INDEX OF REVISIONS

R E V .	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
A	INCLUDED IN 6.1.8 DETAILS ABOUT TANKS AND TANK CHAMBERS INTERNAL CONSTRUCTION AND FINISHING
B	REMOVAL OF ANY MENTION TO TAGs IN A GENERIC TECHNICAL SPECIFICATION; CORRECT DESIGNATION OF NORMAM-201 AT ITEM 2.2; INCLUDED SMALL REFRIGERATOR AT ITEM 6.4.7 TO PRESERVE SAMPLES TAKEN; INCLUDED MAWP - MAXIMUM ALLOWABLE WORKING PRESSURE- REQUIREMENTS AT ITEM 9.1.4; DETAIL ABOUT DESIGN LIFETIME IN ITEM 4.1.1 and INSPECTION AND TEST PLAN DETAILS IN ITEM 9.5.1 .
C	SAMPLING POINTS DETAILS REQUIREMENTS FROM ITEMS 6.4.1 TO 6.4.4; PRESCRIPTIONS ABOUT SLUDGE PUMP IN 6.6.2.2; ROBUST CENTRIFUGAL PUMP SEALING PRESCRIPTION IN 7.3.3; MACERATING DETAILS IN 7.3.4 .

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	FEB/02/24	JUN/11/24	JUL/11/24	AGO/15/24					
EXECUTION	PMX4	PMX4	PMX4	PMX4					
CHECK	CXZ0	CXZ0	CXZ0	CXZ0					
APPROVAL	CJI8	CJI8	CJI8	CJI8					

PAGE

TABLE OF CONTENTS

1. INTRODUCTION

1.1. OBJECTIVE

The purpose of this technical specification is to describe the minimum requirements for the design, manufacturing, assembly, supply, installation, commissioning and tests of SANITARY TREATMENT in conformance with relevant regulations and BASIC PROJECT design documentation.

1.2. DEFINITIONS

PACKAGE: It is defined as an assembly of equipment supplied interconnected, tested and ready to operate, requiring only the available utilities from the Unit for the Package operation.

PACKAGER: It is defined as the responsible for project, assembly, construction, fabrication, testing and furnishing of the Package.

All definitions are found on I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

SEWAGE EFFLUENTS: All feces and urine streams, with water content, originated in toilet basins and urinals, and drained through induced vacuum network.

GREY WATER EFFLUENTS: Used / serviced Waters originated by teeth brushing, baths, cloth washing, galley washing and food preparation activities, etc; drained by gravity.

1.3. ABBREVIATIONS

BOD	Biochemical Oxygen Demand
CS	Classification Society
FAT	Factory Acceptance Tests
FPSO	Floating Production Storage and Offloading Unit
SOS	Supervisory and Operation System
SOS-HMI	Human Machine Interface of SOS
STU	Sewage Treatment Unit

2. NORMATIVE REFERENCES

2.1. INTERNATIONAL CODES, RECOMMENDED PRACTICES AND STANDARDS

The equipment shall be designed and manufactured in accordance with the minimum following codes and standards, if not mentioned otherwise.

- ASME B31.3 – Process Piping
- ASME B16.5 – Pipe Flanges & Flanged Fittings
- AWS D1.1 – Structural Welding Code
- IMO – International Maritime Organization – MPEC.227 (64)
- MARPOL – Chapter IV
- Classification Society defined for the Hull scope.

2.2. BRAZILIAN CODES AND STANDARDS

- NR – Brazilian Federal Government Regulatory Norms (Normas Regulamentadoras NRs)
- NORMAM-201 – Normas da Autoridade Marítima para Embarcações Empregadas na Navegação em Mar Aberto;
- CONSELHO NACIONAL DO MEIO AMBIENTE – CONAMA Resolução nº 430, de 13 de maio de 2011;
- NOTA TÉCNICA CGPEG/DILIC/IBAMA Nº 01/11 – PROJETO DE CONTROLE DA POLUIÇÃO – IBAMA
- INMETRO Resolution 115, March 21st 2022

2.3. CLASS APPROVAL AND CERTIFICATION

The PACKAGE shall be designed, manufactured and tested according to the design reference documents, normative requirements and in accordance with the latest editions of Classification Society Rules, Regulations and Standards.

3. REFERENCE DOCUMENTS

3.1. BASIC PROJECT

REF DOC NUMBER (*)	REF DOC NAME
HULL SYSTEMS	
I-DE- SANITARY SEWAGE AND GREY WATER SYSTEM	SANITARY SEWAGE AND GREY WATER SYSTEM
I-DE- SANITARY SEWAGE AND GREY WATER SYSTEM COLLECTION	SANITARY SEWAGE AND GREY WATER SYSTEM COLLECTION
I-MD- DESCRIPTIVE MEMORANDUM - HULL SYSTEMS	DESCRIPTIVE MEMORANDUM - HULL SYSTEMS
GENERAL	
I-DE- GENERAL ARRANGEMENT	GENERAL ARRANGEMENT
I-DE- AREA CLASSIFICATION – GENERAL	AREA CLASSIFICATION – GENERAL
I-ET- AUTOMATION INTERFACE OF PACKAGE UNITS	AUTOMATION INTERFACE OF PACKAGE UNITS
I-ET- METOCEAN DATA	METOCEAN DATA
I-RL-MOTION ANALYSIS	MOTION ANALYSIS
OUTFITTING	
I-DE- HULL GENERAL NOTES AND TYPICAL DETAILS	HULL GENERAL NOTES AND TYPICAL DETAILS

Table 1 – Basic Design Documents.

- (*) Note: the above documents code number is intentionally omitted since this technical specification is issued for different basic design projects. The actual document code shall be checked across the contractual basic design document list. Title naturally may vary slightly from one project to another.

