

GENERAL SPECIFICATION

Field Operations

GS EP EXP 103

Pre-commissioning and Commissioning Engineering
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1. Scope

The scope of the present document is to specify the implementation of the **Pre-commissioning** and **Commissioning** Technical Engineering.

These tasks shall be performed during the Detail Engineering phase of a Project by the responsible party as defined in the Contract.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP EXP 101	Pre-commissioning and Commissioning Specifications
GS EP EXP 105	Pre-commissioning Execution
GS EP EXP 107	Commissioning Execution
GS EP EXP 501	Equipment & piping numbering
GS EP EXP 213	Minimum Maintenance requirements
GS EP TEC 260	HIPS Design, Implementation and Life Cycle

3. Introduction

3.1 Policy

The **Pre-commissioning** and **Commissioning** activities are sophisticated operations, but of short duration. It is for this reason impossible to afford a learning curve during field execution.

Company policy is therefore to thoroughly prepare the **Pre-commissioning** and **Commissioning** execution activities long before they actually start on site, in accordance with a standard methodology.

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This specification shall be read in conjunction with the following documents:

- **GS EP EXP 101** “Pre-commissioning and Commissioning Specification”, which gives the definitions, rationale and key principles of Pre-commissioning and Commissioning, thus allowing an easier approach to anyone having to prepare or execute this kind of activities.
- **GS EP EXP 105** “Pre-commissioning Execution”, which covers the Pre-commissioning execution, and all Pre-commissioning preparation tasks.
- **GS EP EXP 107** “Commissioning Execution”, which defines all tasks related to the actual performing on site of the Commissioning.

The present specification **GS EP EXP 103** provides a detailed set of instruction that shall be followed by the responsible party defined by the contract, with regard to the tasks, documents and procedures to be prepared during the Engineering phase of Pre-commissioning and Commissioning in order to carry-out the field execution in a planned and efficient manner.

3.2 Roles and Responsibilities

The present specification is drafted in such a way that it can be implemented in various contractual contexts, particularly in all of the following cases:

- The Pre-commissioning and Commissioning Engineering is either the responsibility of a Contractor or of a Company Entity (partially or totally).
- The Execution of Commissioning is either the responsibility of a Contractor, or of a Company Entity.
- Any possible combination of the two options above.

The present specification therefore defines the activities that shall be performed to ensure a reliable Pre-commissioning and Commissioning Engineering, without presupposing which party will be in charge of that activities: it is the contract or a Company internal arrangement that will define case by case which party will be responsible for engineering and/or execution of Pre-commissioning and Commissioning and for which equipment, part of the plant, or plant will be that party responsible for.

Consequently, the following wording has been used in the present document:

- "Engineering Contractor" designates the organization in charge of the detailed engineering of the facilities.
- "Construction Contractor" designates the organization in charge of the fabrication and Pre-commissioning of the facilities.
- "Commissioning Team", designate any organization and its members assigned, by contract or by a Company internal arrangement, to carry out Commissioning activities (Engineering and/or Execution) of equipment, part of plant, or plant.
- "Company" designates the client for whom the Commissioning Team performs Commissioning activities.
- When not specified, the generic term of “Responsible Party” will be used, to refer to the entity indicated by the Contract that is responsible for a given task to be performed.

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3.3 Safety

For Commissioning HSE Policy, reference shall be made to GS EP EXP 101.

4. The Engineering of Pre-commissioning and Commissioning

4.1 Introduction

The Engineering of Pre-commissioning and Commissioning is of paramount importance. It is at this time that optimization of Commissioning scope execution shall be done according to Start-Up sequence and objectives.

Company policy requires a consistent field approach from end of construction until the Start-Up and for this reason the preparation of the Pre-commissioning and the Commissioning shall be processed at the same time.

The engineering tasks, documents and procedures have been made standard by mean of the present General Specification.

Three classes of documents need to be prepared:

- Those related to Management of Pre-commissioning and Commissioning.
- Those purely related to Pre-commissioning.
- Those purely related to Commissioning.

4.2 Pre-commissioning and Commissioning Management

These are high level governing documents and procedures for the Management of Pre-commissioning and Commissioning activities.

They shall include, but are not limited to:

- HSE Plan.
- PTW, SIMOPS and Safety Training procedures.
- Systems and Sub-systems definition.
- Pre-commissioning & Commissioning Execution Plan.
- Organization Charts and Mobilization Plans.
- Technical Training Plan.
- ICAPS© Configuration and Management Procedure.
- Punch List Management Procedure.
- Preservation Plan.
- Transfer of Operation and Maintenance Procedure.
- Whoever the party in charge, these tasks shall always need supervision/approval by Company.

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4.3 Pre-commissioning Engineering

During the **Pre-commissioning** Engineering it shall be issued all documentation required to ensure a safe, timely and efficient execution of field activities as well as a proper planning in order to anticipate and optimize all requirements in terms of tools/consumable supply, resource, logistics, etc....

Construction Contractor, with assistance by **Commissioning** Team where required, shall ensure that all the field activities are then performed in accordance with this preparation and that the means, tools, spares, consumables and resources are available in due time.

All **Pre-commissioning** preparation activities described below shall be carried out during Detail Engineering phase of a Project. They shall take place in parallel with the **Commissioning** Engineering before the beginning of the operations on site.

They are summarized, but not limited to, in the following paragraphs.

4.3.1 Documentation Preparation

This activity typically includes, but is not limited to:

- Establish, from the Sub-systems definition, the **Pre-commissioning** Task Register itemizing all Check Lists and Test Sheets.
- Preparation of specific procedures (hydro testing, flushing, special cleaning etc.).
- Preparation of spare parts and special tools register.
- Adapt if necessary the **Pre-commissioning** specification to the project specificity, by issuing Check Lists and Test Sheets for the project special equipment; preparation of the **Pre-commissioning** dossiers.

4.3.2 Planning

- Produce the **Pre-commissioning** tasks register and program.
- Produce a **Pre-commissioning** network and sequence based on **Commissioning** requirements and Start-Up sequence.
- Evaluate tasks duration and issue planning and RFC dates.
- Prepare a plan for tools, consumables and resources mobilisation.

4.3.3 Contracts

- Prepare **Pre-commissioning** clauses of construction contracts.
- Issue **Pre-commissioning** specific contracts (flushing, hydrotesting, special cleaning etc.).
- Prepare VENDOR's assistance during Pre-commissioning.

4.4 Commissioning Engineering

During the **Commissioning** Engineering, it shall be issued all documentation required to ensure a safe, timely and efficient execution of field activities. A proper planning/scheduling shall be established in order to anticipate and optimize all requirements in term of tools/consumable supply, resource, logistics, etc. The **Commissioning** Team shall ensure that all the field actions

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are launched in accordance with this preparation and that the means, tools, spares, consumables and resources are available in due time.

They are summarized, but not limited to, in the following paragraphs.

4.4.1 Documentation Preparation

This activity typically includes, but not limited to:

- Define Basic Functions by Sub-system.
- Develop the **Commissioning** Task Register.
- Adapt the commissioning specification and issue Functional Test Sheets for the project special equipment.
- Define leak tests principles and programs (PVP).
- Define the list of operational tests, and issue the operational tests procedures.
- Prepare the **Commissioning** dossiers.

4.4.2 Planning

- Produce the **Commissioning** tasks register and program.
- Produce a **Commissioning** network and sequence based on the Start-Up sequence.
- Quantify the scope of work.
- Produce manpower histograms.
- Evaluate tasks duration and issue planning and AOC dates, ensure integrated planning, particularly when the project is split into several subprojects and contracts (FPSO-Subsea, On-shore PLANT- Off-Site, etc.).

4.4.3 Prepare a Plan for tools, consumables and resources mobilisation; Contracts

- Prepare "assistance to **Commissioning**" clauses in the construction contracts.
- Issue specific contracts (leak test, HVAC, etc.).
- Prepare Vendors' assistance to **Commissioning** activities.
- Include **Commissioning** and initial operation spare parts and special tools in PO's.

4.4.4 Supports

- Gather all required engineering and Vendors documentation.
- Perform detailed engineering of required temporary facilities. A particular attention should be paid to the availability of the utilities necessary to carry out the **Commissioning** activities (electricity, nitrogen, air ...) and then removed before transfer to Company.
- Prepare stocks of spares, consumables, test equipment, chemicals, and logistics means.
- Prepare the selection of the execution personnel and their mobilization plan.

5. Pre-commissioning and Commissioning Management

5.1 Introduction

The present Chapter covers the preparation of all tools and procedures which are necessary for the general management of both **Pre-commissioning** and **Commissioning**. These documents shall be prepared during Detail Engineering phase and submitted to Company for review and approval.

This documentation will be indicated as Class A within the **Commissioning** and **Pre-Commissioning** Master document Register.

A sample **Commissioning** Deliverable List is attached in Appendix 5.

5.2 Health, Safety and Environment

For **Commissioning** HSE Policy and Specification reference shall be made to **GS EP EXP 101**.

In addition **Commissioning** will be responsible to purchase and make available at site all safety signs, tags and labels as required by policies and procedures. A sample is given on Appendix 5.

The Responsible Party shall, as a minimum requirement, prepare issue for approval and maintain the following documentation:

Commissioning HSE Plan

Commissioning Permit to Work Procedure

Electrical Isolation Procedure

Electrical Isolation Register

Instrument Inhibit and Override Procedure

Instrument Inhibit and Override Register

Mechanical Isolation Procedure

Mechanical Isolation Register

Mechanical Isolation Mark-up P&ID's

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5.3 Systems and Sub-systems

5.3.1 The "Systems Approach"

The overall planning of the project shall be organized not as whole plant activities, but by sections of the plant, called "Systems" and "Sub-systems" (refer to [GS EP EXP 101](#)).

It is therefore required, as part of the [Pre-commissioning](#) and [Commissioning](#) preparation phase:

- To split the installation into Systems and Sub-systems.
- To define exactly the boundaries and contents of each system and Sub-system.

5.3.2 Partition of the installation into Systems and Sub-systems

A system is a major subdivision of an installation, being either process or utilities that perform a major operational function of the plant. The system includes all the equipment that allows it to operate. The division into Systems generally corresponds to the various fluids or services prevailing.

A Sub-system is a further subdivision of a system that performs a given operational function, with no or little interference from the other Sub-systems during the [Commissioning](#) execution.

The [Pre-commissioning](#) and [Commissioning](#) operations, such as defined in [GS EP EXP 105](#) and [GS EP EXP 107](#), shall be prepared, carried-out and reported by Sub-system.

The partition of the installation into Systems and Sub-systems shall be carried-out during the plant Basic Engineering phase and included in the contractual documentation and then finalized during Detail Engineering providing all required updates. The final list shall be submitted to Company for approval.

This partition shall be performed in accordance with the following rules:

- The list of Systems and Sub-systems shall be initiated during the basic Engineering phase.
- The finalized list of Systems and Sub-systems shall be submitted to Company for approval during the Detailed Engineering phase.
- The Systems and Sub-systems are numbered with consistency with a functional breakdown and the equipment/tagging numbering.

For this reason, in order to be consistent with the [GS EP EXP 501](#), "Equipment & piping numbering", Appendix 2, a sub-system should be identified by a five digit number as follows: **I-CS-CSS-nn**, where:

- "I" (number or letter), identifying the installation, physically independent, managed through a project or sub-project (Wellhead PF 1...2, Production PF, Off-site, PLANT, part of a PLANT, etc.).
- "CS", from 0 to 9, identifies the type of System as per defined in [GS EP EXP 501](#), Appendix 2.
- "CSS", from 0 to 9, identifies the type of Sub-system as per defined in [GS EP EXP 501](#), Appendix 2.

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- “nn”, from 00 to 99, identifies the Sub-system number, when several Sub-systems for the same type of Sub-system CSS”.

The relationship between **GS EP EXP 501** and OPERCOM™ / ICAPS© is summarized in the following chart:

GS EP EXP 501 Appendix 2			Sequential number (00 if only one Sub-system for the Sub-system type “CS-CSS”)
I	CS	CSS	nn
Used if several locations/installations	System number for OPERCOM/ICAPS breakdown		Sub-system number for OPERCOM/ICAPS breakdown

The **Commissioning** System number is a combination of Installation number and **GS EP EXP 501** System.

The **Commissioning** Sub-system number is a combination of **GS EP EXP 501** Sub-system and a sequential number if several Sub-systems must be created.

An abstract from **GS EP EXP 501**, Appendix 2 is included in Appendix 9 for reference.

Whenever a system is not divided into Sub-systems, it will nevertheless be identified and processed as a Sub-system.

The Sub-systems are defined so as to be as independent as possible, not too small, yet of manageable size.

A typical breakdown of Plant into Systems and Sub-systems is found for reference in Appendix 1 of this specification.

The list of Sub-systems shall be established so that it is compatible with the requirements of the plant initial start-up sequence: equipments or parts of the plant started-up at different steps of the start-up sequence shall not belong to the same Sub-system.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Sub-system List and Definition

5.3.3 Sub-systems mark-up

The limits and contents of each Sub-system shall be defined by marking-up on Engineering and Vendors PID's, One Line Diagrams and any other required technical document/drawing, all lines, vessels, mechanical equipment, electrical feeders, bus bars and instrumentations belonging to that Sub-system.

A system of color coding shall be used to differentiate several Sub-systems appearing on the same document, PID or One Line Diagram.

A set of marked-up drawings showing the Sub-systems definition shall be issued for approval not later than one month after the Systems and Sub-systems list has been approved by Company, or not later than five months after the beginning of the Detailed Engineering phase.

The Sub-systems definition will not require up-dating on every later issue of PID's and One Line Diagrams, unless addition of major lines or equipment has taken place. However, a revision of the Sub-systems marked-up drawings shall be issued on "Approved For Construction" documents and on the best available revision at start of physical **Commissioning** works.

The Sub-systems definition shall be carried-out in accordance with delimitation rules given in Appendix 2 of this specification. Examples of Sub-systems mark-up are given in Appendix 12.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Sub-system Identification Mark-up Drawings

5.4 Start-up Sequence

A detailed Sub-system initial start-up sequence shall be established in accordance with the main Start-up milestones or guidelines issued by the Company and submitted to Company for approval.

This activity shall be led in parallel with the partition of the installation into Sub-systems and the partition shall be consistent with the requirements of the start-up sequence: equipment due to start at different points in time of the initial start-up sequence (typical: duty and stand-by equipment) must not be part of the same Sub-system.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Plant Start-up Sequence

5.5 Pre-commissioning and Commissioning Execution Plan

A dedicated Execution Plan shall be developed and issued for **Pre-commissioning** and **Commissioning**, which shall be the high level governing document for all **Pre-commissioning** and **Commissioning** activities including Interim Operations. It shall govern the preparation and execution of all **Pre-commissioning** and **Commissioning** activities and it shall be attached to the Project Execution Plan.

All internal and external interfaces shall be clearly identified and their management properly considered into the Project Interface Management Procedure/Specification.

This Execution Plan should be based and developed according to the Plant Start-up sequence.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Execution Plan

Pre-commissioning and Commissioning Interface Procedure

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5.6 Pre-commissioning and Commissioning Sequences & Schedules

5.6.1 General

A detailed Pre-commissioning, **Commissioning** and Start-Up network plan and schedule shall be developed in due time with proper identifications of the critical path(s) based on the Start-Up Sequences and integrated into Master Contract Schedule.

The schedule shall include, but not limited to:

- Assignment of man hours to each **Pre-commissioning** and **Commissioning** task. (Man-hours estimate shall be subject to Company approval).
- Preparation of **Pre-commissioning** and **Commissioning** overall man hours estimate with planning resources and the associated mobilization and demobilization plan.
- High level and detailed **Pre-commissioning** and **Commissioning** preparation and execution schedules, manning levels, set of S curves, linked to the master contract schedule.

The Integrated Master Schedule shall be kept up to date to ensure that all required **Pre-commissioning** and **Commissioning** activities are incorporated, time allowance is adequate, and installation sequence are logical and properly coordinated with other activities.

Pre-commissioning and **Commissioning** schedule shall be carried out in detail (resource and duration must be evaluated) and shall be checked for consistency with the Construction schedule.

The first check shall be carried out at early stage of the Detail Engineering and not later than four months after beginning of the Detailed Engineering phase.

An integrated schedule shall be produced every month covering **Pre-commissioning** and **Commissioning** activities and every week, a detailed 6 weeks look ahead schedule of the **Pre-commissioning** and **Commissioning** activities.

5.6.2 Pre-commissioning Sequence

A **Pre-commissioning** Sequences shall be implemented that shall include all activities to be executed by worksite. It shall be based on the approved Start-Up Sequences in full consistency with the Scope of Work by Location and by Sub-system.

Construction priorities shall be set based on the Start-Up Sequence and **Commissioning** Sequence before **Pre-commissioning** activities begin.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Sequence

5.6.3 Pre-commissioning Schedule

The responsible party shall, in due time, develop a detailed **Pre-commissioning** schedule with identifications of the critical path(s), based on the Start-Up Sequences and integrated into Master Contract Schedule.

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The schedule shall include, but not limited to:

- Estimation of manpower and duration of the **Pre-commissioning** activities of each Sub-system.
- Preparation of the **Pre-commissioning** bar chart planning level 1, i.e. the schedule by Sub-system of the **Pre-commissioning** execution activities, which shows the activities duration of each Sub-system and the points in time at which they will start and finish.

The inputs to the **Pre-commissioning** schedule level 1 is:

- The best adapted logical **Pre-commissioning** sequence.
- The Sub-systems **Pre-commissioning** duration estimates.
- Planned RFC dates.
- The **Commissioning** schedule level 1, or, if not available, the Sub-systems **Commissioning** sequence, both to be issued by the **Commissioning** Team, unless the sequence is part of the contractual documentation.

The **Pre-commissioning** schedule shall be organized so that it does not introduce constraint to the **Commissioning** activities: the **Commissioning** schedule level 1, or, if not available, the Sub-systems **Commissioning** sequence, issued by the **Commissioning** Team (or available in the contractual documentation) shall be the priority input to determine the **Pre-commissioning** schedule.

The Integrated Master Contract Schedule shall be kept updated to ensure that all required **Pre-commissioning** activities are incorporated, time allowance is adequate, and installation sequences are logical and properly coordinated with other activities.

Remaining construction and subsequent **Pre-commissioning** activities shall be prioritized based on a sub-system progress calculation towards the end of construction activities.

Therefore, upon reaching 70% of construction progress or when **Pre-commissioning** starts (whichever the soonest), the construction progress shall be calculated by sub-system. This is critical in order to optimize the construction, **Pre-commissioning** and **Commissioning** activities on different Sub-systems.

Subcontractors, Vendors/Manufacturers and Third Party inspection activities involved in the Work shall be coordinated and integrated in the **Pre-commissioning** schedule.

The above **Pre-commissioning** planning activities shall be completed and the corresponding documents issued for Company approval, not later than four months before the actual start on site of the **Pre-commissioning** activities.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Engineering Schedule and Milestones

Pre-commissioning Execution Schedule and Milestones

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5.6.3 Commissioning Sequence

A **Commissioning** Sequence shall be developed in a timely manner, including all activities to be executed on all different Worksites. It shall be based on the Approved Start-Up Sequence and detailed at the sub-system Level.

An Integrated Master Contract planning shall be built in such a way that the priorities of the Start-Up and **Commissioning** Sequences are actually driving the priority of construction activities.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Commissioning Sequence

5.6.4 Commissioning Schedule

Commissioning Team shall perform all **Commissioning** planning activities, including but not limited to the following:

- Scope of work by location and Sub-system, including the list by Sub-system of all elementary **Commissioning** tasks to be carried out on that Sub-system, i.e.:
 - Preliminary checks.
 - Each functional test.
 - Main steps of the Piping and Vessels preparations.
 - Main steps of the operational test.
- Estimation of man-hours, manpower, duration of:
 - Preliminary Checks.
 - Functional Tests.
 - Piping and Vessels preparations.
 - Operational Tests.
 of each Sub-system.
- Development of the **Commissioning** Sub-system sequence diagrams (Gant Diagrams), showing the links and relations between Sub-systems activities, as well as external constraints, such as the start-up sequence and the availability of temporary means.
- Preparation of the **Commissioning** schedule level 1, i.e. the schedule by system of the **Commissioning** activities.
- Development, from the Sub-systems activities, man-hours estimates and the **Commissioning** network, of the **Commissioning** schedule level 2, i.e. the schedule by Sub-system and type of activity (Preliminary Check, Functional Tests, etc.) of the **Commissioning** execution activities, which will show the activities duration and the points in time at which they will start and finish. The critical paths shall be highlighted.
- Preparation of the "Ready for Start-Up" dates, i.e. the points in time of which the **Commissioning** activities of each Sub-system will be completed.

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- Preparation of a **Commissioning** progress calculation method, which will be based on physical progress, i.e. on **Commissioning** tasks actually completed, and on a theoretical S-shaped progress curve, that will be derived from the level 2 schedule.
- Preparation of an execution man-hours follow-up method, based on individual time sheets providing detailed allocation of execution man-hours expended each day, at least per Sub-system and type of activity:
 - Preliminary Checks.
 - Functional Tests.
 - Piping and Vessels preparations.
 - Operational Tests.
 - Non productive man-hours (i.e. **Pre-commissioning** witnessing, assistance to others, operations, maintenance, stand-by, punch list clearing, etc.).
- Evaluation of the overall **Commissioning** man-hours, duration, and preparation of the execution histograms by discipline (instrument, electrical, mechanical, operations).
- Preparation of the field **Commissioning** organization and deployment schedule.

The above **Commissioning** planning activities shall be carried out on computer equipment and with planning/resources software approved by Company. They shall be completed, and the corresponding documents issued for Company approval, not later than two months before the actual start on site of **Commissioning** field execution.

The planning documentation will be thereafter kept updated according to actual project progress, and revisions issued accordingly.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Commissioning Engineering Schedule and Milestones

Commissioning Execution Schedule and Milestones

Commissioning Six Weeks Look-Ahead Schedule

5.7 Organization and Technical Training

Pre-commissioning and **Commissioning** organization charts shall be detailed, including all internal and external interfaces. The main function and responsibilities of each position shall be defined through dedicated job descriptions.

Typical organization chart and mobilization plan shall be developed detailing the phases of the work (Engineering and Execution) and each work location.

