Base Load Power Hub (BLPH)

MECHANICAL COMPLETION AND COMMISSIONING EXECUTION PLAN

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.2 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

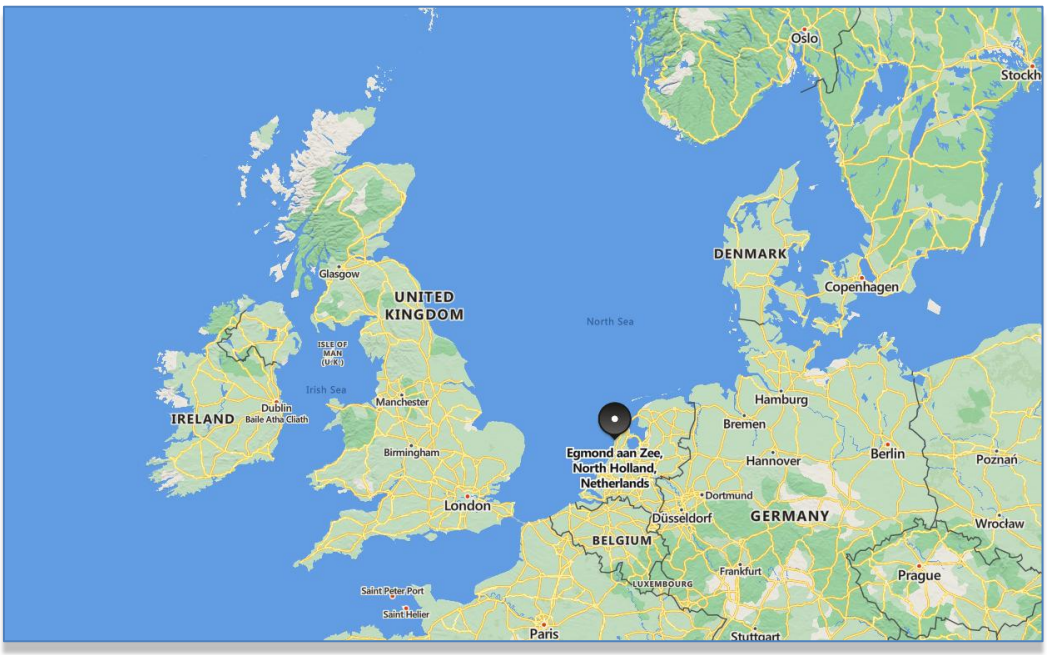


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

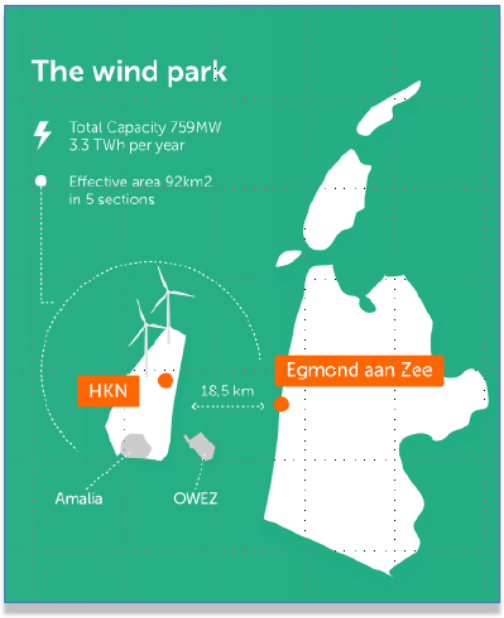


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile is located on coordinates E 590719.1, N 5841602.3 and is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.3 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

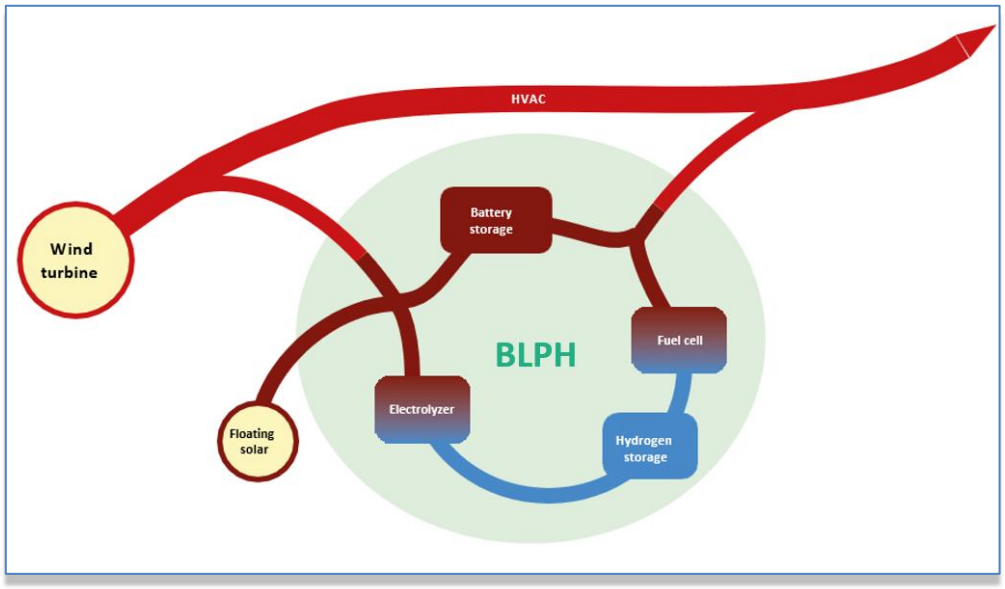


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH is to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. DOCUMENT SCOPE

The purpose of this Execution Plan is to describe the methodology and the planned actions to be implemented for the preparation and execution of Mechanical Completion, Pre-commissioning and Commissioning activities to be performed on the PLANT, including COMPANY PROVIDED ITEMS, at the onshore premises of CONTRACTOR located in Milan (Italy) offices and Piomboni yard - Marina di Ravenna (Italy).

CONTRACTOR, pursuant to CONTRACT and PROJECT requirements, shall implement an exacting methodology, complete with a distinct set of tools and documentation to meet the following key objectives:

Perform the Mechanical Completion, Pre-commissioning and Commissioning on the WORKSITE to the maximum extent possible so as to minimise the commissioning operations on SITE;

- Ensure safety for the people, environment and facilities during the execution of the Commissioning activities at WORKSITE,
- Ensure integrity and operation of the equipment for their lifetime in accordance with PROJECT design and specifications,
- Plan a smooth and flawless execution of the Commissioning activities avoiding unforeseen downtimes and delays.

Achievement of the above objectives shall be obtained by:

- Defining and prioritizing a predetermined sequence of the Mechanical Completion checks, Pre-commissioning and Commissioning tests and tasks,
- Checking, testing systematically and exhaustively all the components of PLANT in compliance with PROJECT approved procedures and CONTRACT terms, managed by a dedicated team of inspectors, technicians and field engineers who will perform the Mechanical Completion, Pre-commissioning and Commissioning tasks and subsequently record the results via discipline specific check, inspection and test sheets,
- Ensuring full traceability of the performed checks and tests, through implementation of a dedicated Project Completions Management Database containing individual references to all tagged items.

