PETROBRAS	**TECHNICAL SPECIFICATION**	Nº: I-ET-3010.2K-1200-600-1DN-001	
	CLIENT: BUZIOS		SHEET 1 of 12
	JOB: FPSO BUZIOS 12		--
	AREA: PRODUCTION		
	TITLE: **PIG FACILITIES FOR BUZIOS 12**		INTERNAL
			BUZIOS/RES-EE/DEEIT

INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL
A	INDEPENDENT PIG LAUNCHER RELAXED REQUIREMENT FOR ALLOWING PIG LAUCHER SHARING IN PO, PWAG AND WAG LINES
B	CONSIDERS RIGID LINES UPDATED DIAMETERS AND INCLUDES ADDITIONAL REFERENCES TO GAS TRANSFER REQUIREMENTS ON LAUNCHER/RECEIVER AND PRE-COMMISSIONING

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	03/02/2025	24/04/2025	30/09/2025						
EXECUTION	C5D3	C5D3	C5D3						
CHECK	BF6I	TRNV	TRNV						
APPROVAL	U44G	U44G	AKRZ						

SUMMARY

1 OBJECTIVES

1.1 GENERAL

1.1.1 This Specification covers the minimum technical requirements and design criteria, manufacture and installation for pigging facilities, for Búzios Module 12 FPSO, which includes FPSO topside piping and PIG launchers or/and receivers.

1.1.2 All the recommendations mentioned in this document shall be followed. This specification shall be evaluated/revised by BUYER with each change generated in Risers Details Table in the GTD, Riser Balcony Lay-out and in the Operational Philosophy specifications.

2 DEFINITION

2.1 GENERAL

2.1.1 “PIG” shall be considered as an apparatus to be passed inside a pipeline in order to keep the normal pipeline flow characteristics (cleaning PIGs) or integrity monitoring (In-line Inspection Pigs). PIG for integrity monitoring purposes is applicable only for subsea rigid or hybrid pipelines.

2.1.2 Cleaning “PIG”: foam, solid cast and/or multi-size rigid PIGs.

2.1.3 Instrumented “PIG”: bidirectional mono-size or one direction multi-size instrumented PIGs for caliper, metal loss or crack detection.

2.1.4 The “PIG” Barrel shall be considered as a pressure vessel. Note that in other documents “Barrel” can be named as “Chamber” or “Scrapper Trap”.

2.1.5 SELLER refers to the entity that is responsible for the Engineering, Procurement and Construction of Floating Production Unit, as established in the contract of the FPU.

3 COMPLEMENTARY DOCUMENTS

3.1 GENERAL

3.1.1 The following documents are considered complementary and shall be considered:

- ABNT NBR 16.381 – Onshore and Offshore Pipelines – Scrapper Trap
- I-ET-3010.2K-1200-941-P4X-001 - GENERAL TECHNICAL DESCRIPTION - BOT
- I-DE-3D10.12-1500-941-P56-001 - RISER SUPPORTS ARRANGEMENT - FPSO BALCONY
- I-ET-3010.2K-1200-940-1DN-001 – PRELIMINARY SUBSEA OPERATION PHILOSOPHY
- SUBSEA LAYOUT – To be supplied during execution phase

4 PIG FACILITIES

4.1 GENERAL

4.1.1 All the topside PIG arrangement (including hard pipes, pig launchers, pig receivers and pig launcher/receivers) shall be compatible with the use of Cleaning and Instrumented PIGs (Instrumented scrapping PIGs). The use of PIG Valve is not allowed.

4.2 PIPING REQUERIMENTS (TOPSIDE PIGALBLE PIPELINES)

4.2.1 Topsides Valves shall be fullbore full opening. Their internal diameters shall be the same as the internal pipeline diameter.