3.2. TYPICAL DOCUMENTS

REF DOC NUMBER	REF DOC NAME
GENERAL	
I-ET-3000.00-0000-940-P4X-002	SYMBOLS FOR PRODUCTION UNITS DESIGN
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS

I-ET-3010.00-1352-130-P4X-001	FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS.
I-ET-3000.00-1200-940-P4X-001	TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN
CONSTRUCTION	
I-ET-3010.00-1200-955-P4X-001	WELDING
I-ET-3010.00-1000-970-P4X-002	REQUIREMENTS FOR NDT
I-ET-3010.00-1200-955-P4X-002	REQUIREMENTS FOR WELDING INSPECTION
I-ET-3010.00-0000-970-P4X-001	REQUIREMENTS FOR PROCEDURES AND PERSONNEL QUALIFICATION AND CERTIFICATION
MECHANICAL	
I-ET-3010.00-1200-300-P4X-001	NOISE AND VIBRATION CONTROL REQUIREMENTS
PAINTING	
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
DR-ENGP-I-1.15	COLOR CODING
SAFETY	
I-ET-3010.00-5400-947-P4X-002	SAFETY SIGNALLING
DR-ENGP-M-I-1.3	SAFETY ENGINEERING GUIDELINE
PIPING	
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS
ELECTRICAL	
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS
I-ET-3010.00-5140-700-P4X-001	SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-002	SPECIFICATION FOR ELECTRICAL MATERIAL FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-003	ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS
I-ET-3010.00-5140-712-P4X-001	LOW-VOLTAGE INDUCTION MOTORS FOR OFFSHORE UNITS

I-ET-3010.00-5140-741-P4X-004	SPECIFICATION FOR LOW-VOLTAGE GENERIC ELECTRICAL PANELS FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-007	SPECIFICATION FOR GENERIC ELECTRICAL EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-009	GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
INSTRUMENTATION AND AUTOMATION	
I-ET-3010.00-1200-800-P4X-002	AUTOMATION, CONTROL AND INSTRUMENTATION ON PACKAGE UNITS
I-ET-3010.00-1200-800-P4X-013	GENERAL CRITERIA FOR INSTRUMENTATION PROJECTS
I-ET-3010.00-5520-888-P4X-001	AUTOMATION PANELS
I-ET-3010.00-1200-800-P4X-015	REQUIREMENTS FOR TUBING AND FITTING (ALIGNED TO IOGP-JIP33 S-716)

Table 2 – FPSO basic design typical documents.

4. DESIGN REQUIREMENTS

4.1. DESIGN CONDITIONS

4.1.1. PACKAGE Equipment shall be designed for a design life defined on I-MD-DESCRIPTIVE MEMORANDUM – HULL SYSTEMS in a corrosive offshore environment without the need for replacement of any major component due to wear, corrosion, fatigue, or material failure.

4.1.2. PACKAGER shall design the equipment for the full range of operational conditions as specified in this technical specification.

4.1.3. PACKAGE Equipment shall be designed with the compliance of the normative and design requirements as stated in this specification and complying with the technical parameters stated on the above item 3 with the BASIC PROJECT reference documents.

4.2. SAFETY REQUIREMENTS

4.2.1. Personnel safety protection shall be provided according to Brazilian Regulatory Norms (NR) issued by Brazilian Government.

4.2.2. Warning signs in Brazilian Portuguese language shall be provided where risk of

personnel injury exist.

4.2.3. Rotating equipment outer parts, such as pulleys, couplings, belts and flywheels, shall have rigid protection, manufactured with aluminum ASTM B211 and shall be capable of being easily removed.

4.2.4. In accordance with the requirements of SOLAS II-1, Regulation 3-5, and MSC.1/Circ. 1379, all equipment and material to be supplied by PACKAGER shall be “asbestos free”.

4.2.5. Safety signaling shall be in full compliance with I-ET-3010.00-5400-947-P4X-002 – SAFETY SIGNALLING.

4.2.6. For additional safety requirements refer to DR-ENGP-M-I-1.3 – SAFETY ENGINEERING GUIDELINE.

4.3. NOISE AND VIBRATIONS

4.3.1. Noise and vibrations limits shall be in conformance with I-ET-3010.00-1200-300-P4X-001 – NOISE AND VIBRATION CONTROL REQUIREMENTS.

4.4. MOTIONS AND ACCELERATION

4.4.1. All equipment shall be able to withstand with the UNIT subjected to 100-year return period environmental conditions.

4.4.2. All equipment shall be able to operate with the UNIT subjected to 1-year return period environmental conditions.

4.4.3. All environmental conditions are defined in I-ET-METOCEAN DATA.

4.4.4. For the Hull loading conditions details and the maximum designed operational trim and heel inclinations refer to I-ET-3010.00-1350-960-P4X-001 – DESIGN REQUIREMENTS – NAVAL ARCHITECTURE.

4.4.5. For the design data and information regarding motion requirements refer to I-RL- – MOTION ANALYSIS.

4.4.6. PACKAGE is also to withstand inertial forces during transportation from construction site to the final offshore location.

5. PACKAGE SCOPE OF SUPPLY

5.1. SCOPE OF SUPPLY

ITEM	Description	Qty
1	Sewage Treatment Unit	2 x 100%
2	Sewage Treatment Unit Panel	2 x 100%
3	Equalization Unit	1 x 100%
4	Grease Trap	1 x 100%
5	Simplex Catcher Unit	1 x 100% - Infirmary Sanitary Sewage Waters
6	Duplex Catcher Unit	1 x 100% - Main Stream of the Sanitary Sewage System Waters
7	Sewage SLUDGE Removal Pump	1 x 100%
8	Manual Handheld kits for measuring DO (dissolved oxygen) levels from samples	2 x 100%

Table 4 – Scope of Supply

5.1.1. According to the above table 4, PACKAGER shall supply two (2 X 100%) biological type Sewage Treatment Units fully assembled each one in a structural skid and being each one able to attend 100% of the FPSO POB.