3. REFERENCE DOCUMENTS

3.1 Project Documents

Document ID	Document Title
[1] 123A90-PML-PM-LIS-01001	Master Document Register
[2] 123A90-PML-COM-LIS-03011	System/Sub-Systems List
[3] 123A90-PML-COM-DG-03012	Sub-System Boundary Limit Diagrams
[4] 123A90-PML-COM-PRO-03007	Commissioning Strategy
[5] 123A90-PML-COM-PRO-03038	Leak Test Procedure
[6] 123A90-PML-COM-SP-03032	Pre-Commissioning Functional Test Sheet Template Collection (ITR-B)
[7] 123A90-PML-COM-SP-03014	Commissioning TDS - Temporary Equipment & Facilities
[8] 123A90-PML-COM-PRO-03019	OTP – Onshore Performance & Integrated Test Procedure
[9] 123A90-PML-COM-LIS-03034	Inhibit-Override Register
[10] 123A90-PML-COM-LIS-03035	PSV Calibration Register
[11] 123A90-PML-COM-PRO-03036	OTP - Black Start Procedure
[12] 123A90-PML-COM-LIS-03024	Commissioning Spare Parts and Consumables List
[13] 123A90-PML-COM-PRO-03022	Initial offshore START-UP procedures
[14] 123A90-PML-COM-RE-03001	Commissioning Final Dossier (ITR-B and ITR-C)
[15] 123A90-PML-QHSE-PRO-00116	Flushing and cleaning procedures
[16] 123A90-PML-QHSE-SP-00118	Mechanical Completion Check Sheet Template Collection (ITR-A)
[17] 123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier (ITR-A)
[18] 123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
[19] 123A90-PML-COM-PRO-03041	OTP - Hydrogen Storage & Venting Systems
[20] 123A90-PML-COM-PRO-03042	OTP - Sea Water Intake & Fresh Water Treatment Systems
[21] 123A90-PML-COM-PRO-03043	OTP - Instrument Air System
[22] 123A90-PML-COM-PRO-03055	OTP - Nitrogen Generation System
[23] 123A90-PML-COM-PRO-03045	OTP - HV Switchgear & 66 kV Transformer Systems
[24] 123A90-PML-COM-PRO-03046	OTP - 6.6 kV Switchgear & Transformer Systems
[25] 123A90-PML-COM-PRO-03047	OTP - LV Switch Boards & LV Distribution Board Systems
[26] 123A90-PML-COM-PRO-03048	OTP - Lighting & Small Power Systems
[27] 123A90-PML-COM-PRO-03049	OTP - Electrical Heat Tracing Systems
[28] 123A90-PML-COM-PRO-03050	OTP - DC UPS System 10kVA UP-200F1

[29]	123A90-PML-COM-PRO-03051	OTP - Data Network Systems
[30]	123A90-PML-COM-PRO-03053	OTP - Navaid System
[31]	123A90-PML-COM-PRO-03054	OTP - F&G and ESD C&E Logics
[32]	123A90-PML-COM-SP-03057	Worksite WEF (Work Execution Flow Scheme)
[33]	123A90-PML-COM-SP-03058	Site WEF (Work Execution Flow Scheme)
[34]	123A90-PML-QHSE-PL-00001	Project HSE Plan
[35]	123A90-PML-QHSE-PRO-00120	Proverlis Management Procedure
[36]	123A90-PML-COM-PRO-03056	OTP – Document Template
[37]	123A90-PML-COM-PRO-03059	OTP - AC UPS System 35kVA UP-200F3
[38]	123A90-PML-COM-PRO-03060	OTP - AC UPS System 15kVA UP-200F4
[39]	123A90-PML-COM-PRO-03061	OTP – Electrolyser (CPI)
[40]	123A90-PML-COM-PRO-03062	OTP – Fuel Cell (CPI)
[41]	123A90-PML-COM-PRO-03063	OTP – BESS (CPI)

Table 1: Reference Project Deliverables

3.2 COMPANY Technical Information

[42]	K559-2254-CG-PHI-001	Commissioning Philosophy
[43]	K559-2254-EL-ELL-002	BLPH Electrical Load List (CCS MODE 2(A) 'HOT STANDBY')
[44]	K559-2254-EL-ELL-003	BLPH Electrical Load List (CCS MODE 3(C) 'DISCHARGING')
[45]	K559-2254-EL-ELL-004	BLPH Electrical Load List (CCS MODE 4(A) 'COLD STANDBY')
[46]	K559-2254-EL-ELL-005	BLPH Electrical Load List (CCS MODE 4A(D) 'EMERGENCY MODE (Island))
[47]	K559-2254-EL-ELL-006	BLPH Electrical Load List (CCS MODE 5(D) 'POWER OUT (Blackout))
[48]	K559-2254-PR-PHI-001	Main process control philosophy

Table 2: Company Specifications

These documents were produced in FEED and made available to RM for info. They have subsequently been superseded by Detailed Design, similar or same deliverables.

4. DEFINITIONS

Can	used for statements of possibility and capability, whether material, physical or casual.
COMPANY (CPY)	means CROSSWIND C.V., owner & developer of the offshore WIND FARM Hollandse Kust Noord Wind Park Project.
CONTRACTOR (CTR)	means ROSETTI MARINO S.p.A., the named party with whom COMPANY will place a contract for engineering, procurement, construction, offshore installation & Commissioning of the facilities associated with the PROJECT.
COMMISSIONING	The commissioning process is the integrated application of a set of engineering techniques and procedures to check, inspect and test every operational component of the project: from individual functions (such as instruments and equipment) up to complex amalgamations (such as modules, subsystems and systems).
COMPANY PROVIDED ITEM(S)	means any itemised equipment and materials to be incorporated into the PLANT by CONTRACTOR and expressly specified as being supplied to CONTRACTOR by COMPANY as listed and defined in the CONTRACT.
COMPLETIONS MANAGEMENT SYSTEM	Refers to the software designated application utilised to manage and record progress of Mechanical Completion, Pre-commissioning and Commissioning activities.
CONTRACT	refers to the contract between the PARTIES created by the execution of the CONTRACT DOCUMENTS.
"he", "him", "his"	are used in relation to CONTRACTOR.
Inspection Test Records (ITR)	A-ITR – used to record and verify construction scope associated with of a tagged item (component). B-ITR – used to record and verify energisation and function testing during pre-commissioning of a tagged item
"it", "its"	are used in relation to COMPANY.
May	used to indicate a course of action permissible within the limits of the specification.
MECHANICAL COMPLETION	Mechanical Completion is the point in the project when construction is complete, and subsystems are ready to be handed over to the commissioning team.
PLANT	Refers to the permanent facilities (Base Load Power Hub) being constructed or to be constructed at SITE resulting from the WORK.
PRE-COMMISSIONING	Pre-Commissioning relates to the preliminary Commissioning activities to test and check the individual basic functions, systems and/or sub-systems within a logical area to ensure that the components of any given system and/or sub-system perform as designed.
PROJECT	Refers to the BASE LOAD POWER HUB project.
Punch List	Work not executed as per approved documents and/or not meeting quality, health, safety, environment, operability/maintainability requirement and/or Standard; and recorded as a list for rectification.
Punch List 'A' Item	Punch List item that will prevent the safe operation of the Equipment, System and Plant and may jeopardise personnel or environment. Such item, as agreed, shall be cleared before the Equipment/System/Plant can progress to the next stage of the Commissioning and Handover phase.

Punch List 'B' Item	Punch List item that will not endanger the safe operation of the Equipment, System and Plant or personnel and/or environment. Such item, as agreed, can be carried over to the next stage and may be cleared later.
Shall	used to indicate requirements strictly to be followed to conform to the specification and accepted by all involved parties.
Should	used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.
SITE	Refers to the offshore location where the PLANT is to be installed and the vicinity thereof (offshore North Sea - Netherlands).
SUBCONTRACTOR	means any company or person, to whom CONTRACTOR has subcontracted directly or indirectly at any level the performance of any part of the WORK.
VENDOR	means any CONTRACTOR's and/or SUBCONTRACTORS' supplier(s) of CONTRACTOR ITEM(s). VENDORS' presence on WORKSITE may be required to assist CONTRACTOR and/or COMPANY for the installation, commissioning and startup of such CONTRACTOR ITEMS and during the execution of PERFORMANCE TESTS.
WORK	means all and any part of the works and services required to be performed by CONTRACTOR under the CONTRACT for the full and complete realisation of the PLANT.
WORKSHOP(S)	means any location(s), other than WORKSITES, including offices, premises and workshops, where any equipment, materials or manufactured items including CONTRACTOR ITEMS shall be engineered, manufactured and assembled.
WORKSITE	means any construction location(s), where any major parts of the PLANT (such as templates, piles, nodes, jacket structure, modules, decks) shall be fabricated and assembled, excluding all other offices, premises and workshops of CONTRACTOR and SUBCONTRACTORS.