4.2.2 For any internal diameter changes, the maximum slope allowed shall be 1:5, in accordance with Figure 1.

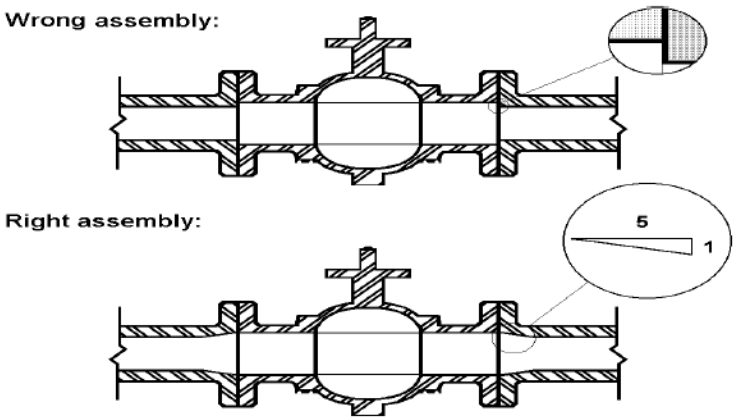

Figure 1: Internal Diameter Changes

4.2.3 All Wye shall be Piggable. Piggable Wye, may be either symmetric or not, but shall be 30º and convergent type, 2 pipelines arriving in one, in accordance with Figure 2.

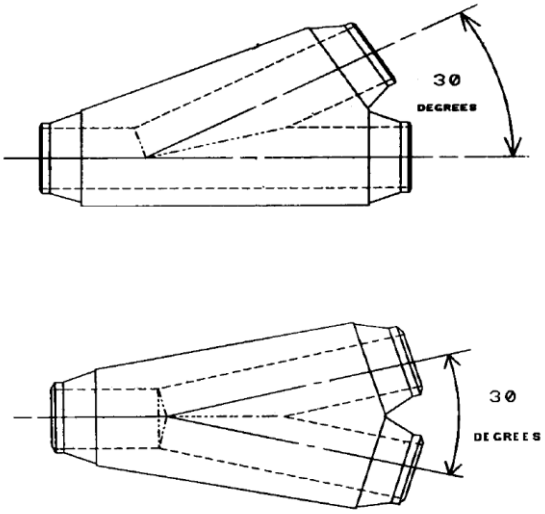

Figure 2: Piggable Wye

4.2.4 Adjoining bends or any two components or features like Tees and Wyes shall be separated by straight spool pieces of pipe with the same O.D and I.D and at least the minimum straight length of spool piece of pipe informed in Table 1 (for the respective pipeline function), referenced to the piping centerline, in accordance with Figure 3.

Table 1 – Minimum straight length of spool pieces of pipe and minimum bend radius of pipes for different pipeline functions (production, injection, service, gas export and gas transfer)

Requirement location	Oil Production, Injection (Water, Gas or WAG) and Service Pipelines	Gas Export Pipeline	Gas Transfer Pipeline
Minimum straight length of spool pipe piece	18”	24”	24”
Minimum bend radius of pipes	18”	24”	24”

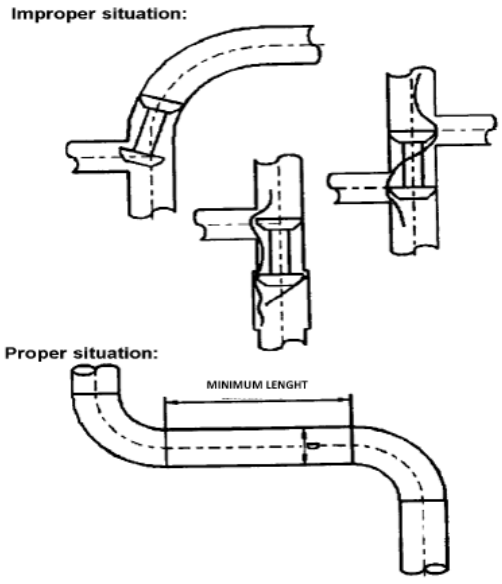

Figure 3: Minimum Straight Length

4.2.5 All bend radius of pipes shall be at least the minimum bend radius of pipes informed in Table 1 (for the respective pipeline function), referenced to the piping centerline.

4.2.6 The allowable internal diameter variations for topside piggable piping (including pig launcher/receiver) shall be in accordance with Table 2 in order to allow compatibility with GTD's Risers Details table and pig tools. BUYER currently adopts a rigid lines standardization based on outer diameter (OD) values, which differs from previous Projects where the definition of rigid lines was based on the internal diameter (ID) values. Due to this reason, maximum IDs in Table 2 are only an estimate based on maximum ODs informed in GTD Riser Details Table. Riser's final ID to be confirmed in accordance with milestones defined in GTD.