5.1.2. Additionally, PACKAGER shall supply a Grease Trap (1 x 100%) to collect the Accommodation Galley grey water, Simplex Catcher Unit (1 x 100%) and Duplex Catcher Unit (1 x 100%) to retain strange objects in sewage waters and also to fragment feces in smaller particles, and a Fixed Pump (1 x 100%) for the STUs sewage sludge removal and discharge. It is also included an Equalization Unit (1 x 100%) to homogenize the grey and sewage waters inventory to be fed to the STPs – Sewage Treatment Plants – in a flow as constant as possible, aiming to turn uniform the aerobic bacteria colony metabolic life cicle.

5.1.3. PACKAGER shall supply all interconnection piping, flanges, valves, electrical panel and terminations, instrument, and any other devices for the safe and full operational performance of the equipment following all normative regulations, standards and the minimum requirements for design and operation herein mentioned on this specification.

5.2. EQUIPMENT LOCATION

5.2.1. PACKAGE shall be installed in Engine Room which is a closed and non-classified compartment as defined on I-DE-AREA CLASSIFICATION - GENERAL.

5.2.2. I-DE-GENERAL ARRANGEMENT shall also be used as reference for the PACKAGE equipment location.

6. PACKAGE SPECIFICATION – SEWAGE TREATMENT UNIT (STU)

6.1. STU GENERAL REQUIREMENTS

6.1.1. STUs (2 x 100%) shall be IMO type approved as per MPEC.227 (64) and shall be designed for a POB of 240 people with a considered daily flow rate of 200 liters per person, resulting in a total daily treatment capacity conceived as 48.0 m^3, encompassing all grey and sewage waters generated at Accommodations. No other effluents may be destined to the STUs besides grey and sewage waters.

6.1.2. For each STU capacity, PACKAGER shall consider a Biochemical Oxygen Demand (BOD) of 600 mg/liter at STUs inlet, to be ratified in detailing phase, conceived uniform along the day by the Equalization Unit adoption.

6.1.3. The STUs (2 x 100%) shall be conceived to keep one of them in operation while the other one is at stand-by. It shall be conceived means to operate simultaneously both Sewage Treatment Units while the one in operation is put out of operation (for instance, maintenance purposes), and the one in stand-by is put to operate.

6.1.4. Focusing on operational change-outs between STUs, it shall be incorporated transference lines between both units, making it possible to transfer part of the inventory from the STU being put out of operation to the other STU being put to operate, aiming biological process agility during these change-outs.

- Note: PACKAGER shall provide a detailed procedure about how to undergo such STUs change-outs, mentioning all operational maneuvers and main operational control parameters to be monitored while the STU being put to operate assumes up to 100% of its operational capacity.

6.1.5. As a recommendation of hazardous operation study, PACKAGER shall guarantee, by means of Equalization Unit and any related devices, protection against high level scenario on STU tanks during the treatment peak demand.

6.1.6. STUs shall be controlled by (2 x 100%) Sewage Treatment Unit Panels. For these control panels requirements refer to 8.1 and 8.2.

6.1.7. Each STU shall be equipped at its outer frame with one H2S sensor and one CH4 sensor. These sensors shall alarm at CCR in case of these gases detection, and also signal at CCR in case of failure. These sensors detection alarms shall only be reset by electronic key and/or authorized password.

6.1.8. All tanks or tank chambers in this Technical Specification in contact with sanitary sewage, shall be built with its internal surface without reinforcements and as flat and smooth as possible in order to minimize sewage incrustation. STU equipment and devices

6.1.9. STU Aeration Blowers

6.1.9.1. To avoid the absence of oxygen and consequently the growth of anaerobic bacteria, each STU shall be equipped with two air blowers (2 x 100%), able to operate separately or simultaneously (in contingencies), guaranteeing the amount of oxygen the process demands. This aeration system shall be conceived with access facilities to perform maintenance and unclogging tasks.

6.1.10. STU biological reactor inspection access hatches

6.1.10.1. The biological reactor of the STUs shall have an ease and practical opening hatch or other similar access device to allow its interior visual inspection or eventual measurements and sample collections from its interior liquid effluents, for example the liquid from the sludge return line or the scum return line.

6.1.11. STU Disinfection Chamber

6.1.11.1. As an integral part of each STU, within STU skid limits, at each STU outlet (towards overboard), the liquid effluents shall pass through a disinfection treatment, where it shall preferably pass through an Ultra-Violet Sterilizer Chamber, or, alternatively, be mixed and disinfected with liquid chlorine (Sodium Hypochlorite). If the liquid chlorine solution is adopted, packager shall supply the complete apparatus to produce Sodium Hypochlorite by sea water electrolysis and remove liquid chlorine in excess of 0,5 mg/L (limit specified in IMO Resolution MEPC 227), before overboard discharge. This 0,5 mg/L limit shall be accomplished by packager by a liquid chlorination remover automatically dosed, as Sodium Bisulfite or Sodium Metabissulfite, with its sea water electrolysis tank, injection device, concentration measure, dosing devices, etc. The preference on Ultra-Violet disinfection option is related to its no-pollutant potential and much simpler installation, being its effectiveness related to adequate treated effluents transparency, so that ultra-violet light may permeate through effluents medium. The packager decision about which method to select is function of the output effluents transparency expected by packager own experience and knowledge.

6.1.12. STU tanks / chambers Level Transmitters and Level Gauges

6.1.12.1. Tanks/chambers inside the sewage treatment units shall have a level transmitter and alarm to indicate the possibility of overflow.

6.1.12.2. The signal obtained by the level transmitter shall be integrated to the platform supervisory system (SOS), alarming in the CCR.

6.1.12.3. This signal shall be interlocked with the SDV valve downstream the Equalization Unit. This valve shall close in case of high level at STU tanks.

6.1.12.4. STUs shall be equipped, aiming better operational awareness, with at least one magnetic visual level gauge(s) in any STU(s) chamber(s) subjected to overflow in case of any related process control failure. The magnetic option is related to the inner STUs effluents characteristics.

