shall be activated by open contacts.

6.2. PANEL REQUIREMENTS

Panels shall have a completely metal enclosed (mild steel) design. The panels shall have a sufficient mechanical strength to be self-supporting for floor mounting or wall mounting, to carry the weight of a person of approximately 90 kilograms without damage and shall have adequate lifting facilities. All floor-standing indoor panels shall be of the same height (maximum 2100mm, including 100mm base frame, width 800mm and depth 1200mm, unless agreed otherwise.

The sheet steel plate thickness shall be minimum 1.5mm for the housing itself and minimum 2.0 mm for the doors.

Painting shall be epoxy based on color RAL7035 unless a different color is described.

Outdoor panels shall be made of SS316L material with >2% molybdenum content, unless agreed otherwise in the tender documents.

The required degree of protection for the indoor panels shall be as follows:

- IP41 with closed doors
- IP20 with opened doors (live parts shielded)

The location of push buttons and switch handles shall be limited to a maximum height of 1750mm and a minimum of 450mm above floor level.

Doors shall be provided with non-absorbent, non-sticking gaskets to minimize the entrance of dust and vermin, be suitable for opening 150 degrees as a minimum for good access to the interior, be suitable for the placement of fans and shall have drawing pockets.

Doors on both front and back of the cabinet are 2 full metal half doors.

Each panel shall have an filtered air inlet and outlet. The inlet is positioned low at the back of the panel. The outlet is on the front side at a high position and has a fan. See [bijlage 4]. The fan is turned on and off via an adjustable temperature switch in the panel.

The panel doors locks shall be of the comfort type with key lock and a ring to accommodate a combination lock.

Each panel shall have a main switch for each incoming supply voltage (400/230VAC, 230VAC, 230VAC UPS, 24VDC, 48VDC etc.). A main circuit breaker for the incoming supply voltage, to protect the panel, is not required, this breaker is installed in the panel where voltage is supplied from. Only circuit breakers for sub-distribution to be installed.

The panels shall be completely assembled and wired. It is allowed to use the panel left- and right hand sides for installing auxiliary equipment.

Equipment located in swing frames shall be built in frames of standard HE-height. Left open spaces shall be covered with filler plates.

An LED type lighting fixture with automatic on / off sensor shall be installed in each panel. In case the mounting plate is mounted in the middle of the panel, in such a way that equipment can be installed on the front and back side of mounting plate, a lighting fixture shall be installed in either the front and back side.

All main circuits shall be protected by means of circuit breakers. No fuse protection or fused terminals shall be used, unless approved by RWS representative.

Panels shall have approximately 20% free space for future equipment.

RWS Contractor shall calculate heat dissipation for each panel. The temperature rise limits, as given in NEN-EN-IEC 61439-1, of the equipment and wiring shall not be exceeded when fully loaded but be less or equal to 75% of these limits.

The panel design shall afford natural ventilation and include measures to avoid condensation, however, forced ventilation is required when the total dissipated heat in the cabinet is 500W or above. In case forced ventilation is required all necessary air filters, thermostat, fans and other possible means shall be part of the RWS Contractor scope of supply.

RWS Contractor shall specify mounting clearances required for ventilation. Openings shall be sufficiently shielded to maintain IP rating.

The mounting rail for installing relays, terminals and other auxiliary materials shall be slotted steel omega (/35) type of rail.

Panels shall be equipped with Multi Cable Transits (MCT's), size to be used depends on the amount of cables entering the panel, size is 4 x 1 (outdoor panel) or 6 x 1 (indoor panels). The use of cable glands is not allowed, unless approved by RWS representative.

6.3. CIRCUIT BREAKERS

The panel design shall incorporate main circuit and component protection by means of circuit breakers. The minimum rated short time with stand current of the circuit breakers shall be 15kA.

No fuse protections shall be used. However it is allowed to use fuse terminals for the protection of incoming / outgoing auxiliary signal cabling.

Circuit breakers and fuse terminals shall be correctly rated to protect equipment, and to provide discrimination between main and sub-circuits.

The incoming power supply (wiring and / or strip) shall always be connected on the top side of the circuit breaker.

All circuit breakers for the protection of lighting & small power circuits and socket outlets shall be executed with 30mA earth leakage protective devices.

DPN type circuit breakers with 30mA earth leakage protective devices shall not be used.

Circuits for the supply of battery chargers, transformers, amplifiers etc. shall be executed with "C" curve (10 – 14x I_n) circuit breakers.

