Exploration & Production

GENERAL SPECIFICATION

GS EXP 101

Precommissioning and commissioning specification

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1. Scope

This specification summarises the COMPANY Group conception of Precommissioning and Commissioning activities. These specifications shall be read as an introduction to the above Technical Specifications as, by giving the rationale and key principles of the Precommissioning and Commissioning, they will allow an easier approach to anyone having to prepare or carry out this kind of operations.

Within COMPANY, the functional aspects of the Precommissioning and Commissioning activities are under the responsibility of DGEP/TDO/EXP. They will be referred to for any assistance on these matters.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

COMPANY General Specifications

Reference	Title
GS EXP 103	Precommissioning and Commissioning Technical Preparation
GS EXP 105	Precommissioning Execution
GS EXP 107	Commissioning Execution

3. Introduction

The technical complexity of the new hydrocarbon installations is on the increase, as displayed by all recent large projects where sophisticated data, control, and safety systems prevail. Moreover, the higher efficiency, reliability, and safety expected from the new plants, as well as the aggressive environments in which they are often built, those surrounding the offshore platforms and especially the deep offshore facilities, challenge the design and construction teams as never before. Consequently, a number of techniques have been developed during the past years to overcome the problems that these demanding conditions create, among which are the tools required to conduct a project through its completion phases.

To cover this specific aspect of project completion activities, COMPANY, based on their know-how and experiences, has developed the OPERCOM™ methodology as defined in the following specifications and ICAPS© (Integrated Commissioning And Progress System) a dedicated tool used to organise and follow through Precommissioning and Commissioning activities:

- GS EXP 103: Precommissioning and Commissioning Technical Preparation
- GS EXP 105: Precommissioning Execution
- GS EXP 107: Commissioning Execution.

These specifications and ICAPS© (when a software is required), mandatory for each COMPANY project, are now the basic tools necessary to obtain a smooth transfer of the installations from the Construction Team to the Operator, as quickly as possible, in full confidence, and with all the required safety.

This set of documentation is complemented by the present:

- GS EXP 101: Precommissioning and Commissioning Specification.

It should be noted that the above set of documentation does not cover all Quality Control activities achieved on a new plant: a number of inspection Tasks distinct from Precommissioning and Commissioning operations- such as the dimensional control of structures, the quality of welding, painting and materials, flange, gasket, will also be undertaken and available for any request from COMPANY. These tasks are covered by a different methodology defined in the Construction QC manuals issued by Construction CONTRACTOR (following GS PJC 501/502/503, GS PVV 912, GS PLR 501/502, GS SPS 001, ….).

4. Safety during activities

The Health, Safety and Environment charter of the COMPANY group governs the position that shall be taken for Precommisssioning and Commissioning activities within or under the control of the COMPANY.

In particular "no economic priority shall overrule consideration of health and safety at work and respect of the environment".

Therefore, it is COMPANY policy,

- When Precommisssioning and Commissioning activities are carried out in the CONTRACTOR yard, to give responsibility of the Permit to Work system to the yard authorities provided that their system is in accordance with a recognised international standard. If not the system shall be upgraded as proposed in COMPANY rules.
- When Precommisssioning and Commissioning activities are carried out on COMPANY site or under COMPANY responsibility, COMPANY Permit to Work system shall apply, according COMPANY specification.

5. Phases

5.1 Completion activities

The completion activities of a new hydrocarbon processing plant consist of a series of various **verifications** carried out just before the plant is brought on line. The aim of these verifications is to ensure, as thoroughly as practicable, that every piece of equipment are built and operate as per design. These verifications are also the last critical review of the design before start-up. Their ultimate goal is to render the plant oil or gas in as safe and troublefree as possible.

These completion activities are separated into two phases, **Precommissioning** and **Commissioning**, this split roughly corresponding to **static** and **dynamic tests** phases respectively.

The completion activities are followed by the **Start-up** phase itself, corresponding to the introduction of the **hydrocarbon** feedstock into the plant.

5.1.1 Precommissioning

The Precommissioning phase includes three main types of field activities:

- **Conformity checks**: Carried out on each item of equipment or component, such as instruments, packages, motors, cables, vessels, etc., to verify visually the condition of the equipment, the quality of the installation, the compliance with Project drawings and specifications, VENDOR's instructions, safety rules, codes, standards and good practice.
- **Static/de-energised tests**: Carried out on equipment to ensure the quality of a number of critical components. This "cold" testing concerns all disciplines, e.g. calibration of ESD instruments, machinery alignments, setting of safety valves, pressure testing of piping, cables continuities, etc.
- **Piping Test (Test Pack)**: Carried out on pipes work and vessels, air or water flushing, pressure test (hydrotest, gross leak test).

5.1.2 Commissioning

The Commissioning phase essentially includes the three following categories of tasks:

- **Dynamic verifications** that for each Plant elementary electrical, telecommunications, and instrumental function, performs properly according to its design criteria. Typical examples of such tests are electrical motors uncoupled runs, instrument loops tests, electrical breakers operation. The energization of the electrical distribution network is part of this activity.
- **Running-in and on-line tests** for a significant period of the **plant utilities** (electrical, air, HVAC, water, crane, etc.), and wherever applicable, of the main process equipment in closed loop **with inert fluids**. Witnessing and assistance from Operator is required to allow a smooth transfer of the facilities from the Commissioning team to the Operator, in full confidence, and with all the required safety.
- **Pre-Start-up activities**: A number of activities related to, such as piping drying-out, chemical cleaning, **Process** leak testing, and inerting, or loading of various chemicals and catalyst.

5.1.3 Surface packages and Subsea equipment

Surface packages and Subsea equipment Commissioning have some particularities compared to conventional facilities.

COMPANY philosophy is that surface packages and Subsea equipment are tested to the maximum, in the manufacture's premises, prior to shipping. These tests are finalised through Factory Acceptance Tests (FATs') and should be carried out according to the OPERCOM™ methodology, wherever applicable. Since surface packages and Subsea equipment often form part of a Plant functional Sub-system further commissioning will be required on site, either in the integration yard/site or at the final Plant location. Generally the reason for additional and/or repeated commissioning, on site, is that the plant functional sub-system is often uncompleted (local and remote control).

All those systems shall be finally commissioned after installation and hook-up and the commissioning and start-up may be carried out sequentially.

In any case, tests to be carried out at the SUPPLIER premise shall demonstrate the correct design, manufacture and operation of the equipment and its performance in accordance with the specification.

For this reason, all Tests carried out at the SUPPLIER premise is considered as a sub-set of the Precommissioning activities, and hence under the responsibility of the Precommissioning CONTRACTOR. Lastly, those tests shall be witnessed by the Commissioning team.

5.2 Start-up

The Start-up activities begins with the final preparation to the introduction of the feedstock into the plant and consist of a series of various tests carried out during the plant is brought on line. The aim of these tests is to ensure that all equipment operate normally and securely. The technical assistance for Start-up from Commissioning team may be required.

The Start-up activities are prepared with the integration of specific Start-up and routine procedures that are draw up according to the OPERGUID methodology.

The field activities consists of two sub-stages:

- **Operate prior oil/gas in:** Line up pipework and vessels (valves, PSV, interlocks, etc.), carry out final safety tests with the provision of associated documents (safety procedures, isolation, inhibition, HC introduction certificate if needed, etc.).
- **Operate after oil/gas in:** bring the process in operation with Oil/gas-in, water injection…ensure the ramp-up and carry out the Performance tests to prove the plant and equipment are performing as per design capacities and can deliver the products within specifications.

In order to carry out a smooth transfer, the Start-Up team shall follow-up, assist, and check Site Acceptance Tests and appropriate Commissioning activities (leak test, Running-in of the plant utilities, Oil or gas-in preparation, ESD demonstration, etc.).

6. Precommissioning and Commissioning methodology

The methodology described below in this chapter is compulsory, and shall be strictly applied. This methodology is supported by a tool ICAPS©, mandatory to be used in COMPANY projects.

The tests to be carried out during Precommissioning and Commissioning activities shall be systematic and exhaustive, according to the methodology described bellow. No equipment or part of the installation shall be accepted without associated check and tests prior to energisation and Start-Up. Each test shall be recorded through dedicated sheet, dated and signed by parties involved, according to the contractual organisation and the witnessing principle as per defined chapter 10.3. The name of the representative of each party shall be clearly recorded.

In the event that Check Lists and Test Sheets (CCK or STS) defined in GS EXP 105 and Functional test Sheets (FTS) defined in GS EXP 107 are omitted for any item of equipment, the CONTRACTOR shall inform the COMPANY, review the requirements, issue a new sheet for COMPANY approval.

The omission from this specification of any item essential for the correct achievement of Precommissioning/Commissioning shall be brought to the attention of the COMPANY by the CONTRACTOR, and any deviation the CONTRACTOR may wish to make to this specification shall be submitted to the COMPANY for approval, which shall have to be received in writing before any deviation is implemented.

Lastly, the CONTRACTOR in charge of Precommisioning and/or Commissioning shall ensure his staff has a good knowledge about OPERCOM™ methodology and ICAPS© tool. Resource for training and implementation of OPERCOM™ and ICAPS© shall be planed at early stage during the Detailed Engineering.

6.1 "Systems" methodology

6.1.1 The "Systems Approach"

The checking and testing phases of a new plant is by necessity a relatively detailed and sophisticated process. Not all parts of the plant reach the same degree of completion at the same time, hence some areas or units may be mechanically completed while others are not. It would therefore be a waste of time to wait for the whole plant to be mechanically completed before starting commissioning activities.

The Start-up sequence of a new plant is driven by operational constraints: where safety equipment and critical utilities are given the highest priority. Other utilities and power generation are required earlier than the process equipment. Hence, contrary to the construction work progress, which is essentially planned by trades, areas and equipment tonnage, the optimisation of the start-up phase goes through the sequential completion of multi-trade operational units: fire pumps, power generation, etc.

In addition, for reasons of optimisation of means and resources, not all tasks related to Precommissioning, Commissioning disciplines can be undertaken simultaneously.

Therefore, the Project planning shall be optimised if the completion activities are organised not as whole plant activities, but by **Operational Systems and Subsystems.**

A system is a major subdivision of an installation, being either process or utility, that performs a major operational function of the plant. The system includes all the various equipment that allows it to operate. The firewater pumps, power generation, control systems, telecommunications, oil, gas, water processing, etc., are typical examples of systems.

A subsystem is a further subdivision of a system, that performs a partial operational function to the system, with no or little interference from the other subsystems. Several equipment with the same function in the system, main packages are typical examples of subsystems.

The "system approach" induces the following terminology, related to the systems, subsystems, and milestones:

- **Subsystems** are **Ready For Commissioning** when all Precommissioning activities are complete
- **Subsystems** are **Ready For Start-Up** when all Commissioning activities are complete
- **Systems or group of Subsystems** are **Ready For Operation** when all Start-up activities are complete.

Start-Up Team or Operator should pay a particular attention when the RFSU is issued. **This status does not presume for the concerned sub-system to bring it on Oil/gas in.**

There is particular case for the surface package and subsea equipment. The package will reach the Ready For Delivery status after the tests at the SUPPLIER premise are successfully carried out. The Ready For Commissioning of the package (if the package is a sub-system) will be achieved when the package will be installed on the target site, fully checked and tested after the integration.

6.1.2 Systems/Sub-systems definition

This specific partition of a plant into systems and subsystems for completions activities takes place as early as possible, at Basic Engineering phase and shall always be submitted for approval to the COMPANY.

The partition of a plant is a key preparation activity, that has a major impact on all aspects of completion operation. The subsystems must be defined so as to be as independent as possible, not too small, but of manageable size, and exactly adapted to the Start-Up sequence. The number of Sub-systems should not ideally be more than 200, but will depend on the size of the plant.

It is carried out by the CONTRACTOR Engineer, in accordance with precise subsystems delimitation rules specified in GS EXP 103, and reported on marked-up PID's and One Line Diagram's as support documents.

The basic principle of the completion activities will be to:

- **Define, organise, prepare, carry out, report** all Precommissioning and Commissioning activities by systems and subsystems
- The completion activities progress will be reported with a partial overlapping between systems and subsystems, according to the **Start-up sequence**

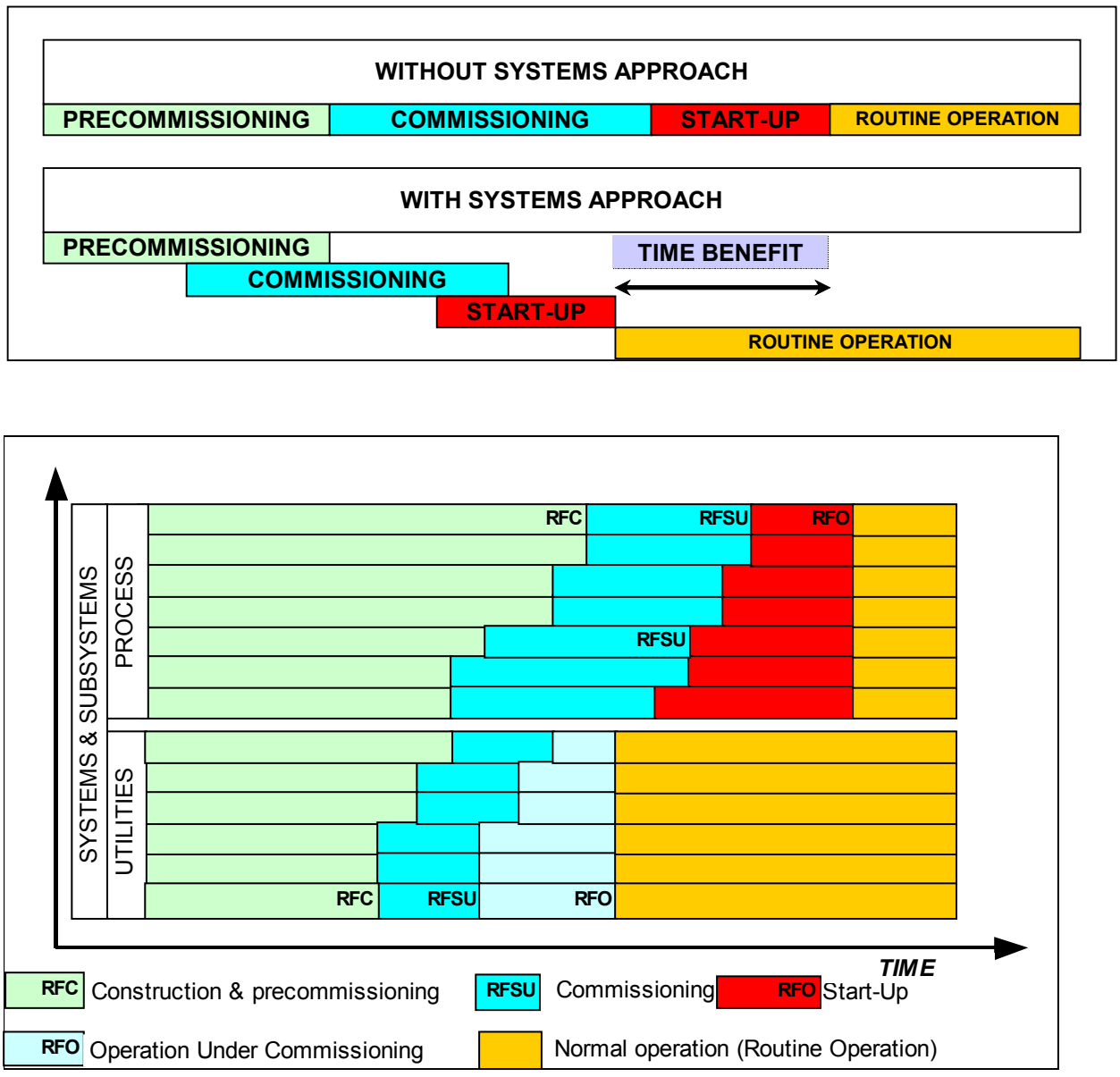


Figure 1 - The systems approach

Phase	Activities	Target milestones
Package/sub-sea equipment	Conformity checks Static/de-energised tests Test pack Local Dynamic verification FAT, E-FAT, etc.	**Ready For Delivery** By package
Precommissioning	Conformity checks Static/de-energised tests Test pack	**Ready For Commissioning** By Subsystems
Commissioning	Dynamic verification Running-in and on-line tests Pre-start-up activities	**Ready For Start-Up** By Subsystems
Start-up	Prepare/Witness Final test prior oil/gas in Operate	**Ready For Operation** By Systems

Figure 2 - Summary of completion activities and milestones

6.2 Precommissioning methodology

6.2.1 Specification

The COMPANY Precommissioning Specifications are:

- GS EXP 103, Precommissioning and Commissioning preparation
- GS EXP 105, Precommissioning execution.