4.2.6.1 Required minimum and maximum ID shall take into account any fabrication tolerance.

Table 2 - Maximum and minimum piping internal diameter

FUNCTION	MINIMUM ID (1)	MAXIMUM ID (1,2)	MAXIMUM OD
Oil production	6"	8.9"	10.75''
Convertible well	6"	8.9"	10.75''
WAG Injection	6"	8.9"	10.75''
Service / Gas Lift	4"	6"	-
Gas Export	8"	9.8"	11.75''
Gas Transfer	6"	8.9"	11.75''

Note 1: Riser's final ID to be confirmed in accordance with milestones defined in GTD.

Note 2: Riser's maximum ID informed in column "MAXIMUM ID" column is based on current estimate on maximum internal diameter considering the respective maximum outer diameter (OD) for each function. Maximum OD is given in GTD Riser Details Table.

4.2.7 SELLER shall take care during the design and construction phase to avoid any pigging problems such as protruding welds inside piping or other arrangement that cause risk to the pigging operation. Barred tees shall be provided for the "Tee" branch connections where the I.D is greater than 2 inches for the piggable pipes.

4.2.8 During the construction phase, the SELLER shall carry out a visual inspection by means of boroscopy to confirm these barred tees and the possibility of overhanging welds.

4.2.9 Welding ultrasonic measurement inspection shall be performed only on PIG launchers/receivers to be connected with rigid risers, where an intelligent PIG operation is more likely to be required in the future.

4.2.10 All welding joints shall be evaluated by ultrasonic measurement inspection to evidence that the penetration height of the root welds is acceptable for the 2.5% ID tolerance. The ultrasonic measurement report and the boroscopy evaluation shall be

submitted to the Classification Society (CS) for approval and to BUYER for information.

4.2.11 SELLER shall also consider topside piping sizing (internal diameter) to handle the required flow rates.

4.2.12 All PIG receivers and PIG launcher/receiver shall have alignment to test headers in order to allow receiving fluids from risers. Pig receivers for production risers shall also be connected with Free Water KO Drum.

4.2.13 SELLER shall supply PIG launcher and/or receiver in accordance with Table 3.

4.2.13.1 SELLER shall design one PIG launcher or launcher/receiver for each slot of Gas Export. SELLER shall design one PIG launcher/receiver for each slot of Gas Transfer. For other functions (oil production, PWAG of WAG injection) the maximum number of slots that may share one PIG launcher or launcher/receiver (per function) is informed in Table 3.

4.2.13.1.1 For shared PIG Launcher or launcher/receiver scenarios, SELLER shall adopt possible solutions below such as using pig diverters or pivoting spools, to be discussed with BUYER during detailed engineering. The design of the proposed pivoting system must ensure continuous operation of gas lift or services of other wells that share the same launcher, during pigging operations.

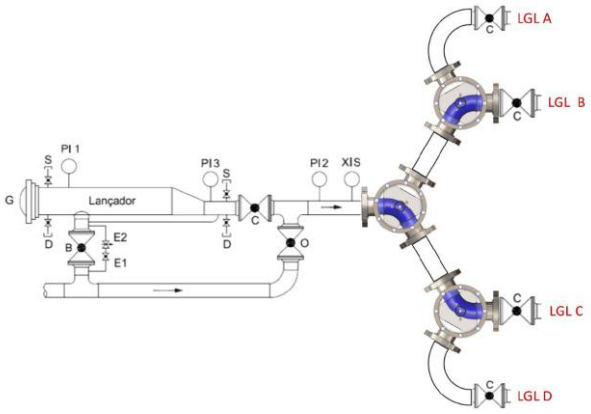

Figure 4 – Example of schematic for shared Pig launcher with pig diverters (schematic for reference sake, maximum number of shared slots for each function is presented in Table 3)