Table 3: Basic Definitions

5. ACRONYMS

AHU	Air Handling Unit
AIS	Automatic Identification System
AOC	Achievement of Commissioning
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
C&E	Cause & Effects
CCS	Central Control System
CCTV	Closed Circuit Television
CMS	Completions Management System
CPI	Company Provided Item
CSU	Commissioning & Start-Up
E&I	Electrical & Instrumentation
EMCS	Electrical Monitoring & Control System
ESD	Emergency Shut Down
F&G	Fire & Gas
FAT	Factory Acceptance Test
FT	Functional Test
GALT	Gross Air Leak Test
HAZID	Hazard Identification Studies
HAZOP	Hazard and Operability Studies
HKN	Hollandse Kust Noord
HSSE	Health, Safety, Security & Environment
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
ICSS	Integrated Control and Safety System
ITR	Inspection & Test Record
MC	Mechanical Completion
MDR	Master Document Register
MOC	Management of Change
NUI	Normally Unmanned Installation
LC	Locked Closed
LO	Locked Open
LOTO	Lock-Out / Tag-Out
LV	Low Voltage
OCC	Onshore Commissioning Complete
OEM	Original Equipment Manufacturer

OICT	Onshore Utility Commissioning Complete
OMAR	Operating Modes Assurance Review
OR	Operations Readiness
ORR	Operations Readiness Review
OTP	Operational Test Procedure (Commissioning)
PACO	Process Automation, Control and Optimisation
PCS	Process Control System
PC&C	Pre-Commissioning & Commissioning
PID (P&ID)	Piping and Instrumentation Diagram
PSSR	Pre Start-up Safety Review
PTW	Permit to Work
PV	PhotoVoltaic
PVP	Piping and Vessels Preparation
RFC	Ready for Commissioning
RFO	Ready for Operation
RFSA	Ready For Sail Away
RFSU	Ready For Start-Up
SAT	Site Acceptance test
SECE	Safety Environmental Critical Element
SIF	Safety Instrumentation Function
SIL	Safety Integrity Level
SIMOPS	Simultaneous Operations & Maintenance
SIS	Safety Instrumented System
SLD	Single Line Diagram
SoF	Statement of Fitness
TIV	Technical Integrity verification
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VooW	Van Oord Offshore Wind
VSAT	Very Small Aperture Terminal
WEF	Work Execution Flow Scheme

Table 4: Acronyms

6. MECHANICAL COMPLETION, PRE-COMMISSIONING AND COMMISSIONING METHODOLOGY

6.1 General

CONTRACTOR shall fulfil the provisions of the contract in defining the methodology to be followed for approaching the MC, PC&C activities relevant to his scope of WORK.

The MC, PC&C activities at WORKSITE consist of a series of checks, inspections and tests to be conducted on the facilities to achieve the READY FOR SAIL AWAY CERTIFICATE, ensuring all the components being part of CONTRACTOR's scope of WORK are fully constructed, commissioned and ready to proceed with the following phase of the PROJECT at SITE (offshore).

The CONTRACTOR's scope of WORK comprises WORKSITE and SITE MC, PC&C activities and shall include:

1. Engineering phase
   The Mechanical Completion and Commissioning Engineering phase is developed in parallel with the detailed engineering design stage of PROJECT, with the aim of preparing a set of dedicated procedures and instructions for execution of MC, PC&C activities at WORKSITE and SITE.
   Deliverables required to be completed during this phase are listed in the PROJECT dedicated Master Document Register (ref. [1]).
2. Execution phase
   The Execution phase identifies the field activities to be executed at both WORKSITE and SITE in accordance with the approved documentation prepared during the respective engineering phase.

6.2 Definitions

The following terminology and definition of terms shall be used throughout this document and all MC, PC&C documentation, to facilitate a common and unambiguous understanding between Stakeholders.

GENERAL	Mechanical Completion	Mechanical Completion (MC) consists in a comprehensive series of static and de-energized checks and inspections to be carried out on tagged items of the plant in order to ensure that the facilities have been constructed in compliance with project Documents, Specifications, Standards and Engineering Best Practices. The Mechanical Completion can be divided into three broad separate "De-Energized" types of activities: • Conformity Checks; • Static Equipment Checks and Inspections; • Piping Cleaning, Checks and Inspections.
	Pre-commissioning	Pre-Commissioning (PC) activities relate to the individual function tests of equipment and devices and are performed as a precursor to execution of the Commissioning procedures. The Pre-Commissioning scope consists of two broad separate "Energized Equipment" types of activities: • Preliminary Checks; • Basic Function Tests;
	Commissioning	Commissioning (C) consists in a comprehensive series of dynamic and energized Checks and Tests to be carried out in order to demonstrate and ensure that the facilities are ready to operate safely and steadily in compliance with project Documents, Specifications, Standards and Engineering Best Practices. The Commissioning scope consists of two broad separate types of activities: • Piping and Vessels Leak Tests and Service Tests; • Operational Test Procedures (Commissioning OTPs).
	Ready for Commissioning	The Ready for Commissioning (RFC) milestone is achieved at the end of the Mechanical Completion phase. To reach RFC, the system must be fully constructed, consequently independently inspected and approved to be confirming with applicable project quality standards. Further to signature of the RFC Certificate, the related system will be handed over from the Contractor Construction Team to the Contractor Pre-Commissioning & Commissioning team.
	Ready for Operation	Ready for Operation (RFO) status applies to all non-hydrocarbon systems and means that a system is fully commissioned, charged with its normal operating medium, and has been tested at operating conditions. An RFO Acceptance Certificate shall be raised on completion of the commissioning procedure scope and presented to the Asset Operator for acceptance before any system (or sub-system) is placed into operation. Note that systems will be required to be at RFO status both at onshore and onshore.

	Ready for Start-Up	Ready for Start-Up (RFSU) is the period during which "Utility", "Safety" and "Process" packages and equipment are gradually put into operational service. Start-up begins when the first equipment is energised and remains in service. These are typically, UPS, LV Power Generation & Distribution, HVAC, Lighting Circuits, Process Utilities, main equipment packages, etc. Prior to RFSU of systems involving hazardous materials, internal system level reviews shall be conducted to assure system integrity. At RFSU, the system or Facility is ready for the introduction of mains power to the electrolysers before testing at operating conditions. Start-up ends when the last item of equipment of the new plant is started for the first time and is left in operation. The plant is then fully in operation and is ready for the final Integrated Test.
	Statement of Fitness	As part of the Shell HSSE & SP Control Framework, the Statement of Fitness (SoF) before commissioning or introduction of hydrogen / hazardous substances in a New Asset, is a requirement of the Asset Integrity - Process Safety Management Application procedure. The Project and Asset Managers are accountable to develop a SoF to demonstrate asset integrity prior to energisation or introduction of hazardous substances. The SoF for the applicable systems needs to be signed immediately prior to the introduction of hazardous substances or energy. This will initially be onshore prior to the introduction of HV electricity, starting up the electrolysers and generating hydrogen in the fabrication yard.
	System	A System is a major subdivision of a plant, being either process or utility, which performs a major operational function of the plant. A System includes all the various equipment that allows it to operate. The division into functional Commissioning Systems corresponds to the prevailing fluids or services.
	Sub-system	A Sub-system is a further subdivision of a System, which performs a partial operational function of the System, with little or no interference from the other Sub-systems. The Sub-system is the basic unit for Commissioning.