Proper training shall be organized for **Pre-commissioning** and **Commissioning** teams, as well as for newcomers in the work. In particular, all **Pre-commissioning** and **Commissioning** preparation

and execution supervision personnel shall undergo OPERCOM™ training and ICAPS© training. This training shall also be made available to Company personnel on Company request.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Job Descriptions

Pre-commissioning and Commissioning Teams Organization Charts

Pre-commissioning and Commissioning Teams Mobilization Plan

5.8 Witnessing and Notification

A clear split of responsibility between **Pre-commissioning** and **Commissioning** teams shall be defined with Hold, Witness and Monitor points for each work location.

Reference shall be made to **GS EP EXP 101** for Witnessing definitions and Specifications.

Commissioning Team discipline representatives shall attend all the Factory Acceptance Tests (FAT). Upon submittal of the FAT list, Company shall decide which FATs require a mandatory representation from Company **Commissioning** team. Contractor shall implement this requirement as Hold Points in the witnessing matrix. Company shall have the right to witness any of the Vendor's tests.

Company shall be informed in due time of all detailed activities subject to be witnessed by Company.

To this end, a notification procedure shall be developed and submitted to Company for review and approval.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Notification and Witnessing Procedure

Pre-commissioning and Commissioning Certificates Signature Matrix

Pre-commissioning and Commissioning Witnessing Matrix

5.9 Cost control

The **Commissioning** Team shall prepare a cost control procedure that will comply with Project Management Procedures.

The budget breakdown structure shall identify the following cost codes, but not limited to:

- Management.

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- Personnel assistance to the management, (i.e. permanent office personnel for documentation, materials and logistics, computers, etc.).
- Execution personnel (i.e. technical disciplines personnel performing productive or unproductive works).
- Vendor representatives.
- Ad hoc field assistance personnel for indirect works like scaffolding, cleaning, etc.
- Temporary installations subdivided into:
 - Temporary equipment, materials and consumables.
 - Labour cost for installation.
- Testing equipment and apparatus.
- Consumables for the execution works.
- Lube oil, fuel oil, desiccants, chemicals, nitrogen, freon, halon, etc., corresponding or not to an initial loading.
- Spare parts and materials for permanent installation like punch list materials.

Any major works to be committed under a single contract, e.g. nitrogen/helium full pressure leak testing including personnel, equipment and consumables.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Commissioning Cost Control Procedure

5.10 Progress reporting.

A detailed progress reporting methodology shall be prepared, covering **Pre-commissioning** and **Commissioning** engineering and execution activities.

Man-hours estimate for each **Pre-commissioning** and **Commissioning** tasks (i.e. check sheet, test sheet, functional test sheet and operational test sheet...) as well as weighting factors corresponding to different locations and environments shall be properly implemented.

Commissioning execution progress calculation shall be based on the approved man-hours estimation of each task, including leak tests and OT's, and shall not be a simple ratio based on the number of tasks completed over the total number of tasks.

Progress figures of all the **Pre-commissioning** and **Commissioning** preparation and execution activities shall be reported as follows:

- Preparation activities: on a Weekly, and Monthly basis.
- Execution activities: on a Daily, Weekly, and Monthly basis.

In particular, a method of progress evaluation shall be prepared in order to ensure the follow-up and the completion of **Commissioning** Engineering and shall take into account the following activities:

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- ICAPS© database set up:
 - Population of ICAPS© database.
 - Compilation of **Pre-commissioning** dossiers.
 - Compilation of **Commissioning** dossiers.
- Issuance of **Pre-commissioning** and **Commissioning** deliverables:
 - Type A: **Pre-commissioning** and **Commissioning** Management.
 - Type B: **Pre-commissioning** Engineering.
 - Type C: **Commissioning** Engineering.

A fine breakdown with weight factors shall be used.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Progress Calculation and Reporting Procedure

5.11 Pre-commissioning and Commissioning Management of Change

All **Pre-commissioning** and **Commissioning** activities shall be included in the Project Management of Change Procedure. In particular, as built drawings, software modifications, Subcontractors and Vendors documentation modifications shall be thoroughly addressed.

All modifications which could potentially affect the Pre-commissioning, **Commissioning** and the Start-Up or the operations of the installation shall be done in accordance with the general procedure managing the issuance of Queries.

It shall be ensured to:

- Maintain all documentation and records of Pre-commissioning, **Commissioning** and Start-Up activities on softcopy and hardcopy.
- Timely implement and control all modifications carried out on each worksite.
- Maintain updated records of all design and organization changes for updating all the documents, drawings, Vendor's documents, Red Line Mark-Ups, operating manuals, etc... and incorporate them into the final documentation.
- Issue and maintain the **Pre-commissioning** and **Commissioning** Management of Change Procedure which shall govern the above mentioned activities with respect to Pre-commissioning, **Commissioning** and Start-Up.

All **Pre-commissioning** and **Commissioning** Documentation shall be submitted for approval and an updated copy of the mark-up drawings and documents reflecting the modifications shall be included in the corresponding **Pre-commissioning** and **Commissioning** Dossiers, as applicable, for reference.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Management of Change Procedure

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Pre-commissioning and Commissioning Red Line Mark-up and As Built Procedure

Software Modification Procedure

Vendors Modifications Control Procedure

Pre-commissioning Discipline Red Line Mark-up Master Dossier

Commissioning Discipline Red Line Mark-up Master Dossier

5.12 ICAPS© Management and Configuration

5.12.1 ICAPS© Management

All software licenses and IT support required for ICAPS© use shall be acquired.

The latest ICAPS© software version available at the time of the effective date of the Contract shall be used. The split of work between several locations creates the need for the ICAPS© database to be set up properly to enable all concerned teams to have direct access to the database.

A “full-read” access to **Pre-commissioning** and **Commissioning** ICAPS© shall be available on all worksites database(s) to all concerned personnel.

Proper IT solutions shall be implemented to ensure the above mentioned requirements are met and to adapt the set-up of the ICAPS© network to the specificity of the Project.

ICAPS© workstations and printers shall be made available to all concerned personnel, the quantity shall be at least one per Company discipline leader for the Construction team and one per Company discipline leader for the **Commissioning** Team.

A revision controls shall be established on all engineering data downloads and access to the ICAPS© database through a dedicated document control procedure.

This shall include the establishment of a proper Backup Strategy of the ICAPS© database.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

ICAPS© Management Procedure

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5.12.2 ICAPS© Configuration

The ICAPS© database shall be prepared as part of the **Pre-commissioning** and **Commissioning** Engineering activities.

ICAPS© typical Data requirement are presented in Appendix 6 of the present General Specification for information.

ICAPS© shall be used to prepare and follow-up the Pre-commissioning, **Commissioning** and Preservation activities up to AOC of the last sub-system, and track all the Punch List even if it takes place after the issuance of the Transfer of Operation and Maintenance Certificate.

During Detail Engineering phase, a procedure shall be developed to adapt all supplied data from the engineering, subcontractors and vendors to the required ICAPS© format in order to ensure efficient download of the information into the ICAPS© database.

All items, test packs, and basic functions, grouped by sub-system, discipline and type of function of all equipment and materials included in the PLANT to be populated in the ICAPS© database shall be properly listed.

The **Pre-commissioning** Task Register and the **Commissioning** technical database shall constitute an exhaustive description of the physical content of each sub-system and shall indicate the type of activities performed on each item, test pack, basic function, and sub-system and arranged by location.

The ICAPS© database shall be delivered at the end of **Pre-commissioning** and **Commissioning** Engineering.

Traceable records shall be maintained in an orderly and timely manner to establish a control of all the modification and engineering data downloads of the ICAPS© database and all the changes from Engineering database shall be tracked and timely update into the ICAPS© database.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

ICAPS© Data Requirements Procedure

Set of Typical Pre-commissioning Check Sheets (per discipline)

Set of Typical Pre-commissioning Test Sheets (per discipline)

Set of Typical Preliminary Check Sheets (per discipline)

Set of Typical Commissioning Functional Test Sheets (per discipline)

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5.13 Punch List Management

There shall be unique single overall Punch List for the Project.

ICAPS© shall be used as the follow-up and management tool for the punch items. The punch lists established during FATs and **Pre-commissioning** shall be continuously updated during **Commissioning** activities to reflect the addition of newly discovered items as well as the identification of cleared items, including those punch items related to Company Items

All remaining punch list items raised during the Factory Acceptance Tests (FAT) shall be timely added in the ICAPS© overall punch item database.

The full ICAPS© punch list database shall be accessible at any time by all concerned personnel.

A dedicated procedure shall be prepared for issuing closing and managing the Punch List all through the Project execution.

An effective follow up of Punch List shall be ensured all through the project execution. Regular Punch List meetings shall be organized with Company in order to timely expedite the clearance of the Punch Items and to avoid the transfer of the clearance of the Punch Items from one location to another.

Reference shall be made to **GS EP EXP 101** for punch items definition and categorization.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Punch List Management Procedure

5.14 Management of Pre-commissioning, Commissioning and Start-Up Tools, Consumables and Spare Parts

Contractor shall put in place an effective management and control of all the related **Pre-commissioning**, **Commissioning** and Start-up tools, consumables and spares parts up to their allocation at SITE or until formal Transfer of Operation and Maintenance.

Contractor shall but not limited to, with regards to tools, consumables and spares parts used for **Pre-commissioning**, **Commissioning** and Interim Operations:

- Maintain a computerized up to date list of his stock.
- Register the location of each item.
- Nominate the person(s) responsible for these items.
- Define the process for request, attribution, use, and return of items.
- Define the process for identification of needs and procurement
- Ensure the correct storage and preservation of the items, etc.

Particular attention shall be given to the provision of tools and spare parts at sail away, whenever applicable, in order to ensure that proper quantity and quality are available during tow.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning, Commissioning & Start-up Consumables and Spare Parts Management Procedure

5.15 Sub-contractors and Vendors Management

A mobilization plan shall be defined for all required Subcontractors and Vendors for the performance of the work that will be subcontracted.

Subcontractor and Vendors activities shall be properly included in the **Pre-commissioning** and **Commissioning** plan and schedule.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Subcontracted Services List

Pre-commissioning and Commissioning Vendors Organization Charts

Pre-commissioning and Commissioning Vendors Mobilization Plan

For each subcontractor and/or vendor's intervention, all the information's, such as: name of the Sub-contracted Company, name of the representative, scope of work, type of assistance (Construction, Pre-commissioning, **Commissioning**), date in/out, etc... shall be recorded and the information included in the relevant Sub-system dossier.

At the end of each subcontractor and/or vendor's intervention, a full activity report shall be prepared and discussed in a dedicated close-out meeting, before the subcontractor/vendor departure from any of the project location (construction yards, shipyards, integration yards, final site, etc ...).

The Responsible Party shall prepare and issue in due time to be used as a reference during the close-out meeting, the following documentation:

Subcontractor/Vendor Close-out Report (One per intervention)

5.16 Packaged Items

Reference shall be made to **GS EP EXP 101** for definition and specifications related to Package Specificity.

Dedicated and specific Package test plan and procedures shall be developed to cover all the **Pre-commissioning** and **Commissioning** tests to be re-performed on site for equipment / items that have been:

- Removed / re-installed.
- Modified through sea-fastening/de-sea-fastening or preservation / de-preservation installation activities.

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- Subject to stress constraint due to moving, lifting or towing.
- Damaged, altered or clashed during transportation although fully commissioned.

All the activities identified in the specific Package test plan shall be logged in the ICAPS© database.

The Responsible Party shall prepare and issue in due time to be used as a reference during the close-out meeting, the following documentation:

Package Test Plan (One per package)

5.17 Preservation, Winterization and Mothballing

5.17.1 Preservation

Reference shall be made to GS EP EXP 101 for definition and specifications related to Preservation.

Dedicated procedures shall be issued, maintained and implemented covering storage, preservation, mothballing and lubrication of all equipment of the plant, including temporary equipment and installations.

All preservation activities shall be and follow-up into ICAPS© database.

All preservation procedures shall be based upon Vendors/Manufacturers, subcontractors and vendors documentation/requirements and specifications.

The preservation program shall be submitted for Company approval prior starting any preservation activities. It shall include but not limited to routine visit, fill in of log sheet for routine visit, provision of consumables, and provision of manpower for work, etc...

At the time of Transfer of Operation and Maintenance to Company of all or part of the plant, the documented history of preservation of the concerned equipment shall be part of the deliverables.

The relevant preservation history and records shall also be made available in the Pre-commissioning dossiers and Commissioning dossiers at the time the issuance of the RFCC or AOCC.

In case of equipment to be moved offshore, adequate means and tools shall be provided onboard during tow including temporary air and nitrogen generators, power supply and any other required equipment and/or tool. These equipment/tools shall be suitable to be operated under tow conditions.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Preservation Procedure

Preservation Schedule

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Preservation Records

5.17.2 Winterization

Reference shall be made to **GS EP EXP 101** for definition and specifications related to Winterization.

Some dynamical tests, consumables or equipment could be affected by the temperature during the cold months (i.e. below 0°C) or different conditions from final location of the Plant.

Therefore, in addition to the preservation, it needs to identify all requirements related to low temperature risk, such as but not limited to:

- Lines flushing after dynamical Operational Tests.
- Use of anti-freezing products.
- Planning the work during day light
- Shelters for people and installations, etc.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Winterization Procedure

5.17.3 Mothballing

Reference shall be made to **GS EP EXP 101** for definition and specifications related to Mothballing.

Packages, piece of equipment, large modules or even complete platform may need to be preserved / mothballed for a significant period in some particular cases like:

- Transportation from construction yard to the final site.
- Drilling campaign on a well head platform.
- Platform ready to operate but cannot because of external constraint (other part of the project not ready), etc.

Such activity will be referred as **Mothballing**: Mothballing is the means to preserve a facility (or part of it) without using it, in order to keep it in a state of readiness to be used.

The mothballing is often similar to preservation, but in some instances some equipment needs to be in continuous service to maintain the integrity of the facility. Typical examples are running of HVAC, circulation of hot medium or permanent purging.

Note that the mothballing of the facilities might also require the removal of some critical part such as core engine or periodic run of some equipment.

The de-mothballing of a facility shall be followed by some new **Pre-commissioning** and **Commissioning** activities as applicable.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Mothballing Procedure (one per equipment)

5.18 Close Out Report

All feedbacks, lessons learn and actions linked to continuous improvements that have arisen during the work shall be documented and properly recorded. A Lesson Learned Register shall be created and continuously updated.

At the early stage of the Project, a list of topics and data shall be defined that shall be required to compile the **Commissioning** Close-out Report. Regular meetings shall be organized to review and update the content of the Close-out Report and the Lessons Learned Register.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Close-out Report

Pre-commissioning and Commissioning Lesson Learn Register

5.19 Master Document Register

A dedicated **Pre-commissioning** and **Commissioning** Master Document Register (MDR) shall developed and maintained, listing all **Pre-commissioning** and **Commissioning** documents to be issued.

Documents will be numbered according to Specifications. In addition, specific document codes shall be applied in order to differentiate the documents related to:

- **Pre-commissioning** and **Commissioning** Management Documents.
- **Pre-commissioning** Documents.
- **Commissioning** Documents.

All the **Pre-commissioning** and commissioning documentation shall be defined and organized following the **Pre-commissioning** and **Commissioning** Execution Plan.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning and Commissioning Master Document Register

6. **Pre-commissioning** Engineering

6.1 Introduction

The present chapter covers the **Pre-commissioning** Engineering tasks. This preparation includes not only the long and mid-term activities such as the definition of the scope of work, planning procedures and contracts, but also the review and addressing of all required **Pre-commissioning** support, e.g. co-ordination with others parties, gathering of documentation, etc.

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Additional preparation scope of work in order to carry out the **Pre-commissioning** execution (planning, resource, logistic, spares, internal organization, material, etc.) and the relevant procedures to be draw up shall also be considered.

Detailed procedures shall be prepared for each sub-system, item by item to the job card level, and including test values, reference documents, testing equipment, estimated test duration in man hours and other test parameters and any other document deemed required for the particular project and specified in the Contract.

The main **Pre-commissioning** Engineering activities can be summarized as follows, but not limited to:

- Issue and maintain the **Pre-commissioning** Sequence.
- Issue and maintain the **Pre-commissioning** Schedule.
- Prepare and issue for approval all **Pre-commissioning** procedure.
- Quantify all the **Pre-commissioning** scope in man hours, and prepare manpower histograms.
- Prepare and issue all the **Pre-commissioning** dossiers for approval at the latest 3 months prior to the start of **Pre-commissioning** execution activities, unless an earlier date is specified. These dossiers shall be continuously updated up to delivery of the final documentation.

6.2 Pre-commissioning Task Register

6.2.1 Definition

For **Pre-commissioning** Task Register definition, reference shall be made to **GS EP EXP 101**.

6.2.2 Objectives

The **Pre-commissioning** Task Register, basic management tool of the **Pre-commissioning** preparation and execution, is the summary of the **Pre-commissioning** scope of work.

It is used at engineering stage to quantify the **Pre-commissioning** workload, hence it allows manpower and planning estimates. The **Pre-commissioning** Task Register is also the reference document used to prepare all **Pre-commissioning** support documents, Check Lists and Test Sheets.

During the execution phase, the completion data of each task shall be recorded, so that the **Pre-commissioning** Task Register is used as the basic progress monitoring tool and the key handover document to the **Commissioning** Team.

6.2.3 Preparation

The **Pre-commissioning** Task Register shall be prepared starting from the Sub-systems equipment lists. The **Pre-commissioning** Task Register shall be implemented on ICAPS© software by input of all the necessary data, whether they are Engineering data or Vendors packages data.

The **Pre-commissioning** Task Register reports shall be issued for Company approval not later than three months before the start of physical **Pre-commissioning** works.

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After Company approval, the **Pre-commissioning** Task Register is issued by the Company or by the Engineering Contractor to the Construction Contractor or whichever party is responsible for the **Pre-commissioning** works.

The Responsible Party shall review the set of **Pre-commissioning** Master Forms (conformity checks and static tests) available in **GS EP EXP 105**, and may adapt or amend these Master Forms as required by the specific distinctive features of the project. These modifications of existing forms and related procedures shall be submitted to Company approval.

If not available in **GS EP EXP 105**, new forms may be developed and related procedures whenever relevant and required for the execution of the work. These new forms and procedures shall be submitted to Company for approval.

The set of the typical check lists and test sheets shall be then prepared and issued for Company approval not later than six months before the start of physical **Pre-commissioning** work.

The set of check sheets and test sheets filled out according to the **Pre-commissioning** Task Register shall be printed out and issued for Company approval not later than two months before the start of physical **Pre-commissioning** work.

The **Pre-commissioning** Task Register shall be established during the engineering phase and permanently maintained / updated during the execution phase.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Task Register:

6.3 Pre-commissioning Spare Parts and Special Tools

The Responsible Party shall identify and review the list of spare parts recommended by Vendors/Manufacturers and the purchase orders issued.

They shall:

- Identify any additional spares and special tools that might be required.
- Replace any missing special tool before transfer to Company.
- Issue dedicate procedures that shall include for each equipment or item the quantities recommended by the Vendors/Manufacturers, and quantities ordered, delivered, used, replaced, location, etc... to provide full traceability of all such items.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Spare Parts and Special Tools List

Pre-commissioning Spare Parts and Special Tools Register

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6.4 Pre-commissioning Tools and Consumables

All the tools and consumables necessary for the safe execution of **Pre-commissioning** shall be properly identified, specified and purchased on time. The consumables shall include diesel, nitrogen, water, inhibitors, chemicals, lubricants and greases, etc...and any other material necessary to perform the Work.

Company shall be allowed to inspect tools and consumables used by Contractor, Sub-Contractors and Vendors at any time during the Work.

Particular attention shall be paid to the expiration date of consumables and all necessary action shall be taken to ensure the timely availability of the product on all worksites as appropriate. A register shall be maintained of all chemicals used for the Work including Material Safety Data Sheets. This register shall be made available to Company.

A proper plan shall be developed for the supply of all the specific tools required for the execution of the Work, including but not limited to:

- Calibration devices (hand pump, thermal bath, etc.).
- Meggering devices.
- Particle counter.
- Pressure gages.
- Charts recorders temperature and pressure.
- Mechanical tools.
- Portable moisture analyzers; etc.

All tools shall have available proper calibration certificates, as required by Contractual Specifications and Technical Standards.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Tools and Consumables List

6.5 Fragile Devices

Fragile devices need to be properly identified in order to plan their removal before the following activities of line cleaning/blowing.

Fragile devices are, but shall not be limited to:

- Valves (Control valves, critical valves, etc...).
- Filters, strainers.
- Restriction orifices.
- Equipment.
- In line instrumentation.
- Other devices as instructed by Company.

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Technical criteria shall be established to define how the fragile devices will be identified.

All fragile devices shall be properly listed by tag and identified on the P&ID's. The document shall include the list and specification of temporary spools, blinds, or any other device used to replace the fragile items during the testing.

It shall be defined how the fragile devices will be stored and preserved after removal, and equipment and manpower shall be supplied to ensure proper handling, storage, and preservation.

All fragile devices shall be removed prior to the hydro testing and cleaning operations (flushing, blow, chemical, passivation, degreasing) and replace them by spools, or isolate them with blinds where required.

Fragile devices shall be re-installed or blinds shall be removed once the hydro testing and the cleaning operations have been satisfactory completed and accepted.

In all of the relevant procedures (i.e. hydro-testing, cleaning, passivation, etc...) shall be clearly indicated the selected method of protection for each type of fragile devices.

As a critical activity, each operation on a fragile device shall be witnessed by Company and classified as a hold point in the **Commissioning** activity witnessing matrix.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Fragile Devices Identification Procedure

Fragile Devices List

6.6 Piping, Vessels and Valves

6.6.1 Critical Valves

A list of Critical Valves shall be identified and shall be supported by a full set of marked up P&IDs for identification in order to plan their removal before the execution of piping cleaning activities as well as the required testing.

Critical Valves shall include, but not limited to:

- Process safety valves (ESDV's, SDV's, BDV's, PSV's, TSV's).
- Process isolation (MOV, XV, Manual).
- Manual isolation valves that are considered critical for maintenance or routine operation.
- Valves on pig launcher/receiver.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Critical Valves List

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6.6.2 Critical Valves Leak Test

A systematic low pressure passing test shall be executed on critical valves upon reception and before installation.