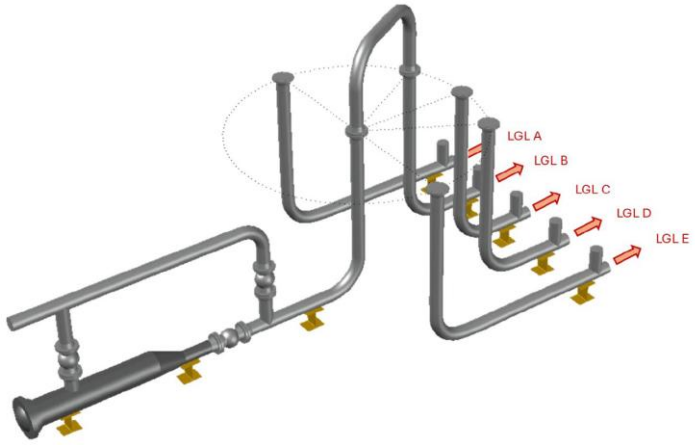

Figure 5 – Example of schematic for shared Pig launcher with pivoting spool (schematic for reference sake, maximum number of shared slots for each function is presented in Table 3)

4.2.13.2 SELLER may design PIG receivers to be shared for up to four slots.

Table 3 - PLR Requirement

FUNCTION	RISER TYPE	PIG BARREL TYPE	MAXIMUM SHARING SLOTS
Oil production	Rigid or Flexible	Receiver	4
Service / Gas Lift (for Oil production function)	Rigid or Flexible	Launcher	2
Convertible well (PWAG)	Rigid or Flexible	Receiver	4
Service / Gas Lift (for PWAG function)	Rigid or Flexible	Launcher	2
WAG Injection (Slot A)	Rigid or Flexible	Launcher	3
WAG Injection (Slot B)	Rigid or Flexible	Receiver	4
Gas Export	Rigid	Launcher and Receiver	1
Gas Transfer	Rigid	Launcher and Receiver	1

4.2.14 For information on pigging operation and pigging readiness requirement, refer to I-ET-3010.2K-1200-940-1DN-001.

4.3 REQUIREMENTS FOR LAUNCHER, RECEIVER AND LAUNCHER/RECEIVER (SCRAPPER TRAP)

4.3.1 For offshore scrapper trap, SELLER shall comply with all the requirements of the NBR-16381, for instrumented pigging of all wells, gas export and gas transfer.

4.3.2 The inside diameter of the barrel of launchers and receivers shall be at least 89 mm (3 1/2 inch) larger than the inside diameter of the pipeline.

4.3.3 The design may consider the depressurization through PIG Launchers, PIG receivers and PIG Launchers/Receivers.

4.3.4 The PIG launcher and/or receiver shall be installed in horizontal direction, parallel to the floor (no slope).

4.3.4.1 For installations with space limitations, arrangement with vertical launchers shall be submitted to BUYER analysis.

4.3.5 The PIG launcher/receiver and PIG receiver shall have (or supply with) adequate basket inside for proper pigging operation. The internal tray shall be proper to foam PIG retaining in the major barrel, to facilitate its removal.

4.3.6 A system for collecting drainage from receivers, launcher and launcher/receivers shall be provided.

4.3.7 Space, trolleys, carts or any device suitable for PIG handling shall be part of the SELLER scope.

4.3.8 The design of closure shall be in accordance with the code ASME BPVC Section VIII, Division 1.

4.3.9 PIG Launcher, receiver and receiver/launcher shall be safety interlocked during chamber hatch and valves operation.

4.3.10 The closure shall be of the quick opening type, provided with hinge or other mechanism capable of supporting the moving part during the opening and closing operation and equipped with a pressure warning device which prevents closure/opening when the barrel is pressurized.

4.3.11 The closure shall have a locking device distributed in a continuous and uniform manner along the entire sealing region.

4.3.12 The reducer of the launcher and the launcher/receiver trap shall be eccentric and that of the receiver trap shall be concentric. For a launcher installed in a vertical position, the reducer of the trap shall be concentric. The included angle of the reducer shall be smaller than or equal to the limit defined on NBR 16381.

4.3.13 For “piggable” systems, the inside diameter of pipes and fittings located between the barrel reduction and pipeline derivation shall not be smaller than the smallest pipeline inside diameter. If the inside diameter of pipes and fittings located between the barrel reduction and main pipe derivation are different, it shall be provided a conical diameter transition, maximum inclination 1:5.