Table 5: Basic terminology and Definitions

6.3 Interim Certificates

Any certificate issued by CPY before the release of the FINAL COMPLETION CERTIFICATE are termed INTERIM CERTIFICATE.

The following Table 6 summarizes the INTERIM CERTIFICATES contractually identified for the PROJECT and related to pre-commissioning and commissioning achievements and beyond.

CERTIFICATE (contractual definition)	each or all of the following certificates: ONSHORE COMMISSIONING COMPLETION CERTIFICATE, ONSHORE INTEGRATED TESTING COMPLETION CERTIFICATE, READY FOR SAIL AWAY CERTIFICATE, READY FOR INSTALLATION CERTIFICATE, HOOK UP COMPLETION CERTIFICATE, READY FOR START UP CERTIFICATE, PERFORMANCE ACCEPTANCE CERTIFICATE, HANDOVER CERTIFICATE, COMPLETION CERTIFICATE and REMEDIAL WORK COMPLETION CERTIFICATE.
Ready For Commissioning Certificate (RFCC)	The RFC Certificate shall state for each functional sub-system of the PLANT that it is mechanically complete and has been subjected to a final tri-party walkdown inspection. The related PLANT sub-system will be subsequently handed over to the Commissioning team for execution of PC&C activities. Permit to Work and SIMOPS procedures will be applicable prior to equipment energization and/or pressurization. Achievement of the RFC Certificates will be the responsibility of the Construction Department.
Ready For Operation Acceptance Certificate (RFOC)	An RFO Acceptance Certificate shall be raised on completion of the commissioning procedure scope and presented to the Asset Operator for acceptance before any system (or sub-system) is placed into operation.
Onshore Commissioning Completion Certificate (OCCC)	This certificate shall be issued by COMPANY certifying that ONSHORE COMMISSIONING COMPLETION has been achieved for the scope, or part thereof.
Onshore Integrated Testing Completion Certificate (OITCC)	This certificate shall be issued by COMPANY certifying that ONSHORE INTEGRATED TESTING COMPLETION has been achieved for the scope, or part thereof.
Performance Test Acceptance Certificate (PAC)	This certificate shall be issued by COMPANY certifying that the PERFORMANCE TEST CRITERIA have been achieved during the PERFORMANCE TESTS.
Ready to Sail Away Certificate (RSAC)	The certificate issued by COMPANY certifying that the PERMANENT WORK is ready for sail away to the INSTALLATION SITE.
Ready for Installation Certificate (RFIC)	This certificate shall be issued by COMPANY certifying that the READY FOR INSTALLATION has occurred.
Hook Up Completion Certificate (HUCC)	The certificate issued by COMPANY certifying that HOOK UP COMPLETION has occurred for the SCOPE or part thereof.
Ready for Start Up Certificate (RFSUC)	This certificate shall be issued by COMPANY when CONTRACTOR will achieve READY FOR START-UP for the PERMANENT WORK or part thereof when the PERMANENT WORK or part thereof are ready for introduction of hydrogen or energy / electrolyser start-up. Two certificates will be issued; one Onshore and the second Offshore.
Hand Over Certificate (HOC)	The Hand Over Certificate issued by COMPANY certifying that HANDOVER of the whole or part of the PERMANENT WORK has occurred.
Completion Certificate (CC)	The certificate issued by COMPANY certifying that COMPLETION has occurred for the scope or part thereof.

Table 6: Project Interim Certificates

6.4 Categorization and Breakdown of Inspections, Checks and Tests

The following Table 7 provides a breakdown of the inspections, checks and tests to be performed.

MC TASKS (Equip. De-Energized)	Item	The smallest piece of equipment identified by a tag, and subject to one or several Pre-commissioning tasks.
	Conformity Checks	Checks carried out on each item in order to verify visually the condition of the equipment, the quality of the installation and the compliance with PROJECT documents and Specifications.
	Static Tests	Tests carried out on items in order to ensure their individual quality/performance.
	Piping Tests	Tests carried out on pipe work in order to verify their mechanical integrity, cleanness, alignment, etc.
PRECOM & COMMISSIONING TASKS (Equipment Energized)	Basic Function	The Basic Function is the smallest referenced unit that can be subject to one or several Commissioning tasks. It is constituted by one or several Items and performs an elementary function of the plant. Each Basic Function has a unique tag.
	Preliminary Check	Preliminary Checks are the multidiscipline verifications performed by the Commissioning Team in order to verify the Sub-System readiness for the commencement of the Commissioning activities.
	Functional Test (FT)	The Functional Tests are the dynamic tests made on each Basic Function in order to prove their operation according to the relevant design intent criteria.
	Operational Test (OT)	An Operational Test consists of bringing the equipment into service, as close as possible to normal operating condition and for a significant period of time, using inert or process fluids as necessary, in order to: • Test all situations and configurations that might lead to problems during normal operation, • Prove that the Safety & Environment Critical Element (SECE) performance standards, the integrity, the operating range, design parameters, the readiness are suitable in the site final configuration. The OTs apply either to equipment, System, Sub-System or a group of Sub-systems.
	Piping and Vessels Preparation (PVP)	Piping and Vessels Preparation consists of a number of activities carried out on pipe work and vessels in order to demonstrate their readiness for the commencement of operation in term of tightness, cleanness, oxygen free, etc.

Table 7: Inspections, Checks and Tests

6.5 Functional Systems and Sub-systems

The MC and PC&C tasks shall be organized and managed by Functional Systems and Sub-systems to cope with the requirements resulting from (1) operational and functional constraints, (2) need to achieve safety and readiness conditions of specific equipment or units before undertaking specific live testing tasks.
Consequently, these conditions identify priorities, predecessors and successors among the group of sub-systems (e.g. availability of LV power distribution or compressed air storage and distribution) that have to be followed in order to progress with the Commissioning activities.

The breakdown structure of the PLANT into functional Systems and Sub-systems (ref. [3]) is selected in a way that each Sub-system is:

(i) independent as much as possible from the others,

(ii) adapted to the requirements and priorities of Commissioning,

(iii) facilitates the formal handover of the PLANT to COMPANY.

The systems and sub-systems partition is depicted on marked-up P&ID's, SLD's and Block Diagrams to exhaustively mark the sub-systems boundary limits by implementing a colour and number coding (ref. [4]).

The marked-up Sub-system boundary drawings will not necessarily be subject to successive updates and amendments, unless significant changes are introduced to the P&IDs or SLDs that could impact the demarcation of boundaries of affected Sub-systems.
Related documentation will be updated in case of design changes introducing new tagged items that will need to be allocated to appropriate sus-systems.

6.6 Project Completions and Handover Flow Scheme

Although one of the key objectives of PROJECT is to minimize the relevant activities at offshore location, due to operational and functional limitations some of the PC&C tasks can only be completed or started once the BLPH will be installed at its final offshore location.
Thus, the full completion of MC, PC&C of PLANT will be achieved through different phases and, in line with the contractual terms, under ownership and responsibility of different Parties as depicted in the following Handover Flow Chart. N.B. CONTRACTOR WILL BE FULLY RESPONSIBLE FOR BLPH COMMISSIONING ACTIVITIES TO BE PERFORMED AT WORKSITE, BEFORE AND AFTER THE INTRODUCTION OF HYDROGEN.