Each circuit breaker shall be provided with a text plate fixed to the cover of the wiring channel, indicating the equipment's tag number as well as the circuit description.

6.4. AUXILIARY RELAYS

Auxiliary relays for DC voltages shall have built in suppression diodes.

Plug-in type auxiliary relays and relays with double coils shall not be used.

6.5. POWER SUPPLY MODULES

(if applicable)

All power supply modules shall be mounted in the top part of the panel as much as possible to avoid cabinet overheating.

6.6. DC / DC CONVERTERS

(if applicable)

All 24VDC and 48 VDC systems shall be floating (have no connection to earth), however there are systems that require a dedicated connection to earth. If this is the case a DC/DC converter capable of supplying the full 24VDC and 48 VDC load requirements of the panel, including field equipment connected shall be installed.

6.7. WIRING CHANNEL

Wiring channels for external cable terminations shall be sized to contain RWS cabling only.

Interface cable sizes will be indicated on the RWS provided drawings.

Wiring channel shall be halogen free.

The minimum distance between equipment and wiring channel shall not be less than 25mm.

Wiring channel shall be mounted with fixing materials that can't damage the internal panel wiring and cabling.

Equipment tag plates and / or text plates may be installed on upper or lower side of wiring channel cover.

AC-, DC- power -, control- and signal wiring operating at different voltage levels shall be segregated as far as reasonable practical with respect to interference of signals and / or differences in wiring diameters.

Wiring channel shall be mounted for routing the external cable cores to the applicable terminal strip locations.

Used capacity of wiring channel shall not exceed 75%.

6.8. INTERNAL PANEL WIRING

Wiring shall be halogen-free, flame retardant, non-fire propagating and moisture resistant, H05Z-K or H07Z-K wiring with class 5 flexible copper conductors. The size and type shall be selected on current carrying capacity, voltage drop and mechanical strength according NEN-EN-IEC61439.

Wiring shall be continuous without splices in conductors.

Conductors shall never be mounted direct to metal.

Internal panel wiring shall be routed neatly in vertical or horizontal wiring channel.

The insulation shall be capable of providing adequate and lasting protection under specified conditions and normal over-currents and over-voltages and high temperatures.

Wiring to door or swing frame mounted devices shall be suitable for hinge wire application.

Individual wires and bundles shall be secured in the panel with nylon sleeves or be wrapped in spirax and shall be as short as reasonable possible. The following minimum wiring sizes shall be used :

- main power circuits	2.5mm ²
- control circuits 400/230VAC	1.5mm ²
- 24V,48V DC voltage free alarm contacts	0.75mm ²
- PLC control wiring	0.75mm ²
- All other control wiring	0.75mm ²

For the applicable wire colors see chapter “ internal wiring colors ”.

Current transformer secondary leads shall be sized 2.5mm² as a minimum.

All internal wiring ends shall be crimped with (twin) wire end ferrules with plastic collars and / or compression type connector pins or lugs.

If wiring is looped, disconnection of a component shall not cause failure of the remaining components installed in that same loop.

6.9. INTERNAL WIRING COLOURS

Wiring Description : *Color*

Earthing

Earth wiring	:	Green/yellow
Instrument clean earth wiring	:	Black/yellow or green

*Voltages $\leq 50V$, control wiring**

Wiring from main switch to circuit breakers + & - voltage	:	Black
Internal supplied VDC	:	White
Internal supplied VAC	:	Grey
Analogue signals Non Ex	:	White
Analogue & digital signals Ex(i)	:	Blue

(5VDC, 12VDC, 24VDC, 48VDC are RWS standard)

*Voltage free contacts **

Control wiring $\leq 50VDC$	:	Red
Control wiring $\leq 50VAC$	:	Orange
Control wiring for voltages $> 50V$	:	Black

*** Vendor to put note on applicable drawings with request for wiring color in engineering phase.**

Terminal strips for voltage free contacts with a control voltage $> 50V$ SHALL have a red warning text plate with white letters indicating the applicable voltage.

Voltage 400/230 VAC 50Hz

Main circuits	:	Black
Control circuits	:	Black

6.10. WIRE IDENTIFICATION

Wires shall be ferruled at both ends with identification. Identification of all wires shall be achieved by use of permanently embossed wire markers of the slip-on type or heat shrinking sleeves. Wrap-around adhesive type markers or clip-on type markers shall not be used. The wires shall be identified in such a way that the wire end has the complete tag number of the device + number of connection point and / or the terminal strip number including the terminal number.