Dedicated procedures shall be prepared with a plan for the provision for all necessary material, tools, consumable and manpower to execute this activity. The **Commissioning** Team shall be formally notified and invited to witness this activity.

Valves shall be tested in close position based on an approved procedure, in both directions at low pressure with Nitrogen at 5 barg and the result of the test shall comply with Vendor datasheet and Specifications.

A specific test sheet shall be available and recorded into ICAPS© database for each critical valve leak test.

Proper means and facilities shall be made available at any time on each Worksite for valves Vendors to perform any required remedial or maintenance work.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Critical Valves Leak Test Procedure

6.6.3 Piping Hydro testing and Cleaning

6.6.3.1 Piping Hydro testing

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Hydro-Testing Procedure

Hydro-Testing Test Pack List

Hydro-Testing Test Pack Dossier (One per Test)

6.6.3.2 Piping Cleaning

Any dirt left in the piping after hydro-test and then dried up will form a solid mud which will not be efficiently removed, and which will later block filters and cause damage to valves and equipment. Accordingly, the flushing and cleaning after hydro-test shall be efficient to ensure piping cleanness. As a critical activity, each flushing shall be a HOLD point in the **Pre-commissioning** activity witnessing matrix and shall be witnessed by Company representatives.

A Piping Cleaning Procedure shall be prepared, with the selected method for each line diameter and service, and the related acceptance criteria as per specification and Vendors documents (e.g. lube oil flushing, fuel gas lines cleanness, etc...).

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A digital electronic boroscopic recorder inspection device shall be available in each worksite, equipped with digital camera capable of pipe inspection with an inspection probe diameter of no more than 6 (six) mm.

Chemical cleaning and similar operations requiring significant logistics shall be properly coordinated between **Commissioning** and Construction Teams.

A risk assessment and the job safety analysis shall be included within the procedures used to perform these activities, with proper consideration to chemicals use and their disposal, whenever applicable.

Procedures shall detail the organization and execution of such activities, define the lists of test packs to which the procedure is applicable, and test packs specifically prepared for these activities.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Piping Cleaning Procedure

Piping Cleaning Test Pack List

Piping Cleaning Test Pack Dossier (one per test)

Chemical cleaning and similar operations requiring significant logistics shall be properly coordinated between **Commissioning** and Construction Teams.

Dedicated procedures shall developed detailing the organization and execution of such activities, define the lists of test packs to which the procedure is applicable, and develop the test packs specifically for these activities. This shall include a risk assessment and the job safety analysis for these activities in the procedure.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Chemical Cleaning Procedure

Chemical Cleaning Test Pack List

Chemical Cleaning Test Pack Dossier (One per Test)

6.6.4 Reinstatement

The **Pre-commissioning** and **Commissioning** piping activities usually entail reinstatement, which shall also include, but not limited to:

- Reinstallation of any removed equipment.
- Insertion of new strainers/filters.

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- Replacement of all gaskets on all flanges which have been opened.

A dedicated procedure shall be prepared and only genuine consumables from Vendor/Manufacturers shall be used.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Reinstatement Procedure

6.6.5 Flange Management

A Flange Management system shall be implemented, in coordination with the Bolt Tensioning and Leak Testing activities.

All activities related to specialized Subcontractors shall be clearly defined and the following points shall be considered, but not limited to:

- Fabrication/Assembly procedures (including: the assembly processes, the equipment and tools to be used, the tensioning/ torque values, the assembly/tensioning sequences).
- Quality Control procedures (including: the Incoming Material receipt, the QC activities, the inspection check lists and record forms).

These special activities shall be executed by a specialized Subcontractor and then related procedure shall be submitted to Company for approval.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Flange Management Procedure

6.6.6 Gross Air Leak Testing

Gross Air Leak Tests have to be systematically performed on all pipe work with objective to demonstrate that the re-instatement has been performed correctly.

Gross Air Leak Tests shall be performed as per **GS EP EXP 105**.

These tests shall be done at worksites to the maximum extent possible.

Procedures shall include a risk assessment and the job safety analysis.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Gross Air Leak Test Procedure

Gross Air Leak Test Packs List

Gross Air Leak Test Pack Dossier (one per test)

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6.6.7 Relief Valves Calibration

All relief valves shall be tested and related certificates made available on each worksite as per contractual specifications and local regulations.

The time frame between each relief valve certification test and the Transfer of Operation and Maintenance to Company of the installation shall not exceed 6 months or what defined by local regulation, whichever the lower. Acceptance of calibration certificate shall be subject to demonstration of the application of proper preservation plan, as defined by procedures and specifications.

The calibration work shall be planned to be carried out also on site, in addition to the calibration already carried-out on worksites or workshops, whenever required.

Certified test benches for pressure valves calibration shall be made available as per Contract.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Relief Valves Certification Procedure

6.7 Instrumentation

A dedicated procedure shall be developed based on specifications, to describe the methods and identify all the tools required to execute the Instrumentation **Pre-commissioning** scope of Work.

Detailed procedure shall be developed for each type of instrument to be tested i.e.:

- Pressure sensors and transmitters.
- Temperature sensors and Transmitters.
- Level sensors and transmitters.
- Analyzers.
- Control Valves.
- ESD Valves.
- F&G devices, etc.

and any other instrumentation device which is part of the scope.

A dedicated procedure shall be developed for instrumentation tubing cleaning and pressure testing.

For each of them, the Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Instrumentation Tubing Cleaning and Testing Procedures

Instrumentation Calibration and Testing Procedures

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6.8 Electrical

A dedicated procedure shall be developed based on specifications, to describe the methods and identified all the tools necessary to execute the Electrical **Pre-commissioning** scope of Work.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Electrical Pre-commissioning Procedure

6.9 Lifting Equipment

A dedicated procedure shall be developed based on specifications, for Lifting Equipment to describe the methods, tools and all the necessary means to execute the **Pre-commissioning** scope of work.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Lifting Equipment Pre-commissioning Procedure

6.10 Subsea Equipment

6.10.1 General

Subsea equipment checks and tests shall be carried-out as per the approved test and inspection plan, as defined in the contract and specifications. This testing activity shall be planned in order to maximize the amount of work to be performed onshore

During these activities, particular attention shall be paid in order to ensure that the tests are not going to cause any damage to subsea equipment and that tests parameters are agreed by subcontractors and Vendors/Manufacturers.

In addition to the verification documentation (FAT report, EFAT report, etc...), a complete check list shall be prepared detailing all the Testing activities (FAT, EFAT, etc...) on a complete Unit (XT, Manifold, etc...) which shall be included in the relevant **Pre-commissioning** dossier.

This check list shall be a record summary of the testing activities including all raised punch items, if any, and shall refer to the relevant verification documentation.

This check list shall be prepared and implemented in the **ICAPS©** system.

Proper interface co-ordination shall be provided with all involved parties, as applicable.

6.10.2 Specificities

Prior to over boarding and subsea installation, checks & tests shall be carried out Onboard the installation vessel to demonstrate that the subsea equipment has not been damaged during transportation and that the preservation measures taken prior to marine transportation have been effective and are still in place.

In the event that the preservation measures have been impinged, then adequate steps shall be taken to re-prepare and/or retest the subsea equipment prior to over boarding.

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During subsea installation, the cleanliness of the test fluids for all lines shall be closely monitored and measured before further pressurization (for the hydraulic control lines within the control umbilical's this shall be the operational fluid).

During load out, transportation, lay out, post installation and hook up, monitoring and testing activities shall be executed to ensure that the integrity of the umbilical's is not compromised. The monitoring operations of the umbilical's, SSIV control cables and Electric Cables shall be planned together with the laying operation, in order to ensure that pressure/electrical/optical monitoring and connections checks are performed from the installation vessel before the abandonment of the second end.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Subsea Equipment Pre-commissioning Procedure

6.11 Pre-commissioning Dossiers

All documentation pertaining to the Pre-commissioning activities of a given sub-system shall be compiled in a Pre-commissioning dossier. The dossier shall contain all information required to demonstrate that a sub-system has reached the Ready for Commissioning status.

For Pre-commissioning Dossier definition and content, reference shall be made to GS EP EXP 101.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Pre-commissioning Dossier (one per Sub-system)

7. Commissioning Engineering

7.1 Introduction

The present chapter covers the Commissioning technical preparation tasks. This preparation includes not only the long and mid-term activities such as the definition of the scope of work, the planning of execution, the issuing of procedures and contracts, but also the thorough review and addressing of all required Commissioning support, e.g. co-ordination with others parties, gathering of documentation, etc.

Any additional preparation scope of work required to carry out the Commissioning execution (planning, resource, logistic, spares, internal organization, material, etc.) and the relevant procedures shall also be considered. Typical list is appended in Annex 6.

Part of these activities shall be performed in parallel with the preparation of Pre-commissioning activities, as per Pre-commissioning preparation milestone and schedule.

7.2 Basic functions (BF)

The Commissioning Team shall establish the list of all instrumentation, electrical, and telecommunication Basic Functions of the plant, whether they are part of packages or of field equipment.

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For the definition of Basic Function, reference shall be made to **GS EP EXP 101**.

This list shall be arranged by Sub-system and by discipline, and established in accordance with the coding, description, and definition drawings of all possible types of Basic Functions given in specification **GS EP EXP 107**.

7.3 Commissioning Task Register

For **Commissioning** Task Register definition and specification, reference shall be made to **GS EP EXP 101**.

The **Commissioning** Team shall implement the **Commissioning** Task Register on ICAPS© software, and shall input all necessary data, whether they are Engineering or Vendors packages data.

The input data to the **Commissioning** Task Register will be found in the following documents, but not limited to:

- List of Systems/Sub-systems.
- Sub-systems equipment lists.
- Sub-systems marked-up drawings (PID's and one line diagrams).
- Instrument and electrical troubleshooting diagrams
- **Pre-commissioning** Task Register.
- Engineering registers.

The preparation of the **Commissioning** Task Register shall be completed not later than three months prior to the start on site of physical commissioning works.

The **Commissioning** Task Register reports shall be issued to Company for approval not later than three months before the start of physical commissioning works.

The **Commissioning** Team shall afterwards keep the **Commissioning** Task Register permanently up-dated throughout the **Commissioning** phase in accordance with latest issues of Engineering Drawings and all modifications carried out on site.

The Responsible Party shall develop, issue and maintain within ICAPS© the following documentation:

Commissioning Task Register

7.4 Functional tests

For **Commissioning** functional definitions and specifications, reference shall be made to **GS EP EXP 101**.

Commissioning shall review the set of electrical, instrument, and telecommunications Functional Test Sheet Master Forms available in specification **GS EP EXP 107**, and shall adapt or amend these Master Forms as required by the distinctive features of the project.

These modifications of existing forms and procedures shall be submitted to Company for approval.

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The **Commissioning** Team may as well develop new Test Sheets and test procedures whenever relevant documents are not available in **GS EP EXP 107**. The new forms and procedures shall be submitted to Company for approval.

The final Master of the functional test sheets (typical) shall be then issued to Company for approval not later than six months before the start of physical commissioning works.

The **Commissioning** Team shall prepare the actual Functional Test Sheets of all instrument, electrical, and telecommunication Basic Functions by filling in the heading of each form, which includes information such as, but not limited to:

- Basic Function number, description and location.
- Sub-system number.
- Drawing number.
- Form revision.

The actual Functional Test Sheets are then grouped by discipline and Sub-system.

The Functional test sheets shall be issued not later than two months before the start of physical commissioning works.

The Responsible Party shall develop, issue for approval and maintain within ICAPS© the following documentation:

Set of Commissioning Functional Test Sheets (one per actual Test)

7.5 Factory Acceptance Tests

A dedicated procedure shall be prepared for each Factory Acceptance Test (FAT).

A **Commissioning** Team discipline representative shall attend and witness all the FAT.

Nevertheless, Contractor shall have the ultimate responsibility at the FAT, and shall be the focal point of scheduling and communication between the different parties involved in the FAT.

A list and schedule of FAT's shall be prepared and distributed to all involved parties, including Company **Commissioning** Team

Upon submittal of the FAT list, Company shall decide which FAT's require a mandatory attendance by Company **Commissioning** Team representatives.

Factory Acceptance Tests shall be properly followed and executes as per Specifications and shall be recorded into ICAPS© software.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

List and Schedule of FAT's

FAT Procedures (one per FAT)

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7.6 Commissioning and Initial Operation Spare Parts and Special Tools

The lists of spare parts recommended by Vendors/Manufacturers shall be identified and a dedicated document created and kept updated. Purchase orders shall be issued accordingly and following all related Specifications.

Any additional spares and special tool that might be required shall be identified and properly procured and any missing or damage special tool shall be replaced before transfer to Company.

A dedicated plan shall be implemented to coordinate all necessary inspections by Vendors/Manufacturers in order to ensure to respect warranty conditions of all spare parts and special tools during transportation, storage and operation periods.

A spare part register shall be prepared and shall include for each equipment or item the quantities recommended by Vendors/Manufacturers. The register shall report the parts ordered, delivered, used, replaced, their location etc... in order to provide full record traceability of all items.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Commissioning and initial Operation Spare Parts and Special Tools List

Commissioning and Initial Operation Spare Parts and Special Tools Register

7.7 Commissioning Tools and Consumables

All tools and consumables necessary for the safe execution of **Pre-commissioning** and **Commissioning** shall be identified, specified and purchased on a timely manner.

Consumables shall include, but not limited to: diesel, nitrogen, water, inhibitors, chemicals, inergen, lubricants and greases, etc...

These include also the supply of various type of warning signs and scaffolding tags (such as Warning Under Voltage, Warning Under Pressure, Warning **Commissioning** Test on-going, Isolation valve, Do Not Open, Do Not Close, Do Not Enter, etc ...), as well as chains and locks (padlocks at least in three different colors for electrical, mechanical, process isolation) suitable for mechanical and electrical isolations.

All tools and consumables used by Contractors, Subcontractors and Vendors shall be available at any time for Company Representatives inspection and/or audit.

A register shall be created and kept updated for all chemical used for the WORK including Material Safety Data Sheets. This register shall be made available to Company.

Particular attention shall be paid to the expiration date of consumables, and shall take all necessary action to ensure of the timely availability of the product on each Worksite as appropriate.

All specific tools, with valid certificate, necessary for the **Commissioning** Team to execute the work shall be made available as per plan in a timely manner, including but not limited to:

- Portable vibration measurement devices.
- IR temperature measurement devices.

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- Portable dew point analysers.
- Pressure/Temperature Generators.
- Clamp-on flow meters.
- Gas detectors.
- Gas detector calibration cylinders.
- Hart communicators.
- O² content analyzers.
- Moisture analyzers.
- Mechanical tools, etc.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Commissioning Tools and Consumables List

7.8 Temporary Installations and Equipment

7.8.1 Temporary Installations

Temporary installations can be required to perform **Pre-commissioning** and **Commissioning** activities at site. They shall be prepared and installed in a similar manner to the permanent installations by implementing specifications and ICAPS© database.

All necessary temporary installations shall be identified in due time, such as, but not limited to:

- Mechanical, electrical and instrumentation by-pass and temporary isolations.
- Temporary strainers, spades and flanges.
- Temporary filter, dryer...

A list and specification of temporary spools or other devices shall be issued together with any required drawings for fabrication and installations.

A specific inspection and test plan shall be issued covering the temporary installations used for Pre-commissioning, **Commissioning**, Start-Up and Preservation activities. This document shall be in accordance with the **Pre-commissioning** and **Commissioning** Temporary Installations Specification.

A dedicated procedure shall be prepared and implemented to manage temporary installation and shall include the coordination with the Inspection and Test Plan.

This procedure shall also ensure that temporary installation are not interfering with any permanent equipment and shall properly identify all the means and procedures for disconnection / removal of temporary equipment before transfer to Company.

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7.8.2 Temporary Equipment

Temporary equipment are brought on worksites to provide services that are not available before actual start up of the plant (e.g. air generation, electrical power, inerting and leak testing gases, etc...).

All temporary equipment mobilized on Company installations shall be subject to a mechanical and/or electrical inspection by Company prior to being approved for installation and use.

All necessary temporary equipment shall be identified in due time, such as, but not limited to:

- Power generators.
- Temporary instrument air supply (including compressors, dryers, and providing clean, dry, oil free instrument air).
- Temporary air conditioning units, dehumidifiers, heaters to protect installed equipment prior to Commissioning of permanent HVAC installation.
- Specific handling equipment and water bags for load tests.
- Local calibration facilities, certified test bench for PSV calibration.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Temporary Installations and Equipment Management Procedure

7.9 First Fills and Re-Fills

As part of Commissioning scope, the Commissioning Team shall be responsible for the loading of all first fills and re-fills whose supply responsibility is defined in the Contract.

These are such as, but not limited to:

- Diesel Oil, Hydraulic Oil.
- Refrigerant, Nitrogen.
- Water, Inhibitors.
- TEG, Catalysts, Chemicals.
- Inergen, etc.

First fill shall include filling of relevant installations and storage tanks, in addition to provision for flushing, venting, draining, and testing as applicable to bring the installations to operational state. All first fills materials shall be stored in a closed warehouse with temperature control and safety protection devices as required by Material Safety Data Sheet and Specification.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

First Fills List and Quantities

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7.10 Piping, Vessels and Valves

7.10.1 Definition

Specific **Commissioning** activities required to prepare piping and vessels for the oil-in or gas-in.

These are:

- Maximum Operating Pressure Leak test.
- Drying-out.
- Inerting.

The scope of work and procedures for each of the above activities are available on **GS EP EXP 107**.

It may happen that some of these activities are not related to a single system or Sub-system (the leak test, for instance, is carried out by level of pressure rather than by Sub-system). A Task report may therefore be created to report the results, which are then referred to in all concerned Sub-systems commissioning dossiers.

7.10.2 Maximum Operating Pressure Leak Testing

Maximum Operating Pressure Leak Tests shall be systematically performed on all pipe work conjointly with Critical Valves passing tests, by using dedicated procedure submitted for approval. Their objective is to demonstrate the tightness of flanges and integrity of valves.

A clear distinction shall be made between the Gross Air Leak Tests, which are part of the **Pre-commissioning** reinstatement activities, and the leak tests at MOP (Maximum Operating Pressure), which are part of the **Commissioning** activities.

A dedicated risk assessment and the job safety analysis shall be performed for this activity and shall be properly included in the relevant procedure.

MOP leak testing and the flange management shall be subcontracted to the same specialized Contractors.

In case of a Work requiring both Onshore and Offshore leak testing, the activities shall be subcontracted to the same specialized Contractor.

Contractor shall identify and confirm the availability of alternative nitrogen supply, in order to avoid any possible disruption of the leak test activity. This is especially critical when Offshore leak test are foreseen. Contractor shall include this information within the related procedure.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

MOP Leak Testing Procedure

MOP Leak Test Packs List

MOP Leak Test Packs Dossier (one per Test Pack)

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7.10.3 Dry-out, Vacuum and Inerting

Drying out by dry air or nitrogen shall include moisture content monitoring, and acceptable moisture content criteria shall be included in the procedure submitted for approval.

Inerting all oil and gas process equipment shall ensure that the oxygen content remain suitable prior introduction of COF as per Specification.

Proper preservation measures shall be taken immediately after chemical cleaning, drying or inerting to ensure integrity of the installations.

The procedure shall detail the organization and execution of such activities, define the lists of test packs to which the procedure is applicable, and develop specific test packs to be used for these activities.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Drying, Vacuum and Inerting Procedure

7.11 Instrumentation and Controls

7.11.1 Instrumentation

A dedicated procedure shall be prepared to describe all the methods and tools for executing **Commissioning** scope of work related to the instrument functional testing of loops, complex loops and the related interface and tie-in of all relevant control equipment.

This procedure shall identify the instrument loop check strategy and the loop folder documents to provide basic information in order to carry out the instrument functional testing activities in a planned and efficient manner.

All tools required for the execution shall be identified and made available also identify the tools used to achieve an effective **Commissioning**.

This procedure shall not include Operational Test.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Instrumentation Loop Testing Procedure

7.11.2 Control Systems

A dedicated Site Acceptance Test (SAT) shall be executed to verify that the Control Systems (i.e. DCS, ICSS) installed on the Plant meet or exceed the specified functional requirements as per Specifications based on a dedicated procedure approved by Company.

All involved Vendors/Manufacturers shall assist Contractor to unpack, install and verify that all equipment, interconnecting cables, external power connections, inverters, operator consoles, engineering workstations, and grounding connections have been installed and operate properly.

Site Acceptance Test shall therefore demonstrate that all equipment are correctly powered up, fully operational to allow loop commissioning tests to start and that no alteration has occurred due to transportation, installation and assemblies activities.

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The SAT shall consist of a series of tests to demonstrate that, and not limited to:

- All equipment have not been affected during transport and handling.
- Equipment has been correctly installed and assembled.
- All equipment/software has been delivered including consumables and spare parts.
- All documentation relevant to the ICSS has been delivered including software licenses.
- Powering and earthing are fully operational.
- All software is correctly installed and revision noted.
- System integrity has not been affected in transport.
- Systems are fully functional.
- All devices, modules, cables and connectors are well fastened and running properly.
- Redundancy functionality is fully operational.
- All Systems and faulty alarms are cleared.
- Field interfaces are fully functional.
- Communication interfaces and networks are fully functional.
- Back-up Systems are fully operational.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

ICSS Site Acceptance Test Procedure

7.11.3 Telecom

A dedicated procedure shall be developed to describe all the methods and tools for executing **Commissioning** scope of WORK related to the Telecom testing, following Specifications. All required tools shall also be indentified to achieve an effective **Commissioning**.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Telecom Commissioning Procedure

7.12 Electrical

A dedicated procedure shall be developed defining all the methods and tools for executing **Commissioning** scope of WORK related to electrical testing activities to be performed following Specifications. This procedure shall not include Operational Test.

Particular attention shall be given to minimum requirement for load bank in order to ensure proper testing of generators.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Electrical Commissioning Procedure

7.13 Lifting Equipment

A dedicated procedure shall be developed based on specifications, for Lifting Equipment to describe the methods, tools and all the necessary means to execute the **Commissioning** scope of work.

A dedicated Operational Test Procedure shall be issued and shall not be assimilated to a Load Testing certification activity which will be the scope of a separate dedicated test with third party witnessing as required by laws and regulations.