They provide all required procedures and support documents to prepare and carry out Precommissioning activities. Their key principles are as follows.

6.2.2 Scope of work and activities

The Precommissioning activities are organised by system and subsystem, following an approved sequence that optimises the start-up phase.

The Precommissioning physical scope of work consists, as previously said, of:

- Systematic **conformity checks** of equipment items
- Selected **static/de-energised tests** of equipment items
- Pipes works **flushing, pressure test** grouped by **Test Pack** (hydrotest, gross air re-instatement leak tests).

6.2.2.1 Check lists

First type of task of the Precommissioning scope of work, the **conformity checks** shall be carried out in accordance with, and reported on **Check Lists**.

These Check Lists define the exact scope of work that shall be systematically performed on every item of equipment or on selected packages, the same support being also used to record the checks.

A set of standard check lists forms, each one adapted to a specific type of equipment, or to packages, is available in GS EXP 105.

One check list is filled in per subsystem and per type of equipment for each discipline.

For package and sub-sea installation check or test sheets are available for each type of equipment and/or group of equipment (by activity). In addition to this the CONTRACTOR shall define further pre-commissioning tests necessary under COMPANY approval which will take place at the VENDORS premises and/or on the installation vessel or site.

6.2.2.2 Test sheets

Second key Precommissioning activity, the static and **de-energised tests** shall be carried out in accordance with technical specifications, and reported on **Test Sheets**.

One standard Test Sheet form is available in GS EXP 105 for every type of Precommissioning test listed in the classification of activities.

One Test Sheet is filled in for each test performed.

6.2.2.3 Piping tests or Tests Packs

Third key Precommissioning activity, the Tests pack shall group Precommissioning activities on pipes work and vessels such as air or water flushing, pressure test (hydrotest, gross leak test).

The Tests pack may be carried out on lines included in different subsystem. Specific procedure, report, Check and Test Sheet available in GS EXP 105 support them.

For each element been a part of a Test Pack, the CONTRACTOR shall record, but not limited to :

- The type of piping and flange
- The quality of welding
- The quality of painting
- The type of gasket used for assembly.

All of these records shall be available for a COMPANY checking.

The Test Packs breakdown may not fully match with a hierarchical sub-system breakdown. The CONTRACTOR shall provide Tests Pack dossiers referenced with associated sub-system, with listing of the lines included (PI&D identification) and the Test Pack dossier reference shall be accepted and approved by COMPANY.

6.2.2.4 Particular requirement for subsea equipment & surface package at the RFC stage

Subsea equipment and surface packages are mechanically completed (RFC status achieved) after installation on the target site, irrespective of the amount of testing that may have taken place at the VENDOR's.

This is due to the fact that the factory tests:

- Are carried out with temporary wiring between the package and its control panel, and without the environment (ESD, F&G, remote control)
- Are essentially aimed at demonstrating the contractual performance point, whereas commissioning must prove all sequences, interlocks, safety trips
- Are achieved long before the start-up on site, hence their validity is doubtful, and often not assumed by the VENDOR himself for reasons of contractual guarantee.

For sub-sea equipment (Xmas trees, manifolds, etc.), the RFC is presented after all sub-sea connections have been completed and the pre-commissioning is complete.

Remark: Specific Site Acceptance Tests (SATs') may be required to demonstrate that packages can function on site when connected to the final power and utility supplies. Those Tests should be split according both phases (Precommissioning prior to energisation and Commissioning after energisation).

6.2.3 Status index

The Precommissioning scope of work is listed in a reference **Status Index.** The Status Index is a **list of all equipment** subject to one or several Precommissioning operations. This list, arranged per subsystem, discipline and type of equipment, shall be created by the CONTRACTOR from the various Engineering and VENDORS equipment lists (instrument list, cables list, piping list, etc.).

The Status Index indicates for each item of equipment (instrument, electrical cables, pumps, etc.) the corresponding Precommissioning tasks, i.e. checks, and tests when applicable, by showing the reference number of the task report document, i.e. Check Lists and Test Sheets numbers. The Status Index is therefore a summary of the Precommissioning scope of work.

The completion data of each task is recorded on the Status Index so that it is a working document used to follow up the work progress.

6.2.4 Punch list (during precommissioning)

The general principles are defined below chapter 6.5.

While the Precommissioning checks and tests are being performed, all discrepancies, damaged or missing equipment, malfunctions, missing documents, **if not corrected immediately**, are recorded in the subsystem **Punch List**.

At the Ready For Commisioning stage, an agreed punch List shall be issued for approval by the Commissioning team. This does not absolve the Construction / Precommissioning CONTRACTOR from his contractual obligations. During Commissioning and Start Up additional punch list items that are found shall be included in the punch list, for resolution by the appropriate CONTRACTOR and/or VENDOR. See section 6.3.4 Punch List (During Commissioning).

6.2.5 Precommissioning dossiers

All documentation pertaining to the Precommissioning operations is compiled in a specific Dossier, arranged by:

- System
- Subsystem.

They contain all the information required to demonstrate that a subsystem has reached the "Ready for Commissioning" status.

Its content is fully defined through GS EXP 105.

6.2.6 Precommissioning activities summary

Task	Discipline	Number	Support Document
Conformity Checks	All	• 1 per item of equipment (field) • 1 per package (wherever OPERCOM™ not applied)	• 1 Check List per type of equipment, package and subsystem (field) • List of checks in the Status Index
Static Tests	All	• 1 test per specified item (field) • 1 test per safety item of package (wherever OPERCOM™ not applied)	• 1 Test Sheet per test • List of tests in the Status Index
Tests Pack	Piping	• 1 per group of lines per Subsystem or network	• Specific procedure and report • Test sheet
Factory Acceptance Tests	All	• As appropriate for each VENDOR supplied package	• VENDOR performance report and any punch list, with associated certificate.

Figure 3 - Summary of Precommissioning methodology

6.3 Commissioning methodology

6.3.1 Specifications

The COMPANY Commissioning Specifications are:

- GS EXP 103, Precommissioning and Commissioning preparation
- GS EXP 107, Commissioning execution.

They provide required procedures and support documents to prepare and carry out Commissioning activities. Their key principles are as follows.

6.3.2 Scope of work and activities

The Commissioning physical scope of work consists, as previously said, of:

- The **dynamic verification** of the elementary plant functions
- The **running-in and on-line tests** of utilities system and the **running-in and on-line tests** with inert fluid of process system**.**
- The **Pre-Start-up Activities**.

From a methodological point of view, the Commissioning scope of work has been divided into four separate activities:

- **Preliminary Checks and Precommissioning witnessing**
- **Functional Tests**
- **Operational Tests**
- **Pre-Start-up Activities.**

All operations are organised by subsystem, following a sequence, identical to that of Precommissioning, which optimises the start-up phase.

Lastly, depending on the Hand-Over to Field Operation strategy, the Commissioning Team may operate a part of the installation, particularly the utilities.

6.3.2.1 Preliminary checks

The Preliminary Checks are the cross verification by the Commissionning Team that is effectively "Ready for Commissioning". They take place when a subsystem nears or reaches the Ready For Commissioning status, and consist of:

- A physical check on site of the installation.
- A thorough review of the Precommissioning Dossier.

The Preliminary Checks are carried out by each discipline and formalised by a specific report form available in GS EXP 107.

In order to avoid rework or recheck (once by Precommissioning team, once by Commissioning team), the witnessing of the Precommissioning by the commissioning as defined chapter 10.3.1 shall be carried out as a part of the Preliminary Checks (PRC) process.

At this stage, a number of new punch list items, discovered by the Commissioning team during their cross-checking of the plant are incorporated in the subsystem **Punch list** (agreed between CONTRATOR and COMPANY).

Once Preliminary Checks have been done, the RFC certificate is countersigned by the commissioning representatives, and the PRC sheet can be issued (signed by each discipline commissioning representative) after Precommissioning dossier check.

6.3.2.2 Functional tests

These are the live tests performed on each **instrument**, **telecommunication**, and **electrical**, elementary function.

For commodity, an item or group of items of equipment that performs an elementary function of the plant is named a **Basic Function**. It is the smallest equipment that can be subject to a commissioning operation. GS EXP 107 lists and defines the main types of Basic Functions of a plant: switchboards, transformers, heaters, process control loops, ESDV's, loudspeaker loops, etc.

The functional tests are carried out in accordance with technical specifications, the results being recorded on **Functional Test Sheets**.

One Test Sheet form is available in GS EXP 107 for every type of functional test listed in the Classification of activities, one form being filled in for each test performed.

There are no spot or random functional tests: every instrument, electrical, and telecommunication Basic Function of the plant is subject to one functional test, **be it part of field or package equipment.**

6.3.2.3 Pre-Start-up Activities (PSA)

These are all the specific Commissioning activities required to prepare the piping network before the introduction of the feed stock into the Plant:

- Leak test
- Drying-out
- Inerting
- Loading of chemicals
- Chemical cleaning.

These are covered by specific procedures and reports.

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

6.3.2.4 Operational tests

Once all Basic Functions have been functionally tested, major equipment, system, subsystem or group of subsystems, is subject to an Operational Test, wherever applicable.

It consists of bringing the system into operation under conditions as close as possible to normal with inert fluids, not only to live test the automated devices, controls, normal and shutdown sequences, but also to reveal possible mechanical or electrical faults (water tightness, vibrations, overheating, overloading, etc.) which may occur during prolonged normal use.

Every operational test is a multi-discipline activity, conducted in accordance with an **Operational Test Procedure** (OTP), which has been established during the Commissioning preparation phase and approved by the COMPANY. There is no standard OTP, since they vary with the plant, but a reference procedure format is given in GS EXP 107.

Typical subsystems subject to an operational test are (but not limited to): fire water pumps, air compressors, power generation, ESD system, export pumps in recycle, process compressors in recycle (with air or nitrogen if possible, under gas after Start-up if not), sub-sea equipment's, freon or propane packages, hot oil loop, etc.

Prior to the preparation of Operational Test Procedures the Operational Tests procedure, acceptance criteria principle shall be defined if there is no contractual requirement (duration of test, number of cycles, etc.) and approved by COMPANY.

The operational test is the key commissioning activity. In any case, it shall be witnessed, followed, assisted and checked by COMPANY and shall be subject to an **Operational Test Certificate.**

This certificate shall state that the subsystem and/or equipment listed on the certificate have been brought into operational condition, and that all related VENDOR equipment has been satisfactorily tested.

6.3.2.5 Particular conditions to be considered for the subsea

In the event that methanol is required to be injected at the sub-sea Xmas tree during Commissioning of the Xmas tree valves for hydrate inhibition purposes, this shall be considered as a Commissioning activity carried out under Field Operations control. The Field Operation's group shall control activities where methanol is required due to the inherent risk on topsides.

For the wells interface, another exception is to be considered. The opening of the Down Hole Safety Valve (SCSSV) onto or from the reservoir is not considered as a commissioning activity, but as a Start-Up activity, operated by Field Operation. During the preparation, the Commissioning team shall issue test procedures. The Commissioning team shall be responsible for drafting the procedures, with final completion by the Start Up team / Field Operator.

At the execution stage, the Commissioning team shall act in assistance to Start-Up/Field Operation team

6.3.2.6 Particularity to be considered for "live" Operational Tests

Some package Operational Tests are to be performed under oil or gas after Start-up. Those tests shall be carried out under Operator control, with the assistance of the Commissioning Team.

This policy should be defined at early stage and specified through the contract. If not, at the beginning of the detailed Engineering phase, the list of systems/package to be performed under oil or gas shall be defined and approved by COMPANY.

At the RFSU the Commissioning team shall identify the remaining Operational Tests to be carried out with hydrocarbons, under the control of the Start Up team / Field Operator. Remaining activities should not be recorded on the Punch List.

6.3.2.7 Operation and maintenance during Commissioning

During the Commissioning phase, certain equipments are required to be operated before hand-over to the Operator e.g. air compressors, generators, etc. The CONTRACTOR shall ensure prior to start-up and to operate those equipments that all safety devices, logics and protections are available and reliable (ESD logic, F&G detection, Fire fighting system, Electrical protection,….).

Some other equipment need to be mothballed (in particular for offshore projects during the period separating end of commissioning in yard and beginning of start-up). By default, the Commissioning team shall perform the initial operation, maintenance and equipment preservation and therefore shall provide the appropriate resources.

Once a package or piece of equipment has been started, it may have to be operated during a short period by the Commissioning team. It shall be the subject of a routine maintenance program - Failure to implement this maintenance may lead to warranty disputes.

The Commissioning team shall submit the maintenance program to COMPANY for APPROVAL before implementation by the Commissioning Team.

This shall include but not limited to:

- Routine visit
- Lubrication schedule and substitute lubricant list if applicable
- Fill in of log sheet for routine visit
- Mothballing and de-mothballing procedures and check sheets

- Provision of consumables and spare parts
- Provision of manpower for work on shift if required, etc.