6.11. TERMINALS

Connections to terminals and other electrical equipment shall be made by means of screwed connections. Wire wrapped connections, soldered, tension clamp, “ADO insulation displacement connection” and other type of connections shall not be used.

Only Weidmuller terminals as described in this document shall be used.

All cores of incoming and outgoing cables shall be connected on terminals.

Terminals for intrinsically safe signals shall have the color blue, terminals for non-intrinsically safe signals shall have the color beige.

All power terminals shall be rated 24 amperes (minimum) at 800 Volt.

Terminals shall have identification numbers on both sides of the terminal.

For horizontal installed terminal strips numbering shall be from left hand to right hand side, for vertical installed terminal strips numbering shall be from top towards the bottom side.

Individual terminals for all conductors shall be provided.

Partitions shall be placed between terminals of different outgoing power circuits, power & control terminals and as separation when jumpers are used.

All wiring / cabling up to or equal 16mm² shall be terminated with standard, heavy-duty terminals.

All wiring / cabling exceeding 16mm² shall be terminated with power terminal blocks, bolted type.

Panel terminations for control signals both analogue & digital shall be knife type terminals, to enable easy loop isolation and testing. For analogue signals the first terminal in a row shall be the + (plus) signal, followed by the – (minus).

Fuse terminals shall be of the “screw-in” or “knife” type with and / or without LED indication. It is not allowed to use fuse terminals with led indications for the protection of PLC input signals and inductive loops.

Minimum size for all power terminals is 4 sqmm.

Each instrument loop requiring power shall be executed with a fused terminal, fused at the “power supply” side.

The use of multi-level terminals is not allowed when there is sufficient space in the panel. The use of multi-level terminals is only allowed after written approval of RWS.

Terminals shall be installed to facilitate the termination of all spare field cable cores.

A minimum of 20% spare terminals shall be provided. The spare terminals shall be divided over the total length of the terminal strip (not on the end of the terminal row only). The connection of spare cable cores shall not be included in this 20% figure.

Terminals installed in Ex(e) panels shall be Ex(e) design.

6.12. TERMINAL STRIPS

The terminals shall be located in horizontal and / or vertical rows on the mounting plate with clear visual separation.

All terminal strips shall have a white plastic-marking strip on the starting end.

All terminal strips which carry a voltage > 50V shall be provided with a yellow / black triangle sticker with flash symbol.

The tag number of the terminal strips shall, if applicable, indicate the panel number it is installed in (e.g. 2X1 for panel 2, 3X1 for panel 3 etc).

Separate terminal strips shall be provided for:

- incoming 24Vdc supply
- incoming 230Vac and / or 400/230Vac supply
- incoming 230Vac UPS supply

- sub distribution of 24Vdc supply:
 - intrinsically safe analogue input signals
 - intrinsically safe analogue output signals
 - intrinsically safe digital input signals
 - intrinsically safe digital output signals

- non-intrinsically safe digital input signals
- non-intrinsically safe digital output signals

- voltage free signals for external 230Vac and / or 400/230Vac supply
- voltage free signals for external 24Vdc supply
- voltage free signals for external 24Vac supply
- voltage free signals for external analogue signals

Other signals shall be subject to RWS approval.

6.13. EXTERNAL CABLE TERMINATIONS

All indoor mounted Non Ex panels shall be equipped with power and control cable entry facilities (MCT's) at the top unless indicated otherwise.

Location of MCT's to be indicated on arrangement drawings.

MCT's shall have at least 20% spare space. MCT blocks (Roxtec) will be provided by the TenneT Contractor (not by RWS Contractor).

Details for MCT's (if required) will be provided by RWS. Determination of the MCT size is part of Vendor's scope of work.

Ex panels shall have a size to facilitate easy terminations, be equipped with cable glands entries located at the bottom side only and be fitted with 30% plugged spare entries.

One side of the terminal strips for external cables shall be kept free for connecting RWS external cable connections only.

All incoming potential free contacts shall be fuse terminal protected.

Spare cable cores shall be connected on terminals.

All connection material, cable clamping and supporting system shall be suitable for the size and number of conductors.

6.14. EARTHING

An earthing system shall be installed to ensure safety to personnel and equipment in case of electrical equipment failures and to prevent fire and damage from static electricity.

Separate earth bars shall be provided for the power earth (PE), the instruments “clean” (IE) and “intrinsically safe” (ISE) earthing systems. Only applicable earth bars shall be installed.