This shall include the provision of appropriate load cells (test weights) of adequate range.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Lifting Equipment Commissioning Procedure

7.14 Operational tests

For definition and specification of Operational Test, reference shall be made to **GS EP EXP 101**.

Unless the list of operational tests is included in the contractual documentation, the **Commissioning** Team shall establish and submit for approval to Company the list of planned operational tests, not later than five months before the start on site of physical **Commissioning** works.

This list shall be established in accordance with the guidelines available in **GS EP EXP 101** and complemented, for each test, by a test summary and schematics. Acceptance criteria shall be defined at early stage and approved by Company.

In case of an OT to be performed both onshore before sail away and offshore after hook up as well as in any case where there is a requirement for different OT's to be performed on the same equipment in different locations, these shall be covered by separate dedicated procedures, in order to properly take into account the specificities of the different environments as well as the different conditions in term of HSE, personnel involved etc.

Once the list and key features of tests have been approved by Company, the **Commissioning** Team shall develop the Operational Tests Procedures and their support documents, in accordance with the test guidelines given in **GS EP EXP 107**.

An OTP reference template is given on Appendix 4 of the present specification.

The OTP's shall be submitted to Company for approval, not later than two months prior to the start on site of physical commissioning works.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

Operational Tests List and Responsibilities

Operational Tests Procedure (one per OT)

Black Start Operational Tests Procedure

7.15 High Integrity Pressure Protection Systems

A dedicated procedure shall be prepared to carry out an Integrated SAT of the High Integrity Pressure Protection Systems (HIPPS) in compliance with Specifications. These tests shall form the formal verification of the HIPPS and will be independent from the final OTP. Reference shall be made to **GS EP TEC 260**.

The Integrated SAT procedure shall include as a minimum:

- Full functional test.
- HIPPS function time.
- Checking of all interactions between the various components.

Once the on-site SAT and facility testing has been completed, an operational test shall be performed prior to facility start-up. The objective and purpose of the OTP is to verify and test;

- That the HIPS has been installed and tested in a safe manner.
- The links with other Systems (e.g. ICSS, IMS) in reality.
- The safety logic, and eventual interlocking logic, in reality.
- The energizing authorizing logic of final elements by the HIPPS and ICSS.
- The interaction between HIPPS and ICSS, and subsea control system (if any).
- That the ICSS HMI in CCR is fully working.
- That the ICSS adequately stores HIPPS data in the ICSS' SOE and PDS.
- The HIPPS trip functions (sensors).
- A dry HIPPS performance test.

The HIPPS performance test must be performed before facility start-up to provide a physical proof that the HIPPS is performing as per project and HIPS Dossier requirements. It shall demonstrate the HIPPS response time of the final installed system.

The test shall be performed by creating real process conditions at sensors, hence requiring multiple dead weight testers for pressure sensors, and liquids inside vessels or standpipes for level sensors. Again, the HIPS performance shall be recorded using the HIPS SOE recorder via the HIPS maintenance work station.

OTP shall be prepared by the HIPS integrator, eventually assisted by Contractor and Company.

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

HIPPS Operational Test Procedure

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7.16 Commissioning Dossiers

For **Commissioning** Dossier definition and specifications, reference shall be made to

The Responsible Party shall, as a minimum requirement, prepare, issue for approval and maintain the following documentation:

OPERCOM™ Commissioning Dossier (one per Sub-System)

7.17 Initial Operations and Maintenance

7.17.1 Initial Operations

The **Commissioning** Team should need to operate permanent installation to complete the scope of the Work. In this case, Contractor shall be responsible for the correct Initial Operation and Maintenance of all the equipment and Sub-system of the Plant until Company will issue a formal Transfer of Operation and Maintenance Certificate.

For minimum maintenance requirements, reference shall be made to **GS EP EXP 213**.

All operating procedures shall be based upon Vendors/Manufacturers documentation and shall include complete records of operation, maintenance, preservation, consumable consumption, spare parts usage during the period. In particular, all fire and gas detectors and/or PSV's shall be regularly tested as required by Specifications.

These records shall be formally transmitted prior to Transfer of Operation and Maintenance to Company.

The start-up of equipment will be authorized based on consistent groups of Sub-system and as per Specifications.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

Initial Operation of Equipment Procedures (one per Equipment / Sub-system)

7.17.2 Maintenance

Dedicated procedures shall be issued, maintained and implemented for maintenance of all equipment of the Plant put in operation, including temporary equipment and installations.

Commissioning shall ensure that all maintenance procedures are based upon Vendors/Manufacturers documentation/specification.

The Maintenance Procedures shall be submitted for approval prior to starting any activities. It shall include but not limited to: routine visit, lubrication schedule and substitute lubricant list if applicable, fill in of log sheet for routine visit, provision of consumables and spare parts, provision of manpower etc...

At the time of Transfer of Operation and Maintenance to Company all records and the documented history of maintenance of the concerned equipment shall be delivered.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

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Maintenance Procedure (one per Equipment/Sub-System)**Maintenance Schedule****Maintenance Records****7.17.3 Initial Operation Spare Parts**

Commissioning Team and Maintenance team shall identify and review the list of spare parts and consumables recommended for initial operation of the installation up to the issuance of the Transfer of Operation and Maintenance.

Initial Operation spare parts shall be different from **Pre-commissioning** and **Commissioning** spare parts and consumables, and also from the Company Operating Spare Parts.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

Start-Up Spare Parts List**Start-Up Spare Parts Register****7.18 Transfer and Completion**

For Transfer of Operation and Maintenance definitions and specifications, reference shall be made to **GS EP EXP 101**.

A dedicated procedure shall be prepared to define the different steps of Transfer and the group of sub-systems to be transferred in each step. This procedure shall identify all the pre-requisites, consequences and responsibilities of each Transfer of Operation and Maintenance and shall treat each transfer milestone independently.

This procedure shall also define and detail all documents and materials to be prepared and compiled in order to be transmitted to Company at the time of Transfer of the Operation and Maintenance.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

Transfer of Operation and Maintenance Procedure

A dedicated Transfer Dossier shall be compiled, containing the information and documents such as, but not limited to:

- Copy of Red line Mark-Up "As Commissioned" drawings (PID's, SLD's, E&I TSLD's, etc...).
- Vendors/Manufacturers Operating procedures and Manuals.
- Data sheets.

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- Copy of the **Pre-commissioning** and **Commissioning** Red Line Mark-up Dossiers.
- All Isolation registers (Electrical, Instrumentation and Mechanical).
- Preservation and Maintenance Records.
- Updated punch list.
- PLC software's.
- Copy of **Pre-commissioning** Dossiers.
- Copy of **Commissioning** Dossiers, etc.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

Transfer Dossier (one per Transfer of Operation and Maintenance Milestone)

At the time of Transfer of the Operation and Maintenance all the remaining Pre-commissioning, **Commissioning** and Start-up spare parts shall be transferred.

A dedicated procedure shall be developed to define the mechanisms to formally transfer to Company these remaining spares, consumables and special tools.

This procedure shall cover the following subjects, but not limited to:

- List of items to transfer.
- Certificate (voucher) of transfer for the items.
- Localisation of the items.
- Logistic (transport, storage place...).
- Inspections, etc.

The Responsible Party shall issue for approval and maintain, as a minimum requirement the following documentation:

Commissioning Spare Parts and Special Tools Transfer Procedure

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Appendix 1

Appendix 1 Example of Systems and Sub-systems Lists

Typical FPSO

Note: this list is not exhaustive for a FPSO. **It is intended to be a sample document.**

System n°	Sub-System n°	Description	Location
01		Fire fighting generation / Distribution	
	0101	Fire water jockey pumps A	Hull
	0102	Fire water jockey pumps B	Hull
	0103	Fire water and Foam Machinery areas	Hull
	0104	Fire water Accommodation areas	Hull
	0105	Fire water pump A	Hull
	0106	Fire water pump B	Hull
	0109	Fire water Ring Main	Hull
	0110	Deluge skid module S8 SZ-0120	Topside
	0115	Deluge skid Starboard riser SZ-0110	Topside
	0122	Foam concentrate Storage and Pumps	Hull
	0123	Foam concentrate Ring main	Hull
	0124	Deluge skid Cargo tank1 A/B	Topside
	0125	Deluge skid Cargo tank2 A/B	Topside
	0132	Helifuel Package deluge / Foam system	Hull
	0133	Chemical / Paint store	Hull
	0134	Fire Water/Foam Monitors	Topside
	0135	Hull Water Mist system	Hull
	0136	Topsides Inergen system P1	Topside
	0137	Topsides Inergen system P8	Topside
	0138	Hull Inergen system & Galley exhaust duct	Hull
	0139	High Expansion Foam system	Hull
	0140	Deluge Skid Chemical injection A/B	Hull
	0150	Wet Chem Fire Exting Syst-galley & Deep Fat dryer	Hull
02		Safety / Evacuation system	
	0201	Safety Portable/Mobile Fire fighting equipment	Hull
	0202	Stern Free fall boats	Hull
	0203	Bow Free fall boats	Hull
	0204	Tertiary Evacuation - Life Boats	Hull
	0205	Rescue boat & davit	Hull
	0206	Work boat & davit	Hull
	0207	Life Raft & Davit	Hull
	0208	Safety showers & Eyes Wash	Hull
03		ESD and Fire & Gas	
	0301	Fire & Gas Detection Hull LQ 0	Hull
	0302	Fire & Gas Detection Hull LQ 1	Hull
	0306	Fire & Gas Detection Hull LQ Roof / Helydeck	Hull
	0307	Fire & Gas Detection Hull machinery space level 1	Hull
	0308	Fire & Gas Detection Hull machinery space level 2	Hull
	0313	Fire & Gas Detection Hull machinery FWD spaces	Hull
	0316	Fire & Gas Detection Oil SAGS	Hull
	0317	HC and O2 Analysers	Hull
	0320	Fire & Gas Detection Cargo Deck	Topside
	0321	Fire & Gas Detection Topsides S1	Topside
	0340	Fire & Gas Detection Topsides P1 E/I	Topside
	0342	Fire & Gas Detection Laboratory	Hull
04		Subsea / Surface control & Supervision	
	0401	ESD System High Level ESD0, ESD1, SD2	Topside
	0402	Engineering Room : ICSS Network & Workstation(s)	Hull
	0403	CCR/Crisis room : ICSS Network & Workstation(s)	Hull
	0404	CCR : Matrix panels	Hull

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System n°	Sub-System n°	Description	Location
	0405	Marine desk & large screens	Hull
	0406	Auxiliary CCR : ICSS Network & Workstation(s)	Hull
	0410	Zone 1 : ICSS Power distribution	Hull
	0411	Zone 1 : ICSS Network & Workstation(s)	Hull
	0412	Zone 1 : PCS	Hull
	0413	Zone 1 : PSS	Hull
	0414	Zone 1 : ESD	Hull
	0415	Zone 1 : FGS	Hull
	0416	Zone 1 : I.S Marshalling Cabinet(s)	Hull
	0418	Zone 1 : Master CMS	Hull
	0420	Zone 1 : Remote HULL PCS	Hull
	0464	P1 : Overall Control Wellheads & Risers (OCWR)	Topside
	0465	Subsea Control System SPS	Topside
	0466	Subsea Separation System SSS (S10 S20 S30)	Topside
	0467	Subsea Data Processing Unit SDPU	Topside
	0468	Subsea HPU Control System	Topside
	0469	P1 & Eng rooms :Subsea workstation (S)	Topside
	0470	Zone 2 : ICSS Power Distribution	Topside
	0471	Zone 2 : ICSS Network & Workstation(s)	Topside
	0472	Zone 2 : PCS	Topside
	0473	Zone 2 : PSS	Topside
	0474	Zone 2 : ESD	Topside
	0475	Zone 2 : FGS	Topside
	0476	Zone 2 : I.S Marshalling Cabinet(s)	Topside
	0477	Zone 2 : Hart Cabinet & Network	Topside
	0478	Zone 2 : VTMS (Vibration & Temp Monitoring System)/CMS	Topside
	0480	Zone 2 : Remote HULL PCS	Topside
	0481	Zone 2 LV MCC Room: Remote Zone 2 PCS	Topside
	0485	Zone 2 : HIPS UM	Topside
	0486	Zone 2 : HIPS O9	Topside
	0487	Vent Gas Monitoring	Topside
	0488	Corrosion and Erosion system	Topside
	0489	Hull monitoring system	Hull
	0490	(O.T.S.) Operator Training Simulator	Topside
	0491	(I.M.S.) Instrument Management System	Topside
	0492	Overall Flow Metering System (OFMS)	Topside
	0493	Process Data Server (PDS)	Topside
	0494	Master Time Server	Topside
	0495	SAGS (Stand Alone Gas Detection System)	Hull
	0496	Living Quarter Addressable Panel	Hull
	0497	Fire Control Station	Hull
	0498	Tank Gauging System	Hull
	0499	Load Master	Hull
05		Emergency Power Generation / Distribution	
	0501	Essential Diesel Generator A	Hull
	0502	Essential Diesel Generator B	Hull
	0504	Emergency Diesel Generator	Hull
	0505	LQ Emergency Power Distribution 0,4kV	Hull
	0506	11 kV Switchgears- Hull Electrical Room	Hull
	0507	6,6 kV Switchgears- Hull Elec room	Hull
	0508	0,4 kV Switchgears- Hull Elec Room	Hull
	0510	0,4 kV Switchgears- Hull Liv Quarter	Hull
	0515	Power Transformer Hull	Hull
	0517	Power Transformer Living Quarter	Hull
	0530	P1 Emergency Power Distribution 0,4kV	Topside
	0531	P1 Essential Power Distribution 0,4kV	Topside
06		Auxiliaries Power Generation / Distribution	
	0601	UPS-230V AC- Hull Inst, syst & telecom	Hull
	0602	UPS-48V DC- Hull Switchgear control	Hull
	0603	UPS-48Vdc PAGA system	Hull

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System n°	Sub-System n°	Description	Location
	0604	UPS-230V AC Hull Instrum	Hull
	0610	UPS-230V AC- TO-P1 Instr, Syst & Telecom	Topside
	0611	UPS-230V AC- TO-P1 Subsea System	Topside
	0612	UPS-230V AC TO-P8 Instr, System & Package	Topside
	0613	UPS-48Vdc TO-P1 Telecom	Topside
	0614	UPS-48V DC- TO-P8 Switchgear Control	Topside
	0615	UPS-48V DC- TO-P1 Switchgear Control	Topside
07		Instrument Air / Gas - Hydraulic Power	
	0701	Topsides Air Compressor A	Topside
	0702	Topsides Air Compressor B	Topside
	0704	Topsides Service Air Receiver	Topside
	0705	Topsides Air Dryer A	Topside
	0706	Topsides Air Dryer B	Topside
	0707	Topsides Instrument Air Receiver	Topside
	0708	Topsides Service Air Distribution	Topside
	0709	Topsides Instrument Air Distribution	Topside
	0710	Hull Air Compressor A	Hull
	0711	Hull Air Compressor B	Hull
	0712	Hull Service Air Receiver	Hull
	0713	Hull Air Dryer UZ 0701A/B	Hull
	0714	Hull Instrument Air Receiver	Hull
	0715	Hull Service Air Distribution	Hull
	0716	Hull Instrument Air Distribution	Hull
	0717	Hull Starting Air Generation	Hull
	0718	Hydraulic Valve Control Package	Hull
	0719	HPU A - Ballast & Cargo Pumps and Distribution	Hull
	0720	HPU B - Ballast & Cargo Pumps and Distribution	Hull
	0721	Hydraulic Oil Storage/Drain/Transfer	Hull
	0722	HPU Subsea	Hull
	0723	HPU Hull water & gas tight Hatch (Cargo)	Hull
	0730	HPU C Desalting pump	Topside
	0731	HPU D Desalting pump	Topside
	0740	Black Start Air Compressor	Hull
08		Communication / Telecom	
	0801	Optical fiber link	Hull
	0802	VSAT Link	Hull
	0803	Inmarsat	Hull
	0804A	PA/GA Central Cabinets	Hull
	0804B	PA/GA Field Equipment / Living Quarters	Hull
	0804C	PA/GA Field Equipment / Machinery Space	Hull
	0804D	PA/GA Field Equipment / Hull Deck	Hull
	0804E	PA/GA Field Equipment Topsides	Hull
	0805	Telephone	Hull
	0806	Data network	Hull
	0807	Marine VHF	Hull
	0808	VHF Aeronautical	Hull
	0809	UHF Operations Radio	Hull
	0810	HF/MF Radio	Hull
	0811	Non Directional Aeronautical Beacon	Hull
	0812	Point to Point Radio Link to Dalia	Hull
	0813	UHF Point to Multipoint Radio Link	Hull
	0814	Berthing AID	Hull
	0815	RADAR & RACON	Hull
	0816	Life boat radios	Hull
	0817	GMDSS & Telex	Hull
	0818	Ship Security Alert System	Hull
	0819	Environmental System	Hull
	0820	Entertainment System	Hull
	0821	CCTV	Hull
	0822	ROV	Hull

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System n°	Sub-System n°	Description	Location
	0823	Internal video	Hull
	0824	Gyro Compass & Positioning systems	Hull
	0825	Access ctrl & Intrusion detec & Pers onboard detec	Hull
	0826	Structured Cabling	Hull
09		HVAC	
	0901	Chilled Water Production - LQ, Hull, Laboratory	Hull
	0902	Topsides P1 - HVAC & Chilled Water Production	Topside
	0903	Topsides P8 - HVAC & Chilled Water Production	Topside
	0904	HVAC - Laboratory	Hull
	0905	HVAC - Galley	Hull
	0906	HVAC - Forward Deck House	Hull
	0907	HVAC AHU Supply & Recirculating Essential Fan A/B	Hull
	0908	Laboratory Exhaust Fan (Safety Cabinet/Fume Board)	Hull
	0909	Living Quarter Sickbay	Hull
	0910	Exhaust Fan - Battery Rooms, Inert Gas Room	Hull
	0911	Exhaust Fan & Supply Fan - HPU Pump room	Hull
	0912	Exhaust Fan - P1 Battery Room	Topside
	0913	Exhaust Fan - P8 Battery Room	Topside
	0914	Supply Fan - LQ Stairway Emergency Pressurization	Hull
	0915	Exhaust & Supply Fan Hull Emergency Generator Room	Hull
	0916	Exhaust Fan - Galley	Hull
	0918	Exhaust Fan & Supply Fan Essential Generator Room	Hull
	0919	Exhaust Fan - LQ Toilet	Hull
	0920	General Exhaust Fan - LQ Room	Hull
	0921	AHU Condensing Water Tank	Hull
	0922	Supply & Exhaust Fan S1	Topside
	0923	Door Limit Switches	Hull
12		Subsea separation pumps PCM	
	1210	PCM A - Control System (PCU)	Topside
	1211	PCM A - HV System	Topside
	1212	PCM A - LV System	Topside
	1213	PCM A - F&G System	Topside
	1214	PCM A - HPU Barrier Fluid System	Topside
	1215	PCM A - HVAC	Topside
20		Separation / Heating / Cooling (includ manif)	
	2001	O9 Production Manifolds Flowline 1	Topside
	2002	O9 Production Manifolds Flowline 2	Topside
	2003	O9 MP Separator Outlet Lines	Topside
	2004	UM Liquid Manifolds P10	Topside
	2007	UM Liquid Production Manifolds A	Topside
	2008	UM Liquid Production Manifolds B	Topside
	2009	UM Gas P10 Flowline 1	Topside
	2010	UM Gas P10 Flowline 2	Topside
	2015	LP Separation / Heater - Train A	Topside
	2017	Sand Jetting Accumulator	Topside
	2020	Density Profiler System	Topside
21		Dehydrat/Desalting/Stabilisation (includ strip)	
	2101	Dehydration - Train A	Topside
	2102	LLP Separation-Train A	Topside
	2105	Desalting Tank A	Hull
	2106	Desalting Tank B	Hull
23		Transfer	
	2301	Transfer Manifold Tanks header	Hull
	2302	Loading Manifold Tanks header	Hull
24		Storage	
	2401	Crude oil coolers (A/B/C/D)	Hull
	2402	Central Cargo Oil Tank 1 & Pumps	Hull
	2410	Side (Port) Cargo Oil Tank 2 & Pumps	Hull
	2414	Side (Starboard) Cargo Oil Tank 3 & Pumps	Hull
	2418	Portable Cargo Pump 1	Hull

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System n°	Sub-System n°	Description	Location
25		Export / Offloading	
	2501	Offloading Manifold Tanks Header	Hull
	2502	Crude Oil Offloading Pumps - A	Topside
	2503	Crude Oil Offloading Pumps - B	Topside
	2506	Crude oil Offloading Buoy	Topside
	2507	Crude Oil Offloading Tandem	Topside
	2510	LDHI Loading / Offloading Tandem	Topside
	2582	OLT Interface and FOC Patch Panel on FPSO	Topside
26		Metering	
	2601	Crude Oil Fiscal Metering	Topside
27		Oily Water Processing	
	2701	Main Produced Water Treatment Desanding-Degassing	Topside
	2702	Produced Water treat - Decantation Tank A	Hull
	2703	Produced Water treat - Decantation Tank B	Hull
	2704	Produced Water treat - Hydrocycl Train A/B Surge	Topside
	2705	Sand Handling system	Topside
	2706	O9 Produced Water Treatment	Topside
	2707	Slop water treatment & ODME System	Hull
	2708	Bilge system dirty oil tanks A/B	Hull
	2709	Bilge System - Bilge Treatment Package	Hull
	2710	Bilge System - Water Tanks & Sludge Tanks	Hull
	2711	Bilge system - MR P/S bilge wells	Hull
28		Closed Drains / Open Drains	
	2801	Closed drain drum & pumps	Topside
	2802	Closed drain networks	Topside
	2803	Hazardous Open Drain header	Topside
	2804	Non-Hazardous Open Drain header	Topside
	2805	Starboard slop tank	Topside
	2806	Port slop tank	Topside
	2810	Laboratory Hazardous Open Drain Header	Topside
29		Dead Oil	
	2901	Dead Oil Recirculation Heater	Topside
	2902	Dead Oil Recirculation Pump A	Topside
	2903	Dead Oil Recirculation Pump B	Topside
	2905	Crude Oil and Water Washing Manifold	Hull
30		Dehydration	
	3001	Gas Dehydration	Topside
	3002	TEG Regeneration	Topside
31		Gas / Compression	
	3101	LLP1/LLP2 Compressor	Topside
	3102	LP/MP Compressor - Train A	Topside
	3103	LP/MP Compressor - Train B	Topside
	3104	MP Gas Compressor Load Sharing and Control	Topside
	3105	HP Compressor	Topside
	3106	HHP Compressor	Topside
	3107	Gas Lift Injection	Topside
	3108	HC blanketing gas & Vent Gas Recovery unit	Topside
	3109	HC Blanketing Header & Slop Tank Inert Gas	Topside
35		Gas Export / Metering	
	3501	Gas Import/Export Metering	Topside
	3502	Import Gas Heater	Topside
	3513	Portable gas freeing fan (Air driven)	Topside
	3514	Portable gas freeing fan (Water driven)	Topside
36		Gas Disposal (Acid gas, flare, vent)	
	3601	HP Flare KO Drum & Pumps	Topside
	3602	LP Flare KO Drum & Pumps	Topside
	3603	HP & LP Flare Tips & Ignition Panel	Topside
	3604	Warm HP Flare header	Topside
	3605	Cold HP Flare header	Topside
	3606	LP Flare header	Topside