6.1.13. STU Effluents Discharge

6.1.13.1. Both STUs shall have two pumps (2X100%) each one, to collect the treated fluid and discharge it to overboard.

6.1.13.2. The STU effluents to be discharged to sea shall follow the MPEC.227 (64) and the Brazilian requirements “CONSELHO NACIONAL DO MEIO AMBIENTE – CONAMA Resolução nº 430, de 13 de maio de 2011” and “NOTA TÉCNICA CGPEG/DILIC/IBAMA Nº 01/11 – PROJETO DE CONTROLE DA POLUIÇÃO – IBAMA”.

6.2. STU GREY / SEWAGE WATERS COLLECTING SYSTEM REQUIREMENTS

6.2.1. The design of the grey and sewage water collecting system from the Accommodation and other areas to the STUs and from the STUs to overboard shall be submitted to the PACKAGER for formal approval. No other effluents may be destined to the STUs besides grey and sewage waters.

6.2.2. Grey and sewage water collecting system piping lines design, slope, accessories, valves, unions, and the STUs vent lines as detailed on I-DE- SEWAGE AND GREY WATER SYSTEM and I-DE- SEWAGE AND GREY WATER SYSTEM COLLECTION shall follow the sewage treatment unit PACKAGER's recommendations.

6.3. STU MAINTENANCE REQUIREMENTS

6.3.1. The time interval between periodic maintenance shall not be shorter than 1 month.

6.3.2. During such interventions the MAXIMUM sludge removal volume shall be 15 m^3, considering the regular sludge age (mean Cell Residence Time) conceived for the STUs dimensioning and effectiveness.

6.3.3. STUs shall not require any other sludge removal intervention between periodic maintenance, or within the one month period mentioned on 6.3.1.

6.4. STU SAMPLING POINTS

6.4.1. Sampling Points shall be installed in a horizontal pipe segment, after accessories and turbulence inducers as curves, control valves, etc.

6.4.2. Sampling Points shall be located before the line block valve, to allow sample collection in case of intermittent flow.

6.4.3. Sampling Points shall be located on the pipeline upper generatrix, without intrusive probe.

6.4.4. The Sampling Point TUBE shall be ¾ inches as a minimum, in Stainless Steel or the same material of the sampling pipeline, always aiming to avoid dissimilar materials corrosion.

6.4.5. STUs shall have two (2) remote sampling points at each treatment tank/chamber. One of these remote sampling points shall be at each tank/chamber bottom.

6.4.6. If there is a sludge settlement tank/chamber, it shall be equipped with four (4) remote sampling points, equally distributed in different heights of the sludge settlement tank/chamber, being one (1) at its bottom.

6.4.7. If there are one or more additional treatments downstream the biological process, there shall be a sampling point between the biological process outlet and this additional treatment; and a sampling point between each treatment, if two or more additional treatments are conceived, besides the last sampling point, immediately before overboard.

6.4.8. It shall be possible to measure the DO (dissolved oxygen) inside the aeration tank/chamber. For this purpose, besides the sampling points mentioned in 6.4.1, 6.4.6 and 6.4.7 above, two (2) manual handheld probes to measure DO levels shall be provided.

- Note 1: the probes shall have appropriate calibration certificates.
- Note 2: other alternatives to measure DO levels in the aeration tank/chamber may be proposed by PACKAGER and shall be submitted to OWNER for approval.

6.4.9. At STUs upstream, (and so, at Equalization Unit downstream), there shall be a sampling point, from which representative effluents samples will be taken, since grey and sewage waters are homogenized inside Equalization Unit, from where these mixed effluents give input to the STUs. The sampling tube (probe) shall be curved 90^0 against effluents flow, center line direction.

6.4.10. The STUs upstream sampling point previewed at 6.5.5 and the STUs downstream sampling points previewed in 6.5.3, will permit the operating STU performance evaluation, and also additional treatment performance evaluation.

6.4.11. There shall be a Refrigerator supplied by packager, 120 liters minimum volume, “exhibitor” type (glass door or other translucid material front door), maintaining samples taken bellow 6 ^oC (six degrees Celsius) for samples representative composition preservation, to be installed close to both STUs, where STUs input and output samples are to be taken.

6.5. STU VENT SYSTEM

6.5.1. Each STU shall have a dedicated vent piping system.

6.5.2. STUs vent system shall be positioned in an open area on Main Deck aft of Engine Room forward bulkhead in a proper place so that it does not cause any disturbance to the crew with odor dispersed.

6.5.3. Also, STU vent piping system shall be distant enough from the Hull air intakes to not create a short circuit.

6.5.4. For the STU venting system additional requirements and details refer to I-DE-SANITARY SEWAGE AND GREY WATER SYSTEM.

6.6. STU SLUDGE REMOVAL

6.6.1. The sludge produced by STU shall be transferred to fill drums or transport tanks at the Topside Laydown Area by a fixed pump (PACKAGER scope) through a fixed piping line (HULL SUPPLYER scope) fully dedicated for this transference.

6.6.1.1. There shall be a local Push-button at Topside Laydown Area, in the vicinity of where the drums / transport tanks will be filled, for EACH pump, with green Start button with led, and red Stop button with led, in accordance with I-DE-3010.00-5140-797-P4X-002 - Electrical System Automation Typical Actuation Diagrams

6.6.1.2. At the Topside Lay-down area, this fixed piping shall be equipped with a quick coupling to attach a hose with sufficient length to fill the drums / tanks.

6.6.1.3. In the hose extremity there shall be a device equipped with a blocking valve to be opened just prior each drum filling, similar like filling pistols used in gas

stations. Pressing the trigger opens the filling device, releasing the trigger closes it. The intention is to prevent sludge spills on Lay-down area.