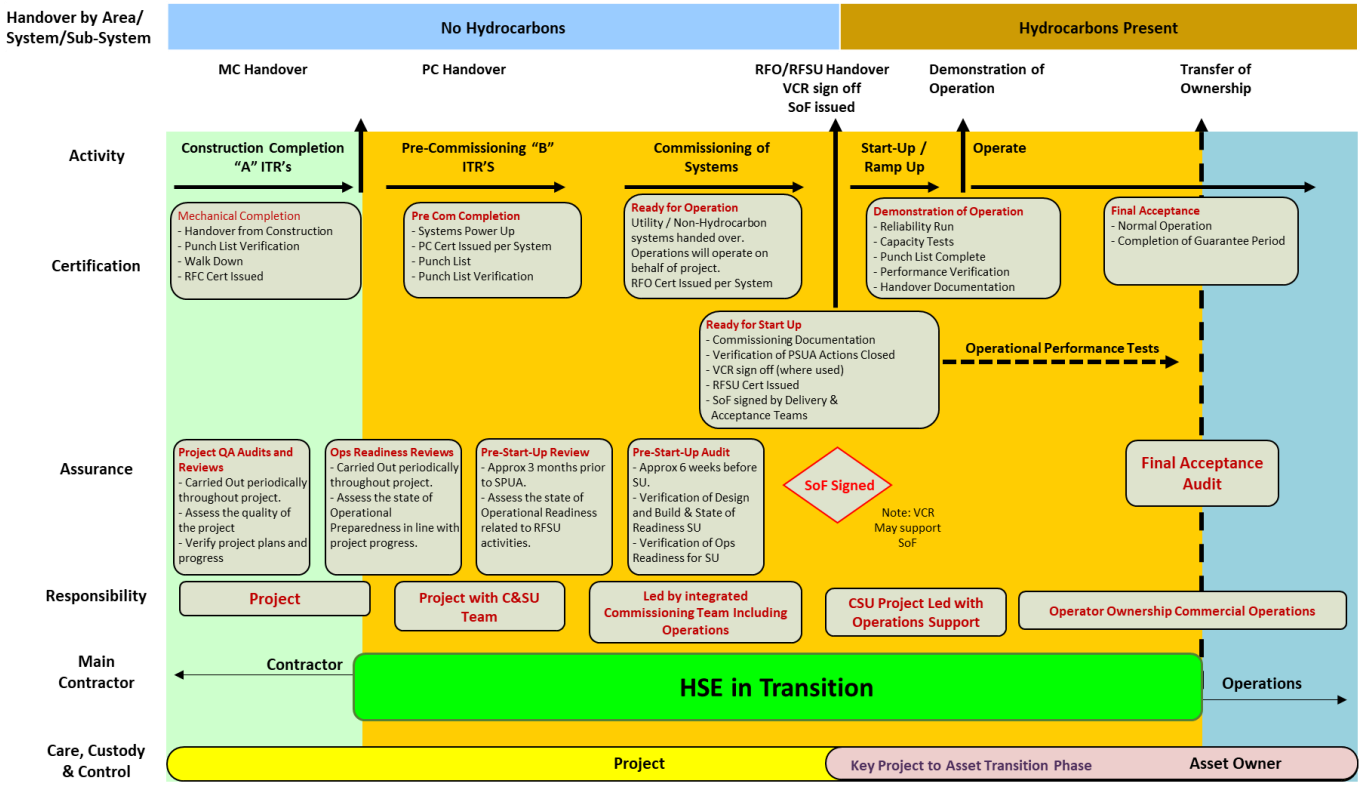


Figure 4 – Handover Flow Scheme

7. MECHANICAL COMPLETION, PRE-COMMISSIONING AND COMMISSIONING ENGINEERING PHASE

7.1 Introduction

The engineering phase of the MC, PC&C activities to be executed at WORKSITE is developed by CONTRACTOR during the PROJECT phase of detailed design engineering and completed before the start of the activities at WORKSITE.

For the development, CONTRACTOR shall assign a dedicated team lead discipline specialists for preparing and planning of MC, PC&C tasks before the overall teams' mobilization at WORKSITE for future execution.

The primary aim of this development phase is to set the basis to be applied later at execution phase and specify the technical requirement through the preparation and issue of relevant engineering deliverables with the objective of maximizing the inspections and testing tasks at onshore locations while limiting carry-over activities offshore.

The tasks and deliverables required to be completed during this phase are outlined in the dedicated MDR (ref. [1]) which includes the following document classes:

- Mechanical Completion, Pre-Commissioning and Commissioning Management and General Operation Procedures;
- Mechanical Completion, Pre-commissioning and Commissioning Technical Procedures and requirements.

7.2 Mechanical Completion Engineering

The main activities to be developed during the engineering phase of Mechanical Completion are listed as follows:

- Preparation
  - Set-up and populate the Completions Management System database with PROJECT and Vendors data,
  - Define and review the applicable Mechanical Completion Inspection Check sheets (ITR-A) and submit for COMPANY approval,
  - Assign Mechanical Completion tasks only on items under CONTRACTOR's scope of WORK,
  - Prepare and issue for approval specific Mechanical Completion procedures to address the technical criteria and methodology for execution of WORKSITE Mechanical Completion activities,
  - Define the list of fragile devices and valves which need to be removed before the piping hydrotest,
  - Review and agree on the identification of the Critical Valves,
  - Review and Update the ATEX register,
  - Define and prepare the procedure and principles for Gross Air Leak Testing and relevant piping discipline test packs list,
  - Prepare the Mechanical Completion Task Register, the exhaustive list of all the Mechanical Completion tasks organised per Sub-system, discipline and type of equipment identifying for each item the corresponding Mechanical Completion tasks,
  - Define the Flange Management procedure in order to record, witness and validate the installation of the of flanged joints throughout their installation process (mechanical alignment of the piping ends, flange surface preparation, gasket control and installation check, assembly tensioning / torquing values and sequence),
  - Prepare and issue for approval the Mechanical Completion Dossier Index.

For each Sub-system, a dedicated dossier shall be prepared to contain all the information required to demonstrate that all the planned and agreed WORKSITE Mechanical Completion tasks have been successfully completed and the Sub-system has reached the status of RFC (partial or complete).
Each dossier will include the following sections:

- Ready for Commissioning Certificate (RFCC),
- System description and marked up drawings,
- Updated punch lists (all cleared items and residual items),
- Specific Mechanical Completion Task Register status,
- Flange Management status report,
- GALT status report,
- Mechanical Completion Check/Test Sheets by discipline,
- ATEX inspection record sheets,
- Legible marked up "RED LINE MARKUP" drawings,
- Piping Test Pack (non-destructive testing reports, flushing, pressure tests, etc).

- ATEX Applicability
  - ITRs identifications as "Hazardous Area Equipment Detailed Inspection" will be coded as CJX01 in the Completions Management System database (PROVERLIS), as indicated by ITP 123A90-PML-QHSE-ITP-00078. Inspections "Initial installation" will be carried out exclusively based on the areas identified as explosive zones (see ref. layout: 123A90-DDL-SAF-DL-30022 & 123A90-DDL-SAF-DL-30024).

    All other equipment identifies as "ATEX" components but installed in safe area will be considered simple equipment, therefore ITR CJX01 will not be applicable (in any case the correct installation instructions issued by the supplier must be assured).
- ATEX Register Applicability
  - The ATEX Register is defined as the document that contains all the inspections carried out on site, and by all suppliers.
    It will contain all the items are indicated in section above (ATEX applicability). The register will contain the scope of CONTRACTOR work indicated as an explosion risk area see ref. layout: 123A90-DDL-SAF-DL-30022 & 123A90-DDL-SAF-DL-30024).