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System n°	Sub-System n°	Description	Location
37		Injection well	
	3701	Gas Injection manifold	Topside
50		Water lifting (water prod wells. transfer lines)	
	5001	Sea water lift pump A	Topside
	5002	Sea water lift pump B	Topside
	5005	Essential Sea water lift pump A	Topside
	5006	Essential Sea water lift pump B	Topside
	5008	Emergency Sea water lift pump A	Topside
	5009	Emergency Sea water lift pump B	Topside
	5010	Sea water cooling return & distribution	Topside
	5011	Emergency / Essential Seawater Cooling Return	Hull
51		Filtration (Main & Preliminary)	
	5101	Sea Water Coarse Filtration Package	Topside
	5102	Essential Sea water filtration package	Topside
	5103	Sea water Fine filtration package	Topside
	5104	Emergency Sea water filtration Package	Topside
52		Electrochlorination	
	5201	Electrochlorination	Topside
53		Water Treatment (Sulphur removal / de-oxygenation)	
	5301	Deaeration Tower A	Topside
	5302	Deaeration Tower B	Topside
	5303	Sulphate Removal Unit Feed Pumps	Topside
	5304	Sulphate Removal Unit Trains	Topside
	5305	Wash water system	Topside
	5306	Wash sand jetting Water Pumps	Topside
54		Water Injection (includ pumps, metering, headers)	
	5401	W I P Pump A to UM Subsea Injection Wells	Topside
	5402	W I P Pump B to UM Subsea Injection Wells	Topside
	5403	W I P Pump to O9 Subsea Injection Wells	Topside
	5404	Water Injection Lines Manifold UM	Topside
	5405	Water Injection Lines Manifold O9	Topside
	5406	Suction manifold pump A/B	Topside
	5407	Sea Water Disposal Caisson	Topside
	5408	Wash water trolley	Topside
	5410	Seal Barrier Fluid system skid	Topside
60		Main Power Generation	
	6001	Main Turbo generator A	Topside
	6002	Main Turbo generator B	Topside
	6006	Wash Water Trolleys A/B	Topside
	6010	Hydraulic Starting Console A	Topside
	6020	Hydraulic Starting Console B	Topside
61		Power Distribution	
	6110	11 kV Switchgear	Topside
	6112	6,6 kV Switchgear	Topside
	6113	0,4 kV Switchgear- Zone 1	Topside
	6114	0,4 kV Switchgear- Zone 2	Topside
	6122	Power transformer A	Topside
	6123	Power transformer B	Topside
	6126	Cable Feeder 11 Kv 1	Topside
	6127	Cable Feeder 11 Kv 2	Topside
62		Lighting	
	6201	Hull Essential Lighting Distribution	Hull
	6202	LQ Emergency Lighting Distribution	Hull
	6203	LQ Essential Lighting Distribution	Hull
	6210	LQ Roof level 4 Port Int/ext	Hull
	6211	LQ Roof level 4 STBD Int/ext	Hull
	6218	MS Level -1 Port STBD Internal	Hull
	6222	HU Main Deck AFT	Hull
	6225	LQ-Roof Level 4 Port STBD Int/Ext	Hull
	6239	Helideck roof HVAC UPS	Hull

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System n°	Sub-System n°	Description	Location
	6245	FWD Space AC400V D/B	Hull
	6246	Power Outlet AC400V D/B	Hull
	6247	Mach Workshop AC400V D/B	Hull
	6248	Piping Store Workshop AC400V D/B	Hull
	6250	P1 Normal Lighting distribution	Topside
	6251	P1 Essential Lighting distribution	Topside
	6252	P1 Emergency Lighting distribution	Topside
	6260	P2-P3 Normal Lighting circuits	Topside
	6261	P2-P3 Essential Lighting circuits	Topside
	6262	P2-P3 Emergency Lighting circuits	Topside
	6280	P1 400V Welding Distrib panel	Topside
	6281	P8 400V Welding Distrib panel	Topside
	6298	Miscellaneous lighting Hull	Topside
63		Earthing	
	6310	Earthing For Hull Elec Tech room	Hull
	6311	Earthing For LQ Emcy room	Hull
	6312	Earthing For LQ transfo space	Hull
	6313	Earthing For Hull intrum tech room	Hull
	6314	Earthing For LQ telecom room	Hull
	6315	Earthing For Radio room	Hull
	6316	Earthing For FWD Elec panel room	Hull
	6317	Earthing For LQ instrum tech room	Hull
	6330	Earthing For P1 building level 0	Topside
	6331	Earthing For P1 building level 1	Topside
	6338	Earthing For Top side overall earthing	Topside
64		Navaid	
	6401	Navaid Helideck lights Obstruction lights	Hull
65		PDCS or Electrical Control System (ECS)	
	6501	Hull PDCS	Hull
	6502	Topsides PDCS	Topside
	6503	PMS / load sharing	Topside
	6504	Load Shedding	Topside
	6510	General Electrical Inter Locking & Inter Tripping	Topside
	6515	Black Start	Topside
70		Fuel Gas	
	7001	HP fuel Gas system	Topside
	7002	LP fuel Gas system	Topside
	7003	HP fuel gas Distribution	Topside
	7004	MP fuel gas Distribution	Topside
	7005	LP fuel gas Distribution	Topside
71		Fuel oil / Diesel oil (storage / Distribution)	
	7101	Raw Diesel storage Tank A	Hull
	7102	Raw Diesel storage Tank B	Hull
	7105	Diesel Overflow tank	Hull
	7106	Diesel Leak Tank	Hull
	7107	Raw Diesel transfer	Hull
	7108	Diesel oil treatment	Hull
	7109	Diesel Treated Service tanks	Hull
	7110	Hull Diesel oil distribution	Hull
	7111	Topsides Diesel oil distribution	Topside
	7112	Raw Diesel Offloading	Hull
	7113	Diesel oil settling tank A	Hull
	7114	Diesel oil settling tank B	Hull
72		Hot water Generation & Distribution	
	7201	Hot water Expansion Drum	Topside
	7202	Hot water circulation pumps	Topside
	7203	Hot water Distribution	Topside
	7204	Waste Heat Recovery unit A	Topside
	7205	Waste Heat Recovery unit B	Topside
73		Lube oil	

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	7301	Lube Oil Storage Tanks & Transfer Pumps	Hull
	7302	Lube Oil Treatment	Hull
	7303	Lube Oil Drain Tanks & Dirty Lube Oil Tank	Hull
74		Inert Gas / Nitrogen generation & Distribution	
	7401	Nitrogen generation & Storage	Topside
	7402	Nitrogen distribution (Topsides)	Topside
	7403	Nitrogen distribution (Hull)	Hull
	7404	Clean Inert Gas Vent and Purge Header (AFT & FWD)	Hull
	7405	Inert gas generation A	Topside
	7406	Inert gas generation B	Topside
75		Chemical Storage & Injection (including methanol)	
	7501	Hull Methanol storage A / pumps	Hull
	7502	Hull Methanol storage B / pumps	Hull
	7503	Methanol (Mtnol) Buffer Drum	Topside
	7504	UM Mtnol Injection Pumps A/B/C	Topside
	7505	O9 Mtnol Injection Pumps A/B/C	Topside
	7506	HHP Mtnol Injection Pumps A/B	Topside
	7507	UM Mtnol Subsea Separators/Mtnol Injection Pumps	Topside
	7508	Mtnol Injection to O9 Product Manifold/Gas Lift	Topside
	7509	Mtnol Injection Distribut UM/ Product Manifold Co	Topside
	7510	Subsea Mtnol Distribution Header - UM Gas Liquid	Topside
	7511	Mtnol Subsea Distribution Header - O9 Production	Topside
	7512	Mtnol Injection Distribution - Topside Gas Inject	Topside
	7513	Methanol Injection to riser manifold - Miocene P10	Topside
	7517	Tops Chemical Injection - Chemical 1	Topside
	7518	Tops Chemical Injection - Chemical 2, etc...	Topside
	7530	Subs Chemical Injection - Chemical 1	Topside
	7531	Subs Chemical Injection - Chemical 2, etc...	Topside
	7539	Hull-LDHI Storage tank A/B	Hull
76		Cooling Water	
	7601	Process Cooling Water Expansion Drum	Topside
	7602	Process Cooling Water Pumps	Topside
	7603	Process Cooling Water Exchangers	Topside
	7604	Process Cooling Water Distribution	Topside
	7605	Topside service cooling water expansion drum	Topside
	7606	Topside service cooling water pumps	Topside
	7607	Topside service cooling water exchangers	Topside
	7608	Topside service cooling water distribution	Topside
	7609	Hull service cooling water expansion drum	Hull
	7610	Hull service cooling water pumps	Hull
	7611	Hull service cooling water exchangers	Hull
	7612	Hull service cooling water distribution	Hull
	7613	Hull Essential DG Black Start Cooling Water System	Hull
	7614	Hull Cooling Water for diesel generator A	Hull
	7615	Hull Cooling Water for diesel generator B	Hull
78		Lifting Equipment	
	7801	Crane A	Hull
	7802	Crane B	Hull
	7803	Monorails, Hoists and Trolleys	Hull
	7804	Forklift Trucks, Two Wheel Four Wheel Hand Trucks	Hull
	7805	Helideck Jib Crane	Hull
	7806	Hulldeck bow crane	Hull
	7807	Riser A Pulling System	Hull
	7808	Riser B Pulling System	Hull
	7809	OIL OFFLOADING LINES PULLING SYSTEM PORTSIDE	Hull
	7810	OIL OFFLOADING LINES PULLING SYSTEM STARBOARD	Hull
	7811	Cargo Lifts	Topside
	7812	Personnel elevator	Hull
	7813	Luggage Handling Equipment	Topside
	7814	Portable Injured Person Davit	Topside

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System n°	Sub-System n°	Description	Location
80		Laboratory	
	8001	Laboratory	Hull
81		Helideck (including Kerosene)	
	8101	Helifuel system	Hull
82		LQ / Catering / Offices / Civil Buildings / Sewage	
	8201	Sewage Collection Network (Black Water)	Hull
	8202	Sewage Collection Network (Grey Water)	Hull
	8203	Sewage Treatment / Biological Pant A	Hull
	8204	Sewage Treatment / Biological Pant B	Hull
	8205	Living Quarters-Water Distribution	Hull
	8206	Galley / Laundry	Hull
	8207	Catering Equipment, Cold Store & Freezer	Hull
	8208	Medical Room equipment	Hull
	8209	Accommodation Drain Deck System	Hull
84		Workshop/Warehouse	
	8401	Workshop / Warehouse equipment	Hull
85		Soft water	
	8501	Fresh Water Production & Storage	Hull
	8502	Hull Fresh Water Distribution	Hull
	8503	Topsides Fresh Water Distribution	Topside
	8504	Drinking water Production	Hull
	8505	Hot Drinking water generation	Hull
	8506	Drinking water Distribution	Hull
	8507	High Pressure Washing Unit	Hull
	8510	Potable Water Hose Reel (Portside & Starboard)	Hull
86		Structures / Mooring / Ballast	
	8601	Ballast 2&3 - Wing Tanks, Ballast Pumps A/B	Hull
	8602	Ballast1 AFT Tanks, Bilge-Ballast Pumps A/B	Hull
	8603	Mooring system	Hull
	8604	Hydraulic Hatches	Hull
	8605	Towing & Emergency Towing Equipment	Hull
	8606	Tandem Back-up Mooring Hawser Storage	Hull
87		Cathodic Protection	
	8701	Hull Cathodic protection	Hull
88		Junction box/multicores cables	
	8801	Hull Junction box / multicore cables	Hull
	8802	Topsides Junction box/multicore cables	Topside
99		No Commissionable Items	
	9901	Hull Structure, Painting, Racking & MCT	Hull
	9902	Topside Structure, Painting, Racking & MCT	Topside
	9903	Living Quarter Structure, Painting, Racking & MCT	Hull

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Appendix 1
Typical Wellhead Platform (Production/Injection)

Note: this list is not exhaustive for a Wellhead Platform. **It is intended to be a sample document.**

System n°	Sub-system n°	Description
01		Fire fighting generation / Distribution
	0101	Fire water deluge System
	0105	Fire water main ring and hydrants
	0120	Total flooding extinguishing system (FM200)
02		Safety / Evacuation system
	0201	Other Safety equipment
03		ESD and Fire & Gas
	0301	Fire and Gas detector loops
	0310	Fire and Gas and ESD system
04		Surface control & Supervision
	0401	PCS and FCW systems
	0405	PSS system
	0415	Master station system
	0420	Junction boxes and multicores / multipairs cables
06		Auxiliaries Power Generation / Distribution
	0601	24VDC UPS and 24VDC/230VAC and distribution Board
07		Instrument Air / Gas - Hydraulic Power
	0701	Wellhead hydraulic control panel
08		Communication / Telecom
	0801	Telephone
	0805	General Alarm
	0815	Operational VHF marine radio, Racon, system
	0825	Radio system (WIMAX) and Optical fiber
09		HVAC
	0901	HVAC system
10		Extraction wells/Flowlines/Manifolds/Pumping/well metering
	1001	Well 1
	1002	Well 2
	1020	Production manifold and export line
	1025	Test manifold
	1031	Flowlines well 1
	1032	Flowlines well 2
11		Slug catcher, main/test separation & metering
	1101	Multiphase flowmeter
12		Transfer (produced liquid processing)

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System n°	Sub-system n°	Description
	1202	Pig launcher
28		Closed Drains / Open Drains
	2801	1500# closed drain header
	2802	900# closed drain header
	2803	150# closed drain header
	2805	Closed drain drum & pumps
	2810	Classified Open drain headers
	2815	Open drain drum & pumps
	2820	Non classified Open drain headers
	2825	Disposal caisson & pump
34		Transfer (produced gas processing)
	3402	Pig receiver
36		Gas Disposal (Acid gas, flare, vent)
	3601	Cold vent header
	3603	Cold vent KO drum, pump & tip
37		Injection well (produced gas processing)
	3701	Gas lift injection line well 1
	3702	Gas lift injection line well 2
	3720	Gas lift manifold and feeding line
55		Injection wells / Flowlines / Manifolds (water processing)
	5501	Water injection well 1
	5502	Water injection well 2
	5510	Water injection manifold
61		Power Distribution
	6105	HV 6,6KV/400 V transformer & HV 6,6 KV switchboard
	6110	LV 400 V switchboard
	6115	400/230V transformer & 230V switchboard
	6120	Valve motorization switchboard
	6125	400 V Temporary Preservation Diesel Generator
	6130	Earthing system
62		Lighting
	6201	Normal Lighting and sockets system
	6202	Emergency Lighting system
64		Navaid
	6401	Nav aid system
75		Chemical Storage & Injection (including methanol)
	7501	Methanol injection system
	7505	Anti scale injection system
	7510	Demulsifier injection system

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System n°	Sub-system n°	Description
	7515	Corrosion inhibitor system
	7520	Biocide system
78		Lifting equipment
	7801	Crane
	7802	Handling devices
82		LQ / Catering / Offices / Civil Buildings / Sewage
	8201	Sewage water
83		Technical rooms
	8301	Electrical room
	8305	Instrumentation room
85		Soft water
	8501	Fresh water system
87		Cathodic protection
	8701	Cathodic protection system

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Appendix 1
Typical Living Quarter Platform

Note: This list is not exhaustive for a Living Quarter Platform. **It is intended to be a sample document.**

System n°	Sub-System n°	Description
01		Fire fighting generation / Distribution
	0100	Fire water pump package - chlorination
	0101	Fire water ring main & hose reel
	0102	Helideck foam system
	0103	FM200 Extinguishing system
	0104	Laundry Aerosol Fire Suppression
	0105	Galley Hood Fire Suppression
02		Safety / Evacuation system
	0201	Survival and Fast Rescue Crafts
	0202	Portable / mobile Fire Fighting Equipment
	0203	Life Saving & safety equipment - Escape routes
03		ESD and Fire & Gas
	0301	Fire & Gas detection - Fire addressable system
04		Subsea / Surface control & Supervision
	0401	Process control system
	0402	ESD & Fire and Gas
	0403	Optical Fibre Link
05		Emergency Power Generation / Distribution
	0501	Emergency diesel generator package
07		Instrument Air / Gas - Hydraulic Power
	0701	Instrument air distribution
	0702	Utility air distribution
08		Telecommunication
	0800	PABX and Telephones
	0801	PA/GA system
	0802	CCTV
	0803	Non Directional Beacon (NDB) - Racon
	0804	VSAT Satellite & Broadband Global Area Network
	0805	Office networks - Video conferencing
	0806	Wimax PTP Digital Microwave radio link
	0807	Wimax PTM Digital microwave Scada radio
	0808	Entertainment system
	0809	UHF - FM trunk radio system
	0810	VHF - FM marine & crane radio system
	0811	MF - HF SSB radio system
	0812	VHF - AM aeronautical radio system
	0813	Meteorological system
	0814	Auto identification - Early warning radio system
	0815	GMDSS - SART (Life rafts)
09		HVAC
	0901	Chilled water (Chiller, condensers and pumps)
	0902	AHU, ducts and dampers A/B
	0903	LQ exhaust (ducts, fans, dampers)
	0904	Galley exhaust (ducts, fans, dampers)
28		Closed Drains / Open Drains
	2801	Open drain collection
	2802	Disposal tube and pump
61		Power distribution
	6100	6,6 KV Transformers
	6101	400 VAC LV Switchboard
	6102	400 VAC LV essential Switchboard
	6103	Electrical control system (ECS)
	6104	24 VDC UPS A/B
	6105	48 VDC UPS A/B

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	6107	230 VAC UPS A/B
	6108	Normal lighting, small power transformer & DB
	6109	Essential lighting, small power transformer & DB
	6110	Welding receptacles
	6111	Workshop power distribution
	6112	Laundry power distribution
	6113	Galley power distribution
62		Lightning
	6201	LQ Lightning
63		Earthing
	6301	LQ Earthing
64		Navaid
	6401	Navigation Aid & Aviation lights
	6402	Helideck lighting
72		Hot water Generation & Distribution
	7201	Hot water calorifiers and circulation pumps
	7202	Hot water distribution
78		Lifting equipment
	7801	Pedestal crane
	7802	Monorails / Pad eyes / Handling devices
81		Helideck (including Kerosene)
	8101	Aviation fuel dispensing unit
	8102	Diesel storage & distribution
82		LQ / Catering / Offices / Civil Buildings / Sewage
	8200	Sewage treatment package
	8201	Sewage treatment caisson
	8202	Black water, grey water, galley water collection
85		Soft water
	8501	Fresh water make-up filter, storage tanks & pumps
	8502	Fresh water filters, sterilizer and PW outside LQ
	8503	PW inside LQ lower, mezzanine, main, 1st deck levels
	8504	PW inside LQ 2nd deck, 3rd deck levels
	8505	Wash water pump & distribution
	8506	Service water outside LQ
	8506	Service water inside LQ
87		Cathodic Protection
	8701	QPS jacket, boat landing
	8702	Flare tripod
	8703	Topside
	8704	Telecom tower
	8705	Cathodic protection
99		Non Commissionable Items
	9900	Lower Deck
	9901	Mezzanine Deck
	9902	Main Deck
	9903	First Deck
	9904	Second Deck
	9905	Third Deck
	9906	Infirmery, medic office / store
	9907	HLD / admin office, transit lounge, reading area
	9908	Cables ladder, cables trays, MCTs

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Appendix 2 Systems/Sub-systems Boundaries Definition Rules

The following paragraphs define the rules to be applied to define Sub-systems boundaries.

1. Interfaces between process and utility Systems/Sub-systems

1.1 General rule

As a general rule the physical limit of a Process or Utility System or Sub-system will be, wherever possible, an isolation valve, allocated to the System or Sub-system that has the highest priority and is to be commissioned first (figures 1, 2 and 3).

Where a blind is necessary, the Sub-system limit will be at the most suitable flange.

In certain instances where a facility is being extended, the limit will be at the tie-in point.

1.2 Flare Systems/Sub-systems

The Flare Systems or Sub-systems will include the isolation valves between associated Process Systems and the Flare Systems.

Consequently, Flare limits will be downstream of:

- Safety valves.
- Pressure control valves.
- Blowdown valves.
- Choke valves (Figure 4).

1.3 Closed Drains Systems/Sub-systems

The above rule applies (Figure 5).

1.4 Diesel Oil and Fuel Gas Systems/Sub-systems

System/Sub-system limits to user Systems or Sub-systems will be downstream of the last manual supply isolation valve to each consumer. All controls, blowdown or ESD valves, filtration Systems and so on will be part of the consumer Sub-system (Figure 6).

1.5 Inert Gas System/Sub-systems

As above, System/Sub-system limits to user Systems or Sub-systems will be downstream of the last manual supply isolation valve.

1.6 Chemical Injection Systems/Sub-systems

The System/Sub-system limit will be downstream of the supply isolation valve for each injection point into the Process Lines or items of Equipment.

1.7 Hydraulic Systems/Sub-systems

System/Sub-system limits will be downstream of the first supply isolation valve to each user.

1.8 Exchangers

When Heat Exchangers require a utility service such as cooling water, hot oil, steam, etc., to control the temperature of a Process stream, the Heat Exchanger will be part of the Process System/Sub-system (Figure 7).