4.3.14 The branches shall be assembled at horizontal position (3 or 9 o'clock positions) or on the top of pipe (12 o'clock position) and cannot be located on the bottom of pipe (6 o'clock position) or in any descending position.

4.3.15 A pressure equalization line of the pig trap shall be installed, equipped with a block and a throttling valve. The pipe nominal diameter of pressure equalization line shall be 25 mm (1 in) for pipelines with a nominal diameter up to 150 mm (6 in) and 50 mm (2 in) for the other nominal pipeline diameters.

4.3.16 Launchers/receivers designed for intelligent PIG passage with nominal diameter of 200 mm (8") and larger shall have a flanged outlet with nominal diameter of 50 mm (2") to help loading the pig into the barrel, using a pulling cable. This outlet shall be installed in horizontal (3h or 9h positions), inclined at 45° and without interference with the equipment block valve.

4.3.17 Two vents shall be installed, one upstream and another downstream from the reducer, to make possible the adequate filling or depressurizing of the PIG trap.

4.3.18 In installations that require closed system vents, there shall be vents additional to the atmospheric ones. At installations of PIG launcher, receiver and receiver/launcher, blowdown shall be firstly done for closed system aligned to flare or platform vent.

4.3.19 Pigging system shall consider pressure indicators in different scale ranges to guarantee accuracy in lower pressure measurements.

4.3.20 Three pressure indicators shall be installed in the PIG trap, the first shall be installed in the pipe of smaller diameter before the reduction (near the blocking valve) and the second in the pipe of larger diameter, near the closing plug. A third gauge, also called as vacuum gauge, ranged on 760 mmHg full scale from zero through 2 bar, shall be installed on the major barrel. Over pressure protection shall be provided for every pressure gauge (set up 2.2 bar). These both pressure indicators shall be capable to indicate the operating pressure in the middle third of the scale range. Note that a fourth pressure indicator shall also be installed in the bypass line.

4.3.21 All PIG launchers, receivers and launcher/receivers shall have closed drain system. This drain system shall be connected to a sump tank.

4.3.22 When the passage of an inspection PIG is expected, a branch shall be installed in the PIG trap, with a block valve, for nitrogen injection, positioned upstream from the atmospheric vent block valve which is installed closest to the closure. The nitrogen injection branch shall have a check valve to avoid that the product being transported by the pipeline return to the nitrogen system.

4.3.23 All topsides piping, free access areas, launcher and launcher/receiver nominal/internal diameter and length shall comply with the requirements of the NBR 16381 and shall be submitted to BUYER comments/information before placing orders.

4.3.24 A Preliminary General Arrangements representing the required free access areas shall be also submitted to BUYER comments/information.

4.3.25 All PIG receivers and PIG launcher/receiver shall have line to test separator in order to allow receiving fluids from risers after flushing during commissioning, subsea lines fluid circulation and WAG operations.

4.3.26 All PIG launcher/receivers, PIG launchers, launcher/receiver and PIG receivers' installation imply in providing facilities to inject lift-gas to push the PIGs, as well as other fluids required.

4.3.27 Pigging operation may also be performed with nitrogen as drive fluid. See GTD item for Nitrogen Generator Unit (NGU) details.

4.3.28 TEMPORARY PIG LAUNCHER/RECEIVER FOR RIGID RISERS

4.3.28.1 For all rigid riser positions SELLER shall provide a connection flange (NOTE 1) and free access area in order to allow the mounting and operation of a temporary vertical PIG Launcher/Receiver in case an in-line inspection service is needed, with umbilical and/or bidirectional instrumented PIG. The temporary PIG launcher/receiver will be supplied by BUYER and mounted/operated by SELLER.

4.3.28.1.1 This temporary PLR may also be used for rigid pipelines pre-comissioning - refer to "Riser System Requirements" technical specification, section "Rigid Riser Pre-Comissioning Activity" (I-ET-3D10.12-1350-274-PX9-001).

