




|   |   |            |            |            |                                     |        |        |                              |        |
|---|---|------------|------------|------------|-------------------------------------|--------|--------|------------------------------|--------|
| <br><b>PETROBRAS</b> | <b>TECHNICAL SPECIFICATION</b>  |            |            |            | <b>IET-3000.00-1516-823-PEK-006</b> |        |        |                              |        |
|   | CLIENT: <b>E&amp;P</b>  |            |            |            |                                     |        |        | SHEET: <b>1</b> DE <b>11</b> |        |
|   | PROGRAM:  |            |            |            |                                     |        |        |                              |        |
|   | AREA: <b>STATIONARY PRODUCTION UNITS</b>  |            |            |            |                                     |        |        |                              |        |
| E&P-SERV/US-SUB/EQSB  | TITLE: <b>SPU PROJECT DETAILS<br/>WET MONITORING SIGNALS (TPT, PT and PDG)</b>  |            |            |            |                                     |        |        |                              |        |
| <b>INDEX OF REVIEWS</b>   |   |            |            |            |                                     |        |        |                              |        |
| <b>REV.</b>   | <b>DESCRIPTION AND/OR SHEETS ACHIEVED</b>   |            |            |            |                                     |        |        |                              |        |
| 0   | ORIGINAL EMISSION   |            |            |            |                                     |        |        |                              |        |
| A   | GENERAL   |            |            |            |                                     |        |        |                              |        |
| B   | Items 5.3.3.1, 5.3.5.1, 5.3.6, 5.3.7, 6.2.2 and 6.3.9.  |            |            |            |                                     |        |        |                              |        |
| C   | Review considers DIP SUB/ES/DCT/CDRT 0004/2018.<br>Exclusion of items 5.1.2 and 6.1.2 (Rev. B) and review of items 6.2.3 and 6.3.9. |            |            |            |                                     |        |        |                              |        |
|   | REV. 0  | REV. A     | REV. B     | REV. C     | REV. D                              | REV. E | REV. F | REV. G                       | REV. H |
| DATE  | 17/07/2008  | 01/07/2009 | 14/09/2009 | 04/12/2019 |                                     |        |        |                              |        |
| PROJECT   | EQSB  | EQSB       | EQSB       | ECE        |                                     |        |        |                              |        |
| EXECUTION   | HM78  | CQP1       | CQP1       | BFN7       |                                     |        |        |                              |        |
| VERIFICATION  | HMHT  | CTMK       | CTMK       | ES34       |                                     |        |        |                              |        |
| APPROVAL  | HM80  | HM80       | HM80       | UR6A       |                                     |        |        |                              |        |
| THE INFORMATION IN THIS DOCUMENT ARE PETROBRAS PROPERTY, BEING PROHIBITED TO USE OUTSIDE ITS PURPOSE. |   |            |            |            |                                     |        |        |                              |        |
| STANDARDIZED FORM ACCORDING TO PETROBRAS STANDARD N-0381 REV. H.                                      |   |            |            |            |                                     |        |        |                              |        |

|  |   |    |                              |       |      |       |
|--|---|----|------------------------------|-------|------|-------|
|                                 | TECHNICAL SPECIFICATION   | Nº | IET-3000.00-1516-823-PEK-006 |       | REV. | C     |
|  | E&P   |    |                              | SHEET | 2    | de 11 |
|  | TITLE:<br>SPU PROJECT DETAILS<br>WET MONITORING SIGNALS (TPT, PT and PDG) |    |                              |       |      |       |
| INDEX  |   |    |                              |       |      |       |
| 1  | OBJECTIVE .....   |    |                              |       |      | 3     |
| 2  | SYMBOLS OR ACRONYMS .....   |    |                              |       |      | 3     |
| 3  | GENERAL INFORMATION .....   |    |                              |       |      | 3     |
| 4  | GENERAL REQUIREMENTS .....  |    |                              |       |      | 6     |
| 5  | PDG MODULES .....   |    |                              |       |      | 6     |
| 6  | TPT-AR MODULE .....   |    |                              |       |      | 9     |
| 7  | TECHNICAL DOCUMENTATION .....   |    |                              |       |      | 11    |
| AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE. |   |    |                              |       |      |       |
| FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.   |   |    |                              |       |      |       |

|   |  |    |                              |       |         |
|---|--|----|------------------------------|-------|---------|
|  | TECHNICAL SPECIFICATION  | Nº | IET-3000.00-1516-823-PEK-006 | REV.  | C       |
|   | E&P  |    |                              | SHEET | 3 de 11 |
|   | TITLE: <b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                              |       |         |

## 1 OBJECTIVE

Provide the necessary details to carry out the adequacy project, the installation and operation of the PDG module, the TPT-AR module and TPT and PT reading and recording signals in the Stationary Production Units (SPU) of wells connected directly to WCT HD control via subsea umbilical.