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The utility pipework within the limits of the Heat Exchangers supply and return valves will also be part of the Process system/Sub-system.

Refrigeration Heat Exchangers operating on the principle of evaporation of a liquid such as Propane or Freon, will be part of the Refrigeration loop (Figure 8).

1.9 Instrument air

The instrument air distribution Sub-system in its totality will be considered as part of the instrument air system. Limits will be made at each branch of the distribution system downstream of the final piping isolating valves, and before the item of equipment being supplied with instrument air by the said branch line, i.e. control valves, etc. (Figure 9).

2. Interfaces for instrument Sub-systems

2.1 Process or utility Sub-systems

A process control loop will preferably be allocated to the Process or Utility Sub-system where the measuring device is installed (Figures 1, 3 and 10).

Where a Distributed Control System is utilized, it is considered to stand alone as a DCS Sub-system from the Input / Output racks. Outgoing wiring to individual loops will be allocated to Process or Utility Sub-systems as either open or closed loops, as defined by the Trouble-Shooting Loop Diagrams (TSLD's).

2.2 Emergency Shutdown System (ESD)

ESD Programmable Logic Controller (PLC) based system will stand alone as a Sub-system, from the Input/Output racks as for Distributed Control Systems. Input/Output loops will be classified as open loops and allocated to Sub-systems as the outgoing wiring of Distributed Control Systems.

2.3 Fire and Gas (F&G)

F&G Programmable Logic Controller (PLC) based system will stand alone as a Sub-system from the Input/Output racks. Loops will be classified as open loops and allocated to Fire and Gas Sub-systems, with the exception that these Sub-systems will be based on designated Fire Areas.

3. Instrument/Electrical interfaces

When there is an interface between an Electrical and an Instrument Sub-system, the Instrument limit will normally be at the terminals of the item of Electrical equipment shown on the Instrument Trouble-Shooting Loop Diagram (TSLD).

4. Interfaces for electrical Sub-systems

4.1 Electrical Distribution Network

The Electrical Distribution Network will be sub-divided by category of service: i.e.:

- Normal Service.
- Essential Service.
- Emergency Service.

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Switchboards and Distribution Boards are dedicated to a service and this forms the basis of an Electrical Sub-system. Depending on the complexity of the distribution network then these base Sub-systems will be further sub-divided to suit the Project requirements.

The interface/break points between Sub-systems will be at the most practical point as required the commissioning energization sequence.

Typical break points:

- Transformers.
- Switch/Distribution Board incoming breakers.

An Electrical Sub-system will contain all items relative to the distribution network but excluding all starters, contactors, switch-fuse, etc., where the electrically powered device is allocated to a Process or Utility Sub-System.

4.2 Process or Utility Sub-systems

As stated above, any electrically powered device (i.e. item of equipment) will be allocated to the Process or Utility Sub-system.

For example, where the electrically powered device is a Motor, then the following will also be included in the applicable System or Sub-system:

- Starter at switchboard.
- Cabling (power and control).
- Associated control gear.
- Motor.

The interface with Instrument Group will be at the point of the termination of any electrical control into an instrument device, e.g. Marshalling box, Process Control System (PCS) cabinet, Fire and Gas (F&G) cabinet, etc.

4.3 Heat Tracing

For ease of installation and **Commissioning**, Trace Heating will be split differently from the description above. The circuit breaker/fuse, cabling and associated junction boxes, will be grouped within an Electrical Sub-system. Trace Heating tapes will then be grouped into the Process or Utility System/Sub-system to which the piping is allocated.

4.4 Uninterrupted Power Supply (UPS) system

Certain large machines have Uninterrupted Power Supplies which are dedicated to that machine only.

In this instance the Uninterrupted Power Supply (UPS) system and distribution will be allocated to that Process or Utility System/Sub-system.

4.5 Multicore Cables

All multicore cables, the cores or pairs of which are connected to equipment belonging to different Sub-systems, will be included in a specific multicore cables Sub-system.

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The Sub-system limits will be:

- At the Output racks in the technical room (marshalling cabinet).
- At the field junction boxes.

The junction boxes will be also part of the multicore cables Sub-system.

The multicore cables, all cores of which are connected to equipment of a single Sub-system, will belong, with the junction boxes, to that Sub-system.

5. Mechanical equipment

Items of Mechanical Equipment will fall completely within the limits of a Process or Utility System or Sub-system.

In certain instances, Stand-by and/or Parallel equipment, which are often complete Vendor Packages, may also be designated as complete Sub-systems. This will match the initial Start-Up philosophy, in order to achieve, for example, early Oil or Gas production.

Typical examples:

- Main Oil Pump.
- Gas Compressor.
- Main Generator.
- Pedestal Cranes.
- Lifts.

6. Telecommunications

6.1 Radios

When Troposcatter Radio or Line of Sight Multichannel Techniques are used, the Multiplexer will be included in the Radio System. The Multiplexer device will interface between, the telephones, computers, and telexes. The limit of this Sub-system will be the input terminals on the Multiplexer.

There are instances where a "Phone Patch" interface is used to patch the Public Address System and/or Radio into the Telephone System and vice versa. In these cases, the "Phone Patches" will either be included into the Telephone or Radio System, depending on the Vendor.

6.2 Telephones

The Telephones Sub-system will include the PABX, Extensions, Operator Console, Facsimile, Telex, Main Distribution Frame (MDF) and cabling out to the Multiplexer and/or single unit Radio Transceiver, also cabling to the Public Address Control Panels.

6.3 Public address

The Public Address Sub-system will include the Alarm Racks, Amplifier, Control Panel, Override Stations, Loudspeakers and Interconnecting Cabling. The limit of the Sub-system will be the Input/Output terminals on the Control Panel, and the Input loop terminals in the Alarm Rack from the Fire and Gas detection system.

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7. Sub-sea Network

7.1 Sub-sea Systems

The Sub-sea Network will be sub-divided into four category of system following:

- Production loops and lines.
- Water injection loops and lines.
- Gas injection loops and lines.
- Control.

7.2 Sub-sea Sub-systems

The sub-sea loops are further divided into Sub-systems using a numeric code to signify a group of sub-sea equipment item/package:

- Xmas tree.
- Well jumpers.
- Manifold.
- Lines and riser.
- Dynamic control umbilical.
- Static control umbilical.

The sub-sea control system is divided into two stand-alone packages:

- Control station.
- Hydraulic power unit.

one being the control system itself and this could be stand-alone as a separate sub-system as for the Distributed Control System or a package to be integrated in the D.C.S. The second package in the control system is the hydraulic power unit. This sub-system will also be attached to a dedicated sub-system (Loop or Hydraulic control).

Consequently there will normally be partial hand-overs of Systems and sub-systems for sub-sea equipment as drilling and sub-sea installation activities are carried out in parallel with commissioning and start-up.

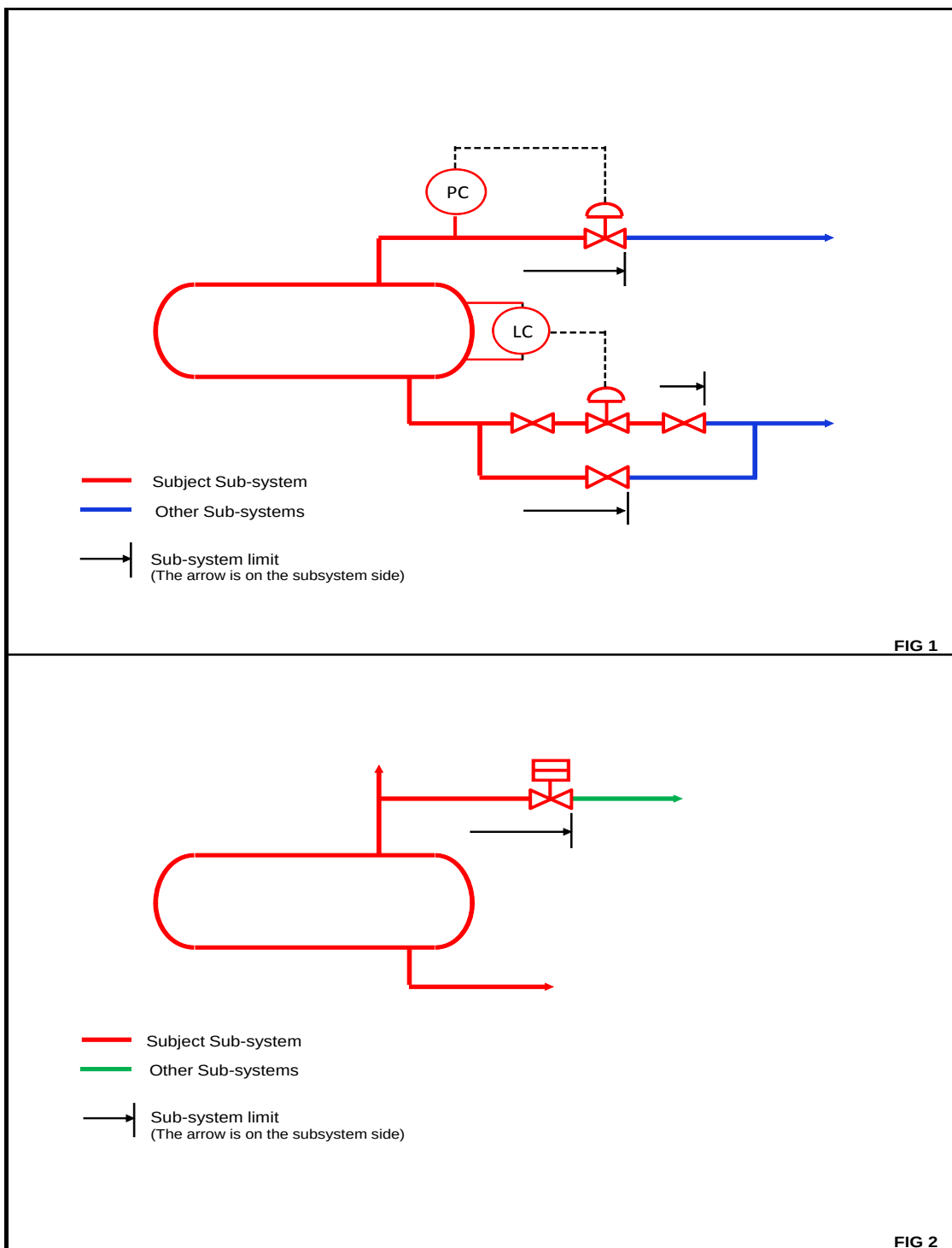
For example, the hand-over for the first production loop will contain all flowlines and risers, all control umbilicals, all production manifolds and possibly only one or two Xmas trees. A similar example for an injection line would be that the first hand-over would include all flowlines and risers, all control umbilicals all umbilical connection devices and possibly only one injection Xmas tree.

See figures 11 and 12 for examples of sub-sea production and injection packages/Sub-systems color mark-up.

8. Other cases

Whenever the above Sub-systems delimitation rules do not cover any specific case, the Engineering Contractor will define a delimitation rule adapted to that case and submit it to Company's approval.

Appendix 3 Systems/Sub-systems Boundaries Definition Schematics

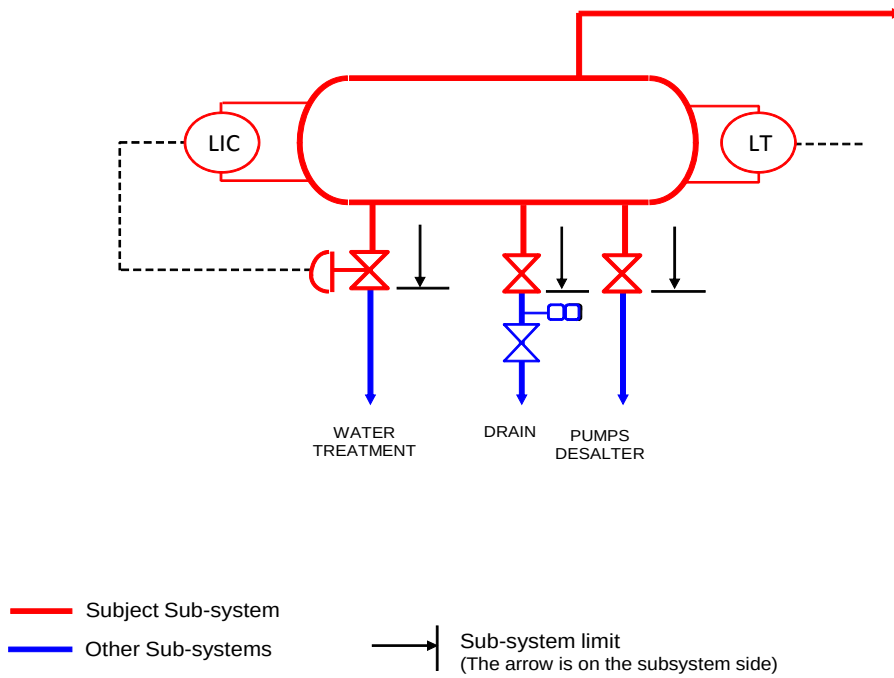
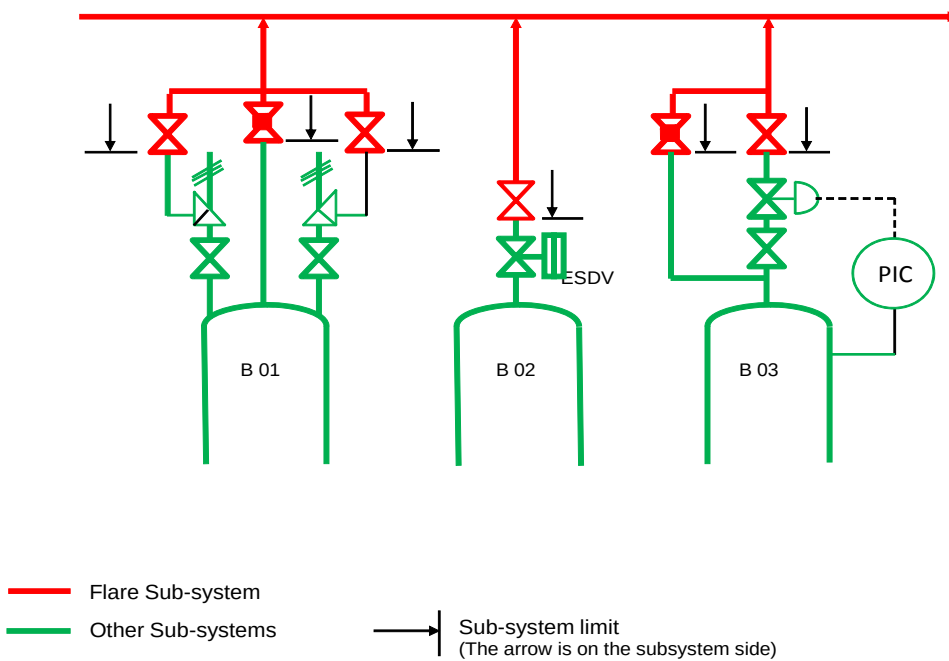