6.3.3 Technical data base

All Basic Functions, grouped by subsystem, discipline and type of Basic Function, are listed in a **Technical Data Base**, which is therefore the exhaustive description of the physical content of all subsystems. It is the equivalent of the Status Index used for Precommissioning.

The Data Base indicates, for each Basic Function, the type of Commissioning operation required, by reference to the task report form of this operation, and it also gives other relevant information (**set points**, drawings No., etc.).

The completion date of each activity is also recorded, so that it is a working document used to follow up the commissioning progress.

The Technical Data Base, main tool of the commissioning preparation and follow up, is established by the Commissioning Team during the preparation phase.

6.3.4 Punch list (during Commissioning)

The subsystems punch list, once established at the Ready for Commissioning stage, is continually updated during the commissioning and Start-up operations, by adding all newly discovered items and deleting cleared ones.

At the time of the Ready for Start-up, those new items discovered by the Commissioning team or the Operator team during their cross-inspection of the plant are included in the Punch list according to the Punch list general principle describe in § 6.5. All the punch list items that prevent starting the system have to be cleared at this stage.

6.3.5 Commissioning dossier

All documentation pertaining to the commissioning operations is compiled in a specific Dossier, arranged as the Precommissioning dossier by:

- System
- Subsystem.

They contain all the information required to demonstrate that a subsystem has reached the "Ready for Start-up" status. Its content is fully defined through GS EXP 107.

For sub-sea equipment, particular attention should be paid about the status of the installation left by the commissioning team and the associated documentation, as detailed in the chapter 11 Hand-Over to Field Operation.

6.3.6 Commissioning activities summary

Task	Discipline	Number	Support Document
Preliminary Checks	All	1 per subsystem	1 task report form per subsystem + punch list items in Precomm. dossier
Functional Tests	Electrical Instruments Telecommunication	1 test per Basic Function	1 Functional Test Sheet per test List of tests in the Technical Data Base
Pre-Start-up Activities	Process	1 per subsystem, or level of pressure, or main circuit	Leak test, inerting reports, specific to the installation
Operational Tests	Test: multi-discipline	1 test per subsystem with main mechanical equipment (depending on the consistency of the Sub-system breakdown, several OTP's may be carried for one Sub-system).	1 Operational Test Procedure by subsystem, specific to the installation OTP Certificate

Figure 4 - Summary of the Commissioning methodology

6.4 Precommissioning and Commissioning preparation

6.4.1 Policy

The preparation of Precommissioning and Commissioning is of paramount importance. It is at this time that optimisation of tasks is done according to Start-Up objectives.

The preparation activities shall commence during the Basic Engineering phase and be developed completely during Detailed Design.

As shown by their respective methodologies, the activities are relatively sophisticated operations, but their durations nevertheless remain short when compared to fabrication time.

It is then impossible to afford in these areas a learning curve, or an initial period of loose organisation, that could be disastrous for such short works, and the project overall schedule.

COMPANY policy is to thoroughly prepare long before the beginning of completion activities, not only all Precommissioning and Commissioning tasks, but also all side activities, such as organisation and co-ordination between various parties, gathering of documentation, spares, etc. So that the organisation can be efficient right from day one. Furthermore, COMPANY policy consists to a common approach from end of construction until the Start-Up. For this reason the preparation of the Precommissioning and the Commissioning shall be processed commonly, with particular respect of three phases:

- Common general and technical preparation from the basic phase to be completed during the detailed engineering, including Start-Up requirements and objectives

- Dedicated technical preparation of the Precommissiong activities with attached milestones
- Dedicated technical preparation of the commissioning activities with attached milestones.

To ensure that preparation works become a standard feature of Projects, the preparation procedures and tasks have been made standard. They are covered by the following specification:

- GS EXP 103: Precommissioning and Commissioning Technical Preparation.

A check list of the preparation is presented Appendix 4.

6.4.2 General preparation

The general preparation activities are the following, but not limited to :

- Develop general Precommissioning/Commissioning procedure, according to COMPANY strategy specification
- Validate the start-up sequence, and ensure if requested incentive schema
- Synchronise the list of sub-system (Commissioning sequence) and priority with start-up and incentive
- Detail on-shore/off-shore scope of work for off-shore projects
- Clarify Hand-Over process and witness activities
- Define start-up check lists and detailed start-up procedure
- Define ‘’ready for oil/gas-in activities’’
- Issue marked-up PID's and OLD's showing limits of subsystems
- Define resource and resource mobilisation, ensuring that there is sufficient knowledge about OPERCOM™ and ICAPS©
- Issue planning/scheduling and cost control reporting
- Anticipate temporary means and facilities to be supplied for commissioning or for start-up
- Define list and quantities of First Fills & Commissioning Consumables Schedule.
- Define the list of OTP to be carried out, particularly for the main machines and equipment’s
- Integrate package and/or Long Lead Items, with particular attention to ensure interface matter and optimised construction schema
- Gather Engineering and VENDORS data
- Compile equipment lists by subsystem.

These tasks are always part of the Engineering CONTRACTOR's scope of work, with supervision by COMPANY. The CONTRACTOR shall propose a measurement progress system of the preparation phase, according to the technical milestones defined in the GS EXP 103.

6.4.3 Precommissioning preparation

During the Precommissioning preparation, many documents shall be issued in order to anticipate and optimise in term of tools/consumable supply, resource, logistics, etc…. The CONTRACTOR shall ensure that all the actions are launched in accordance with this preparation and that the means, tools, spares, consumables and resources are available in due time.

6.4.3.1 Documents

These activities typically include, but not limited to:

- Establish, from the subsystems definition and equipment lists, the Status Indexes with itemising all Check Lists and Test Sheets
- Preparation of specific procedures (hydro testing, flushing, etc.)
- Preparation of the Precommissioning dossier
- Planning, resources mobilisation plan, etc.
- Adapt if necessary the Precommissioning specification to the project particularities, by issuing Check Lists and Test Sheets for the project special equipment.

6.4.3.2 Planning

- produce a Precommissioning network and sequence based on Commissioning requirements and Start-Up sequence.
- Evaluate tasks duration and issue planning and RFC dates.

6.4.3.3 Contracts

- Prepare Precommissioning clauses of construction contracts.
- Issue Precommissioning specific contracts (flushing, hydrotesting, etc.)
- Prepare VENDOR's assistance during Precommissioning operations.
- All above Precommissioning preparation activities are carried out by the Engineering CONTRACTOR. They take place in parallel with the Commissioning preparation, around 6 to 8 months before the beginning of the operations on site.

6.4.4 Commissioning preparation

During the Commissioning preparation, many documents shall be issued in order to anticipate and optimise in term of tools/consumable supply, resource, logistics, etc…. The CONTRACTOR shall ensure that all the actions are launched in accordance with this preparation and that the means, tools, spares, consumables and resources are available in due time.

6.4.4.1 Documents

These activities typically include, but not limited to:

- Define Basic Functions by subsystem
- Develop the Technical Data Base
- Adapt the commissioning specification and issue Functional Test Sheets for the project special equipment

- Define leak tests principles and programs (PSA)
- Define the list of operational tests, and issue the operational tests procedures
- Prepare the Commissioning dossiers
- Planning, resource mobilisation plan, etc.

6.4.4.2 Planning

- Produce the tasks register and commissioning program
- Quantify the scope of work
- Produce manpower histograms
- Ensure integrated planning, particularly when the project is split into several subprojects and contracts (FPSO-Subsea, On-shore PLANT- Off-Site, etc.).

6.4.4.3 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 spare parts and special tools in PO's.

6.4.4.4 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, air, …)
- Prepare stocks of spares, consumables, test equipment, chemicals, and logistics means
- Prepare execution personnel selection and mobilisation.

However some activities take place earlier in the Project, the contracts-related activities essentially. The Engineering CONTRACTOR therefore shall carry these out.

6.5 Punch list general principle

While the Precommissioning, Commissioning and Start-up activities have being performed, all discrepancies shall be recorded in the **Punch list**, according to the Punch List general principle following:

- One point is considered as a block point if it challenge for the concerned sub-system :
  - The safety or operational aspect for the following activity
  - The integrity of the system if risk of damage
  - The missing of requirements due to particular local rules/regulations.
- One point is linked to a Subsystem (or equipment belonging to the sub-system).

- From the construction to the routine operation three Punch List priority level should be considered:
  - PL A: Item considered as a block point for Commissioning activity of the sub-system
  - PL B: Item considered as a block point for Start-up activity of the sub-system
  - PL C: Item not considered as a block point for Start-Up activity, but linked to a contractual performance from the equipment and milestone (for example Partial Acceptance, Hand-Over, ….).
- These lists edited in accordance with the CONTRACTOR's representative shall be kept updated during the Completion activities, so as to have a precise status of each subsystem at the Ready for Commissioning and Ready for Start-Up status.
- Each Punch list item shall contain the following information:
  - Subsystem and Equipment identification number
  - Discipline activity
  - Priority level
  - Defect description, corrective action to be done and action by
  - Materiel required/assistance required
  - Schedule.

Lastly, during the preparation phase, particular attention shall be paid by the CONTRACTOR to integrate in its organisation the correct level of resource in order to manage the Punch List database (record, follow-up, feed-back process to the Engineering, remedial action, etc.).

For the package or subsea equipment fabrication, Punch List priorities should be adapted as follows:

- PL 0 prior to Ready For Delivery (to be cleared at SUPPLIER premise)
- PL A prior to RFC of the sub-system on which attached
- PL B prior to RFSU of the sub-system on which attached
- PL C prior to the final milestone until the SUPPLIER is involved.

Subsea Projects

The Commissioning group before RFC acceptance shall verify the Sub-Systems as mechanically Complete. Only minor punch list items may be accepted on the punch list. No physical punch list items (missing equipment, etc.) will be accepted for sub-sea installed equipment. Documentation punch list items may be acceptable at this stage.

6.6 Progress and status principle

The progress and status follow up shall be defined according to project specification. But due to particularity of Precommissioning and Commissioning activities, the progress shall be calculated with a manhours evaluation and not the number of activities or sheets remaining/completed. The progress and status shall be split by subsystems with using following definition :

- Estimated manhours : evaluation of the time of the remaining activities
- Earned manhours : evaluation of the time of the completed activities based on the initial estimated evaluation.
- Expended manhours : evaluation of the time really spent per activities.

The progress for a sub-system or for a group of activities (if presented by discipline for example) shall be the ratio of the estimated and the earned evaluation.

The status shall state the completed activities and those remaining according to the manhours weighting.

Lastly, productivity factor should be calculated with comparing earned and expended manhours.

6.7 ICAPS©

This ICAPS© software application provides the means to organise and to follow all Precommissioning and Commissioning activities according to the OPERCOM™ methodology, with respect of principles described above, and particularly to :

- Manage the status Index and the Technical Data Base.
- Generate/print out automatically the Precommissioning tasks (Check & Test Sheets) and the Commissioning tasks (Functional Test sheet) based on the equipment type.
- Record and follow the Punch Lists
- Monitor status and progress.

7. Start-Up methodology

This chapter aims to describe the technical scope of the Start-Up execution activities in order to clarify as much as possible the interface between Start-Up and Commissioning and to identify the overlap between both activities. OPERCOM™ does not presume any Start-Up/Operator organisation (merged, separated, etc.).

Prior to execute the Start-up from an operational point of view, the Start-up scope of work includes activities preparation and witnessing of the Commissioning activities. After that, the operational activities properly speaking are split prior to and after oil/gas introduction.

- **Operational activities prior oil/gas in**
- **Operational activities prior oil/gas in.**

7.1 Start-up and performance test preparation

It mainly includes the following activities, but not limited to :

- clear identification, programming and planning of the activities with / without Hydrocarbon (Methanol, Diesel, …)
- Definition of ‘’ready for oil/gas-in’’ activities
- Pre-requirements to start-up a task definition
- Operational risk assessment and environment impact
- Resource/training/knowledge definition and certification if necessary.

7.1.1 Documents

These activities typically include, but not limited to:

- Gather VENDOR and PROCESS LICENSOR START-UP documentation.
- Prepare detailed start-up procedures according OPERGUID methodology
- Prepare associated start-up check lists
- Define list and description of ‘’ready for oil/gas-in’’ activities (technical checks, safety audits, organizational audits, etc…)
- Prepare detailed Performance Test Procedures.
- Prepare planning, resource mobilisation plan, etc…
- List documents to be included in the ‘’Ready For Operation’’ dossier.

7.1.2 Planning

- Produce the start-up and performance test program and planning. (Ensure integrated planning, particularly when the project is split into several subprojects and contracts (FPSO-Subsea, On-shore PLANT- Off-Site, ..)
- Quantify the scope of work.
- Produce manpower histograms

7.1.3 Contracts

- Prepare the "assistance to start-up" (reviewing the assistance to be provided by EPC contractor, Vendors, Licensors, …),
- Prepare the specific assistance required for execution of the performance tests (in particular the Laboratory assistance),
- Issue all specific contracts to be started at time of start-up (for logistics matters, for maintenance and operations subcontracts, etc…)
- Include start-up and spare parts and special tools in PO's.

7.1.4 Supports

- Gather all required engineering and Vendors documentation.
- Perform detailed engineering of required start-up or performance tests facilities (sometimes temporary).
- Prepare stocks of spares, consumables, test equipment, chemicals, and logistics means.
- Prepare execution personnel selection and mobilisation.

7.2 Witnessing

The **Witness activities** are the cross verification of the completion activities by the Start-up/Operator Team (refer chapter 10.3.1 Witness principle). They consist of:

- A physical check on site of the installation included FAT's and/or SAT's
- A physical check of Commissioning activities (Operational tests, leak test, Running-in of the plant utilities, Oil or gas-in preparation, ESD demonstration, etc.)
- A thorough review of the Commissioning Dossier.

At this stage, a number of new punch list items, discovered by the Start-up team during their crosschecking of the plant are incorporated in the subsystem **Punch list** (agreed between commissioning and Start-up representatives).

7.3 Start-Up performance

The team in charge of start-up shall conduct the ''ready for oil/gas-in'' activities.
These are all the specific activities required to prepare the oil or gas-in and to bring the plant in operation:

- Put on pipe work and vessel on line (valves, PSV, locking devices…)
- Check that all valves subject to a ''locked status'' are in the locked open or locked closed position, in accordance with the Approved drawings and procedures;
- Check all isolations by spading and blinds are in accordance with the Approved drawings and procedures;
- Establish the list of available equipment;
- Prepare the ICSS inhibition sheets that list the inhibition that will be required for oil-in or gas-in;
- Perform the audits and technical reviews scheduled to be necessary for the issuance of the ''ready for oil/gas-in'' certificate.
- Check that all punch list items needed to be cleared before start-up were treated accordingly and that the punch lists were updated;

- Complete first fills.
- Ensure safety equipment's and critical utilities availability and reliability.
- Carry out the final safety tests (ESD, deluge, …)

At this stage the ''Ready for Oil or Gas-in Certificate'' shall be issued. **This certificate is not related to any transfer of responsibility from one entity to the other (systems are kept in hands of the party in charge of the start-up).** It relates to the specific ''oil/gas-in'' milestone to which may be associated a number of prerequisite (case of turnkey contracts).