## 2 SYMBOLS OR ACRONYMS

|        |   |
|--------|---|
| PDG    | Permanent Downhole Gauge  |
| SAS    | XTree Signal Acquisition System Panel   |
| TPT    | XTree Pressure and Temperature Transducer   |
| PT     | XTree Pressure Transducer   |
| TPT-AR | XTree Pressure and Temperature Transducer-High Resolution   |
| WCT    | Wet Christmas Tree  |
| SPU    | Stationary Production Unit (FPSO)   |
| JB     | Junction Box  |
| UEH    | Subsea Electro Hidraulyc Umbilical ( <b>U</b> mbilical <b>E</b> letró <b>H</b> idráulico Submarino) |
| PLC    | Programmable Logic Controller   |

## 3 GENERAL INFORMATION

The following information are valid for any and all SPU.

The specific and particular variations of each SPU will be described in subsequent items.

3.1 The monitoring signals from the WCT can be as follows:

- 3.1.1 A TPT Pressure signal installed in the WCT production/injection “bore”, which may be analog type (4~20 mA) or digital type (TPT–AR);
- 3.1.2 A TPT Temperature signal installed in the WCT production/injection “bore”, which may be analog type (4~20 mA) or digital type (TPT–AR);
- 3.1.3 A PT Pressure signal installed in the WCT annular “bore”, analog type (4~20 mA);
- 3.1.4 A digital Pressure and Temperature signal from the PDG installed inside the well, passing through the WCT through an electrical penetrator.

|  |
|--|
| AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE. |
| FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.   |

**SPU PROJECT DETAILS**  
**WET MONITORING SIGNALS (TPT, PT and PDG)**

3.2 All WCT electrical monitoring signals are interconnected to the SPU through the subsea UEH, normally with three pairs of 2.5 mm<sup>2</sup> wires.

3.3 WCT sensors interconnection, for each well, with subsea umbilical's electric cable wire may have one of the following configurations:

3.3.1 Electrical system with TPT (analog) + PDG (without the annular PT - item 3.1.3)

| Wire Number | Configuration              |
|-------------|----------------------------|
| 1           | TPT Pressure signal (+)    |
| 2           | TPT Pressure signal (-)    |
| 3           | TPT Temperature signal (+) |
| 4           | TPT Temperature signal (-) |
| 5           | PDG signal (+)             |
| 6           | PDG signal (-)             |


3.3.2 Electrical system with TPT (analog) + annular PT (analog) + PDG (digital)

| Wire Number | Configuration                        |
|-------------|--------------------------------------|
| 1           | TPT and PT sensors common supply (+) |
| 2           | TPT Pressure signal (-)              |
| 3           | TPT Temperature signal (-)           |
| 4           | PT Pressure signal (-)               |
| 5           | PDG signal (+)                       |
| 6           | PDG signal (-)                       |

3.3.2.1 In this configuration, the signals from the three analog sensors (TPT-Pressure, TPT-Temperature and PT) are transmitted by only four wires, through the UEH, being one of the wires (#1) used for common supply (+24 Vdc) and each of the three remaining wires (#2, #3 and #4) used to obtain the signal from each of these three sensors.

3.3.3 Electrical system with TPT-AR (digital) + PT (analog) + PDG (digital)

| Wire Number | Configuration |
|-------------|---------------|
| 1           | TPT-AR (+)    |
| 2           | TPT-AR (-)    |
| 3           | PT (+)        |
| 4           | PT (-)        |
| 5           | PDG (+)       |
| 6           | PDG (-)       |

|   |   |    |                              |       |         |
|---|---|----|------------------------------|-------|---------|
|  | TECHNICAL SPECIFICATION   | Nº | IET-3000.00-1516-823-PEK-006 | REV.  | C       |
|   | E&P   |    |                              | SHEET | 5 de 11 |
|   | TITLE:<br><b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                              |       |         |

3.4 TPT and PT analog sensors electrical and metrological characteristics are:

3.4.1 TPT Pressure Sensor:

|                 |                                   |
|-----------------|-----------------------------------|
| Power supply    | 12 to 36 Vdc – Typical = 24 Vdc   |
| Output signal   | Analog 4 ~ 20 mA                  |
| Operating range | 0 to 5,000 psi or 0 to 10,000 psi |
| Transmission    | 1 (one) wires pair                |