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FIG 3

FIG 4

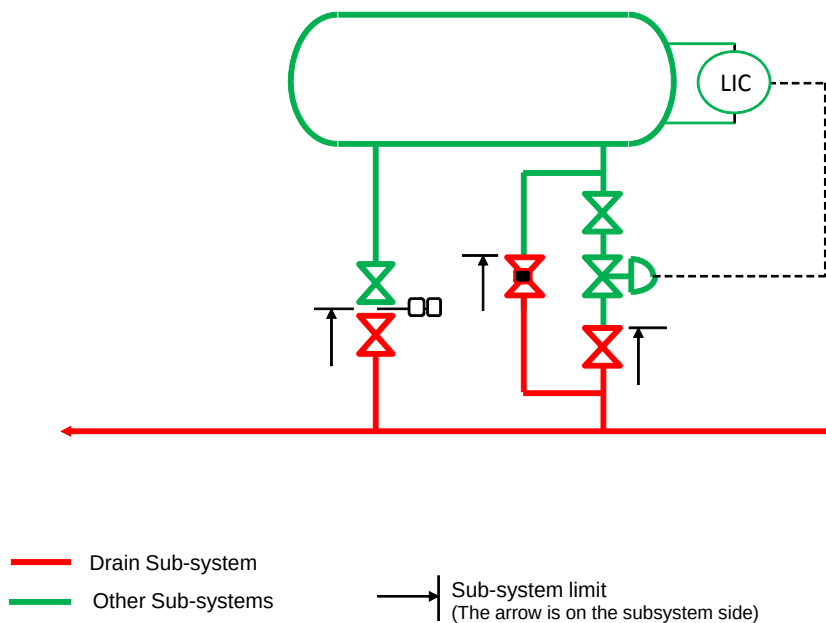


FIG 5

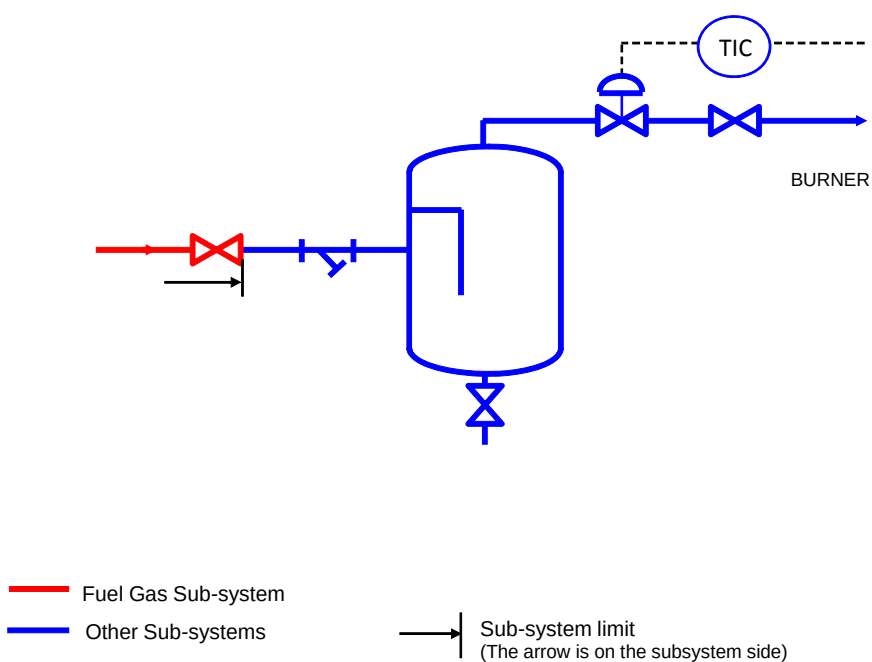


FIG 6

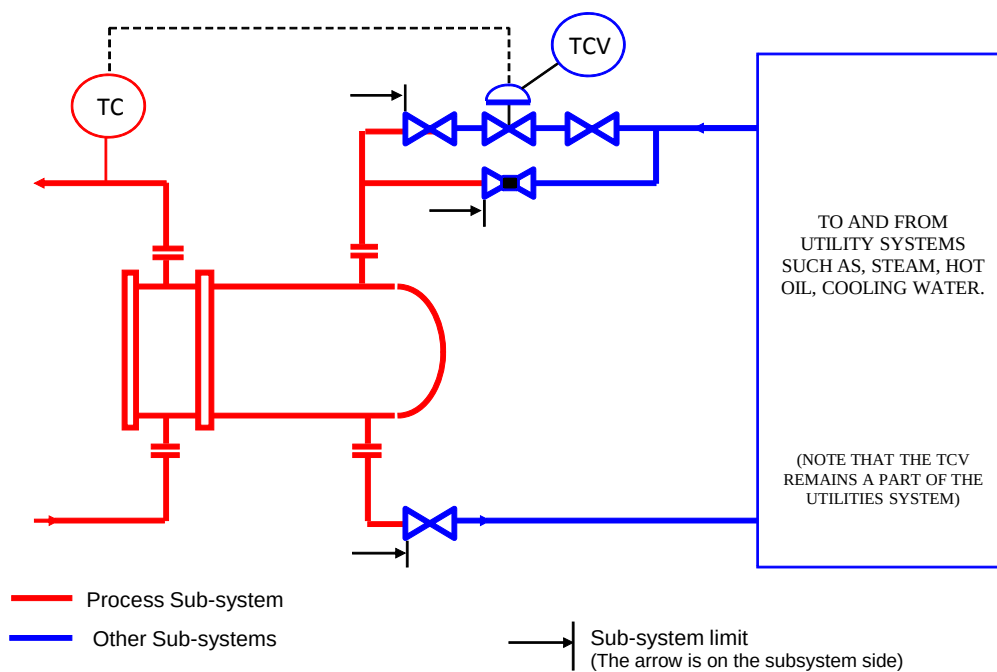


FIG 7

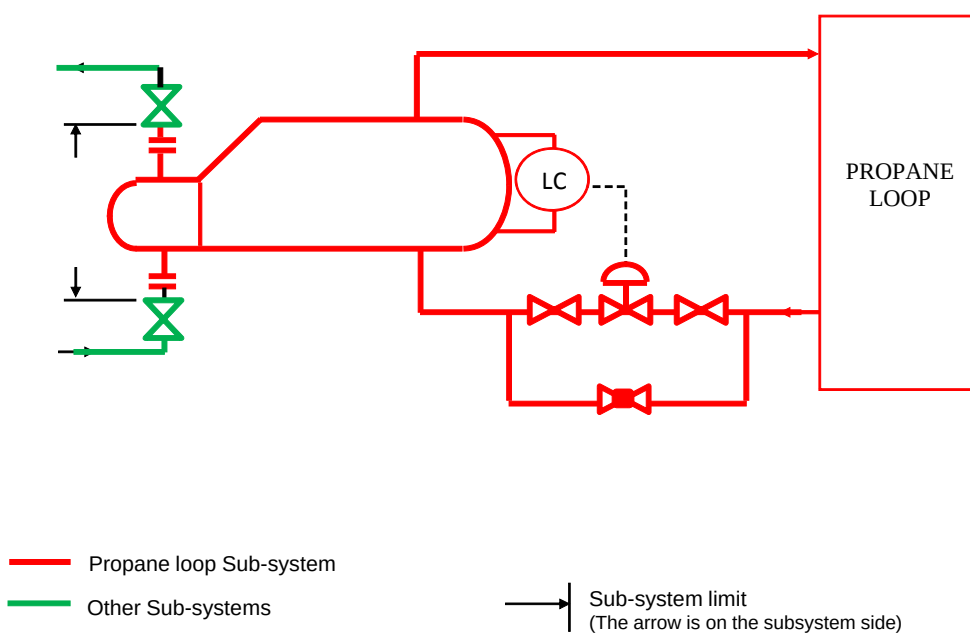


FIG 8

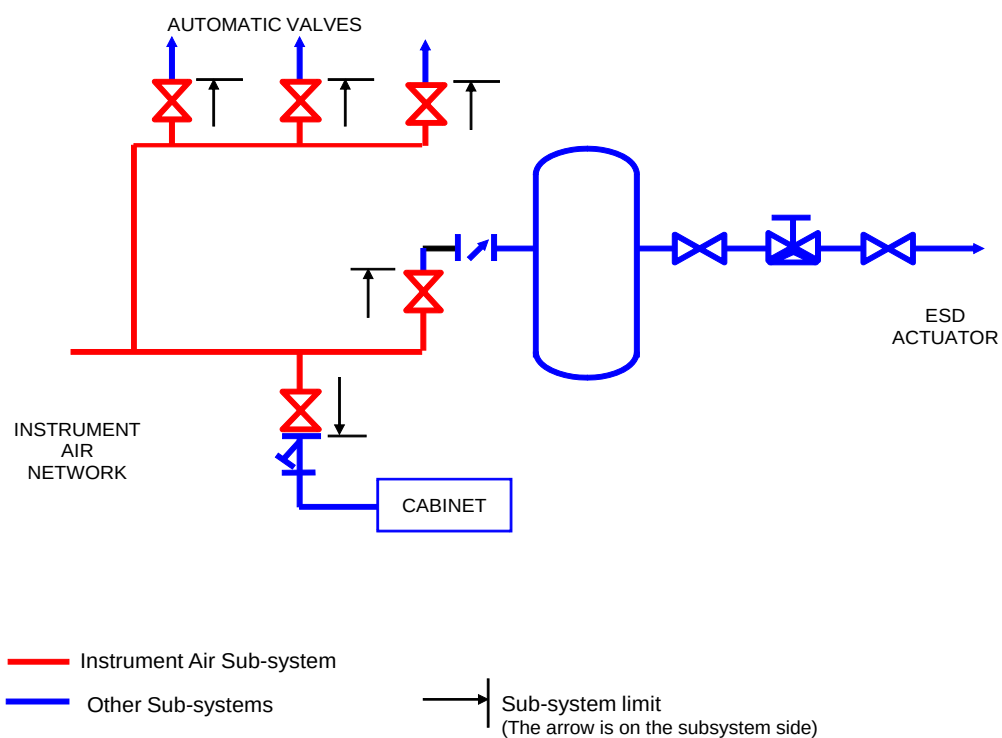


FIG 9

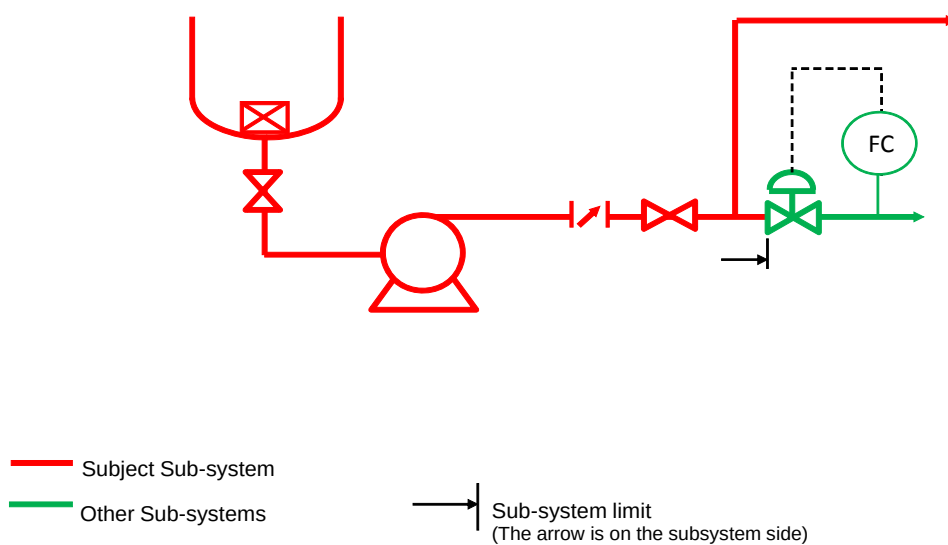


FIG 10

Off line Manifold architecture

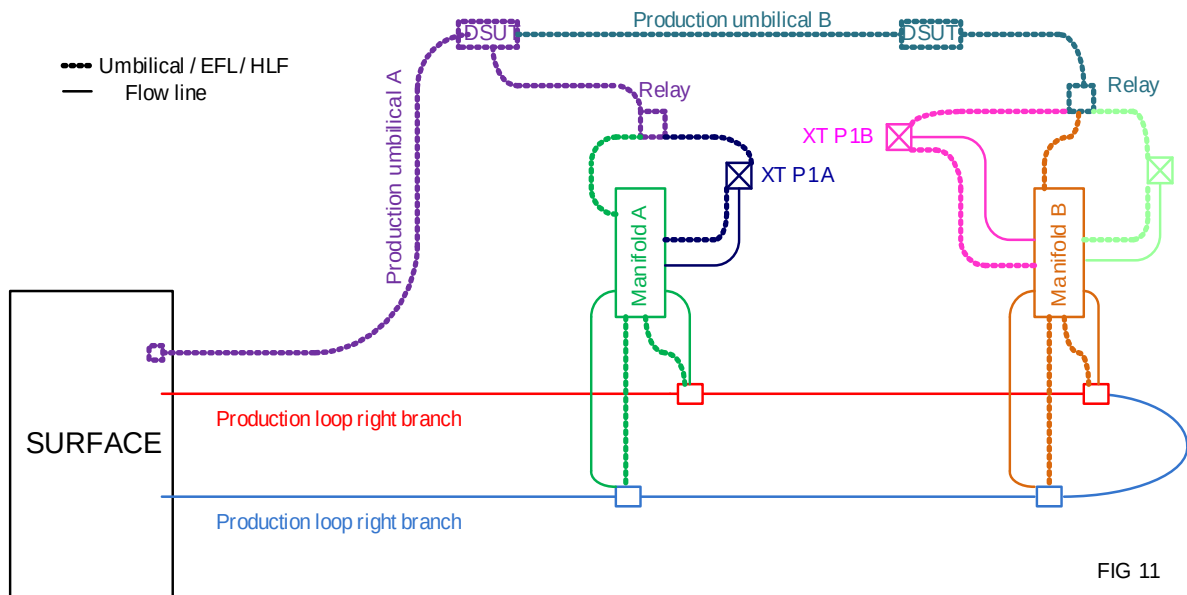


FIG 11

On line Manifold architecture

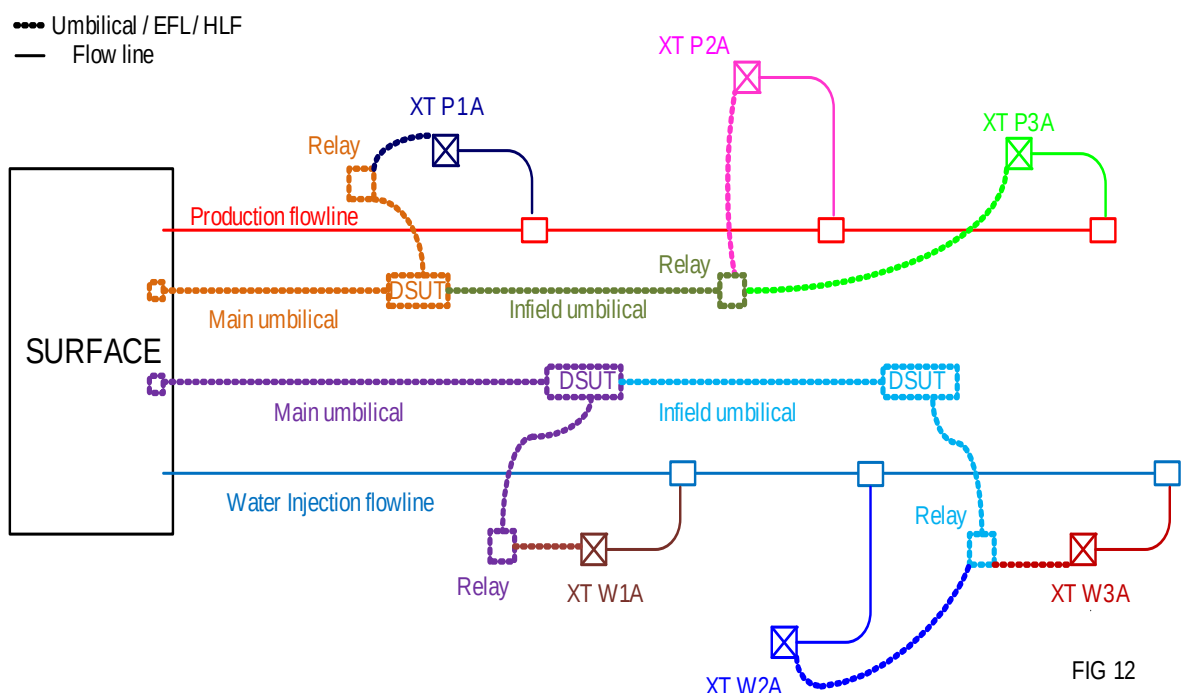
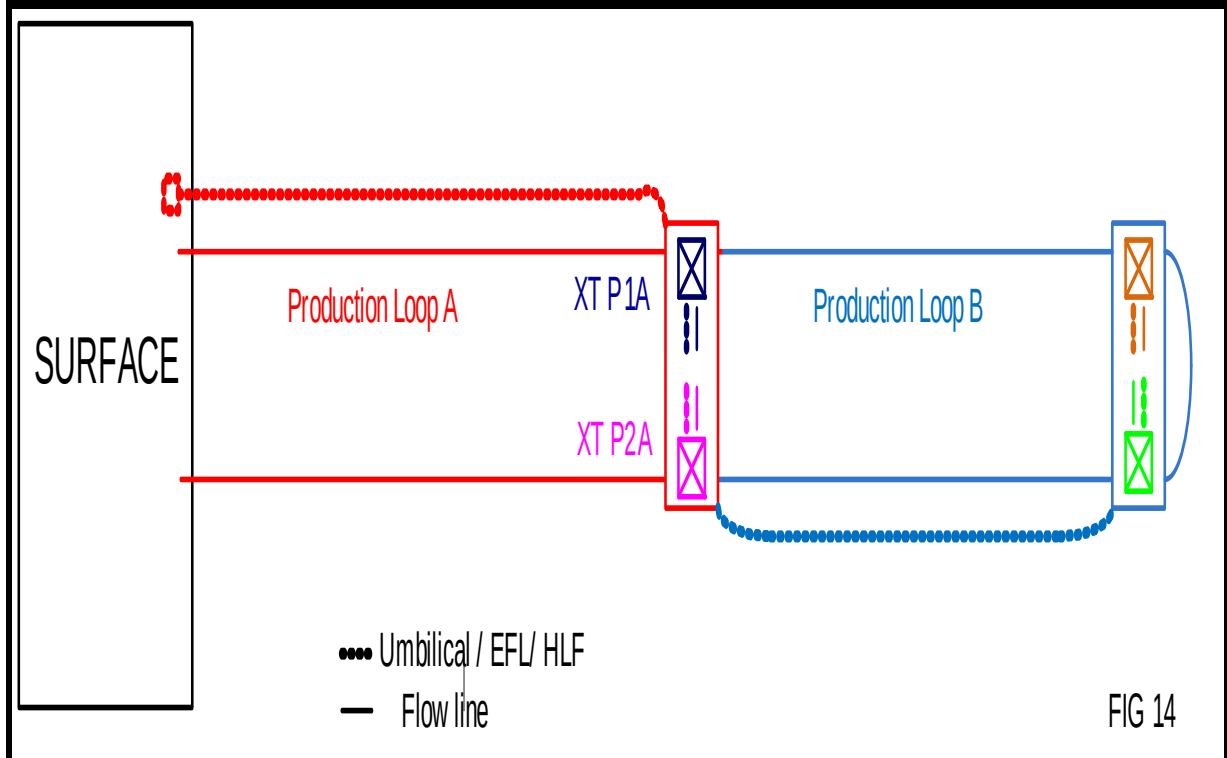
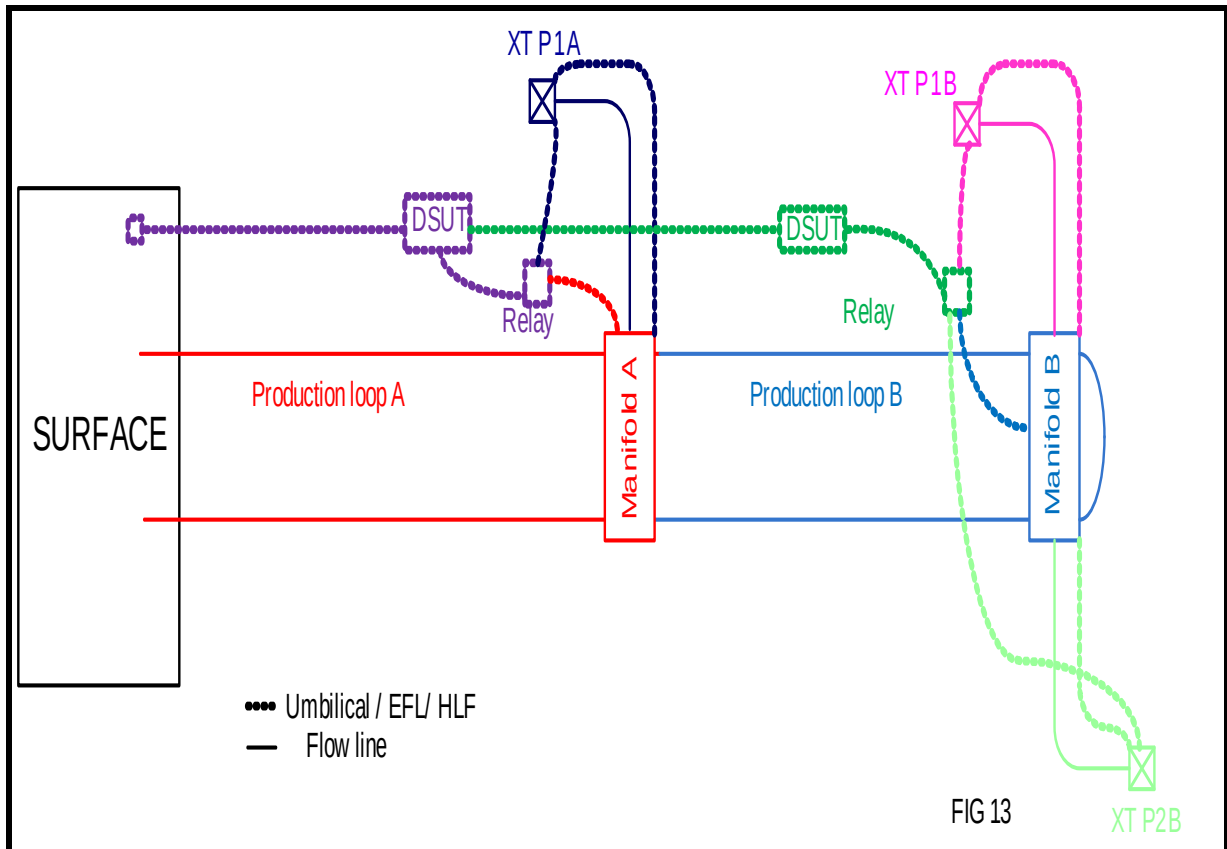
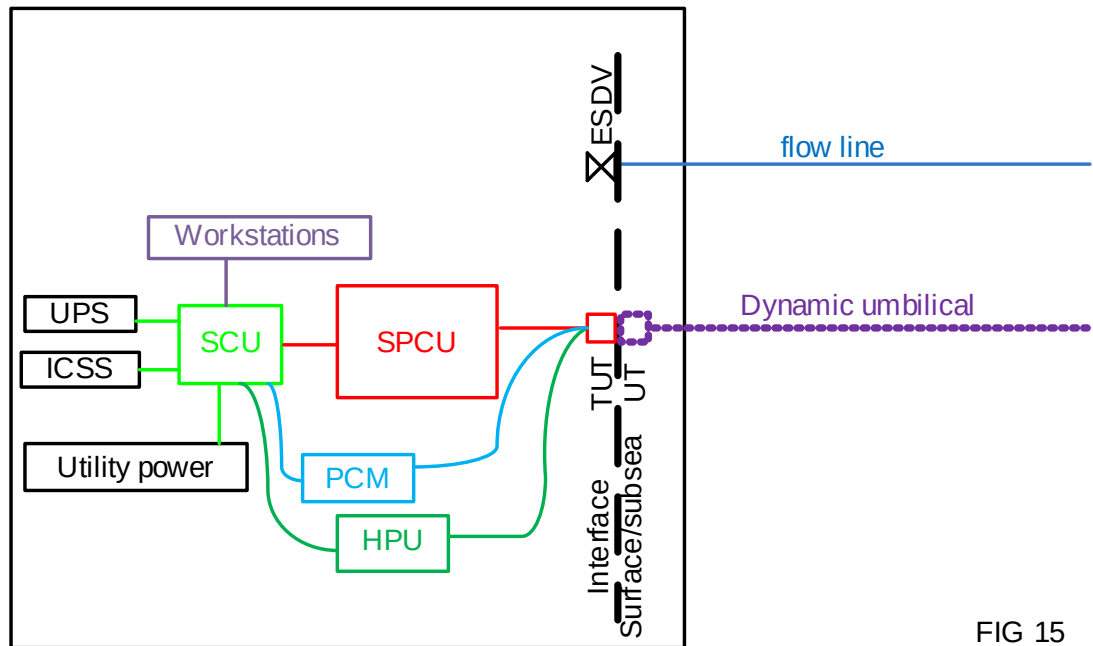