After issuance of the ''ready for oil/gas-in certificate'' are performed all the following activities required to start-up the plant with first introduction of the feedstock into the plant :

- Bring the process in operation (Oil/gas-in, water injection…)
- Carry out outstanding Commissioning Operational test
- Carry out the Performance tests to prove the plant and equipment and design capacities products specifications, etc.

In particular case, several "Oil/Gas In" certificates may be issued. For example, if external gas supply is available, a first "Fuel Gas In" certificate may be issued for the utilities, and a "Gas/oil In" certificate will be issued for the Process facilities.

7.4 Start-Up dossier

All documentation pertaining to the Start-up activity is compiled in a specific Dossier.

They contains all the information required to demonstrate that a system has reached the ''Ready for Operation" status.

Its content is the following:

- First Start-Up sequence and procedure with all notes taken during the start-up for further update of the procedure
- Marked-up P&IDs showing the status for blinds and spades at time of transfer to the OPERATOR.
- Ready for Operation Certificate
- Updated Punch List
- Operational Test Procedure, reports, and Operational Test Certificate carried out during the start-up phase
- Routine Start-up procedures, Emergency and routine shutdown procedures according OPERGUID methodology.

8. Offshore projects Specificity

The commissioning methodology applied for offshore projects does not differ from that of a single phase installation, excepted that some re-commissioning, i.e. the performance onshore then a second time offshore of the same commissioning operation, may take place.

Two aspects of completion activities reviewed so far, namely:

- The sequence of activities: Precommissioning, Commissioning, Start-up
- The Commissioning methodology.

Are slightly amended in the case of offshore projects, a characteristic of which consists in their two-step construction:

- Onshore at one or several fabrication yards or during the Factory Acceptance Tests (FAT) at the MANUFACTURER
- Offshore during the hook-up phase.

Consequently, there is an opportunity to carry out commissioning activities right from the onshore phase, i.e. before the construction (hook-up works) is complete.

8.1 Policy

COMPANY policy on this matter is to carry out as much Commissioning onshore as possible, to:

- Ensure that fabrication has truly reached a satisfactory degree of completion
- Reduce the amount of offshore commissioning activities, as their cost is significantly higher than onshore
- Save time on the overall planning
- Discover possible defects when time is still available to correct them.

8.2 Onshore scope of work

Onshore commissioning is achievable on a large scale for single-module platforms, or when the design of the modules includes distributed systems for process controls, electrical power and safety, which allows complete basic functions and systems within a given module.

Furthermore, even if technically possible onshore, some testing may be postponed until the final phase if their performing onshore requires unrealistic temporary facilities such as HV power supply, cooling means, fuel storage, etc.

At last, the amount of testing that can take place at the yard highly depends upon the level of completion of the modules: a 100% completed module usually allows onshore a significant share of the commissioning scope of work, may be up to 60 or 70%, whereas a 90% completion will not authorise significant onshore commissioning progress.

Therefore no general rule on onshore commissioning is applicable: the onshore scope is defined on a case by case basis, considering:

- The technical self-sufficiency of each module
- The requirements in temporary equipment
- The targeted onshore construction achievements.

A number of equipment will most often fulfil the conditions required to perform onshore testing:

- HVAC
- Technical rooms
- Control room
- Diesel engines
- Small packages, i.e. air compressors
- Sub-sea equipment's
- Software's.

The activities will consist of, but not limited to :

- Dynamic verifications including electrical motors uncoupled runs, local loops/local
- Panels, electrical breakers operation, etc.
- The mechanical preparation and running-in of equipment.

For sub-sea installation both pre-commissioning and part of the commissioning is carried out onshore. For sub-sea control systems full commissioning is carried out at the onshore site and shall include the sub-sea control system, the sub-sea hydraulic power unit and the integration with the topsides distributed control system. For the sub-sea (wet) systems such as the Xmas trees and manifolds, the equipments shall be tested onshore usually at the VENDORS premises prior to marine transportation.

The selection being made for each project, and the Precommissioning and Commissioning arranged accordingly.

The possibility for Commissioning activities to be carried out onshore shall be developed during Basic Engineering, and finalised during Detailed Design.

8.3 Offshore scope of work

Yet a number of commissioning operations remains anyway offshore tasks, with taking into account:

- Activities remaining, with adding postponed from on-shore to off-shore
- All system/equipment/loose items integrated, de-installed/re-installed after Hook-Up
- All system/equipment modified through sea-fastened/un-sea-fastened or preserved/un-preserved activities
- All system/equipment subject to stress constraint due to moving, lifting or towing
- All system/equipment visually damaged or clashed although fully commissioned.

This re-commissioning specifically covers, but not limited to:

- SAFETY tests (life boats trials, ESD demonstrations, Blow down test at real operating pressure using inert gas, real condition deluge test, etc.)
- Equipment critical protections
- Loops random checks, if there are doubts that the equipment may have been damaged during load-out or installation
- HV switchboards and generators windings insulation tests
- Machinery alignments
- Dynamic verification for all equipment not fully verified onshore
- Verification of all control and safety related functions
- Final verification and energisation of electrical equipment
- The mechanical preparation and running-in and on-line tests.
- N2/He testing after offshore hook-up
- Sub-sea equipment after integration (controlled from DCS through SCU, SPCU, etc.).

Verification by the Commissioning team that the Construction team has achieved his full Precommissioning scope of work. These checks shall be done on a Sub-system basis and shall include, but not be limited to:

- Assessment that the Precommissioning task have been performed
- Review of As built drawings
- Review of the punch list items
- Visual inspection for operability, etc.

The same procedures and support forms should be used for the commissioning, and the re-commissioning of the same equipment where applicable.

8.4 Particularity for Wellhead Platform

The split of the Commissioning scope of work between onshore (Topside construction) and offshore (Topside completion) shall be assessed according to drilling program and wells Start-Up sequence. In some case, a minimum progress of the Commissioning activities should be done onshore, to avoid damage during drilling (sensitive equipment dismounted, final well head connection not done). In any case, particular attention shall be paid to the preservation and the protection during the drilling phase (physical protection around drilling area to be mounted (Wellbay)). CONTRACTOR shall be responsible for carrying out this preservation and for supplying dedicated material.

9. Surface package and Subsea equipments specificity

9.1 specificity

Sub-sea and packages Commissioning has to be considered separately to the normal topsides or plant systems environment in that the sequence of activities, Precommissioning, Commissioning and Start-up are not sequential. Part of both Precommissioning and Commissioning is carried out during the Factory Acceptance Tests (FAT's) and may be repeated after installation and hook-up to the topsides or plant equipment.

9.2 Precommissioning Check and Test

For sub-sea or package installation Check and Test sheets are available for each type of equipment and/or activity. In addition to this the CONTRACTOR will define further pre-commissioning tests necessary which will take place at the VENDORS premises and/or on the installation vessel

A set of check sheets including sub-sea equipment, each one adapted to a specific type of equipment, or to packages, is available in GS EXP 105.

9.3 Field test & integration

The field equipment's are subject to this full scope of work. There are no spot or random checks and tests. Every equipment that can be subject to a check and a test shall effectively be precommissioned. On the other hand, a reduced Precommissioning is carried out on those packages that have been thoroughly tested at the VENDOR's. For these packages, the scope is limited to a single general check list (instead of check lists per item of equipment) and to tests of safety related items only ESD's equipment protection.

All the equipment's/items, part of the package, modified or impacted after the integration/installation of the package and/or the subsea equipment shall be exhaustively checked and tested according to specifications and principles defined chapter 6.2 and 6.3. According to an similar approach with the split of the activities between on-shore/off-shore, re-work must be carried out after package integration, with following considerations:

- All system/equipment/loose items integrated, de-installed/re-installed after Hook-Up
- All system/equipment modified through sea-fastened/un-sea-fastened or preserved/un-preserved activities
- All system/equipment subject to stress constraint due to moving, lifting or towing
- All system/equipment visually damaged or clashed although fully commissioned.

The RFC status of the package or of the sub-system of the package can be reached when all Precommissioning activities after integration are carried out and completed.

10. Organisation

This chapter aims to define technical responsibilities between CONTRACTOR and COMPANY and typical organisation principle in order to match as far as possible CONTRACTOR scope and organisation and COMPANY scope and organisation.

10.1 Contractual aspects

Depending on the circumstances, COMPANY projects are implemented through various contractual schemes. Also, the facilities of one project are often split between several sub-projects, each one having its own distinct contractual arrangement.

The general contractual categories take into account the completion activities as follows:

- The Precommissioning activities are always performed by the Construction CONTRACTOR or the Main CONTRACTOR, except for COMPANY-supplied items, for which the VENDORS may carry it out.
- The Commissioning activities are performed by the COMPANY or Project in case of separate contracts or EPC schemes, by the Main CONTRACTOR in case of EPCC or turnkey contracts.
- The Start-up activities are performed by the COMPANY or by the Main CONTRACTOR in case of turnkey contract.

Therefore:

- The COMPANY Commissioning specifications GS EXP 103, GS EXP 105 and GS EXP 107 are drafted so as to define how the completion activities shall be carried out, from a technical point of view, without presupposing which party is in charge. Hence, these specifications will be equally applied by CONTRACTORS, Projects, and COMPANY teams within their respective limits of obligations.
- The Precommissioning/Commissioning classification of activities gives a technical split of activities, which to a large extent matches the split of contractual obligations, but it is the Contract that stipulates exactly "who does what".

10.2 Commissioning Team organisation

The Team's organisation will also be established case by case, but the following points will most often be retained. The organisation of the commissioning team allows to overlap the Construction approach (by discipline/area/VENDOR) and the Start-Up approach (by functional system). For this reason, Commissioning team should be considered as a matrix, based on following Job tickets principle:

- A **Commissioning Site Leader** (CSL): Depending on the size of the project and the geographical location (onshore site and/or offshore site), the Commissioning Team can be divided in several Commissioning Site Teams, each managed by a Commissioning Site Leader.
- **Discipline Superintendents**: (Electricity, Instrumentation, Telecommunication, Mechanical, Piping, HVAC, Subsea, etc.) directly managing their execution teams. They witness a part of Precommissioning checks and control preliminary checks, basic function tests, operational tests.

- **System Engineers**, in charge of the commissioning utility/process activities, with operation & safety consideration. In charge of the progress and documentation follow-up, the inter disciplines Superintendents co-ordination, for those subsystems each of them he has the supervision. These positions, very much specific to Commissioning Operations, are considered to be key roles.
- A number of **support positions** (safety, planning/progress, logistics, computers, Punch List, cost control, etc.).

For offshore projects, or more generally any Project for which a personnel rotation system is required, the two rotational Commissioning Teams are complemented by a **Commissioning Manager** and a reduced staff based in Project Head Office, who ensure proper continuity between the teams, offshore support, and long term decisions.

For onshore projects, this role, less required, is devoted to the CSL.

The CSL, System Engineers and Discipline Superintendents, are most often DGEP-seconded. Wherever possible a few commissioning supervisors, and **as many operations personnel as possible** originate from the Operator, to constitute the Commissioning team to benefit from the training period the commissioning phase constitutes by controlling Operational tests, Pre-start-up activities, Hydro-tests / flushing / cleaning / leak tests witnessing, PID conformity checks, etc.

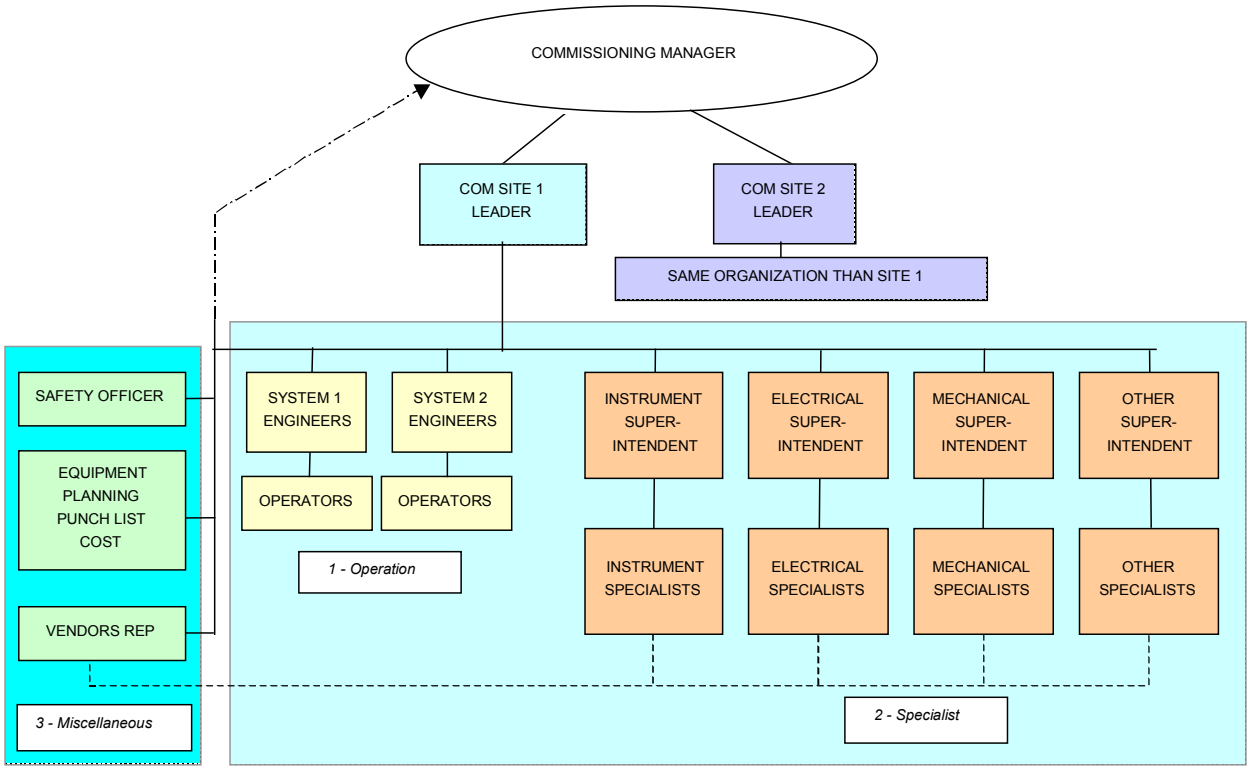


Figure 5 - Commissioning Team organisation chart

10.3 Roles and Responsibilities

The table below describes the main responsibilities during the different phases of a project. This table highlights which resources for Commissioning preparation must be mobilised at the Basic Engineering phase.