3.4.2 TPT Temperature Sensor:

|                 |                                 |
|-----------------|---------------------------------|
| Power supply    | 12 to 36 Vdc – Typical = 24 Vdc |
| Output signal   | Analog 4 ~ 20 mA                |
| Operating range | 0 to 100 °C or 0 to 120 °C      |
| Transmission    | 1 (one) wires pair              |

3.4.3 PT Pressure Sensor:

|                 |                                   |
|-----------------|-----------------------------------|
| Power supply    | 12 to 36 Vdc – Typical = 24 Vdc   |
| Output signal   | Analog 4 ~ 20 mA                  |
| Operating range | 0 to 5,000 psi or 0 to 10,000 psi |
| Transmission    | 1 (one) wires pair                |

3.5 The electrical and metrological characteristics of the TPT – AR (digital) sensors are:


|                             |                                   |
|-----------------------------|-----------------------------------|
| Power supply                | 12 to 36 Vdc – Typical = 24 Vdc   |
| Output signal               | Digital                           |
| Operating pressure range    | 0 to 5,000 psi or 0 to 10,000 psi |
| Operating temperature range | 0 to 100 °C or 0 to 150 °C        |
| Transmission                | 1 (one) wires pair                |

3.6 The electrical and metrological characteristics of the PDG (digital) sensors are:

|                             |   |
|-----------------------------|---|
| Power supply                | 12 to 36 Vdc – supplied by the SAS module |
| Output signal               | Digital                                   |
| Operating pressure range    | 0 to 10,000 psi or 0 to 16,000 psi        |
| Operating temperature range | 0 to 125 °C or 0 to 175 °C                |
| Transmission                | 1 (one) wires pair                        |

AS INFORMAÇÕES DESTES DOCUMENTOS SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE.

FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.

|   |   |    |                              |       |         |
|---|---|----|------------------------------|-------|---------|
|  | TECHNICAL SPECIFICATION   | Nº | IET-3000.00-1516-823-PEK-006 | REV.  | C       |
|   | E&P   |    |                              | SHEET | 6 de 11 |
|   | TITLE:<br><b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                              |       |         |

## 4 GENERAL REQUIREMENTS

The details for the execution of the SPU adequacy project for receiving the signals from the WCT sensors are described in this Technical Specification and its execution is SPU manufacturer sole responsibility.

Each and every SPU, regardless of the individual and particular characteristics and needs described in the next main items and their sub-items, must have all the necessary equipment and requirements described in this item, and its sub-items, for electrical monitoring signals interconnection from the WCT installed in all oil production or water injection wells that will be directly interconnected through the UEH.

4.1 The SPU must install the following materials for WCT sensors signals interconnection from the umbilical arrival point (balcony) at the SPU to its corresponding panel.

4.1.1 Two 2.5 mm<sup>2</sup> wires twisted pairs from the electrical junction box to the SPU PLC, to enable the reading of analog TPT and PT sensors.

4.1.2 Two 2.5 mm<sup>2</sup> wires twisted pairs from the electrical junction box to the SAS cabinet. One pair is used to connect the PDG signal to the SAS panel and the other is a backup.

4.2 The SPU shall install all the junction boxes (JB) necessary for the wires pairs interconnection mentioned in item 4.1;

4.3 The PLC for WCT analog signals sensors acquisition must have “passive” type analog input cards to allow the TPT and PT sensors reading according to the connection described in item 3.3.2. If there is no passive analog input cards, electric current isolators must be installed.

4.4 The SPU should provide a cabinet to accommodate the PDG reading module (SAS) and the TPT–AR reading devices. The characteristics of these cabinets are described in items 5 and 6 of this specification.

4.5 The communication between the analog sensors PLC and the SPU automation system must be via an Ethernet network through a switch. The PLC supplier must provide an OPC type communication driver (software).


  

## 5 PDG MODULES

The PDG module (SAS) is an equipment installed in a cabinet called “SAS panel” located in the SPU instrumentation panel room, provided by SPU (item 4.4), whose purpose is to supply electrical power and receive, store and transmit the PDG data from different wells connected to the SPU.

|  |
|--|
| AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE. |
| FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.   |

|   |  |    |                              |       |         |
|---|--|----|------------------------------|-------|---------|
|  | TECHNICAL SPECIFICATION  | Nº | IET-3000.00-1516-823-PEK-006 | REV.  | C       |
|   | E&P  |    |                              | SHEET | 7 de 11 |
|   | TITLE: <b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                              |       |         |

5.1 PDGs module general description

5.1.1 The PDG module is supplied to SPU by E&P-SERV/US-SUB/EQSB, which is the Petrobras sector that specifies, buys and performs its installation and maintenance at SPU.