  - The ATEX register will not include the following Items:
    - Manual valve
    - Cylinders
    - Everything that will not be tagged, and any other items identified and agreed with the CPY.
- Supplied Skid Planning
  - Any static or calibration test on the equipment package already done in workshop does not have to be performed again on worksite, except in specific cases where transportation or storage conditions might have corrupted the equipment. Skid checks will be performed as follow:
  - For CPY provided Skid will be applicable only the ITR CZX01M,
  - For CTR provided Skid will be applicable the ITRs CZX01E, CZX01I, CZX01M.

- Walkdown management and execution
  - CONTRACTOR is responsible for organization of the dedicated subsystem tri-party walkdown. The activity carried out facilitates the inspection and acceptance of the completed subsystem by the Commissioning team, therefore "handover" from Mechanical Completion will be confirmed. Formal acceptance will be achieved upon joint signature of the dedicated Ready for Commissioning Certificate (RFCC).

  Activity will be performed by:
  - One electrician (if present E&I items) by CONTRACTOR,
  - One QC for Discipline by CONTRACTOR,
  - One pre-comm leader by CONTRACTOR,
  - CPY will be invited as an optional attendee, but a signature is not mandatory in this process and therefore, if not available, then the CONTRACTOR construction and commissioning representatives will proceed.

  Document requirement:
  - Battery limit of sub-system,
  - Layout (general information),
  - "RFC" Certificates to be signed after tri-party walkdown by CPY and CTR representatives,
  - Punch List status.

Walkdown shall be subject to a minimum notification time of:

- 24 hours for activity start:
- In case of inspection rescheduling, CONTRACTOR's mutual agreement with COMPANY is that it can be decided on the spot and not necessarily 4 hours in advance (COMPANY will be notified in advance in order to be part of the inspection)

The above-mentioned notification time has been considered as the minimum requirement.
Geographical physical location shall be considered and detailed on the inspection notification

- Planning
  - Prepare schedules, manning levels for Mechanical Completion engineering and execution, and align in PROJECT schedule,

7.3 Commissioning Engineering

CONTRACTOR shall carry out all activities related to the WORKSITE and SITE commissioning engineering, with the objective to maximise the completion of PLANT commissioning activities at WORKSITE.
The Commissioning Engineering phase encompasses the below listed main tasks required to be defined and mutually agreed among the Parties prior to execution of relevant activities at WORKSITE:

- Preparation
  - Define the list of Systems together with respective System Boundary Drawings,
  - Define and prepare the project Commissioning Strategy and sequence of priorities by Sub-systems, identifying and integrating the priorities to be assigned to the preceding Construction and Mechanical Completion activities,
  - Prepare the onshore and offshore WEFs,
  - Define the Commissioning Basic Functions by Sub-system, discipline and type of function,
  - Assign Commissioning tasks to each Basic Function, Sub-system and System,

- Define and review the applicable Commissioning Test / Check record sheets and submit for COMPANY approval,
- Prepare and populate the Completions Management System database (PROVERLIS) with PROJECT and Vendors data,
- Prepare the punch list management procedure,
- Develop and issue the required procedures for executing the Commissioning Operational Tests, ensuring to review and implement the relevant Vendors' input,
- Define and prepare the Leak Test principles and procedures,
- Prepare the Commissioning Task Register, the exhaustive list of all the Commissioning tasks organised per Sub-system, discipline and type of activities, to quantify the Commissioning tasks assigned to each Sub-system and track the execution progress,
- Define and issue for approval the Hand-Over Commissioning Dossier Index. The dossiers shall be arranged by Sub-systems and contain all information required to demonstrate that all the planned and agreed WORKSITE Commissioning tasks have been successfully completed and the Sub-system has reached the status of RFO (Ready for Operation, partial or full as applicable).
- Each dossier shall include as minimum the following listed sections and shall be submitted to COMPANY once the PLANT is transported to SITE:

  - Ready for Operation Certificate (RFO),
  - Sub-system description and identification drawings showing Sub-system boundaries,
  - Updated punch lists (both cleared and residual items),
  - Basic Function list by discipline,
  - Functional Test Sheets by discipline,
  - Mechanical reports,
  - Chemical cleaning reports (if applicable),
  - Leak tests and inerting mark-ups and final reports,
  - Manufacturers/Vendors Reports and Vendor technical correspondences,
  - Legible marked up "As Commissioned" P&ID's, Single Line Diagrams, Loop Diagrams, VENDOR drawings and manuals, etc.
  - Specific Commissioning procedures,
  - All relevant parts of the FINAL DOCUMENTATION,
  - List of Modifications with relevant references,
  - PSV and instrument ranges, alarms & trip settings,
  - PSV calibration certificates,
  - Certificates issued by Third party / Certifying Authority,
  - System final Status, with:
    - location and position of blinds/spades,
    - location and position of isolation LO & LC valves,
    - list of electrical isolation status,
    - list of remaining inhibits and overrides, etc.
    - identification of pressurized sections, such as inerting or section filled with fluids,
  - List of remaining Commissioning and Start-up spare parts and consumables.

- Planning
  - Quantify and assign the Commissioning activities in man-hours (CONTRACTOR internal KPI) and manning levels for Commissioning engineering and execution, and align in PROJECT schedule,
  - On a weekly basis, prepare and distribute a Two Weeks Look Ahead schedule for the duration of the Commissioning activities,
  - Define Vendors' assistance requirements during the Commissioning at WORKSITE as well as at SITE as required.

- Additional requirements
  - Identify, procure/rent on time, any special/temporary equipment, instrumentation, consumables and services to be mobilised on WORKSITE for Commissioning execution,
  - Identify and review the list of spare parts and special tools required for Commissioning in line with Vendors' recommendations,
  - Identify and select external Contractors required to execute specialized activities (e.g. high-pressure N_2 / H_e leak tests),
  - Ensure the procedures and documentation produced by external Contractors are in line with the Project requirements and approved,
  - Identify and plan the inspections and tests requiring Third Party certification,
  - Identify and agree with COMPANY the Commissioning tasks to be executed at offshore SITE.

7.4 Commissioning Management System Package (CMS)

CONTRACTOR shall implement a dedicated Commissioning Management System software package as a tool to manage the master database of all MC, PC&C and Punch Item activities.

Main functionalities of the software package are:

- Set up a database and register all PROJECT items under CONTRACTOR's scope of WORK, including related elementary activities to be performed during Mechanical Completion, Pre-commissioning and Commissioning at WORKSITE and SITE,
- Generate and print out the Mechanical Completion (ITR-A), Pre-commissioning (ITR-B) and Commissioning inspection and test record sheets,
- Update and monitor the status of the Mechanical Completion, Pre-commissioning and Commissioning activities,
- Continuous and progressive monitoring of progress towards Systems and Sub-systems MC, PC&C completion,
- Trigger the signature process of subsystem Mechanical Completion and Commissioning acceptance certificates,
- Generate status and progress reports, dashboards and sub-systems skyline,
- Record and follow-up the Punch list raising and clearance activities,
- Generate and print out all required records of Preservation tasks and record and monitor its progress status,
- Identify the tasks, if any, to be carried out offshore by COMPANY.

The Completions Management System database will be populated starting from the Engineering phase, uploading data gathered from PROJECT design documents and Vendors and maintained during the Mechanical Completion, Pre-commissioning and Commissioning at WORKSITE and SITE.

CONTRACTOR will assign a dedicated resource to configure, populate, and manage daily updates including any changes that may be required to the commissioning management system.