The table below is based on an EPSCC Contract. The CONTRACTOR Organisation is not detailed, and different CONTRACTOR Teams (Construction, Commissioning) should be involved at different stages.

Project Phase	Activity Description	Actors Responsibilities			
		CONTRACTOR	COMPANY Construction Manager	COMPANY Commissioning Manager	COMPANY Operation Manager
Basic	Contract strategy, Precommissioning & Commissioning scope of work (split on-shore / off-shore), Commissioning organisation requirements		Define (with contract team)	Approve (Commis-sioning Exhibit)	
Engineering	Start-up sequence, sub-system break down	Define (Basic Engineering CONTRACTOR)		Approve	
Detailed Engineering	Commissioning organisation procedures	Define		Approve	
	Precommissioning and Commissioning preparation (technical dossier) according to GS EXP 103 deliverables.	Carry out		Approve	
Construction, Precommis-sioning and Commissioning	Precommissioning Activities	Carry Out	Control	Witness	
	Commissioning Activities *(in case of EPSC contract)*	Carry out *(Assist)*		Control *(Carry Out)*	Witness
Start-up	Start-up Activities & Performance test			*Assist*	Carry Out

The list of the documents to be issued are described in GS EXP 101 chapter 6.4 and GS EXP 103 (Precommissioning and Commissioning technical preparation).

10.3.1 Witness general principle

10.3.1.1 Definitions

In order to ensure a efficient overlap between the different phases and to ensure a control by the COMPANY, Commissioning team shall witness of some Precommissioning tests and the OPERATOR Start-Up team shall witness some Precommissioning and Commissioning tests performed by the CONTRACTOR and the Commissioning Team. This overlap facilitates the hand-over and avoids re-work and re-tests.

In any case, the COMPANY may witness any Precommissioning and Commissioning activities performed by the CONTRACTOR. Witnessing procedures shall be written in due time for COMPANY approval. Witnessing principle as described below and in attachment 2 defines the minimum requirement.

The witnessing is defined according to three levels defined as follows:

Level 1: HOLD

HOLD points are defined as points within the project life cycle at which the approval of COMPANY shall be obtained. Subsequent activities directly linked may not proceed until Inspection/Surveillance activity is carried out.

Level 2: WITNESS

WITNESS points are defined as points at which COMPANY may elect to witness activities, and approve progress to subsequent activities, as applicable (for example 100% Inspection of items). Should COMPANY representative not be present at the appointed time, then based on verbal agreement with COMPANY, the activity is permitted to proceed.

Level 3: MONITOR

MONITOR points are defined as points at which the COMPANY (or nominated representative) may monitor inspection of activities, service, equipment or material, but where specific approval is not required from COMPANY for the CONTRACTOR to proceed.

CONTRACTOR shall issue a two-weeks look-ahead schedule for Pre-commissioning activities on a weekly basis, for COMPANY follow-up. The Commissioning Team will do the same for Commissioning activities for OPERATOR.

Witnessing activities shall be discussed during the daily and weekly meeting.

Note that the COMPANY (or its nominated representative) in attendance will personally sign only the relevant test sheet attached to the Pre-commissioning activities he did witness.

10.3.1.2 Precommissioning witnessing LEVEL 1: HOLD

When the VENDOR/CONTRACTOR is ready to Pre-commission any part of any System or Sub-system, the VENDOR/CONTRACTOR shall advise the Commissioning Representative and COMPANY Representative The COMPANY or its nominated representative shall witness all activities.

The VENDOR/CONTRACTOR shall not perform any level 1 activity without the COMPANY attendance.

In principle, but not limited to, the following activities are classified level 1:

- Overall NDT clearance
- Air flushing operation
- Hydrostatic/pressure testing
- Vessel inspection
- Insulation test
- Life saving equipment inspection.

10.3.1.3 Commissioning witnessing LEVEL 1: HOLD

When the Commissioning team is ready to Commission any part of any System or Subsystem, the Commissioning Team must advise the OPERATOR Representative.

The OPERATOR or its nominated representative shall witness all activities. The Commissioning team shall not perform any level 1 activity without the OPERATOR attendance.

In principle, but not limited to, the following activities are classified level 1:

- Operational Tests
- Energisation
- ESD and F&G demonstration
- Pre-Start-Up Activities.

10.3.1.4 Witnessing Matrices

Witnessing matrices for Pre-commissioning and Commissioning activities shall be created during Basic Engineering and developed during Detailed Engineering with respect to the increasing levels of development of the project information. These matrices identify the required level (Hold/Witness/Monitor) with respect to the activities of the Precommissioning and Commissioning phases.

A typical is appended to this specification (refer Appendix 3).

10.3.2 Technical transfers between Activity

Independently of the contract type, technical **Interim Certificates** shall be issued between each activities stage with:

- **Subsystems** are **Ready for Commissioning** when all Precommissioning activities are complete
- **Subsystems** are **Ready for Start-up** when all commissioning activities are complete
- **Systems or group of subsystems** are **Ready for Operation** when all Start-up activities are complete.

We can consider there are three different parties, Construction (CONTRACTOR), Commissioning (CONTRACTOR and/or COMPANY) and Start-Up (CONTRACTOR and/or COMPANY) who are respectively in charge of Precommissioning, Commissioning and Start-Up activities. Between each stage, for each sub-system, Interim Certificates should be issued:

- Ready For Commissioning (RFC), between the Construction party (CONTRACTOR and/or VENDORS) and the party responsible for Commissioning
- Ready For START-UP (RFSU), between the parties responsible for Commissioning and Start-Up
- Ready For Operation (RFO), between the parties responsible for Start-Up and Operation.

Since both the Commissioning and Precommissioning are part of the Main CONTRACTOR's scope of work in EP(S)CC contract, there is no more transfer of responsibility, contractually speaking, at the RFC stage. The Commissioning team, however, will most often be an entity distinct from Construction, which means an internal transfer of responsibility.

Since both the Start-up and Routine Operation are a part of the Operator scope of work in EPCC contract, there is no more transfer of responsibility, contractually speaking, at the RFO stage. The Start-up team, however, will most often be an entity distinct from Field Operation, which means an internal transfer of responsibility.

In any case, the Precommissioning, Commissioning & Start-Up specifications, activities, dossier with its certificate and punch list especially will be adhered to, carried out and compiled exactly as if a contractual transfer was to take place.

Additionally, formal transfer of the facilities from one party to another shall be defined, with a transfer of responsibility for operation, maintenance and safety and as such shall be described and recorded in the Contract/documents between the relevant parties (Hand-Over Certificates should be issued). The accepting party being thereafter responsible for all consequences resulting from misoperation.

These additional certificates may not correspond to the sub-system break down used during Precommissioning and Commissioning activities.

10.3.3 RFC & RFSU & RFO Interim certificates

These interim Certificates are defined in the Agreement. These certificates are technical certificates that states that the activity associated to this certificate is completed. The signature of this certificate does not presume that the concerned sub-system is handed-over, except if this case is defined in the contract. In general case, Hand-Over process is formalised by a dedicated certificate (generally by group of sub-system).

This chapter aims to define crosscheck to be carried out prior to involved parties signature.

Without presuming of the numerous contractual cases of transfer between CONTRACTOR and COMPANY (partial transfer (Utility/process, different project phases) or global transfer), the parties involved should sign the RFC and RFSU certificates, as shown below:

	EPSC Contract			
	Construction CONTRACTOR	Construction COMPANY	Commissioning COMPANY	Operation COMPANY
RFC	Issue + sign	Sign	Countersign	
RFSU			Issue + sign	Sign

	EPSCC Contract				
	Construction CONTRACTOR	Commissioning CONTRACTOR	Construction COMPANY	Commissioning COMPANY	Field operation COMPANY
RFC	Issue + Sign	Countersign	Sign	Countersign	
RFSU		Issue + Sign		Sign	Countersign

	Turn Key Contract					
	Construction CONTRACTOR	Commissioning CONTRACTOR	Operating / SU CONTRACTOR	Construction COMPANY	Commissioning COMPANY	Field operation COMPANY
RFC	Issue + Sign	Countersign		Sign	Countersign	
RFSU		Issue + Sign	Sign		Sign	Countersign
RFO			Issue + Sign			Sign

Sign: to be considered as contractual issue

Countersign: to be considered as technical issue

10.3.3.1 Ready For Commissioning Certificate

The certificate is defined in the Agreement. Additionally, this mutual agreement of the subsystem status is achieved through:

- The cross-inspection by the Commissioning Team of the subsystem facilities, and their thorough review of the Precommissioning dossier
- The actual witnessing by the Commissioning Team of at least critical Precommissioning activities, such as setting of PSV's, machinery cold alignment, piping flushing, protection relays setting
- The establishment of the "Punch List", mutually agreed between the two parties.

10.3.3.2 Ready For Start-Up Certificate

The certificate is defined in the Agreement. Additionally, the mutual agreement on the subsystem status is achieved through:

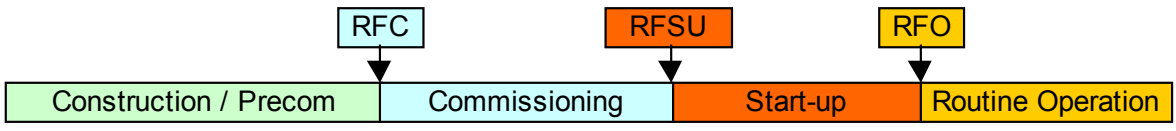
- The cross inspection by the Start-up team or Operator of the subsystem facilities, and their thorough review of the commissioning dossier
- The actual witnessing and countersigning of the Operational Tests, most significant commissioning operation
- The updating of the mutually agreed "Punch List".

10.3.3.3 Ready for Operation Certificate

The certificate may take place on a system basis or by consistent groups of sub-system. This certificate shall state that the Start-up activities associated with the Subsystem listed on the certificate have been completed and is in a state of readiness for commencement of the associated routine operation activities.

The mutual agreement on the system status is achieved through:

- The cross inspection by the Operator of the system facilities, and their thorough review of the Hand-over dossier witch contain the Precommissioning, Commissioning and start-up dossiers.
- The actual witnessing and countersigning of the Operational Tests, Performance tests, most significant commissioning and Start-up operation.
- The updating of the mutually agreed "Punch List".



At last, it is recalled that the Certifying Authority will also witness completion activities according to their contractual obligations, and that Local Authorities may equally do so as required by local regulations.

On the other hand, it does not relieve the Engineering CONTRACTOR, the Construction CONTRACTOR, and the VENDORS from their contractual obligations.

10.4 Specific certificates

Specific certificates shall be issued in order to formalise particular milestone for example.

10.4.1.1 Operational Test Certificate

The certificate is defined in the Agreement. This certificate does not induce neither technical transfer nor Hand Over transfer. This certificate states the activities performed as required chapter 6.3.5. As defined in the Witness Principle, the Operational Tests are monitored with strong participation and involvement of the future Field Operation Team. It aims to ensure and formalise that the Operator is fully involved in the test, with demonstrating that the sub-system or the unit is working with respect of:

- Safety control and alarms are operational
- Project specifications are reached
- operability/control is checked (first start-up and normal condition).

In respect to this certificate, Operator will assume to avoid requirement for re-test or re-work.

10.4.2 Partial Certificate

Although the basic principle of the plant completion is to carried out all disciplines activities by systems and subsystems (see § 6), for different reason not all discipline activities may be reach the same degree of completion at the same time. Some discipline activities may be complete while others are not. It would therefore be a waste of time for the accepting party to wait for the whole subsystem reaches the Ready for Commissioning or the Ready for Start-up status before starting their activities.

Nevertheless, an **additional subsystem** may be created or a **Partial Certificate** may be done to allow the accepting party to do their activities according to the specifics rules following:

- It will always be an exceptional procedure
- It shall always be submitted for approval to the COMPANY
- They are no safety or technical interference from the other discipline In the subsystem.

10.4.3 Oil/Gas In certificates

This certificate shall be issued additionally in order to formalise particular milestone before to bring on Gas/Oil between Operation management and Start-up or Operation Field Team.

These certificates may not correspond to the sub-system breakdown used during Precommissioning and Commissioning activities.

This certificate shall state that the Commissioning and Start-up activities associated with the process system listed on the certificate have been completed, in particular (leak test, ESD pipe work and vessel are on line, etc.), and is in a state of readiness for Gas/Oil in. This certificate is to be considered as technical issue with regarding additional requirement for personal training/knowledge, organisation/procedures readiness and other certification (local rules/regulation).

11. Hand Over to Field Operation

This chapter aims to define the HAND OVER from the Commissioning Team to Operation, without presuming contractual schema. This HAND OVER is a sequence of technical stages, in order to:

- Guarantee the continuity between the different checks and tests performed during the Completion activities
- Ensure a good historical along the completion activities to avoid time lost and rework at the final stage.

In any cases, the formal transfer of a part of the facilities from a Party to another is a **transfer of the responsibility for operation, maintenance and safety** of this equipment, the accepting party being thereafter responsible for all consequences resulting from mis-operation.

The Hand Over process has to be adapted the organisation between project and operation, the contractual strategy and the type of project.

This formal Project to Operations transfer of responsibility is called Hand-Over. This Hand-Over process should include:

- The complete transfer of historical data, dossier and information throughout the various project phases
- The specific requirement a per contract (Operating & Maintenance manual, spare, etc.).

This Handover process will be formalised by the **Hand-Over Certificate.** This certificate may be different that this one defined in the Agreement.

This certificate shall state that the scope of work under Project responsibility have been completed, including the provision of all documentation, spare, etc., as per contract.

11.1 General Hand Over to Operation

A Hand Over schema shall be decided according to the Start-Up sequence and shall be synchronised with contractual milestones or incentive schema. The Hand Over shall be processed by group of sub-system, according to Precommissioning/Commissioning break down.

Commissioning activities shall take place at the onshore and offshore sites. Hand-Over of certain Systems/Sub-systems can therefore take place at both sites.

During Commissioning execution, the Operational Test Procedures shall be signed off with the applicable amendments by the responsible Commissioning engineer and the Field Operations representative. When the Commissioning activities described in the procedure have been completed, the Commissioning procedure will be an historic record of the tests carried out as well as a record of solutions to problems encountered during Commissioning.

A RFSU certificate and the signed off Commissioning procedure shall be compiled in a Hand-over dossier together with all other relevant documents. This will be presented to Field Operations for acceptance of the relevant Sub-system(s).

Acceptance of the Hand-over dossier including the relevant RFSU certificates represents the transfer of responsibility to Field Operations for the relevant Sub-Systems.

The hand-over process includes documentation issued at each step of the project phases (engineering, construction, installation, pre-commissioning, commissioning). A hand over dossier will be prepared and implemented during the hand-over process with reference to project documents.

At the final stage, the HAND OVER dossier is the compilation of the Precommissioning Dossier and the Commissioning Dossier of the sub-system to be handed over.