5.1.2 The PDG module technical characteristics, such as communication and power specific to each manufacturer, are described in the PDG manufacturer's manual and will be made available by E&P-SERV/US-SUB/EQSB to the SPU manufacturer.

5.1.3 The PDG module can only be operated by or under the guidance of specialized E&P-SERV/US-SUB/EQSB personnel.

5.2 Standard features of the PDGs module:

Any PDG module has some standard features, listed below :

5.2.1 Electrical

DC input voltage = 24 Vdc  
AC input voltage = 127 Vac to 230 Vac automatic.  
Internal battery (in case of AC power)  
Overvoltage protection.

5.2.2 External communication interfaces MODBUS RTU RS-485 and Ethernet, selected by software, for interconnection with the SPU supervisory system.

5.2.3 Enough inputs for interconnecting up to ten PDGs.

5.3 PDG module interconnection in the SPU

To enable the installation and operation of the PDG module in the SPU, the following items and requirements must be provided and made available by the SPU


5.3.1 2.5 mm<sup>2</sup> wires twisted pairs sufficient to interconnect all wires pairs related to PDGs that arrive at the umbilical entry slots through junction boxes to the place where the PDG modules will be installed.

5.3.2 Sufficient space for the installation of up to four modules of the PDGs, or a sufficient amount to attend the reading of all PDGs that will be interconnected to the SPU.

5.3.3 A standard 19" enclosure, in which PDG modules and TPT-AR modules will be installed, in addition to the 24 Vdc power supply, ethernet switch, circuit breakers and other equipment necessary to ensure the operation and protection of all modules sensor readings.

AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE.

FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.

|   |   |    |                                     |       |          |
|---|---|----|-------------------------------------|-------|----------|
| <br><b>PETROBRAS</b> | <b>TECHNICAL SPECIFICATION</b>  | Nº | <b>IET-3000.00-1516-823-PEK-006</b> | REV.  | <b>C</b> |
|   | <b>E&amp;P</b>  |    |                                     | SHEET | 8 de 11  |
|   | TITLE:<br><b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                                     |       |          |

5.3.3.1 SAS Panel (cabinet) recommended dimensions:

Width: 19" standard

Height: 70" (The height can be changed according to the quantity of PDG modules that will be needed)

Depth: 24"

5.3.3.2 It must have a terminal block for the installation of 40 pairs of wires, sufficient to interconnect 40 PDG sensors in four PDG modules, or the quantity projected for the SPU.

5.3.3.3 It must have a transparent front door to protect the PDG modules, allowing the reading of the monitored signals indicated on the equipment's local display.

5.3.3.4 It must be placed in an easily accessible place for the installation of the PDG module, interconnection of the pairs of wires of each PDG, which is made at the rear of the module, and interconnection of the communication cables of each module with the SPU supervisory system.

5.3.3.5 It must have internal ventilation, sized for the thermal load generated, internal lighting, grounding and thickness of the sheet and paint compatible with the durability specified by the UEP project.

5.3.4 The interconnection of all pairs of wires from the PDGs, with the respective wells correctly identified, at terminal entrance in the cabinet (refer to item 5.3.3.2).

5.3.5 Electrical outlets near or, preferably, internal to the cabinet, for connection of PDG modules and for service, being:

- two 24 Vdc sockets
- two 110 or 230 Vac outlets

5.3.5.1 The outlet pattern is NEMA 5-15.


5.3.6 The electrical supply to the sockets referred to in item 5.3.5 must be made available with an associated UPS of recommended capacity equal to four hours of operation, allowing the continuity of the PDG modules acquisition and data storage in the event of failure in the main electrical supply, which can be a general platform failure, if any.

5.3.7 The cabinet must be dimensioned for at least 1.5 KVA consumption.

5.3.8 The communication between the PDG Modules and the SPU automation system must be through an Ethernet network through a switch. The modules supplier must provide an OPC type communication driver (software)

AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE.

FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.

|   |   |    |                                     |       |                |
|---|---|----|-------------------------------------|-------|----------------|
| <br><b>PETROBRAS</b> | <b>TECHNICAL SPECIFICATION</b>  | Nº | <b>IET-3000.00-1516-823-PEK-006</b> | REV.  | <b>C</b>       |
|   | <b>E&amp;P</b>  |    |                                     | SHEET | <b>9 de 11</b> |
|   | TITLE:<br><b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                                     |       |                |

5.4 The PDG modules installation in the cabinet may be carried out by the company supplying the cabinet, with the accompaniment of specialized personnel from E&P-SERV/US-SUB/EQSB at a time previously negotiated with the UEP builder.

## 6 TPT-AR MODULES

The TPT-AR module is an equipment installed on the SAS panel and its purpose is to supply electrical power and receive, process and transmit data from the TPT-AR installed in the different wells connected to the SPU.

### 6.1 TPT-AR module general description:

6.1.1 The TPT-AR module is supplied to SPU by E&P-SERV/US-SUB/EQSB, which is the Petrobras sector that specifies, purchases and performs the installation and maintenance of the TPT-AR signal acquisition module at SPU.

6.1.2 Technical characteristics, such as communication and power, are described in the module manufacturer's manual and will be made available by the E&P-SERV/US-SUB/EQSB to the SPU manufacturer.

6.1.3 The TPT-AR module may only be operated by or under the guidance of specialized E&P-SERV/US-SUB/EQSB personnel.

### 6.2 TPT-AR module standard features:

The TPT- R module has the following standard features:

6.2.1 Electrical:  
DC input voltage = 24 Vdc


6.2.2 External communication interfaces MODBUS RTU RS-485.

6.2.3 Mechanics:  
The equipment must be of "DIN Rail Mountable Enclosures" type.

6.2.4 Individual TPT-AR interconnection, that is, each TPT-AR has its corresponding signal acquisition module although that module can read more than one TPT-AR simultaneously.

AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE.

FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.

|   |   |    |                              |       |          |
|---|---|----|------------------------------|-------|----------|
|  | TECHNICAL SPECIFICATION   | Nº | IET-3000.00-1516-823-PEK-006 | REV.  | C        |
|   | E&P   |    |                              | SHEET | 10 de 11 |
|   | TITLE:<br><b>SPU PROJECT DETAILS</b><br><b>WET MONITORING SIGNALS (TPT, PT and PDG)</b> |    |                              |       |          |

6.3 TPT-AR module interconnection at SPU:

To enable the installation and operation of the TPT–AR signal acquisition module at SPU, the following items and requirements must be provided and made available by SPU:

- 6.3.1 2.5 mm<sup>2</sup> wires twisted pairs sufficient to interconnect all pairs of wires related to TPT–ARs that arrive at the umbilical entry slots through junction boxes to the SAS panel.
- 6.3.2 Sufficient space for the installation of up to 40 (forty) TPT–AR modules, or an amount sufficient to meet the reading of all TPT–ARs that will be interconnected to the SPU.
- 6.3.3 Enough DIN Rail in a standard cabinet, in which the 40 (forty) signal acquisition modules will be installed, or enough to meet the reading of all TPT–ARs that will be connected to the SPU.
- 6.3.4 It must have a terminal block for the installation of 40 pairs of wires, sufficient to interconnect 40 (forty) TPT–AR sensors in its modules, or to the quantity projected for the SPU.
- 6.3.5 On the SAS panel, TPT–AR modules installation location, interconnection of wire pairs for each TPT–AR and interconnection of the communication cables with the SPU supervisory must be easily accessible.
- 6.3.6 The interconnection of all wires pairs of the TPT–ARs, with the respective wells correctly identified, at the entrance of the terminal block (refer to item 6.3.4).
- 6.3.7 The electrical supply interconnection for all TPT–ARs modules.
- 6.3.8 The power supply referred to in item 6.3.7 must be provided by a stabilized source that is not susceptible to possible electrical network fluctuations.
  - 6.3.8.1 The manufacturer's manual provides the module consumption information.
- 6.3.9 The TPT–AR modules communication to the SPU automation is RS-485 standard through the MODBUS-RTU protocol.
- 6.3.10 The TPT–AR modules installation in the cabinet can be carried out at the company supplying the cabinet, with the accompaniment of specialized personnel from the E&P-SERV/US-SUB/EQSB at a time previously negotiated with the SPU builder.

AS INFORMAÇÕES DESTE DOCUMENTO SÃO PROPRIEDADE DA PETROBRAS, SENDO PROIBIDA A UTILIZAÇÃO FORA DA SUA FINALIDADE.

FORMULÁRIO PADRONIZADO CONFORME NORMA PETROBRAS N-0381 REV. H.