Each panel shall be provided with all applicable copper earth bars. Earth bars shall be installed along the entire terminal strip area of the panel or close to the cable entries for termination of cable armoring, braiding and earth cores.

Each earth bar shall have a minimum cross section of 50mm² and at each end be provided with a brass or stainless steel bolt, of minimum size M10 for the external connection to the external earth bar.

The earth bar shall be equipped with threaded holes and bolts for the termination of all external cables (including 20% spare). Clamped connectors shall not be used.

Not more than one earthing wire shall be connected to each earthing bolt.

Each earth bar shall be capable of withstanding a maximum temperature rise above ambient maximum temperature of 160 °C under the specified prospective short circuit conditions.

The intrinsically safe earthing and instruments “clean” earthing systems shall be completely separated from other earth bars (floating) and be installed on to insulated supports.

Where a number of electrical components, mounting plates and other metal parts are to be earthed, parallel earthing shall be employed (serial earthing is not allowed). Special attention shall be paid to swing frame and door earthing.

Equipment earthing or bonding jumpers shall be yellow/green insulated.

Removable parts shall be earthed by means of a flexible insulated earth wire (links to doors) yellow/green.

On equipment, earth conductor connections shall be made with crimp type connectors.

Secondary circuits of current transformers and of voltage transformers shall be earthed.

Minimum size of earth conductors shall be 2.5mm², except for earthing of individual I.S. barriers then 1.5mm² wiring is sufficient.

Joints in the main earth bar shall be tinned and bolted with galvanized or cadmium plated bolts, nuts and washers, easily accessible and checked for tightness and electrical contact (clean, not corroded).



6.15. COMPONENTS AND PARTS

See [bijlage 4, appendix 4.6].

7. TAGGING AND IDENTIFICATION

Language on tag labels, tag plates and text plates shall be English.

7.1. TAGGING AND IDENTIFICATION FOR PANELS

All tag plates and text plates for internal use shall be constructed of 3 ply laminated Phenolic (white-black-white) and engraved through the white lamination.

Danger or warning / caution notices shall be (red-white-red) and engraved through the red lamination and be attached directly to the applicable equipment.

Tag plates and text plates on the outside of the panel shall be fixed with rivets.

The tag number shall appear on the first line, the other lines required shall describe the service.

Language on text plates shall be English.

Panel shall be labelled with Tag number of the panel on the first line and "panel description of RWS" on the following lines, with a minimum text height of 20 mm.

Each panel shall also have a NEN1010-6 inspection text plate. As a minimum the following SHALL be clearly marked on a text plate on the outside of the panel:

- name of the RWS Contractor
- RWS Contractor order number
- RWS order number
- the year of manufacture
- the text " tested and inspected in accordance with NEN1010-6 "
- nominal voltage and current
- the IP classification
- other relevant information

Permanent tag plates shall also be provided identifying each component (switch, circuit breaker, relay, terminal strips, etc.), according the documents / drawings.

Each circuit breaker shall be provided with a text plate indicating the equipment's tag number as well as the circuit description.

Inside the panel component tag plates and text plates shall have a minimum text height of 4 mm and shall be fixed with self-adhesive double-sided tape.

Smaller lettering is only acceptable where physical restrictions dictate this.

7.2. TAGGING AND IDENTIFICATION FOR OUTDOOR EQUIPMENT

Tag plates, text plates and labels shall be located such that they are easily read from normal access ways.

All field mounted instruments shall have a Stainless Steel 316 tag label with black engraved text, stating the tag number(s), item description, etc. This label shall preferably be screwed or riveted to or in the vicinity of the instrument, using stainless steel screws. Where stainless steel screws cannot be used, due to certification, a two-pack epoxy or heavy duty Stainless Steel 316 wire may be used.

The tag number(s) of the equipment/instruments shall be in accordance with the RWS approved Equipment list [bijlage 5].

The tag number shall appear on the first line, the other lines required shall describe the service.

Other tag plates and text plates shall be constructed of 3 ply laminated Phenolic and engraved through the first ply lamination.

The following colors shall be used for 3 ply laminated Phenolic:

- white/black/white, for common use
- red/white/red, for safety related items and warning plates

Tag plates and text plates shall be securely and permanently attached to the equipment with two-pack epoxy adhesive or rivets, double side adhesive tape shall not be used for tag plates installed in outside areas. Tag plate shall be affected in such a way that equipment certification is not affected. Alternatives shall be proposed if the above fastenings described will affect certification and/or zone ratings.