11.2 Particular Hand Over to Operation for Subsea

The objective of this chapter is to define the conditions to be fulfilled by Commissioning for acceptance of the sub-sea systems by Field Operations at final hand-over.

The process described in this document is applicable to all sub-sea systems, composed of SPS and UFL systems. It is applicable during the first phase of a field's commissioning and hand-over immediately before field start up/first hydrocarbons, as well as for any intermediate commissioning and hand-over of part of the sub-sea equipment installation after this phase. The Hand-over process conforms to the sub-system breakdown described in general specification GS EXP 103.

Nevertheless, there is an internal "Hand-over" for the Xmas trees, performed in two stages:

- After well completion from drilling to Field Operations. Commissioning then take responsibility for the Operational Test Procedure after the Xmas tree has been connected sub-sea
- After subsequent pre-commissioning and commissioning activities are completed. The Xmas tree is then taken over by Field Operations from the commissioning group.

The installation reports, (including the as built survey) is a part of the hand-over dossier. They should include all pertinent information about the sub-sea equipment status after installation and commissioning, lay out, maps, video references, etc.

The sub-sea system Hand-over dossier shall include all completed sub-sea commissioning procedures and the commissioning dossier.

The Hand-over should formally take place at the end of the commissioning of each sub-sea system (e.g. production loop) on the basis of the final updated Hand-over dossier. However partial Hand-over will take place to enable early production. Punch lists will be established at each hand-over point.

For example, the hand-over for a 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.

11.2.1 Hand-over documentation

The equipment specific documents listed in the table below are the general requirement for the Hand-over dossier. Other generic documents such as operating manuals, list of spare parts and specific tools etc. are not included here. These documents are considered contractual deliverables from the SUPPLIERS.

Item	Document	Reference (1)	Hand-over (2)
01	Installed equipment designation and identification		X
02	Certificate of conformity issued by MANUFACTURER (3)		X
03	Factory Acceptance Test reports	X	
04	Hook-up and Function Test reports	X	
05	Installation reports	X	
06	As installed survey reports (lay out, mapping, topology, video, CP measurement)	X	
07	Xmas tree completion data as per project requirements (4)	X	
08	Production/Injection Manifold/Tee arrangement (project specific) fluid, valve and pressure status		X
09	Hook up and Pre-commissioning records	X	
10	Completed sub-sea commissioning procedures		X
11	Completed sub-sea commissioning reports		X
12	Equipment characteristics and specificity (length, marking, equipment id, etc.)	X	
13	Remaining punch list status		X
14	Anomaly records summary		X
15	Pre-commissioning Status Index Summary		X
16	Available spare parts and consumable materials lists		X
17	Final status of the sub-sea installation including valve positions, fluid and pressure status and preservation		X

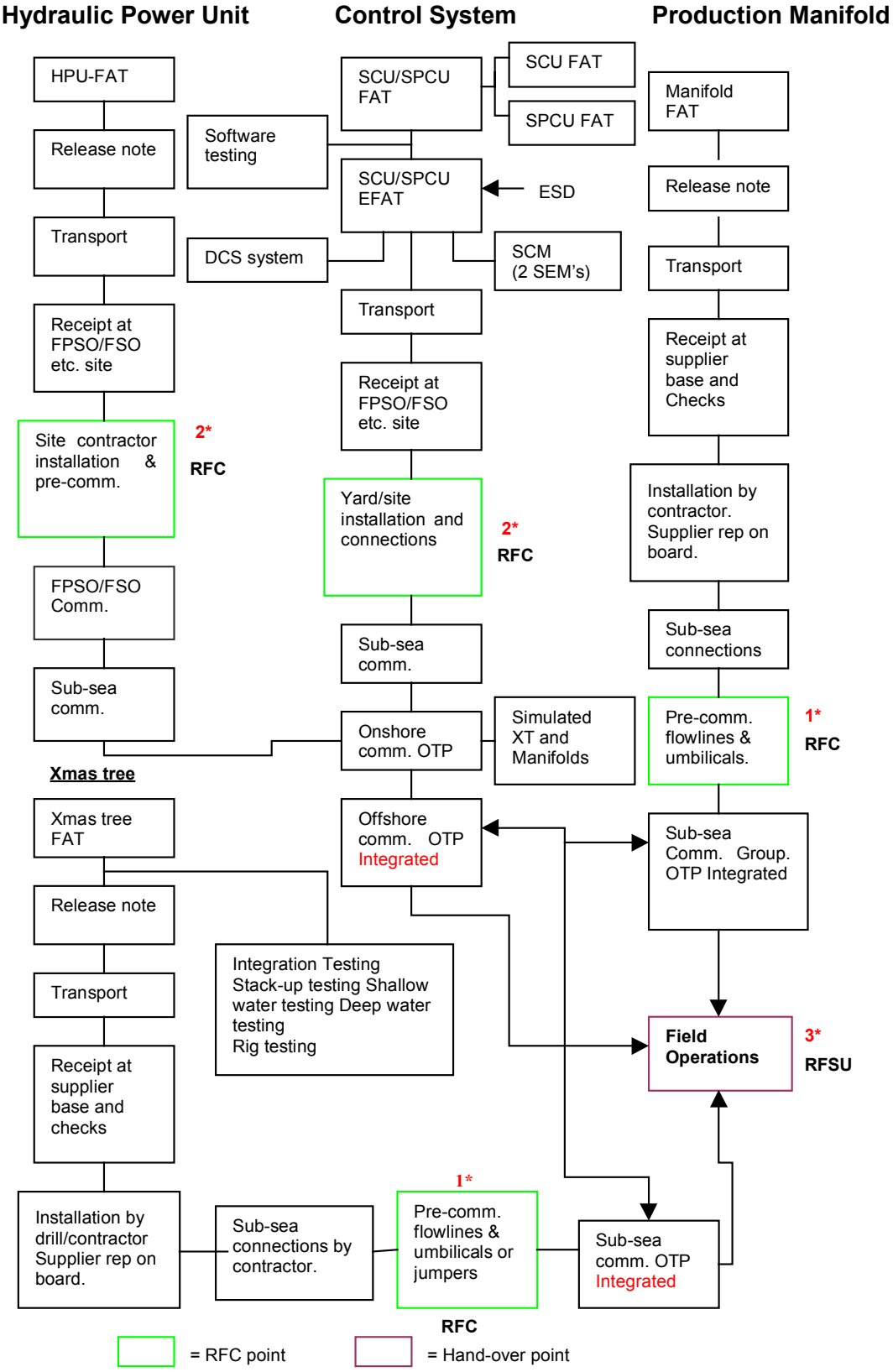
(1) **Reference** means: document identification, status and filing place.

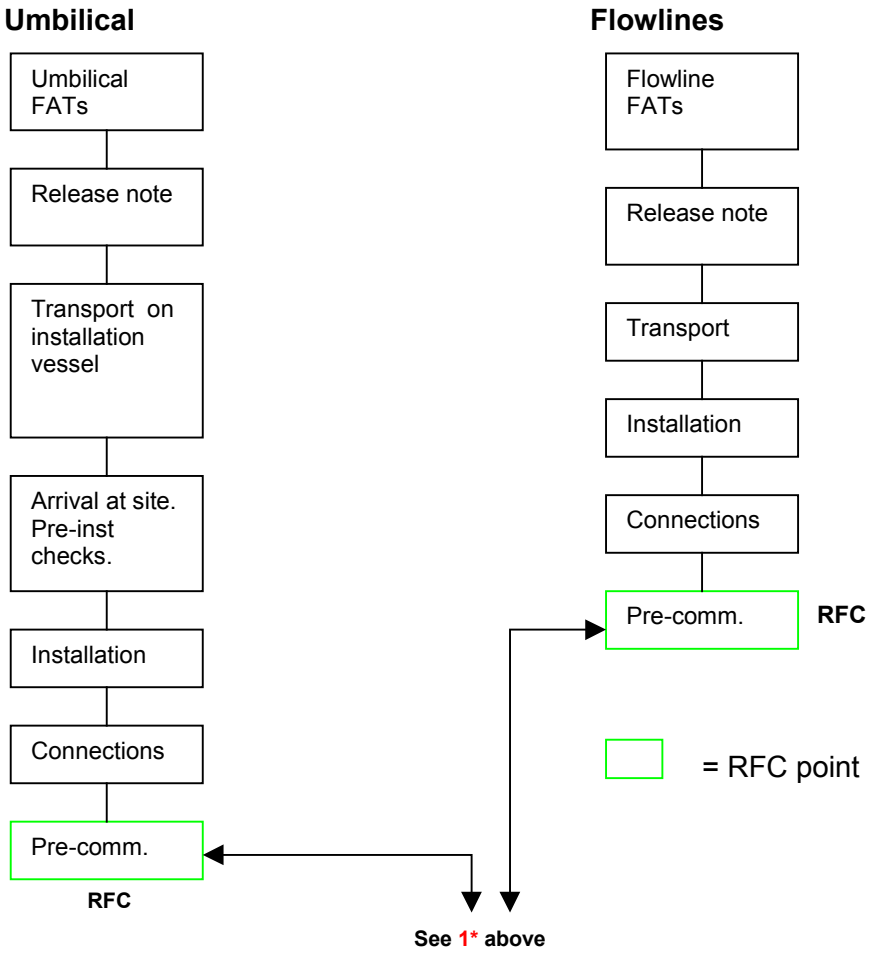
(2) **Hand-over** means: to be included in the Hand-over dossier.

(3) Included only if received from MANUFACTURER.

(4) It is permissible to accept for RFC and Hand-over a completed Xmas tree with only the minimum documentation. This documentation must include the pressure and fluid status of the Xmas tree body including status of all sections. Also required is status of all valves and any individualities or specific warnings as a result of the drilling group's intervention on the Tree.

11.2.2 Equipment Hand-over flow





1 * : RFC of the attached sub-system (Loop)

2* : RFC of the attached sub-system (ICSS or stand-alone or Loop)

3* : hand-Over of the whole Loop and Control/Hydraulic System attached.

12. Glossary

Agreement: Core of the Contract.

Basic function: It is the smallest equipment, that can be subject to a commissioning operation, consisting of a group of items of equipment that performs an elementary function of the plant.

Certifying authority: The Third Party in charge of the verification that the relevant Standards and Codes are met.

Commissioning: Live tests and major equipment on line tests.

COMPANY: The party who signs the contracts and commitments on behalf of the OWNER. Most often COMPANY and OWNER are the same party, then called COMPANY.

Completion activities: Precommissioning and commissioning activities.

Construction CONTRACTOR: The organisation in charge of the construction of the facilities.

Engineering CONTRACTOR: The organisation in charge of the detailed engineering of the facilities.

Functional Test: Live test of an instrument, electrical or telecommunication basic function.

Functional Test Sheet: Supporting document to record the results of a functional test.

Hand over: Formal transfer of responsibility between Project and Operator as per contract, included the complete transfer of historical data and dossier throughout the various project phases.

ICAPS©: (Integrated Commissioning and Progress System) Software, property of COMPANY, designating the tool to be used during the precommissioning and commissioning completion activities, supporting the OPERCOM™ methodology.

Main CONTRACTOR: The organisation in charge, for certain contracts, of both the engineering and the construction of the facilities.

Mechanical completion: Status of the plant when all subsystems are ready for commissioning.

Operational Test: On line test of a subsystem in conditions as close as possible to the normal operating conditions.

Operator: The organisation in charge of the Start-up and the normal operation of the facilities. Operator is usually part of COMPANY organisation as the Start-up team is usually a part of Operator organisation.

OPERCOM™: Trademark, property of COMPANY, designating the methodology of the completion activities described through GS EXP 101/103/105/107.

OWNER: The final client for whom the facilities are built.

Performance tests: Tests carried-out to prove the plant and equipment design capacities, products specifications.

Precommissioning: Conformity checks and cold tests.

Precommissioning Check list: Definition of the scope of work of conformity checks to be performed on elementary items of equipment.

Precommissioning Test Sheet: Supporting documents to record the results of static or de-energised tests carried out on certain items of equipment.

Preliminary Checks: Verifications that a subsystem has reached the ready for commissioning stage.

Pre-start-up activities: Process operations preparing the oil or gas-in.

Project Team: The organisation set up by COMPANY to manage all phases of the project, from Basic Engineering until Final Acceptance.

Punch List: A live database containing a list of all uncompleted or missing precommissioning, commissioning and start up items, which must be cleared during the course of a project, at various handover points (RFC, RFSU, Provisional Acceptance, Final Acceptance).

Ready for Commissioning: Status of a subsystem when all Precommissioning operations on that subsystem are complete.

Ready for Start-up: Status of a sub-system when all Commissioning operations on that sub-system are completed.

Status Index: List of equipment subject to Precommissioning operations and summary of the Precommissioning scope of work.

System: Major subdivision of an installation, being either process or utility, that performs a major operational function of the plant. The system includes all the various equipment that allows it to operate

Subsystem: Subdivision of a system, that performs a partial operational function to the system, with no or little interference from the other subsystems. Defined in the AGREEMENT as per “functionnal system”.

Technical Data Base: List of basic functions constituting a subsystem, i.e. physical description of that subsystem.

VENDORS: The SUPPLIERS of equipment and packages.

Witnessing: Means concurrently spot-checking (or dedicated checks for critical systems or subsystems) done by commissioning representative for Precommissioning activities and by operations representative for Commissioning activities.

13. Abbreviation

CCK: Precommissioning Check Sheet

EP(S)C: Main contract including Engineering, Procurement, Supply, and Construction

EP(S)CC: Main contract including Engineering, Procurement, Supply, Construction and Commissioning

FAT: Factory Acceptance Tests

FO: Field Operation

FTS: Commissioning Functional Test Sheet

LLI: Long Lead Item

OT / OTP: Operational Tests/Operational Tests Procedure

PL: Punch List

PRC: Preliminary Check

PSA: Pre Start-Up Activity

RFC: Ready For Commissioning

RFO: Ready For Operation

RFSU: Ready For Start-Up

STS: Precommissioning Static Test Sheet

SU: Start-Up

Appendix 1 Activities classification

The Project Completion Activities are now further defined in the following "classification of activities".

This classification, although it cannot be considered as an exhaustive scope of work, provides a useful list of all main completion and start-up activities, by discipline and major types of equipment, and it establishes to which category they belong, namely Precommissioning, Commissioning, or Start-Up.