6.6.1.4. This gas station similar-like filling pistol shall close automatically, when the drum (or tank) being filled gets fulfilled. After each drum (or tank) filling, this blocking device is maintained blocked (trigger released) until the next drum (or tank) filling, pressing the trigger.

6.6.1.5. To avoid circuit lines integrity failure, while this filling pistol-like device is blocked, and the sludge pump (centrifugal or positive displacement) is working, the circuit lines shall be protected. In case of centrifugal solution, the lines circuit shall resist to shut-off pressure intervals (filling pistol trigger released); in case of positive displacement solution, adequate integrity guarantees shall be adopted, as internal by-pass in positive displacement pumps. In any case, after two minutes with the trigger released, the operating pump shall be automatically turned-off. The Status On-Off shall be shown in the CCR, from where the operating pump may also be turned-off.

6.6.2. The Sewage Sludge Removal Pump shall be designed, selected and supplied by PACKAGER.

6.6.2.1. PACKAGER may adopt electrical centrifugal pump or pneumatic positive displacement pump. In any case, the solution shall be conceived to preserve the equipments, environment, safety and health during drums filling operations at Lay-down area.

- Note: for pump minimum capacity reference design refer to I-DE-PIPING AND INSTRUMENT DIAGRAM SANITARY SEWAGE AND GREY WATER SYSTEM.

6.6.2.2. If Centrifugal Pump, specific for SLUDGE (sewage) applications, is adopted, a developed and reliable solution for Sealing shall be applied, as minimum PLAN 53B. Sludge leaks to the environment should be zeroed, if possible. If Positive Displacement is adopted, hermetic SLUDGE (sewage) Pneumatic Pump is also an option. In any case, SEALING shall be robust to BLOCK the possibility of Sludge normal SEALING passage developing to complete failure.

6.6.2.3. PACKAGER shall provide a data sheet of this fixed pump with all corresponding design characteristics.

7. PACKAGE SPECIFICATION – OTHER EQUIPMENT

7.1. GREASE TRAP

7.1.1. Grease trap shall be built entirely with AISI 316L, rectangular type and installed at a level below the galley and messroom, but above Equalization Unit.

7.1.2. Grease trap shall have safe ergonomic access facilities for operation, inspection

and maintenance and hot / cold water connections for washing and cleaning. It shall also have one (1) drain point in a containment coaming.

7.1.3. All fatty residues result of grease trap washing and cleaning shall be disembarked inside drums and not discarded directly to the sea, nor discarded to the STUs. The STUs, via Equalization Tank, shall receive just liquid effluents from the Grease Trap.

7.1.4. The wet volume of the grease trap shall be within 900 and 1,100 litres for 240 POB.

7.1.5. PACKAGER shall provide instructions for grease trap cleaning with information of the minimum interval for cleaning to ensure the system efficiency.

7.2. CATCHER UNIT AND DUPLEX CATCHER UNIT

7.2.1. Sewage system shall have one (1) Catcher Unit to collet solids and large objects from INFIRMARY Sanitary Sewage Waters collection system; and one (1) Duplex Catcher Unit to collet solids and large objects from ALL OTHER Sanitary Sewage Waters collection system, as detailed on I-DE- SANITARY SEWAGE AND GREY WATER SYSTEM.

7.2.2. An exclusive Catcher Unit for INFIRMARY SEWAGE Waters relates to potential contaminants to be conveyed (to the Equalization Unit) as much as segregated as possible. The adoption of a DUPLEX Catcher Unit on all the other system SEWAGE Waters, and not a Simplex one, relates to continuous flow permitted during the screen filter element cleaning tasks, allowed by such devices. In a DUPLEX type filter, when the aligned screen element filter gets clogged, the other screen element filter may be manually aligned (selected) generally by a lever. Then, the clogged element filter may be removed and cleaned, all these tasks guaranteeing system flow continuity.

7.2.3. From now on in this document, when both Catcher Unit and Duplex Catcher Unit need to be mentioned, they will be referred to as "**Catchers**". Both Catchers shall be equipped with a Differential Pressure Indicator, visually alarming locally and remotely to CCR the aligned screen element filter cloggage, and so, the need for element filter cleaning. There shall be access and adequate surrounding space for maintenance.

7.2.4. These Catchers have DOUBLE function: i) to retain foreign objects like, for example, soap packings and plastic cups; ii) and also to fragment feces content in smaller particles prior sewage entrance at Equalization Tank. Considering the unhealthy nature of these Catchers maintenance / cleaning tasks, it shall be avoided the maximum as possible direct contact between maintainer personnel and its inner residues.

7.2.5. These Catchers "Element Filters" shall have a quadrangular screen gross mesh not greater than 12 milimeters in diagonal or not greater than 10 milimeters in diameter in case of circular perforated screen, or an equivalent passage area.

7.2.6. Catchers as described here may be replaced by another solution approved by PACKAGER once solids and large objects collected could be easily removed, and the feces content could be initially fragmented prior input to Equalization Tank, while ensuring advantages mainly related to health aspects.

7.3. EQUALIZATION UNIT

7.3.1. The adoption of an Equalization Tank, and its organic unit devices, aims to homogenize the grey and sewage waters inventory, conceived as 48 m^3/day, to be fed to the STPs – Sewage Treatment Plants – in a flow as constant as possible, around 2 m^3/hour, aiming to turn uniform the aerobic bacteria colony metabolic life cycle. While the Equalization Tank output is set around 2 m^3/hour, the inner tank level may decrease during smaller sewage and grey waters ingress, along the day; or this inner tank level may increase during greater sewage and grey waters ingress along the day. So, this Equalization Tank shall absorb grey and sewage waters collection fluctuations along 24 hours. See Figure 1 bellow.

7.3.2. The Equalization Unit shall receive grey water collected by gravity and sanitary sewage waters collected by a vacuum system, with vacuum induced by Equalization Unit organic Centrifugal Pumps and Eductors. These three organic Centrifugal Pumps shall be adequate to sewage applications, avoiding sewage incrustations in these pumps volutes.