Permanent tag plates shall also be provided identifying each control-, heater-, work switch, etc., according to the latest RWS approved drawings. The tag number(s) shall appear on the first line, the other lines shall describe the service.

Junction boxes shall be labelled with "junction box description" + Tag number of the junction box with a minimum text height of 10mm.

Component labels, tag plates and text plates of auxiliary materials shall have a minimum text height of 4mm.

In case equipment is installed above a floor level of 3 meters, minimum text height shall be 20mm

Smaller lettering is only acceptable where physical restrictions dictate this.

8. RELEVANT DOCUMENTS SUPPLIED BY RWS

Relevant document supplied by RWS are [Bijlage 3], [bijlage 4], [bijlage 5], [bijlage 6] and [bijlage 7].

9. VENDOR DOCUMENTS REQUIRED

RWS Contractor documents required and their minimum requirements are detailed in this chapter.

All documents submitted will become property of RWS.

9.1. DRAWING REQUIREMENTS

The complete Work and all items described in the purchase order / contract shall be supplied complete with a comprehensive set of drawings for fabrication and testing, to facilitate installation, commissioning and “fault finding” during operation of the equipment.

For details of Electrical Drawing Package requirements see [bijlage 4]

RWS Contractor shall ensure that the lay-out of supplied documents complies with the RWS provided drawings.

9.2. DRAWING NUMBERS

RWS has a drawing numbering standard based on fixed drawing numbers for each project and each particular system / part of the installation, which is applicable for all disciplines. In some cases this also applies to sheet numbers, see document [bijlage 4]. The drawing number shall be clearly shown on all drawings produced.

9.3. SHEET NUMBERS

Sheet numbers that can be used are 1 up to and including 999.

9.4. MODIFICATIONS

All modifications/revisions to the drawing to be mentioned in "clouds" and indicate all relevant revisions.

9.5. DOCUMENTATION

Complete and up-to-date drawings shall be maintained from the start of the Work. The RWS Contractor shall put all changes, additions, etc. on copies of each relevant document or drawing. Those documents / drawings shall be available for review at all times and shall be completely marked up to represent the actual "as built" status when RWS is invited for testing. Possible updates/modifications mentioned during testing shall be included.

RWS Contractor shall update all documentation to "as built" status at completion of the Work.

One copy of the complete set of the "as built" status at completion of the Work shall be handed over to the RWS Representative.

RWS Contractor shall update applicable documentation to "as built" status at completion of the panel Factory Acceptance Test (FAT). Preparation of "as built" drawings after the onshore - and offshore fabrication phase, is only required if requested by RWS.

9.5.1. GENERAL

Company may request to receive un-priced copies of RWS Contractor Purchase Orders for materials/equipment.

Each set of documents to be sent to RWS shall be accompanied by a transmittal, which contains as a minimum the following information:

- a. RWS Contractor general information
- b. Project name + RWS/ RWS Contractor purchase order number
- c. RWS Contractor order reference
- d. date of sending
- e. transmittal sequence number
- f. reason for submittal
- g. tag number of main item(s)
- h. name of applicable contact person(s)
- i. name of RWS Contractor contact person(s)
- j. applicable document number(s) + description
- k. number of copies
- l. revision(s)

A document transmittal record shall be issued by RWS Contractor indicating the first issue forecast date, date of first issue + revision and date + revision of all other issues.

All final documentation shall be packaged into manuals and made available on a data carrier and subdivided under the following chapters:

- documents
- data sheets
- drawings
- RWS Contractor/manufacturer documentation
- certificates
- PLC documentation (if applicable)

An index sheet showing the tree set-up with chapters, the documentation code and description shall be issued for RWS approval before the final set-up is being made. RWS Contractor make a colour scan of applicable equipment and material documentation and other documents that were not prepared by RWS Contractor into an electronic format.

Technical drawings, data and documentation shall be issued in the quantities as described in this chapter.

Drawings shall be generated in AutoCad, the drawing files shall be in “.dwg” or .dxf format (“.pdf” files will not be accepted by RWS as final documentation), Microsoft Word version 2007 shall as a minimum be used for text documents. Data bases (index, schedule, lists, etc.) and spreadsheets shall as a minimum be Microsoft Access and/or Excel version 2007.