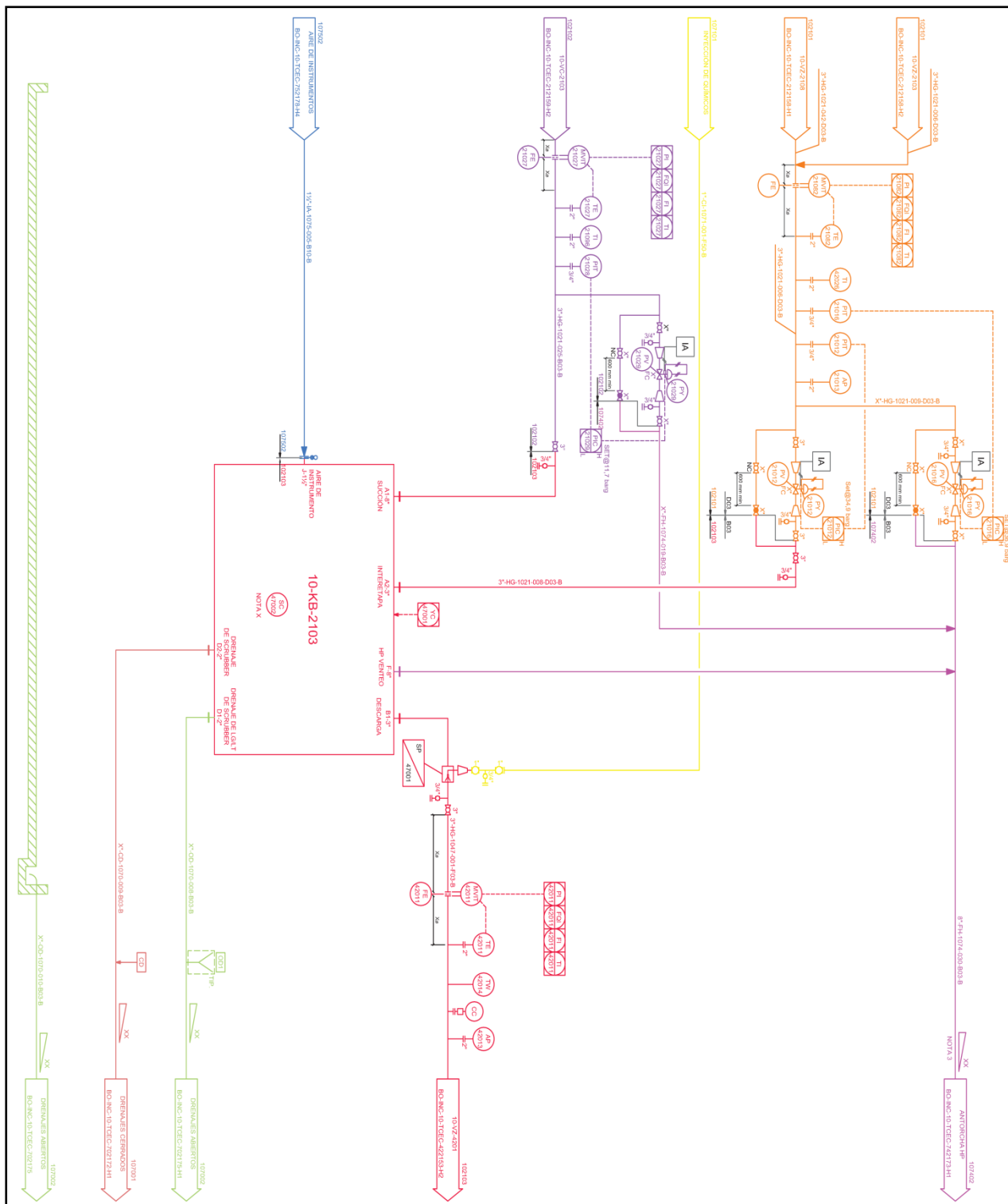
FIG 12



SURFACE


FIG 15

Appendix 4 Examples of P&ID and SLD Mark-up



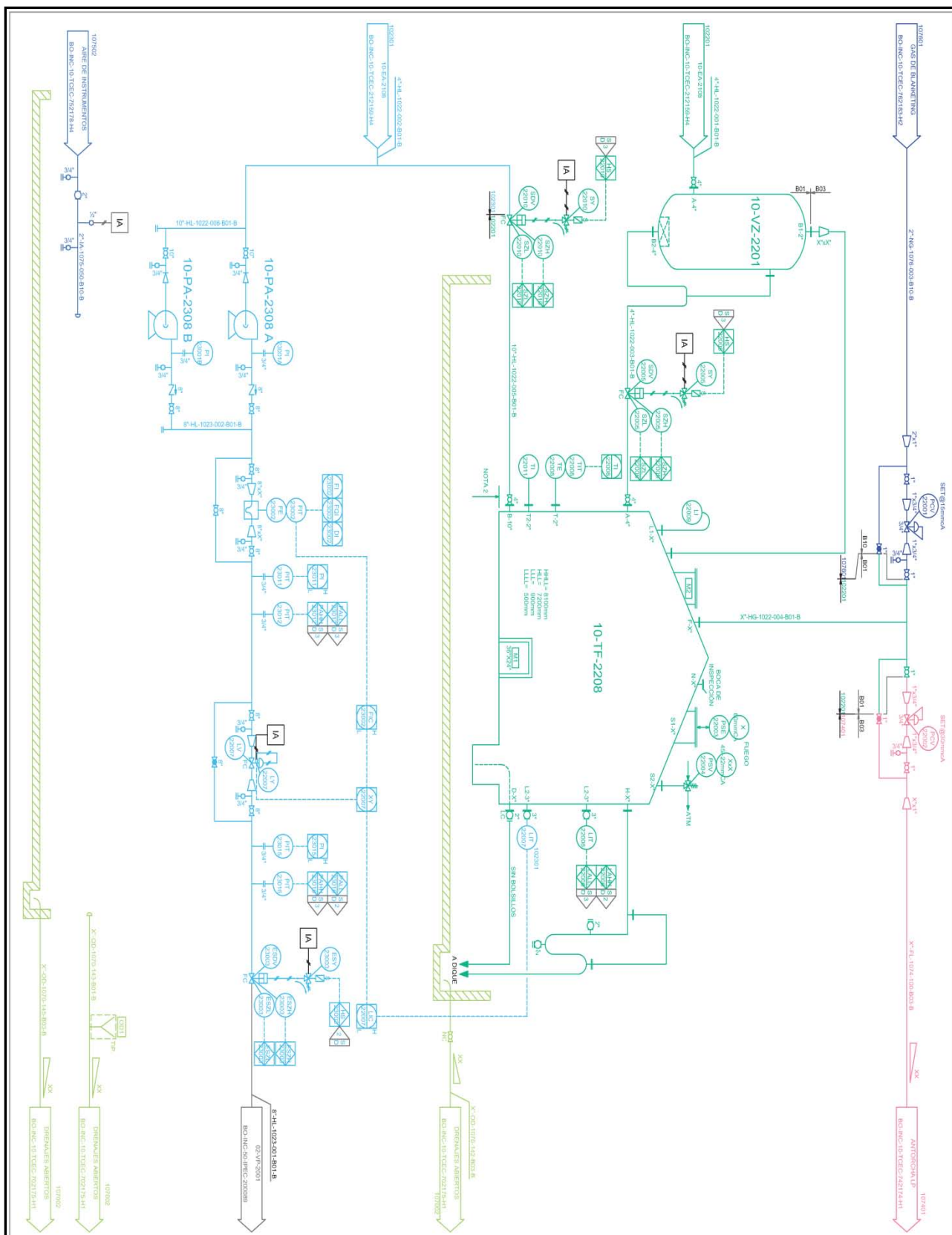
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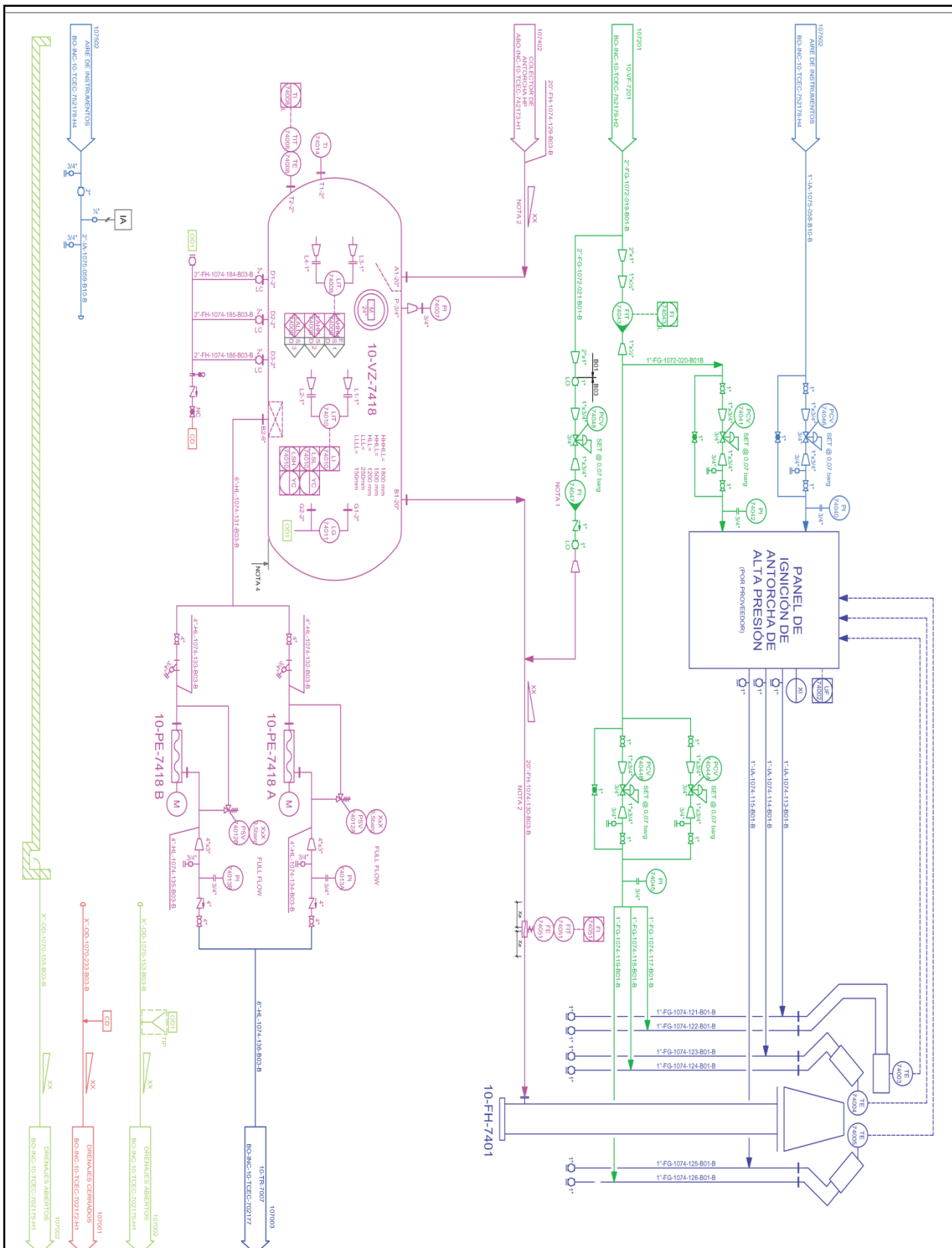
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Appendix 4



Appendix 5 Pre-commissioning and Commissioning Deliverables list

The list of deliverable is intended to define the minimum requirements for Engineering Documents related to **Pre-commissioning** and **Commissioning** to be prepared and issued.

- Group A: **Pre-commissioning** and **Commissioning** Management Documents.
- Group B: **Pre-commissioning** Documents.
- Group C: **Commissioning** Documents.

	Deliverable Title	TYPE
1	Commissioning HSE Plan	A
2	Commissioning Permit to Work Procedure	A
3	Electrical Isolation Procedure	A
4	Electrical Isolation Register	A
5	Instrument Inhibit and Override Procedure	A
6	Instrument Inhibit and Override Register	A
7	Mechanical Isolation Procedure	A
8	Mechanical Isolation Register	A
9	Mechanical Isolation P&ID Mark-Up	A
10	Sub-systems List and Definition	A
11	Sub-systems Identification Mark-Up Drawings	A
13	Plant Start-Up Sequence	A
14	Pre-commissioning and Commissioning Execution Plan	A
15	Pre-commissioning and Commissioning Interface Procedure	A
16	Pre-commissioning Sequences	A
17	Pre-commissioning Engineering Schedule and Milestones	A
18	Pre-commissioning Execution Schedule and Milestones	A
19	Commissioning Sequences	A
20	Commissioning Engineering Schedule and Milestones	A
21	Commissioning Execution Schedule and Milestones	A

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	Deliverable Title	TYPE
22	Commissioning 6 Weeks Look Ahead Schedule	A
23	Pre-commissioning & Commissioning Job Descriptions	A
24	Pre-commissioning & Commissioning Teams Organization Charts	A
25	Pre-commissioning & Commissioning Team Mobilization Plan	A
26	Pre-commissioning and Commissioning Witnessing and Notification Procedure	A
27	Pre-commissioning and Commissioning Certificates Signature Matrix	A
28	Pre-commissioning and Commissioning Witnessing Matrix	A
29	Commissioning Cost Control Procedure	A
30	Pre-commissioning and Commissioning Progress Calculation and Reporting procedure	A
31	Pre-commissioning and Commissioning Management of Change Procedure	A
32	Pre-commissioning and Commissioning Red-line Mark-up and as Built Procedure	A
33	Software Modification Procedure	A
34	Vendors Modifications Control Procedure	A
35	Pre-commissioning Red Line Mark Up Master Dossier	A
36	Commissioning Red Line Mark Up Master Dossier	A
37	ICAPS© Management Procedure	A
38	ICAPS© data requirement procedure	A
39	Typical Pre-commissioning Check Sheets (per discipline)	A
40	Typical Pre-commissioning Test Sheets (per discipline)	A
41	Typical Commissioning Preliminary Check Sheets (per discipline)	A
42	Typical Commissioning Functional Test Sheets (per discipline)	A
43	Punch List Management Procedure	A
44	Pre-commissioning, Commissioning & Start-up Tools, Consumables & Spares Parts Management Procedure	A
45	Pre-commissioning and Commissioning Subcontracted Service List	A
46	Pre-commissioning and Commissioning Vendors Organization Charts	A
47	Pre-commissioning and Commissioning Vendors Mobilization Plan	A

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	Deliverable Title	TYPE
48	Subcontractor/Vendor Close-out Report (one per intervention)	A
49	Package Test Plan (one per package)	A
50	Preservation Procedure	A
51	Preservation schedule	A
52	Preservation Records	A
53	Winterization Procedure	A
54	Pre-commissioning and Commissioning Close Out Report	A
55	Pre-commissioning and Commissioning Lesson Learn Register	A
56	Pre-commissioning and Commissioning Master Document Register	A
57	Pre-commissioning spare parts and special tools list	B
58	Pre-commissioning spare parts and special tools register	B
59	Pre-commissioning Tools and Consumables List	B
60	Critical Valves List	B
61	Critical Valves Leak Test Procedure	B
62	Hydro-Testing Procedure	B
63	Hydro-Testing Test Pack list	B
64	Hydro-Testing Test Pack Dossier (One per test)	B
65	Piping Cleaning Procedure	B
66	Piping Cleaning Test Pack List	B
67	Piping Cleaning Test Pack Dossier (One per test)	B
68	Chemical Cleaning Procedure	B
69	Chemical Cleaning Test Pack List	B
70	Chemical Cleaning Test pack Dossier (One per test)	B
71	Reinstatement Procedure	B
72	Flange Management Procedure	B
73	Gross Air Leak Test Procedure	B

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	Deliverable Title	TYPE
74	Gross Air Leak Test Pack list	B
75	Gross Air Leak Test pack Dossier (One per test)	B
76	Relief Valves Certification Testing Procedure	B
77	Fragile Device Identification Procedure	B
78	Fragile Device List	B
79	Instrumentation Tubing Testing and Flushing Procedure	B
80	Instrumentation Calibration and Testing Procedure	B
81	Electrical Pre-commissioning Procedure	B
82	Lifting Equipment Pre-commissioning Procedure	B
83	Subsea Equipment Pre-commissioning Procedure	B
84	Pre-commissioning Dossier (one per Sub-system)	B
85	Commissioning Functional Test Sheets (one per actual test)	C
86	List and Schedule of FAT	C
87	FAT Procedures (one per FAT)	C
88	Commissioning spare parts and special tools list	C
89	Commissioning spare parts and special tools register	C
90	Commissioning tools and consumable list	C
91	Temporary Installations and Equipment Management Procedure	C
92	First Fills List and Quantities	C
93	MOP Leak Testing Procedure	C
94	MOP Leak Test Pack list	C
95	MOP Leak Test Pack Dossier (One per Test Pack)	C
96	Drying, Vacuum and Inerting Procedure	C
97	Instrumentation loop testing Procedure	C
98	ICSS Site Acceptance Test Procedures	C
99	Telecom Commissioning Procedure	C

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	Deliverable Title	TYPE
100	Electrical Commissioning Procedure	C
101	Lifting Equipment Commissioning Procedure	C
102	Operational Tests list and Responsibilities	C
103	Operational Tests Procedures (one per OT)	C
104	Black Start Operational Tests Procedure	C
105	HIPPS Operational Test Procedure	C
106	Commissioning Dossier (one per Sub-system)	C
107	Initial Operation of Equipment Procedures (one per equipment / sub-system)	C
108	Maintenance of Equipment Procedures (one per equipment / sub-system)	C
109	Maintenance schedule	C
110	Maintenance records	C
111	Start-up spare parts list	C
112	Start-up spare parts register	C
113	Transfer of operation and maintenance Procedure	C
114	Transfer dossier (one per Transfer of Operation and Maintenance Milestone)	C
115	Pre-commissioning and Commissioning Spare Parts and Special Tools Transfer Procedure	C

Appendix 6 OTP Template

Project Header Template



OTP for XXXXXX

SYSTEM: XXXX

Sub system covered: XXXX

BV review requested	☐ ☐
If yes	
Approved by	
Date	

Reserved to Company	
The document is :	
Approved without comment	code 1 ☐
Approved with comments	code 2 ☐
Not Approved	code 3 ☐
Date:	
ASB final acceptance	
Date:	

Rev.	Status	Date	Revision memo	Issued by	Checked by	Approved by

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Project Header Template

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Appendix 6**Project Header Template****1. OTP SUMMARY****1.1 PROCESS SYSTEM DESCRIPTION****1.1.1 Process description****1.1.2 Control Philosophy****1.1.3 Functional sketch**

**INSERT A SKETCH/PFD
OF THE EQUIPEMENT/SYSTEM
INVOLVELD IN THE OT**

Project Header Template

1.2 SAFETY DEVICES

Items	Set Point	Description	Action	Yes/No

1.3 OTP OBJECTIVE

The objective and purpose of this operational test procedure is as follows:

.....

1.4 HSE MANAGEMENT

1.5 REFERENCE DOCUMENTS

1.5.1 P&ID

1.5.2 PFD

1.5.3 OWS & PSS Functional analysis

1.5.4 Electrical Drawings

1.5.5 Safety logic diagram

1.5.6 Vendor document

1.5.7 Equipment Datasheets

1.6 ACCEPTANCE CRITERIA

Project Header Template

2. OTP PLANNING AND MANPOWER

2.1 MANPOWER

TASK DESCRIPTION AND COMMISSIONING PERSONNEL	MAN-HOURS				
	E	I	M	FO	TOTAL
Discipline Leader					
Discipline Supervisor					
Technician					
Field Supervisor					
Control Room Operator					
Field Operator					
Vendor Representative					
TOTAL					

2.2 TEST DURATION ESTIMATE

2.3 VENDOR ASSISTANCE

2.4 INTERDISCIPLINE COORDINATION AND RESPONSIBILITY

Project Header Template

3. OTP TEST REQUIREMENTS

3.1 PRECOMMISSIONING ACHIEVEMENT

3.2 COMMISSIONING ACHIEVEMENT

3.3 OTHER SUB-SYSTEMS REQUIRED FOR TEST

The following subsystems interfaced with this OTP and must be commissioned and/or operational before starting the OT:

Sub-Systems	Description

3.4 TEST EQUIPMENT

3.5 LISTING OF ELECTRICAL USERS

TAG N°	Description	kW	Voltage

3.6 SPECIAL TOOLS

3.7 CONSUMABLES INCLUDING OIL & GREASE / FIRST FILL ETC

3.8 COMMISSIONING SPARES

3.9 TEMPORARY FACILITIES/EQUIPMENT

Project Header Template

4. OTP DESCRIPTION

4.1 OTP TEST PREPARATION

4.1.1 Mechanical preparation

Step N°	Task description	Completion		
		Comments	Sign	Date

4.1.2 Electrical preparation

Step N°	Task description	Completion		
		Comments	Sign	Date

4.1.3 Instrument preparation

Step N°	Task description	Completion		
		Comments	Sign	Date

4.1.4 Piping preparation

Step N°	Task description	Completion		
		Comments	Sign	Date

4.1.5 Other system preparation

Step N°	Task description	Completion		
		Comments	Sign	Date

Project Header Template

4.2 OTP STEPS DESCRIPTION

4.2.1 Operating test

4.2.1.1 Before COF Introduction

Step N°	Task description	Completion		
		Comments	Sign	Date

4.2.1.2 After COF Introduction

Step N°	Task Description	Completion		
		Comments	Sign	Date

4.2.2 Shut Down

Step N°	Task description	Completion		
		Comments	Sign	Date

4.2.3 Post test conditions

Step N°	Task description	Completion		
		Comments	Sign	Date

4.2.4 Reinstatement tasks

Step N°	Task description	Completion		
		Comments	Sign	Date

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Appendix 6
Project Header Template
5. OTP TEST REPORTS / HIGHLIGHTS AND RECOMMENDATIONS
5.1 DATA RECORDING

NOTE: This section summarizes / explains the expected results, charts, etc, to be recorded during OTP for the different equipment involved / tested. It shall be customized as per actual OT requirements, on a case by case basis

Tag	Description	Value							

6. OTP ACCEPTANCE CERTIFICATE
7. APPENDICES
APPENDIX 1 RED LINE MARKED UP DOCUMENTS

In this section, integrate the list of all marked-up documents done during operational tests

DOCUMENT NUMBER	REV	DESCRIPTION

APPENDIX 2
APPENDIX 3

Appendix 7 Safety signs samples





Appendix 8 Typical data requirement for ICAPS© database

Note: Refer to ICAPS documentations for more details.

Systems

As defined in [GS EP EXP 101](#)

Data required	Type	Size
System number	Character	30
System description	Character	50

Sub-Systems

As defined in [GS EP EXP 101](#)

Data required	Type	Size
Sub-system number	Character	30
Sub-system description	Character	100

Items

As defined in [GS EP EXP 101](#)

Data required	Type	Size
Item TAG number	Character	30
Item description	Character	50
Type of Equipment as defined in GS EP EXP 105	Character	30
Sub-system number of the equipment.	Character	30
PID number of the equipment.	Character	50

Test Packs

As defined in [GS EP EXP 101](#)

Data required	Type	Size
Test Pack number	Character	30
Test Pack Sub-system number.	Character	30
Test Pack description.	Character	30

Basic Functions

As defined in [GS EP EXP 101](#)

Data required	Type	Size
Basic Function Tag number	Character	30
Type of Basic Function as defined in GS EP EXP 107	Character	30
Basic Function Sub-system number.	Character	30
Basic Function description.	Character	30

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Appendix 9
Appendix 9 Extract from GS EP EXP 501, Appendix 2.

CS	CSS	Sub-system
0	1	Fire fighting generation/Distribution
0	2	Safety/Evacuation equipment
0	3	ESD and Fire & gas
0	4	Subsea/Surface Control & Supervision
0	5	Emergency power generation/distribution
0	6	Auxiliaries power generation/distribution (UPS, 48/24/12 Vcc)
0	7	Instrument Air/Gas - Hydraulic power
0	8	Communication/Telecom
0	9	HVAC
1	0	Extraction Wells/Flowlines/Manifolds/Pumping/well metering
1	1	Slug catcher, main/test separation & metering
1	2	Transfer
2	0	Separation/Heating/Cooling (including manifold)
2	1	Dehydration/Desalting/Stabilisation (including Stripping)
2	2	Sweetening (Mercaptan, Mercury, H ₂ S, CO ₂ , RSH)
2	3	Transfer
2	4	Storage
2	5	Export/Off loading
2	6	Metering
2	7	Oily water processing
2	8	Closed drains/Open drains
3	0	Dehydration/Sweetening
3	1	Gas Compression
3	2	Liquid extraction
3	3	Sulphur recovery/Sulphur storage and export
3	4	Transfer
3	5	Gas export/Metering
3	6	Gas disposal (acid gas, flare, vent)
3	7	Injection well
4	0	NGL extraction (including Liquid extraction)
4	1	Refrigeration
4	2	Fractionation
4	3	Dehydration/Sweetening
4	4	Storage
4	5	Export/Off loading

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Appendix 9

4	6	Metering
CS	CSS	Sub-system
4	7	Sulphur recovery/Sulphur storage and export
5	0	Water lifting (including water production wells, transfer lines)
5	1	Filtration (main and preliminary)
5	2	Electrochlorination
5	3	Water treatment (Sulphur removal/de-oxygenation)
5	4	Water injection (including pumps, metering, headers)
5	5	Injection wells/Flow-lines/Manifolds
6	0	Main Power generation
6	1	Power distribution (HV, LV)
6	2	Lighting
6	3	Earthing
6	4	Navaid
7	0	Fuel gas
7	1	Fuel oil/diesel oil (including storage/distribution)
7	2	Hot water generation and distribution
7	3	Hot oil generation and distribution
7	4	Inert gas/Nitrogen generation and distribution
7	5	Chemical storage & injection (including methanol)
7	6	Cooling water
7	7	Industrial water/Generation and distribution
7	8	Lifting equipment
7	9	Insulation/trace Heating
8	0	Laboratory
8	1	Helideck (including Kerosene)
8	2	Living quarters/Catering/Offices/Civil buildings/Sewage
8	3	Technical rooms
8	4	Workshop/warehouse
8	5	Soft water
8	6	Structures/Mooring/Ballast
8	7	Cathodic protection