8. WORKSITE PRE-COMMISSIONING AND COMMISSIONING EXECUTION PHASE

8.1 WORKSITE Execution Plan

The Execution phase of MC, PC&C of the PLANT at WORKSITE shall follow a sequence of checks and testing activities that will progress through defined verification gates, structured to bring the facilities from construction phase to a condition at which the systematic testing of the facilities can be achieved in a safe and successful manner.

The progress of the activities shall be pursued through the defined verification gates (namely RFC and RFO) adopting a system / sub-system safety-first approach for synergy of deployed resources and time optimization.

The completion of the activities assigned to each verification stage and Sub-system shall be formalized with the issuance to COMPANY of specific interim certificate that authorizes and allows CONTRACTOR to progress with the next stage.

N.B. COMPANY signature of non-CPI Ready for Commissioning Certificates is not a mandatory requirement.

The below**Errore. L'origine riferimento non è stata trovata.** illustrates the overall workflow principle of progressing the MC, PC&C activities for each System / Sub-system.

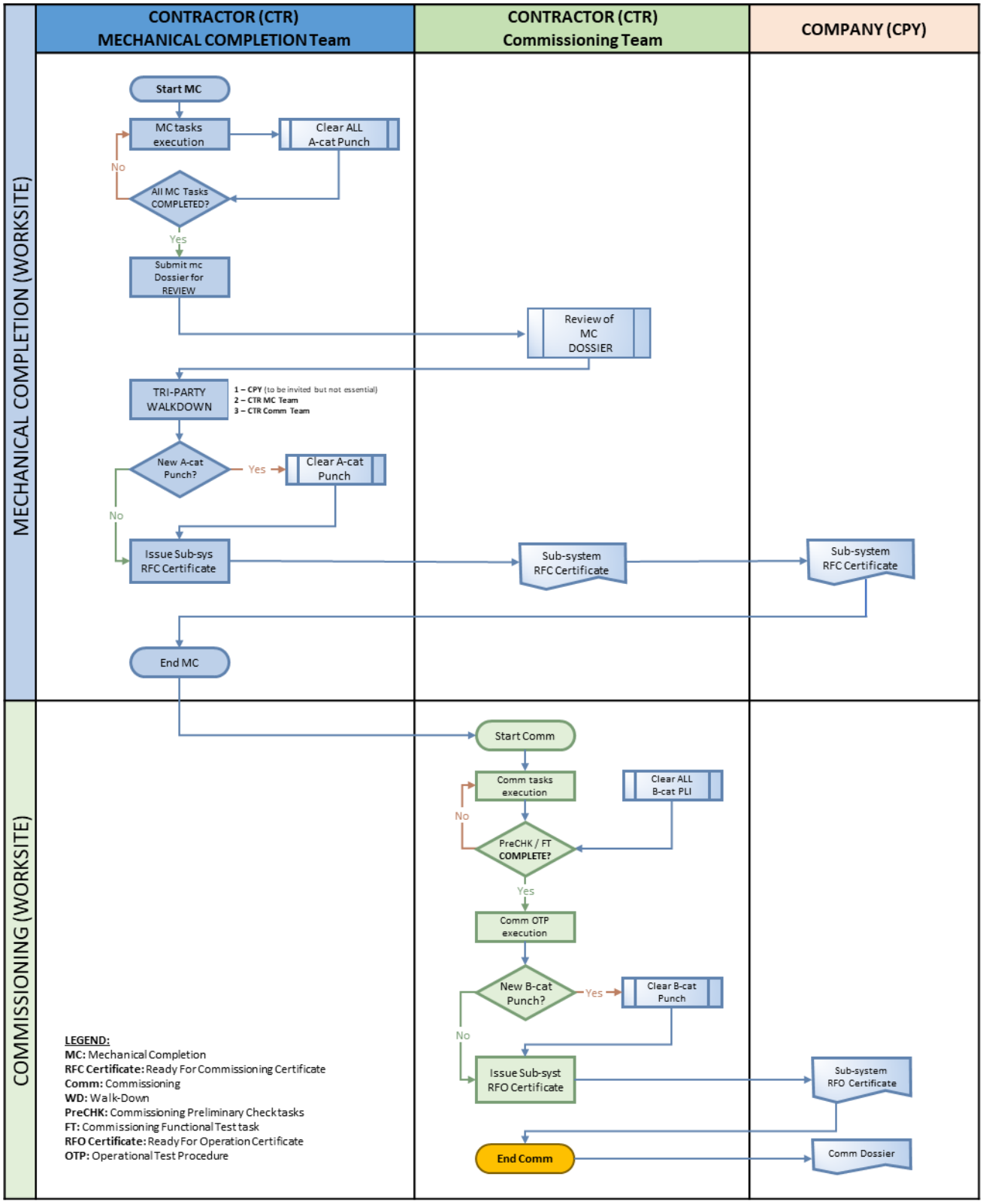


Figure 5 – MC, PC&C Work Flow

As illustrated in Figure 6, with reference to WORKSITE and SITE activities, CONTRACTOR Mechanical Completion team remains the owner of each Sub-system until the achievement of RFC status, and consequently all related party signatures on the Ready For Commissioning Certificate (RFCC).