7.3.3. Considering the high unhealthy potential and nature of the Sanitary Sewage effluents, these three centrifugal pumps shall have extremely robust Mechanical Sealing conception (as a minimum PLAN 53B) to limit “passages” (or leaks) to a minimum, if not zero leak to the environment.

7.3.4. The three (3 X 100%) organic Centrifugal Pumps have TRIPLE function: a) to recirculate and homogenize the Equalization Tank content; b) to induce vacuum in the sewage waters network via one of the two organic Eductors (2 X 100%) and c) to macerate even more, by its impellers, the feces particles already reduced at the Catcher Units and continuously sheared by effluents jet at Eductors suction eye. The suction height (from the inferior vertex) and suction network design, inside the Equalization Tank, shared by these three pumps, shall be determined to maximize the feces macerating function.

7.3.5. The Equalization Tank shall have an inverted pyramidal bottom, with its interior homogenized content flowing in a constant rate to the operating STU through its inferior vertex. This general design is to guarantee that sewage and grey waters mixture will have no opportunity to generate anaerobic bacteria colony, and so, H2S and CH4.

7.3.6. There shall be a minimum level (minimum volume) that, once reached, shall close the illustrated output SDV. It is mandatory, as the Homogenization and Vacuum Inducing Pumps shall have its vacuum inducing function through Eductors guaranteed. About High Level, Overflow occurrences are not prohibited, but shall be avoided, as the constant flow output (one of the objectives of this Equalization Unit) shall be guaranteed just by the FVs (Flow Valves), initially set at 2 m^3/h.

7.3.7. The Equalization Tank “modulation volume” was conceived according to Ripple Diagram method, estimating the grey and sewage waters collection along 24 hours. As so, it is being assumed a fixed 20 m^3 reservoir modulation volume, plus 1.5 m^3 for upper dead space volume, plus 3,5 m^3 inferior minimum volume, resulting in total 25 m^3 for the Equalization Tank. But these 3,5 m^3 inferior minimum volume and these 1.5 m^3 upper dead space volume may be re-considered by packager in detailing phase, considering surface liquid movements and the inverted pyramidal bottom.

7.3.8. The two redundant FVs (flow valves) shall have an adjustable range between 1 and 4 m^3/h. The initial adjustment conceived is 2 m^3/h, but Operation may adjust its value according to historic experience, to ideally BLOCK the occurrences of both Overflows and mainly minimum level SDV closing, as constant flow rate to the STUs is a major objective of this Equalization Unit.

7.3.9. The Equalization Tank shall be built in AISI 316L with a Wear Double Plate to deal with the effluents jet erosion, sum of Pump discharge and suctioned sanitary sewage waters. The Tank is conceived for 30 (thirty) years in continuous operation. But if this Equalization Tank has to be put out of operation for any reason (for instance, the sole lower SDV maintenance), it is represented several lines that could be aligned so that the Homogenization and Vacuum Inducing Pumps could suction effluents directly from the operating STU, discharging back to the same STU, through overflow adjacent lines, guaranteeing vacuum induction continuity. This by-pass is also possible regarding grey waters illustrated lines.

7.3.10. Figure 1 above illustrates the conceived lines and control / block valves, allowing the desired selections / alignments. There shall also be Check-valves in the three pumps discharges, not represented.

7.3.11. The Equalization Tank shall be equipped, aiming better local operational awareness, with one magnetic visual level gauge. The magnetic option is related to the effluent’s characteristics, and shall encompass the overflow maximum level and minimum volume SDV actuation level. The LITs (Level Indicator and Transmitters) shall be of the Differential Pressure type, considered more robust for sewage applications.

7.3.12. There shall be leakage barrier containments and fresh water serving all devices subjected to washing activities. All washing and cleaning effluents, with high unhealthy potential, shall be forwarded directly to the Equalization Tank itself or to the operating STU.

7.3.13. Other details to highlight in Figure 1 are: i) the Vent to a high and free area, with the same cares mentioned in 6.6, with no possibility of sewage odors be suctioned by any other system nor felt by any personnel board; ii) the FIT (flow and indicator transmitter) signaling and alarming to the CCR for operational awareness in case of overflow or Tank by-pass occurrence, etc; and iii) the Sampling Point, immediately upstream both STUs.