The above, however, is a mere guideline, as the split of scope of work CONTRACTOR/Project/Operator may not exactly be the Precommissioning/ Commissioning/Start-Up technical split such as defined in the Classification of Activities (see paragraph 6) as shown by the following examples:

- Sub-sea and packages are very specific equipment usually dealt with specific contract by several sub-CONTRACTOR. Part of both Precommissioning and Commissioning is carried out during the Factory Acceptance Tests (FAT's) and may be repeated after installation and hook-up to the topsides or plant equipment.
- The HVAC is a very specific equipment usually dealt with as a turnkey contract by a sub-CONTRACTOR. Therefore, even if the Project is implemented through an a) or b) type contract the commissioning of the HVAC system will in this case be performed by the Main CONTRACTOR.
- Similarly, the cranes, hoists, lifts, etc., load testing in accordance with local regulations is classified as a commissioning operation, but this equipment may be required for construction purpose, hence its commissioning will be generally included in the CONTRACTOR's scope of work.

	PCom	Com	S-Up
Electrical			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X* QA QC		
Perform preliminary tests with equipment de-energised, including: • Insulation resistance measurements • Di-electric strength tests • Loops and circuits continuity tests • Earthing resistance measurements	X		
Fill in transformers with oil and carry out breakdown test of oil samples	X		
Fill in batteries with electrolyte	X		
Modify connections if wrong direction of rotation	X		
Check direction of rotation of electrical motors		X	

	PCom	Com	S-Up
Energise and test control power system		X	
Perform all functional tests, including: • Adjustment and testing of protective devices • Check-out and adjustment of electrical instruments • Operation of safety devices		X	
Energise and test emergency and instrument power systems		X	
Start up and test power plant		X	
Carry out preliminary load test (when possible)		X	
Energise sub stations		X	
Carry out batteries discharge tests		X	
Test battery chargers, inverters, UPS		X	
Perform motors four hours no load runs. Test motors ancillary equipment		X	
Check temperature rise of motors, bearings, transformers, relays, when loaded (if possible)		X	
Check operation of manual and auto controls		X	
Check normal and emergency lighting intensities		X	
Conduct performance tests where applicable			X
Instrumentation			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Remove in-line instruments before hydraulic tests (except control valves)	X		
Perform required pressure tests on: • Instrument take-off piping • Air piping • Air tubing	X		
Reinstall instruments after pressure tests and flushing of the process lines	X		
Calibrate all instruments other than F&G detectors prior to installation	X		

	PCom	Com	S-Up
Check continuity of transmission and identification of indication, control and alarm signals • Perform continuity and insulation tests for instrument cables • Perform continuity and tightness tests for pneumatic tubing	X		
Install sealing fluids where required	X		
Calibrate all F&G detectors, synchronise with F&G panel		X	
Test marshalling relay boxes, programmable logic controllers, sequential operators and all numeric control systems		X	
Carry out loop testing		X	
Test shutdown systems, interlocks, and sequencers		X	
Piping			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice. Verify especially gaskets and bolts types	X		
Carry out hydrostatic testing of piping	X		
Remove all temporary supports, protections, bracings, sea fastening stops, that were installed to prevent equipment damage during shipping, storage and erection	X		
Alleviate any excess piping stresses that may be imposed on pipes, compressors or pump flanges	X		
Provide and install all strainers, both temporary and permanent, spectacle blinds and temporary blanks required for start-up	X		
Check packing and packing materials and lubrication of valves; repack and lubricate if necessary	X		
Supply and install line identification tags and signs, stencil lines for identification	X		
Set or check pipe anchors, guides, spring hangers and supports after hydrotest. Provide cold and hot setting data	X		
Install safety valves or temporary spool pieces during construction	X		
Remove as necessary and transport all safety valves to and from test facilities	X		
Test, set, and tag all safety valves, then carry out safety valves final installation	X		
Supply car seals or locking devices for block valves and safety equipment	X		
Carry out piping water or air flushing operations	X		

	PCom	Com	S-Up
Install car seals or locking devices on block valves and safety equipment		X	
Carry-out leak test of shutdown valves		X	
Perform chemical cleaning where applicable		X	
Fill in hydraulic unit and network with appropriate oil		X	
Perform drying-out where applicable		X	
Carry out leak testing		X	
Carry out inerting		X	
Provide list and location of all blinds installed	X	X	X
Define, temporary blanks required for start-up		X	
Install corrosion probes			X
Carry out oil and gas-in			X
Perform hot or cold bolting of piping and equipment during initial plant start-up			X
Check spring hangers, pipe anchors and guides in hot position			X
Remove temporary strainers (normally after start-up)			X
Buildings and structures			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X* QA QC		
Air fin coolers			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X* QA QC		
Clean inside of the hood and remove all extraneous particles around the air fin cooler	X		
Set and align fan and driver if applicable. Set V belts, and fan blades pitch. Check fan ring clearance	X		
Check satisfactory operation of louvres and variable pitch assembly		X	
Start up fans and check vibrations, motor loading, and proper operation of autovariable fans		X	
Conduct performance test			X

	PCom	Com	S-Up
Furnaces, ductwork and stacks			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Perform hydrostatic test on completed furnace coils	X		
Empty water from coil and air blow if necessary	X		
Issue furnace dry-out procedure based on VENDOR's recommendations		X	
Check mechanical operation of soot blowers, dampers, and burners louvres		X	
Prepare furnace and fuel systems for dry-out operation. Ensure tubes are vented adequately		X	
Dry out the furnace following the approved procedure		X	
After drying-out, clean stack and duct, open manholes and other openings for inspection. Check operation of dampers. Close stack and duct after inspection		X	
Vessels - Towers, reactors and drums			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Install all tower, reactor and drum internals and perform tray leakage test and levelling adjustments as required	X		
Clean out all vessels	X		
Carry out vessels final inspection	X	X	X
Issue to CONTRACTOR written authority to close up each vessel			X
Properly close up all vessel internal manways and openings after final inspection or after loading of chemicals, catalysts, etc. is completed	X		
Cure and dry out castable linings		X	
Inspect all towers and drums for cleanliness and dryness before loading catalysts, etc.		X	
Load all chemicals (including hot oil, amine, glycol, freon, inhibitors, etc.), dessicants, catalysts, tower packings		X	
Carry out air blowing if required		X	
Inspect after final loading. Obtain samples of all catalysts loaded		X	

	PCom	Com	S-Up
Carry-out leak testing		X	
Carry-out the Start-up			X
Conduct performance test			X
Tankage			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Install appurtenances	X		
Hydrostatic test tank and internal piping, and clean inside tank	X		
Carry out tank final inspection	X	X	X
Issue to CONTRACTOR written authority to close up each vessel			X
Close manways	X		
Strap tank and issue record	X		
Organise independent calibration of product tanks for custody transfer where required by government regulations			X
Carry-out first oil in			X
Shell and tube exchangers			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X* QA QC		
Cary-out leak test		X	
Pumps			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Set and cold align pumps and drivers	X		
Couple pumps to drivers	X		
Install temporary strainers	X		
Check that piston seal packaging followers, if any, are correctly tightened	X		
If discharge flow dampers are fitted (normally nitrogen filled bladder type) check these are correctly charged and installed	X		

	PCom	Com	S-Up
Check pump gear box oil levels		X	
Run-in pump in recycle, check pump and motor operation and do any required dowelling of the pump driver		X	
Check oil for presence of chips after no load run		X	
Check gears, bearings and parts for signs of wear and damage		X	
Make final hot alignment check		X	
Run unit after start-up and conduct performance test			X
Gas turbines, compressors and expanders			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Install all piping and make piping corrections as required by VENDOR's tolerances. Set and cold align units	X		
Clean chemically suction and interstage piping and lube/seal oil piping		X	
Disassemble above piping for cleanliness inspection as required		X	
Fill lube and seal oil systems		X	
Carry out lube and seal oil systems flushing, circulate oil until test patches are clean		X	
Drain lube and seal oil systems then refill with new oil, if required		X	
Run in driver (uncoupled) (except for expanders)		X	
Couple driver and driven unit		X	
Run in compressor in recycle on air or inert gas, if possible and/or suitable, on gas after gas-in otherwise. Check operation		X	
Check hot alignment		X	
Carry out comprehensive vibration tests		X	
Check equipment noise levels		X	
Run unit on stream			X
Check plant noise levels			X
Conduct performance tests			X

	PCom	Com	S-Up
Diesel engines			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Set and cold align units	X		
Clean lube oil piping	X		
Fill lube oil system	X		
Drain lube oil system then refill with new oil, if not required		X	
Test run Diesel engines and their accessories uncoupled		X	
Couple diesel engines to driven equipment		X	
Test run coupled unit and verify all operating parameters		X	
Check alignment after operational test		X	
Carry out noise measurement tests		X	
Conduct performance test			X
Miscellaneous mechanical equipment			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Fill-in lube and hydraulic oil systems of lifting equipment		X	
Test lifting equipment in presence of Insurance Inspector or appropriate governmental authority		X	
Calibrate all solids weighing and measuring devices in their field-installed operating positions. Show that equipment meets specified tolerance for accuracy over full range of operating conditions		X	
(As an exception to the above, COMPANY will arrange for independent calibration of weight scales and product meters for custody transfer where required by government regulations)			X
Drilling equipment			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		

	PCom	Com	S-Up
Carry out following Drawworks and Rotary Table specific activities:			
• Check brake systems and command control systems		X	
• Clean and fill oil systems		X	
• Perform run-in test at no load for four hours		X	
• Check oil after run test for signs of swarf		X	
• Examine bearings and gears after run test for signs of wear or damage		X	
Carry out following Mud Pumps specific activities:			
• Perform operational test at low and high pressure with water, through the choke manifold and record all parameters (pressure, flow, stroke number, current intensity and voltage)		X	
• Adjust SCR setting to obtain proper performance values as per SUPPLIERS data			X
Carry out following Cementing Unit specific activities:			
• Check proper functioning of re-circulating mixer.		X	
• Make cement slurry of different specific gravities		X	
Carry out following Blow Out Preventers and Control Units specific activities:			
• Check BOP functioning from all control panels		X	
• Verify operation of indication panel		X	
• Check preload pressure and fluid levels in control unit accumulators		X	
• Shutdown air and electric driven pumps of control unit and operate BOP's functions. Check closing times, fluid volumes used, unit pressure at end of operation		X	
• Test alarm and emergency closing functions of BOP's		X	
Carry out following Derrick specific activities:			
• Dynamic alignment test for crown block assembly and other sheaves assemblies		X	
• Mechanical function test stabbing board and finger board winch		X	
Carry out following Well Test Equipment specific activities:			
• Operate burner booms		X	
• Check pilot ignition of burner heads		X	
• Check burner heads by burning diesel oil		X	
• Check proper function of water spray devices		X	

	PCom	Com	S-Up
Check equipment noise levels		X	
Conduct performance tests			X
Sub-sea production systems			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Production manifold pressure testing	X		
Production Xmas tree pressure testing	X		
Injection Xmas tree pressure testing	X		
Sub-sea production lines pressure tests and gauging	X		
Sub-sea injection lines chemical cleaning to cleanliness specification	X		
Sub-sea control umbilical pressure/ tests	X		
Sub-sea control system integrated testing at VENDOR	X		
Sub-sea control system integrated testing at onshore site		X	
Sub-sea control system integrated testing offshore		X	
Sub-sea hydraulic power system testing	X	X	
Sub-sea verification of status of manifolds and Xmas trees including fluid status		X	
Electrical testing of sub-sea control umbilical	X		
Energise sub-sea control umbilical		X	
Pressurisation of the production/injection flowlines	X	X	
Leak testing of flowlines and control umbilical lines.		X	
Instrument communication checks		X	
Instrument checks		X	
Pressurisation of the control umbilical hydraulic and chemical lines		X	
Sub-sea choke valve testing		X	
Sub-sea valve testing (includes signature curves) (Commissioning activity under control of Field Operations)		X	
Sub-sea valve sequence testing. (Preservation and flow assurance)		X	
Sub-sea shutdown testing including control from PCS and SSS (Commissioning activity under control of Field Operations)		X	
ROV override testing (Commissioning activity under control of Field Operations)		X	

	PCom	Com	S-Up
Sub-sea valve tightness testing (Commissioning activity under control of Field Operations)		X	
Flow testing hydraulic and chemical lines (Commissioning activity under control of Field Operations)		X	
SCSSV testing		X	
Start up of a well/loop/line.			X
HVAC equipment			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Check alignment of motors/fans and drives	X		
Check that tension on drives is correct	X		
Check that fans and motors rotate manually and run freely	X		
Check that anti-vibration mountings are correctly installed	X		
Check that sealing compound of fire dampers is installed correctly	X		
Check that linkage and blades of dampers operate correctly and freely	X		
Check that dampers actuators operate correctly		X	
Check that airflow direction in preheaters is correct	X		
Carry out ductwork leak tests		X	
Energize and run unit. Test sequences and interlocks. Check vibrations		X	
Carry out airflow and balancing tests		X	
Control and adjust rooms temperature and pressurisation		X	
Conduct Performance Test			X
Living quarters equipment			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Pressurise water pipes (hot and cold) and test taps, sinks, toilets, showers		X	
Energise specific (kitchen) electrical appliances and check functions with reference to electrical procedures		X	
Leak test Fresh Water Maker system		X	

	PCom	Com	S-Up
Energise and test run unit		X	
Verify conformity to specifications of the water quality		X	
Conduct performance test			X
Life saving equipment, survival craft and life raft			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Check especially that Survival Craft, Life raft, Life buoys, and Life jackets certification and shop testing conform and agree to offshore regulations and are acceptable to the applicable legislation	X		
Check that all Survival Craft and Life raft survival equipment has been installed i.e. radio, tools, spare parts, lamp, emergency radio beacon	X		
Check that all Survival Craft and Life raft instructions for use are clearly marked	X		
Check that the Life raft painter line is attached to a strong part of the installation and has an adequate length	X		
Check davit and launching apparatus	X		
Check that the Survival Craft security belt has been installed and hammer is ready to use (if using this system)	X		
Carry out Survival Craft motor test and functional launching test		X	
Organise Survival Craft sea trials with VENDOR		X	
Carry out Survival Craft sea trials			X
Check Life Buoys storage locations	X		
Check Life Jackets storage locations within individual cabins and on decks and that they are clearly marked	X		
Check that all Escape Routes signs are clearly marked to indicate escape ways and muster points (such as arrows, numbers, display boards and routes)	X		
Check that escape ways are safe and secure	X		

	PCom	Com	S-Up
Fire-fighting equipment			
Check storage locations of all extinguishers	X		
Function test CO_2/Halon skids without actual release		X	
Carry out operational tests of Deluge System, Hydrants and Monitors		X	
Carry out specific tests as required by local Authorities		X	
Telephones (include interphones, intercoms, fax, telex, switchboard, etc.)			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Check especially that EX equipment has been installed in classified areas	X		
Energise and carry out equipment functional tests		X	
Test actual operation of all equipment		X	
Public address			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Energise and carry out PA loops functional tests		X	
Test actual operation of loudspeakers and flashing beacons, including check and adjustment of operational features on field such as: range/coverage, visibility, etc.		X	
Radios (include Marine and Aero VHF, MF/UHF SSB, NDB, UHF local network, Troposcatter and line of sight radio links, Multiplex, Radio paging, satellite earth stations, etc.)			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Check connections of antennas, feeders, radio transceivers and associated equipment	X		
Energise and carry out one in-station test per radio equipment		X	
Test radio systems operation		X	