Revisions to documents shall be:

During detailed engineering phase	revision number D01, D02, D03, etc
During construction phase	revision number C01, C02, C03, etc
As built	revision number A, B, C, etc

9.5.1.2. CERTIFICATES

1. NEN 1010-6 inspection/test reports, hand filled out by RWS Contractor

9.5.1.3. DRAWINGS

The following drawings are required for the design, construction and testing of the panels, including auxiliary equipment and field junction boxes required. Examples can be found in [bijlage 4]

1. block diagrams
2. schematic diagrams
 - incoming / sub-distribution 400/230Vac
 - incoming / sub-distribution 230Vac
 - incoming / sub-distribution 24Vdc
 - power supply controllers
 - schematic diagrams
 - system configuration overview
 - system configuration (in detail)
3. connections field equipment
4. connection diagrams (on tagging sequence)
5. panel views, foundation plan / foot print
6. material list

Example drawings of similar panels can be made available on request of RWS to ensure that the minimum required information shown meets the RWS requirements.

Tag numbers of auxiliary equipment to be determined as shown in the following example.

Tag number relay 40K1

- | | | |
|----|---|--|
| 40 | = | sheet number |
| K | = | code for relay |
| 1 | = | line number 1 (this number is referred to the line number shown in top of the drawing outline 0 u / I 9) |

Company common used auxiliary equipment codes are:

- | | | |
|-----|---|--------------------------|
| K | = | relay |
| F | = | circuit breaker / fuse * |
| L | = | signal lamp |
| T | = | transformer |
| S | = | switch |
| PB | = | push button |
| PSU | = | power supply unit |
| U | = | auxiliary control gear |
| P | = | meter |
| R | = | resistor |
| D | = | diode ** |
| B | = | buzzer |

* = not used for fused terminals, these will form a part of terminal code.

** = not used for diode terminals, these will form a part of terminal code.

"Shop as built" drawings of the construction drawings of panel made by RWS Contractor will be completely marked up by RWS Contractor to represent the "shop as built" status when RWS is invited for the FAT test. These changes will be checked before the FAT will be executed. The

panel “as built” shall include these comments. Also the possible updates / modifications found during the FAT test shall be included.

Possible “as built” changes made during the construction phase at the construction yard and construction phase offshore have to be updated by RWS Contractor.

9.5.1.4. VENDOR DOCUMENTATION

RWS Contractor documentation of all materials & equipment used/installed shall be issued.

9.5.1.5. CERTIFICATES

As a minimum the following certificates shall be provided:

- copies of all documentation issued by the relevant regulatory authorities stating full acceptance of Vendor equipment, component parts, usage and parameters as detailed in the specifications
- certificates of fitness by the “European authorized certifying body”
- current certificates of approval

10. REPRESENTATIVES, SITE VISITS, INSPECTION AND TESTING

The representative(s) from RWS, its Contractor and the Certifying Authority shall be allowed free access to the work sites and retain the right to be present during any activity i.e.

- acceptance test for materials
- work in progress
- inspections

RWS reserves the right to inspect the equipment stage of manufacture during normal working hours.

The RWS Contractor shall provide assistance and all facilities necessary for the purpose of inspections and quality assurance to RWS and/or assigned Inspection Authority.

Inspection and tests shall be carried out on the complete assembled panels/equipment.

Transport sections (if applicable) shall be fully interconnected.

After erection of equipment, completion of the installation and connections, FAT tests will be executed by the RWS Contractor and witnessed by RWS to prove general conformity to the drawings and applicable laws, regulations, codes and standards as defined in this standard specification.

An internal acceptance test by RWS Contractor shall be conducted prior to the FAT, for both hardware and software. This test shall cover as a minimum, all tests to be done during the FAT. If any failures are detected and replacements are being made, these shall be logged in a test report. This test report shall be available for RWS one week before the start of the FAT.

The RWS Contractor shall provide, at his expense, all appliances, instruments, labor and other facilities, required for the FAT, including all required power supplies, test equipment to simulate all analogue & digital I/O 's + power loading for the powered outputs and other functions.

The intention of the FAT test is to carry out a complete functional test and check the installation on any defects and execute possible design modifications which should be resolved before put into service offshore, supervised by Company.

Test procedures shall be submitted to RWS for approval at least four (4) weeks prior to commencement of test. Testing shall not proceed until RWS, without comment, has approved the required test procedure.

FAT test shall be carried out prior to dispatch from the works, unless agreed otherwise with RWS.

Testing of the electrical installation shall be done in accordance with the last rules of the NEN 1010-6.