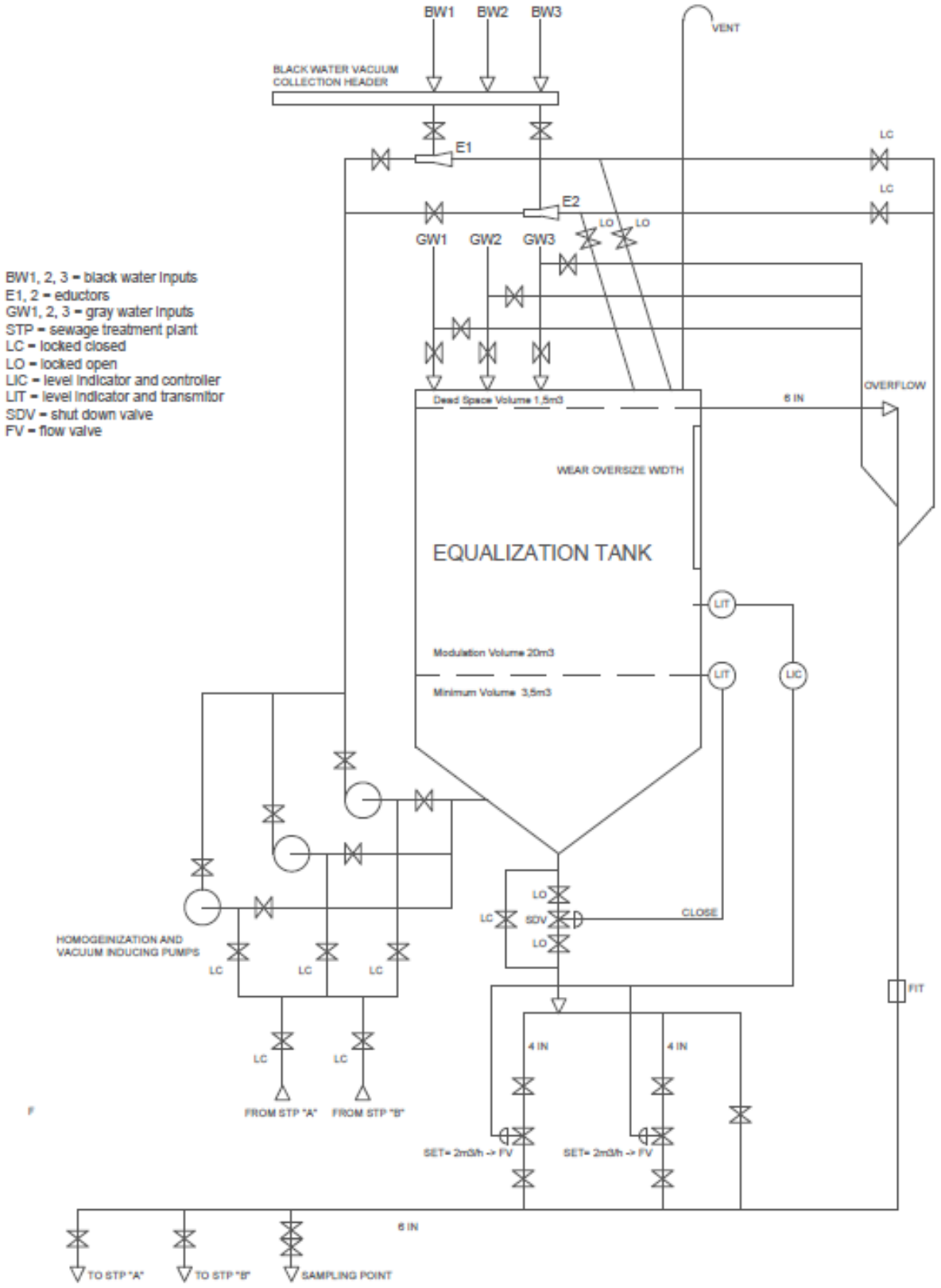

FIGURE 1 - Equalization Unit Schematic and its Tank

7.3.14. The two redundant FVs (flow valves) shall have an adjustable range between 1 and 4 m^3/h. The initial adjustment conceived is 2 m^3/h, but Operation may adjust its value according to historic experience, to ideally BLOCK the occurrences of both Overflows and mainly minimum level SDV closing, as constant flow rate to the STUs is a major objective of this Equalization Unit.

7.3.15. The Equalization Tank shall be built in AISI 316L with a Wear Double Plate to deal with the effluents jet erosion, sum of Pump discharge and suctioned sanitary sewage waters. The Tank is conceived for 30 (thirty) years in continuous operation. But if this Equalization Tank has to be put out of operation for any reason (for instance, the sole lower SDV maintenance), it is represented several lines that could be aligned so that the Homogenization and Vacuum Inducing Pumps could suction effluents directly from the operating STU, discharging back to the same STU, through overflow adjacent lines, guaranteeing vacuum induction continuity. This by-pass is also possible regarding grey waters illustrated lines.

7.3.16. Figure 1 above illustrates the conceived lines and control / block valves, allowing the desired selections / alignments. There shall also be Check-valves in the three pumps discharges, not represented.

7.3.17. The Equalization Tank shall be equipped, aiming better local operational awareness, with one magnetic visual level gauge. The magnetic option is related to the effluent's characteristics, and shall encompass the overflow maximum level and minimum volume SDV actuation level. The LITs (Level Indicator and Transmitters) shall be of the Differential Pressure type, considered more robust for sewage applications.

7.3.18. There shall be leakage barrier containments and fresh water serving all devices subjected to washing activities. All washing and cleaning effluents, with high unhealthy potential, shall be forwarded directly to the Equalization Tank itself or to the operating STU.

7.3.19. Other details to highlight in Figure 1 are: i) the Vent to a high and free area, with the same cares mentioned in 6.6, with no possibility of sewage odors be suctioned by any other system nor felt by any personnel board; ii) the Two FITs (flow and indicator transmitters) signaling and alarming to the CCR for operational awareness, permitting different readings, for instance, in case of normal operation, overflow or Tank by-pass occurrence, etc; and iii) the Sampling Point, immediately upstream both STUs.

7.3.20. Besides other STUs parameters, the Equalization Tank overflow occurrence (and its flow value) and the Equalization Tank SDV closing shall be visually alarmed / signaled to CCR. The diameters shown in Figure 1 shall be verified during detailing phase.

8. GENERAL REQUIREMENTS

8.1. ELECTRICAL REQUIREMENTS

8.1.1. Electrical equipment installed in hazardous areas shall have the safety execution specified in accordance with standards IEC 60079, IEC 61892 series and, for FPSO/FSO units, IEC 60092. Electrical equipment installed in external safe areas, that shall be kept operating during emergency shutdown (ESD-3P and ESD-3T) shall be certified for installation in hazardous areas Zone 2 (EPL Gc) Group IIA temperature T3, unless they are automatically disconnected if there is gas in the equipment area, according to IEC 61892-1. For more details, refer to I-ET-3010.00-5140-700-P4X-009 – GENERAL REQUIREMENTS FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

8.1.2. Electrical equipment and material shall comply with requirements of the references mentioned on Table 2.

8.2. INSTRUMENTATION AND AUTOMATION REQUIREMENTS

8.2.1. PACKAGE instrumentation and control design shall fulfill the requirements of the technical specifications mentioned on Table 2.