	PCom	Com	S-Up
Meteorological equipment			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Carry out the calibration of sensors	X		
Energise and test the operation of each loop		X	
Test the System test processing		X	
Test logging equipment		X	
Telemetry (MTU and RTU's)			
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications and good practice	X		
Energise and test data transmission		X	
Carry out instrument interface tests		X	
CCTV systems			
Check condition of equipment, quality of installation, and compliance with MANUFACTURERS instructions, safety rules, Project drawings, specifications and good practice	X		
Check free operation of cameras and pan-and-tilt equipment	X		
Energise and check proper functioning of equipment		X	
Test System test, scanning, sequencing, etc.		X	

Appendix 2 Witness matrix

PRE COMMISSIONING Witnessing Matrix									
	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
ACTIVITY DESCRIPTION	H	W	M	H	W	M	H	W	M
ELECTRICAL									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURER instructions, safety rules, and specifications.			X						
Perform preliminary tests with equipment de-energised, including: – Insulation resistance measurements – Di-electrical strength tests – Loops and circuits continuity tests – Earthing resistance measurements		X	X X X						
Carry out breakdown test of oil samples, and fill transformers with oil and		X							
Fill batteries with electrolyte.		X							
INSTRUMENTATION									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURER instructions, safety rules, specifications.			X						
Remove in-line instruments before hydraulic tests.			X						
Carry out preliminary cleaning of hydraulic tubing lines and check the cleanliness conformity.		X			X				
Air Sub-header flushing		X			X				
Perform required pressure tests on: – Instrument take-off piping – Air piping – Air tubing – Hydraulic tubing			X			X			
Reinstall instruments after pressure tests and flushing of the process lines.		X							
Calibrate all instruments other than F & G detectors prior to installation			X						
Check continuity of transmission and identification of indication, control and alarm signals. – Perform continuity and insulation tests for instrument cables. – Perform continuity and tightness tests for pneumatic tubing.			X						

PRE COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
Install sealing fluids where required			X						
Checking of the earthing network			X						
PIPING									
Check quality of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications (painting and insulation needed). Verify especially gaskets and bolt types.			X						
Produce NDT clearance	X			X					
Carry out piping water or air flushing operations.	X				X				
Carry out preliminary cleaning and hydrostatic testing of pipes.	X			X					
Remove all temporary supports, protections, bracing, sea fastening stops, which were installed to prevent equipment damage during shipping, storage and erection.			X						
Alleviate any excess piping stresses that may be imposed on pipes, compressors or pump flanges.			X						
Provide and install all strainers, both temporary and permanent, spectacle blinds and temporary blanks.			X						
Check packing and packing materials and lubrication of valves; repack and lubricate if necessary.			X						
Supply and install line identification tags and signs, stencil lines for identification.			X						
Set or check pipe anchors, guides, spring hangers and supports after hydrotest. Provide cold and hot setting data.			X						
Install safety valves or temporary spool pieces during construction.			X						
Remove as necessary and transport all safety valves to and from test facilities.			X						
Test, set and tag all safety valves, then carry out safety valves final installation.		X			X				
Supply car seals or locking devices for block valves and safety equipment.			X						
Carry-out leak test of shutdown valves.	X			X				X	
VESSELS									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURER instructions, safety rules, specifications			X						
Clean all vessels internally	X								
Carry out vessels final inspection		X						X	
Properly close up all vessel internal manways and openings after final inspection or after loading of chemicals, catalysts, etc. is completed			X						

PRE COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
TANKAGE									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications			X						
Install appurtenances			X						
Clean inside tank			X						
Carry out tank final inspection		X							
Close manways			X						
PUMPS									
Check condition of equipment, quality of installation, and compliance with project drawings, MANUFACTURERS instructions, safety rules, specifications			X						
Set and cold align pumps and drivers			X						
Couple pumps to drivers			X						
Install temporary strainers			X						
Check that piston seal packaging followers, if any, are correctly tightened			X						
If discharge flow dampers are fitted (normally nitrogen filled bladder type) check these are correctly charged and installed			X						
COMPRESSORS									
Check condition of equipment, quality of installation, and compliance with Project drawings, VENDOR's instructions, safety rules, specifications			X						
Install all piping and make piping corrections as required by MANUFACTURER's tolerances. Set and cold align units			X						
DIESEL ENGINES									
Check condition of equipment, quality of installation, and compliance with Project drawings, VENDOR's instructions, safety rules, specifications.			X						
Set and cold align units			X						
Clean lube oil piping			X						
Fill lube oil system		X							

PRE COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
LIFTING EQUIPMENT									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications			X						
HVAC EQUIPMENT									
Check condition of equipment, quality of installation, and compliance with Project drawings, VENDOR's instructions, safety rules, specifications			X						
Check alignment of motors/ fans and drivers			X						
Check that tensions on drivers are correct			X						
Check that fans and motors rotate manually and run freely			X						
Check that anti-vibration mountings are correctly installed			X						
Check that sealing compound of fire dampers is installed correctly			X						
Check that linkage and blades of dampers operate correctly and freely			X						
Check that airflow direction in pre heaters is correct			X						
LIFE SAVING EQUIPMENT, LIFEBOATS AND LIFERAFTS									
Check condition of equipment, quality of installation, and compliance with Project drawings, VENDOR's instructions, safety rules, specifications		X							
Check especially that lifeboat, Liferaft, Life Buoys, and Lifejacket certification and shop testing conform and agree to offshore regulations and are acceptable to the applicable legislation		X							
Check that all lifeboat and Liferaft survival equipment has been installed i.e. radio, tools, spare parts, lamp, emergency radio beacon		X							
Check that all lifeboat and Liferaft instructions for use are clearly marked			X						
Check that all Liferaft painter line is attached to a strong part of the installation and has an adequate length		X							
Check launching apparatus			X						
Check that the lifeboat security belt has been installed and hammer is ready to use (if using this system)			X						
Check Life Buoys storage locations			X						
Check Life Jackets storage locations within individual cabins and on decks and that they are clearly marked			X						
Check that all Escape Routes signs are clearly marked to indicate escape ways and muster points (such as arrows, numbers, display boards and routes)		X							
Check that escape ways are safe and secure		X							

PRE COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
ALL FIRE FIGHTING EQUIPMENT									
Check storage locations of all extinguishers		X							
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications	X								
TELEPHONES									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications			X						
Check especially that EX equipment has been installed in classified areas	X								
PUBLIC ADDRESS									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety rules, specifications			X						
BUILDINGS AND STRUCTURES									
Check condition of equipment, quality of installation, and compliance with Project drawings, MANUFACTURERS instructions, safety, rules, specifications		X							
DRAWINGS & DOCUMENTATION									
Compile OPERCOM™ Dossiers		X			X				X
Red line Mark up on Discipline Master Dossiers		X			X				X
Red line Mark up on VENDOR's Dossiers		X			X				X

Appendix 3 Commissioning witnessing matrix

COMMISSIONING Witnessing Matrix									
	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
ACTIVITY DESCRIPTION	H	W	M	H	W	M	H	W	M
ELECTRICAL									
Energise and test control system.	X				X				X
Perform all functional tests, including: - Adjustments and testing of protective devices - Check-out and adjustments of electrical instruments - Operation of safety devices		X							
Energise and test emergency and instrument power system		X		X					X
Start up and test emergency power plant		X		X				X	
Carry out preliminary load test (when possible)		X							
Energise sub stations		X							
Carry out batteries discharge tests			X						
Test battery chargers, inverters, UPS		X							
Check direction of rotation of electrical motors. (Modify connections if wrong direction of rotation)			X						
Perform 4 hour no load run on motors. Test motor's ancillary equipment		X							
Check temperature rise of High Voltage motors, bearings, transformers, relays, when loaded (if possible)	X								
Check operational of manual and auto controls			X						
Check normal and emergency lighting intensities			X						
INSTRUMENTATION									
Calibrate all F&G detectors, synchronise with F&G panel.			X						
Test marshalling relay boxes, programmable logic controllers, sequential operators and all numeric control systems		X							
Carry out loop testing			X						
Test functions of hydraulic control cabinet (Wellhead Safety Cabinet) and associated valves and instruments	X								
Test shutdown and process control system, interlocks and sequencers	X								
Black Start Test	X								
VESSELS									
Carry out vessels final inspection.		X							

COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
TANKAGE									
Carry out tank final inspection.		X							
PIPING									
Install car seals or locking devices on block valves and safety equipment.			X						
Perform chemical cleaning where applicable.			X						
Fill in hydraulic unit and network with appropriate oil.		X							
Perform drying-out where applicable.			X						
Carry out leak testing.	X			X					
Carry out inerting	X								
Provide list and location of all blinds installed.			X						
PUMPS									
Check pump gearbox oil levels			X						
Run-in pump in recycle, check pump and motor operation and do any required doweling of the pump driver	X								
Check oil for presence of chips after no load run		X							
Check gears, bearings and parts for signs of wear and damage			X						
Make final hot alignment check		X							
COMPRESSORS									
Clean chemically suction and interstage piping and lube/seal oil piping			X						
Disassemble above piping for cleanliness inspection as required			X						
Fill lube and seal oil systems		X							
Carry out lube and seal oil systems flushing, circulate oil until test patches are clean		X							
Drain lube and seal oil systems then refill with new oil, if required		X							
Run in driver (uncoupled) except for expanders.		X							
Couple driver and driver unit			X						
Run in compressor in recycle on air or inert gas, if possible and/or suitable, on gas after gas-in otherwise. Check operation	X								
Check hot alignment		X							
Carry out comprehensive vibration tests		X							
Check equipment noise levels			X						

COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
DIESEL_ENGINES									
Test run Diesel engines and their accessories uncoupled	X								
Couple diesel engines to driven equipment			X						
Test run coupled unit and verify operating parameters	X								
Check alignments after operational test		X							
Carry out noise measurement tests			X						
LIFTING EQUIPMENT									
Fill-in lube and hydraulic oil systems of lifting equipment		X							
Test lifting equipment in presence of Certifying Authority	X			X					
Calibrate all solid weighing and measuring devices in their field-installed operating positions. Show that equipment meets specified tolerance for accuracy over full range of operating conditions		X							
HVAC EQUIPMENT									
Check that dampers actuators operate correctly			X						
Carry out ductwork leak tests	X								
Energise and run unit. Test sequences and interlocks. Check vibrations	X								
Carry out airflow and balancing tests		X							
Control and adjust room temperature and pressurisation		X							
FIRE FIGHTING EQUIPMENT									
Function test CO_2 skids without actual release	X								
Carry out operational test of Deluge System, Hydrants and Monitors	X								
Carry out specific test as required by local Authorities									
TELEPHONES									
Energise and carry out equipment functional tests		X							
Test actual operation of all equipment	X								
PUBLIC ADDRESS									
Energise and carry out PA loops functional tests.		X							
Test actual operation of loudspeakers, flashing and non-directional beacons, including check and adjustment of operational features on field such as: range/coverage, visibility, etc.	X								

COMMISSIONING Witnessing Matrix

ACTIVITY DESCRIPTION	CONTROL POINTS								
	COMPANY			Cert. Authority			OPERATOR		
	H	W	M	H	W	M	H	W	M
LIFE BOAT									
Carry out lifeboat motor test and functional test	X								
Organise lifeboat sea trials with VENDOR	X								
DRAWINGS & DOCUMENTATION									
Compile OPERCOM™ Dossiers		X			X				X
Red line Mark up on Discipline Master Dossiers		X			X				X
Red line Mark up on VENDOR's Dossiers		X			X				X

PRE START-UP activities Witnessing Matrix

ACTIVITY DESCRIPTION	COMPANY			Cert. Auth.			OPERATOR			LEADER	
	H	W	M	H	W	M	H	W	M	Com	Op
Pre Start Up Activities											
Operational Test as per approved procedures on utility equipment. (no use of Hydrocarbon Fluids)	X			X	X			X		Com	
Operational Test as per approved procedures on process equipment. (use of Hydrocarbon Fluids)	X			X	X		X				Op

PRE START-UP activities Witnessing Matrix

ACTIVITY DESCRIPTION	COMPANY			Cert. Auth.			OPERATOR			LEADER	
	H	W	M	H	W	M	H	W	M	Com	Op
Pre Start Up Activities											
- Leak testing	X				X		X			Com	
- Chemical Cleaning	X				X		X			Com	
- Dry out	X				X		X			Com	
- Chemical Loading	X				X		X				Op
- Plant depressurisation demonstration	X				X		X				Op
- ESD Highest level demonstration	X				X		X			Com	
- Black start procedure demonstration	X				X		X			Com	
- Deluge demonstration	X				X		X				Op
- Inerting	X						X				Op
- PAGA test	X				X		X			Com	
- Gas in							X				Op

Appendix 4 Preparation summary

Precommissioning	Commissioning
General at the basic stage Select the contractual strategy with associated milestone/incentive schema Define on-shore/off-shore scope of work Define Overall Organisation Key Personnel/Field Resources Develop & Implement Commissioning Methodology & Tool supply Define preliminary list of sub-systems, OTP's required Prepare all Sub-Contracts Define Hand-Over principle	
General at the detailed stage Finalise Commissioning PLAN according to contractual strategy and Start-Up schema Establish (FAT) & (SAT) Procedures Establish List of Systems and Sub-Systems Identify Plant Start-up Sequences & Priorities Issue Marked-up Drawings Issue ICAPS deployment PLAN	
• Issue Precommissioning Procedures • Produce Precomm & Comm Planning & Logic Networks • Issue Overall Planning by RFC Date • Configure ICAPS© Technical Data • Itemise all Plant Equipment by Sub-System Discipline • Import Engineering Data to ICAPS© • Prepare Check & Test Sheets • Establish VENDOR Assistance and Mobilisation Schedules • Define all Spares Part & Special Tool Requirements • Define Temporary Equipment, Blinds, Spades etc. • Issue Precommissioning Preservation/lubrication Schedules • Prepare Precommissioning Dossiers	• Define all Basic Functions per Sub-System / Discipline • Establish Commissioning Logic & Stage Priorities • Establish Planning & Manpower • Issue Comm Procedures • Identify VENDOR Requirements, Mobilisation / Manuals / Spares • Input Comm Data to ICAPS© • Prepare Check & Test Sheets • Develop Operational Test Procedures • Define all Temporary Utility Requirements & Logistics • Define Leak Test, Drying & Inerting Procedures • Issue Precommissioning Preservation/lubrication Schedules • Establish Test Equipment, Tools, Consumables/First Fills • Issue Operating & Maintenance Manuals • Prepare Commissioning Dossiers