As a minimum the following tests / checks shall be carried out by RWS Contractor:

- to check for compliance with latest revision of approved drawings, specifications, regulations and codes of practice
- physical appearance for quality of workmanship in fabrication, assembly and wiring
- quantity check for assurance that all equipment required is present, mounted and wired
- to check for mechanical integrity
- check if equipment is not damaged or incomplete
- to check tagging, identification and text plates
- the completeness of the data on the nameplate
- the proper mounting of components

- the internal wiring and cabling system, including all interposing loops
- the correct wiring of main and auxiliary circuits
- verification of polarity and phase sequences
- the degree of protection of the enclosure
- the degree of protection of the equipment installed
- insulation resistance test between each phase and neutral against earth, with the remaining phases / neutral connected to earth
- tests of continuity including point to point wiring checks
- 100% one to one I/O check
- testing of all configuration and application software
- full 100% functional software test
- the suitability of clamping, earthing and terminating arrangements
- the availability of the earthing system throughout the panel
- testing of the mechanical and electrical operation of equipment and devices including checks on calibration of protective devices
- functional & performance tests of equipment and systems

The above tests shall not relieve the RWS Contractor's responsibility to ensure that the delivered equipment is in accordance with the requisition.

The activities specified herein do not preclude the necessity for further inspection and testing to suit individual features or Manufacturer's instructions and equipment.

10.1. Test Reports

As a minimum the following information shall be shown on the test reports :

- identity and tag number of equipment
- date of test, time of test
- make and type of test equipment used
- test results
- any corrective action taken to make equipment pass test
- statement as to what is required, when and how it will be corrected or completed, for faulty equipment, shall be made before it is energized or placed in service
- name of person or persons responsible for execution of test including approval signatures of both RWS and RWS Contractor

RWS's NEN 1010-6 inspection / test report for electrical & instrumentation panels and checklist electrical & instrumentation panels to be filled in completely prior to FAT.

Test results shall be handed over to the RWS representative immediately after completion.

11. PREPARATION FOR SHIPMENT

This chapter is meant for both shipment to the mock-up and the yard.

RWS Contractor shall be solely responsible for the adequacy of the preparation for shipment in order to deliver equipment being part of the Work at its destination in ex-works condition when handled by commercial carrier systems.

The RWS Contractor shall quote total shipping weight and physical size of each skid, panel, transport section and /or individually delivered piece of equipment being part of the Work before shipment.

In case equipment being part of the Work needs to be stored before transportation it shall be stored in a dry, heated store and handled in such a manner that upon final installation all materials and equipment reflect satisfactory finish, appearance and performance.

Preparation for shipment shall be in accordance with the RWS Contractor's standard practice, unless indicated otherwise in the Tender documents and / or Purchase Order.

The RWS Contractor shall provide the actual (not calculated) centre of gravity for non-standard items.

All openings in the electrical enclosures shall be plugged. Cable entries and junction boxes shall be sealed against liquid ingress.

Equipment being part of the Work or its parts that can be damaged during shipment shall be packaged separately in the original manufacturer's boxes, for example the LIDAR or Nautical Radar.

Each package shall be properly identified with a purchase order number + Tag number, be marked 1 of x, 2 of x etc. and each have a content list in a weatherproof envelope.

All loose items shall be tagged, boxed and shipped affixed to equipment being part of the Work.

RWS reserves the right to inspect and approve preparation for shipment prior to shipping.

All cost involved in order to transport the cabinets from its manufacturing, test location to Stellingen (RWS location) are for the RWS Contractor.

11.1. MATERIAL RECEIPT AND STORAGE

The RWS Contractor shall be responsible for the care, condition, maintenance and preservation of all equipment being part of the Work when delivered by RWS Contractor. Such maintenance and preservation shall comply with RWS Contractor recommendations. The RWS Contractor will produce a "Maintenance and Preservation" procedure for RWS review. This will apply to equipment both stored and installed. All equipment being part of the Work, materials and labor required for maintenance and preservation shall be furnished by the RWS Contractor.

On receipt of equipment being part of the Work and/or material, the RWS Contractor shall check if equipment and/or material is not complete/damaged. RWS shall be immediately notified in writing if this is the case.

All electrical and instrumentation equipment being part of the Work shall be stored in environmentally controlled warehouses.



The RWS Contractor shall be responsible for a calibration check of all instruments before shipment. Results shall be recorded on instrument test/calibration forms.

12. MECHANICAL COMPLETION / COMMISSIONING

ONSHORE INSTALLATION

TenneT Contractor shall execute the installation of the equipment being part of the Work during fabrication of the platform and / or WTG onshore.