8.3. PAINTING REQUIREMENTS

8.3.1. Painting and coating in accordance with I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING and DR-ENGP-I-1.15 COLOR CODING.

8.3.2. All components shall be delivered fully painted/coated, unless otherwise indicated on this specification.

8.3.3. The performed pre-treatment and complete coating shall be in accordance with the paint manufacturer’s data sheets.

8.4. SKIDS LAYOUT AND FOUNDATION REQUIREMENTS

8.4.1. PACKAGE components detailed on item 6 which are supplied assembled on skids shall follow the below minimum requirements.

8.4.2. PACKAGE skid structure shall be designed to withstand the design conditions mentioned on item 4.4 and to ensure the lifting conditions on manufacturing site and shipyard. Lifting lugs shall be provided according to PACKAGER lifting procedure.

8.4.3. The Skid main frame shall be all welded construction. Structural skid welds, including lifting facilities shall be continuous and shall comply with AWS D1.1 (structural welding code) and CS Rules. Skid structure shall be designed to be welded to the supporting structure unless otherwise specified.

8.4.4. PACKAGE skid layout and arrangement shall be designed to provide sufficient access to pumps, instruments, equipment, and control panels so as to ease the operability and maintenance with safe conditions. Instruments and valves shall be installed on a suitable height to allow safe access for monitoring, operation, and maintenance.

8.4.5. Access ladders, platforms, gratings and any other access device shall comply with I-ET-3010.00-1352-130-P4X-001 - FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS. Metallic material is also acceptable and I-DE-3010.00-1351-140-P4X-001 – HULL GENERAL NOTES AND TYPICAL DETAILS, item 3.23, shall be followed for metallic grating requirements.

8.4.6. PACKAGE skid shall have a drip pan to collect drained water from the equipment with drain flanges for the connection with the Hull draining system.

8.4.7. PACKAGE Equipment and components shall be located entirely within the skids / equipment base perimeter, including all equipment, piping, valves, electrical, instrumentation and controls.

- Note: For the Sewage Treatment Unit Panel (PN-Z-5312502A/B) location requirements refer to I-ET-3010.00-5140-700-P4X-003 – ELECTRICAL REQUIREMENTS FOR PACKAGES FOR OFFSHORE UNITS.

8.5. NAMEPLATES AND TAG NUMBERING

8.5.1. PACKAGER / MANUFACTURER Equipment shall have nameplates in Brazilian Portuguese language, made of stainless steel AISI 316L, with 3 mm minimum thickness and fixed by stainless steel (AISI 316L) bolts or fasteners on visible and accessible location.

8.5.2. Tagging of all instruments, electrical, mechanical and piping items, including valves, shall be carried out as detailed on I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN

9. PACKAGE MANUFACTURING AND DELIVERY REQUIREMENTS

9.1. GENERAL

9.1.1. All materials and equipment supplied by PACKAGER / MANUFACTURER shall be brand new (not overhauled), field proven, free from defects and accepted by Owner and the Classification Society.

9.1.2. Materials and equipment shall be manufactured according to internationally recognized standards for the offshore oil drilling and production industries and shall be in conformance with the Basic Design and Agreement specifications and requirements.

9.1.3. Field proven definition: Systems and equipment shall demonstrate satisfactory operation at least in 3 floating offshore installation units, operating under process conditions (pressure, flow, capacity and similar fluids) for a minimum of 24,000 hours. For rotating equipment, they shall demonstrate operation with fluid, flow and discharge pressure similar to the design. Unproven designs or prototypes (including components) without offshore service will not be accepted.

9.1.4. PACKAGE/equipment Maximum Allowable Working Pressure (MAWP) shall be

higher than the maximum pressure that may occur at PACKAGE/equipment inlet tie-in point.

9.1.4.1. In particular cases where it is not possible to comply with above requirement, it shall be included on PACKAGE scope of supply devices for pressure control together with devices for protection against over pressure, for example, a combination of a self-operated pressure reducing valve and a pressure relief valve.

- Note: This requirement (item 9.1.4) is also applicable for PACKAGE required utilities, such as, but not limited to, seawater/fresh water cooling, compressed air, diesel, nitrogen.

9.2. WELDING

9.2.1. PACKAGE equipment, structures and piping welding, welding inspection, non-destructive testing (NDT), bolted joints assembly and piping fabrication and commissioning activities shall be performed in compliance with the following technical specifications:

a) I-ET-3010.00-1000-970-P4X-002 – Requirements for NDT.

b) I-ET-3010.00-1000-955-P4X-002 – Requirements for Welding Inspection.

c) I-ET-3010.00-1000-955-P4X-001 – Welding.

d) I-ET-3010.00-1200-200-P4X-001 – Requirements for Bolted Joints Assembly and Management.

e) I-ET-3010.00-1200-200-P4X-115 – Requirements for Piping Fabrication and Commissioning.

9.3. DOCUMENTATION

9.3.1. For the PACKAGE documentation and data-book requirements refer to EXHIBIT III – DIRECTIVES FOR ENGINEERING.

9.3.2. Additionally, for the PACKAGE documentation, data-book requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

9.4. SPARE PARTS

9.4.1. For the PACKAGE, spare parts, special tools, CS required spare parts and spare parts list recommended for two (2) years of operation refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.

9.5. INSPECTION AND TESTS

9.5.1. For PACKAGE Inspection and Test Plan (ITP), Factory Acceptance Test (FAT), Inspection Release Certificate (IRC) and Site Acceptance Test (SAT), refer to EXHIBIT V - DIRECTIVES FOR PROCUREMENT, EXHIBIT VII - DIRECTIVES

FOR QUALITY ASSURANCE SYSTEM and EXHIBIT VIII - DIRECTIVES FOR COMMISSIONING.

9.6. PRESERVATION, PACKING AND TRANSPORTATION

9.6.1. For PACKAGE preservation, packing and transportation requirements refer to EXHIBIT V – DIRECTIVES FOR PROCUREMENT.