4.3.28.1.2 For gas export pipeline pre-comissioning requirements, refer to "Riser System Requirements" technical specification, section "Gas Export and Gas Transfer Pre-Comissioning Activity" (I-ET-3D10.12-1350-274-PX9-001).

4.3.28.1.3 For gas transfer pipeline pre-comissioning requirements, refer to "Riser System Requirements" technical specification, section "Gas Export and Gas Transfer Transfer Pre-Comissioning Activity" (I-ET-3D10.12-1350-274-PX9-001).

4.3.28.2 For such operations, access for opening/closing the Launcher/Receiver barrel shall be provided, as well as a connection point and space for assembling a temporary pipping for N_2/water/diesel supply.

4.3.28.3 SELLER shall provide free access area according to the Figure 6 and Table ***4***. The dimensions and other requirements shall be confirmed during project execution phase.

NOTE 1: The connection flange shall be located between riser and “topside convergent wye”.

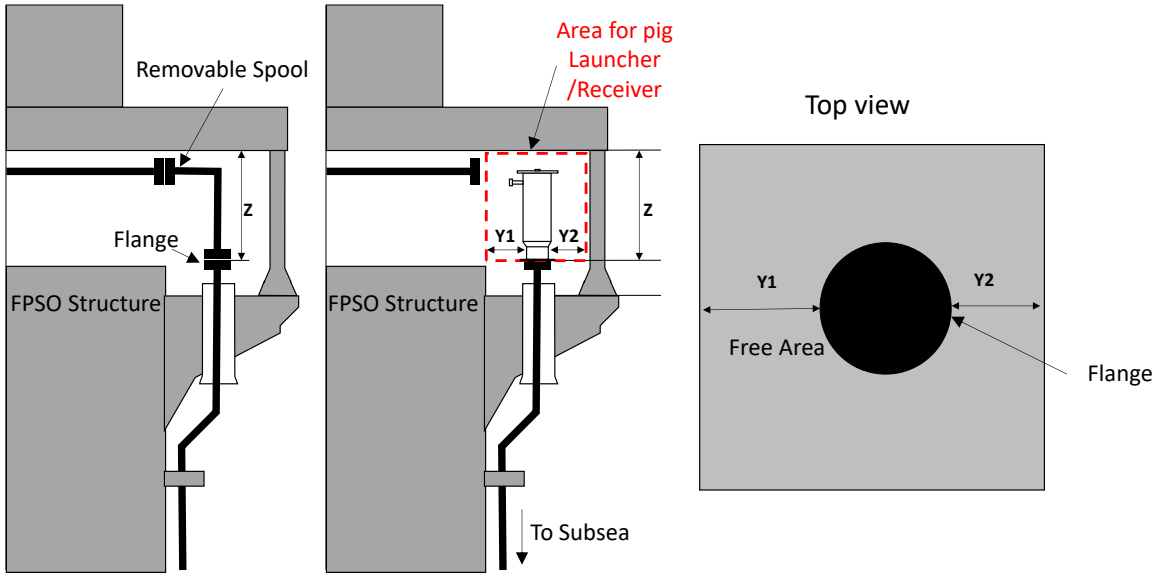

Figure 6: Free area for temporary PIG Launcher/Receiver mounting for production rigid risers

Table 4 - Access area sizing for temporary PIG Launcher/Receiver for production rigid risers

Minimum Free Area for PIG temporary Launcher/Receiver for production SLWR (note 2)		
Y1 (Side clearance)	**Y2 (Side clearance)**	**Z (Vertical distance from flange to upper obstacle)**
1 m	1 m	3.8 m

NOTE: Distances in Table 4 are the minimum requirement and must be confirmed by BUYER during execution phase.

4.3.28.4 Temporary PIG launcher and receiver will have the following maximum basic dimensions:

- Maximum weight: 3,000 kg.
- Maximum dimensions:
  - Length: 3.5 m;
  - Barrel External Diameter: 675 mm.

NOTE: Temporary PIG launcher and receiver will be tailor made for each case, for this reason, information such as drawings and P&IDs are not available. If a special connection is required, it will be part of the design of temporary PIG launcher / receiver. The connection on the temporary PIG launcher/receiver will be flanged to corresponding topside piping class.