During the installation period onshore RWS Contractor shall supervise the installation work, if required.

RWS Contractor shall prepare installation procedures, which will be issued to the TenneT Contractor via RWS. RWS Contractor shall inspect the equipment being part of the Work on completion of installation and confirm that the work is executed satisfactorily, prior to any testing being carried out. Materials, parts, etc. required for installation of RWS Contractor's deliveries according to this document shall be included in the cost.

12.1. COMMISSIONING

ONSHORE

The equipment being part of the Work shall be commissioned by the TenneT Contractor and RWS with the support of the RWS Contractor (if required) to the maximum extent possible onshore.

The SAT test will include a hook-up check, functional testing of all interfaces to / from other platform and / or systems, alignment, instruments, cabling and performance testing.

RWS Contractor shall provide technical support to the TenneT Contractor to ensure that his warranty is not impacted.

RWS Contractor shall provide all spare parts required for the commissioning of the equipment being part of the Work as part of the scope of supply.

The services of RWS Contractor's representative(s) at the fabrication site shall be provided under a separate work order.

OFFSHORE

Following installation, a hook-up of the topside module offshore, the final commissioning of the equipment being part of the Work will be carried out by RWS.

RWS Contractor shall provide technical support to RWS to ensure that the performances of the equipment being part of the Work meet the requirement of the order.

RWS Contractor shall provide all spare parts required for the commissioning of the equipment being part of the Work as part of the scope of supply.

The services of RWS Contractor's representative(s) offshore shall be provided under a separate work order.

All personnel travelling offshore shall have, as a minimum, a VCA certificate, a valid offshore training certificate for Substation offshore platforms and Wind Turbine Generators (WTG's) and valid health certificate. All costs associated with such training shall be for RWS Contractor's account.

12.2. START-UP ASSISTANCE

Start-up and/or commissioning assistance after installation may be required for the following activities:

- to check whether equipment installation conforms to all RWS and RWS Vendor specifications
- to power-up the equipment and run diagnostic programs to ensure hardware integrity
- to install equipment configuration
- to perform a site acceptance test (SAT), witnessed by RWS

Schedule of rates applicable for start-up assistance including travelling and other cost shall be included in the quotation.

13. ABBREVIATIONS

AC	Alternating Current
AI	Analogue Input
AO	Analogue Output
ATEX	ATmospheriques EXplosives
CE	Communauté Européenne
CPU	Central Processing Unit
CU	Control Unit
DC	Direct current
DCS	Distributed Control System
DI	Digital Input
DO	Digital Output
EMC	Electro Magnetic Compatibility
FAT	Factory Acceptance Test
FDS	Functional Design Specification
GA	General Arrangement (drawings)
GRP	Glass Reinforced Polyester
HVAC	Heating, Ventilation and Air Conditioning
HVS	High Voltage Switchgear
ICSS	Integrated Control and Safety System
IE	Instrument Earth
IEC	International Electro technical Commission
I/O	Input / Output
IOM	Installation and Operating Manual
IP	Ingress Protection
IPF	Instrumented Protective Function
IS	Intrinsically Safe
ISE	Intrinsically Safe Earth
ISO	International Standardization Organization
ITP	Inspection and Test Plan
LAN	Local Area Network
LED	Light Emitting Diode
MCT	Multi Cable Transit
MCC	Motor Control Centre
MRB	Manufacturer's Record Book
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore
NA	Not Applicable
NDT	Non-Destructive Testing
NEN	Nederlandse Norm (Dutch Standards)
NIS	Non Intrinsically Safe
PC	Personal Computer
PE	Protective Earth
PLC	Programmable Logic Controller
P.O.	Purchase order
RFI	Radio Frequency Interference
RS-232	Standard for point to point serial communication in computer equipment
RS-422	Standard for 2-wire differential uni-directional multi-drop serial communication in computer equipment
RS-485	Standard for 2-wire differential bi-directional multi-drop serial communication in computer equipment
RWS	Rijkswaterstaat
SAT	Site Acceptance Test



SIT	Site Integration Test
TBA	To Be Advised
TCP/IP	Transmission Control Protocol / Internet Protocol
UPS	Un-interrupted Power Supply
VDU	Visual Display Unit
VDRL	Vendor Document Requirement List
VHF	Very High Frequency
VTA	Vendor To Advise
WOZ	Wind Op Zee projecten
WTG	Wind Turbine