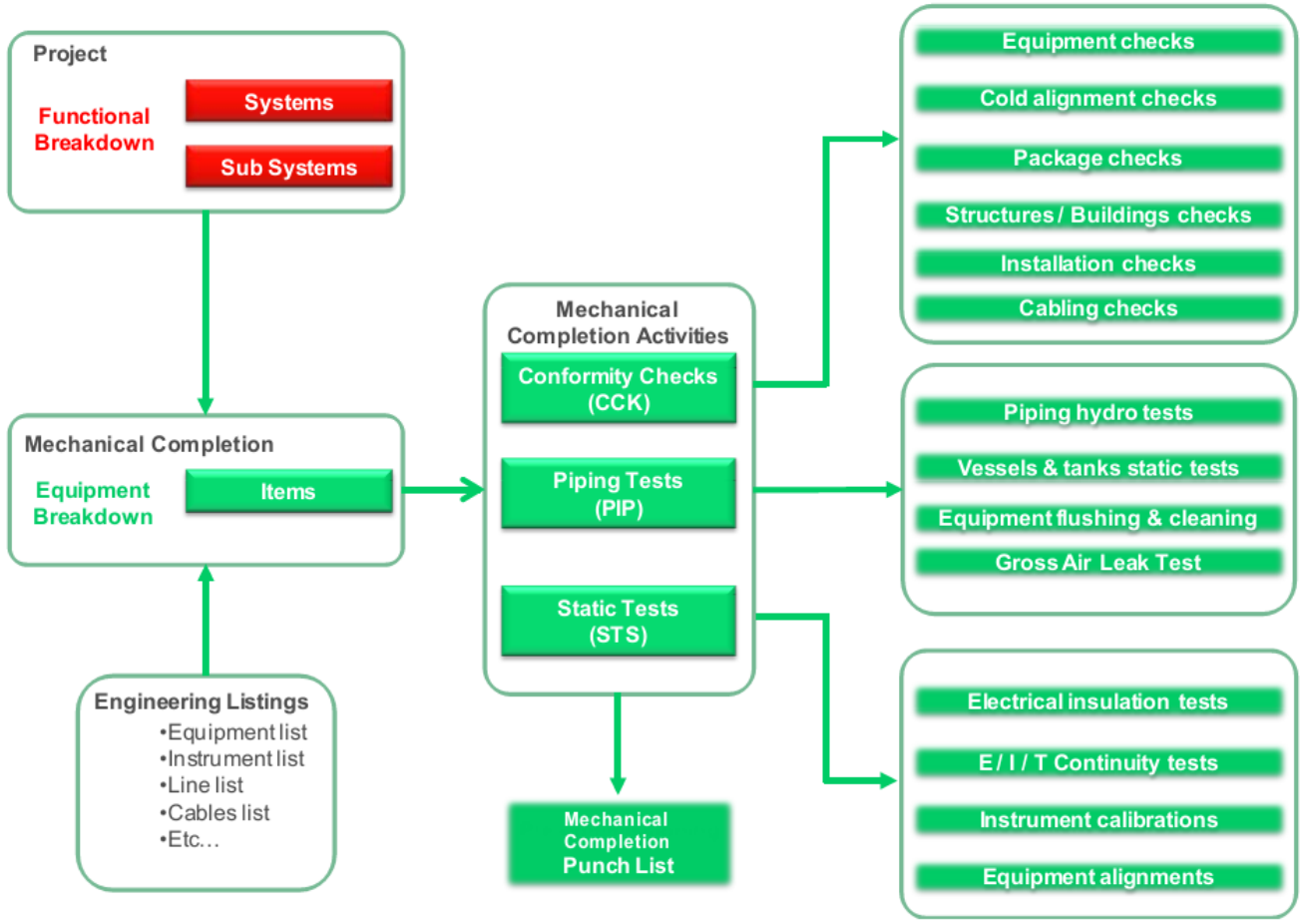


Figure 7: Mechanical Completion Activities Breakdown

For each Sub-system (commissionable), upon completion of the pre-defined Mechanical Completion tasks and review of the relevant Mechanical Completion dossier by Stakeholders, the Parties concerned, namely CONTRACTOR Mechanical Completion, CONTRACTOR Commissioning and respective COMPANY representatives, will perform a Tri-Party Walkdown, a group site inspection aimed to demonstrate the actual readiness and safe conditions of the specific Sub-system prior to progressing with the Commissioning activities.

In case unexpected defects or omissions are raised during the walkdown, the Owner Party will proceed to immediately resolve those issues, however in case of specific difficulties preventing resolution then a Punch Item will be raised to ensure full traceability before closure.

Upon successful completion of the Tri-Party Walkdown and clearance of any raised category "A" punch list items, the relevant RFC Certificate will be signed by CONTRACTOR and the nominated COMPANY representative (MANDATORY ONLY FOR CPI WORK SCOPES), and the control of the specific Sub-system is formally handed over to CONTRACTOR Commissioning team for initiation of the related Commissioning tasks.

In case of particular constraints preventing the full achievement of the RFC status for a specific sub-system, the Parties concerned, namely COMPANY and CONTRACTOR Commissioning discipline leads, may agree to sign a Partial RFCC and allow the start of the commissioning tasks without hindering the Project schedule.

This Partial RFCC option will be subject to verification of the correct and safe conditions of the sub-system in question to undertake the required commissioning tasks (for example, instrument loop checks). It is understood that, as soon as the conditions allow achievement of the complete (full) RFC status of the specific sub-system, the finalization of the outstanding Mechanical Completion tasks shall be coordinated with the CONTRACTOR Commissioning team to verify and implement as necessary the required LOTO actions to be discussed and agreed during dedicated daily SIMOPS meetings.

8.2 Mechanical Completion Team Organization Chart

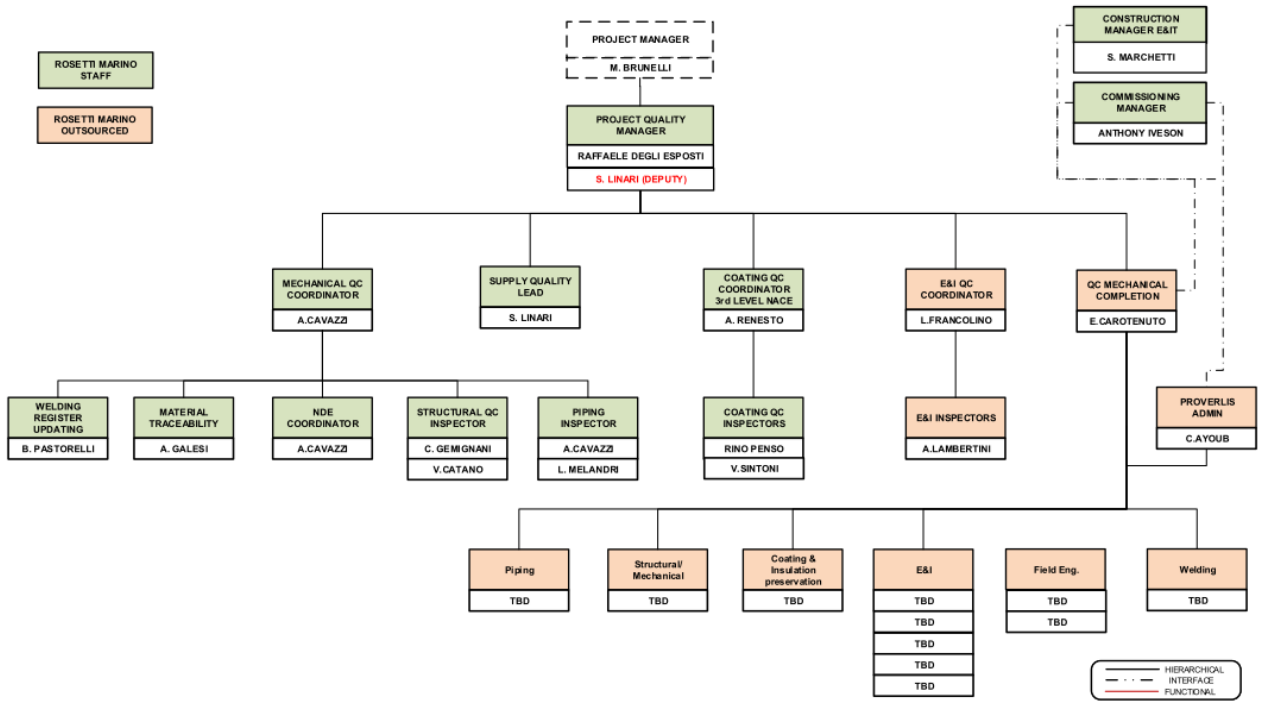


Figure 8: Mechanical Completion Org Chart

8.3 Responsibilities within CONTRACTOR Organization

The Construction department will be responsible for all BLPH fabrication works and will provide support to the Mechanical Completion team to resolve any issues or deficiencies that may impact the smooth progress of positive inspections required for the achievement of RFC of all Systems and Sub-systems.
The Construction department will also assume the lead role with resolution of Punch List Items (note that exceptions can be expected with certain issues raised by Commissioning team that are associated with the functioning of packages or equipment).

During the Mechanical Completion execution phase, the Mechanical Completion team will be responsible for conducting all conformity checks and cold testing activities leading to the achievement of the RFC status on all Systems and Sub-systems. Mechanical Completion inspectors shall report to the QC department and will consequently be considered independent from the Construction department.

Under no circumstances, Mechanical Completion or Commissioning Check and Test sheets shall be signed off by improperly raising corresponding Punch List Items, to cover any eventual inspection discrepancies.

The Commissioning team will continuously monitor the progress of the Construction team and also the inspectors that will perform the actual Mechanical Completion activities of all planned Systems and Sub-systems according to the established Project sub-system commissioning sequence of priorities.

COMPANY will be expected to deploy in a timely manner its own Project discipline specialists to onshore WORKSITE and, according to the ITP, actively participate in the inspection, witnessing and/or reviewing of Mechanical Completion activities, and consequently jointly sign-off the RFC Certificates related to all Sub-systems (MANDATORY ONLY FOR CPI WORK SCOPES).

As a rule, COMPANY discipline specialists will be notified to attend (Witness) the Mechanical Completion equipment, devices, cabling and piping inspections, whereas the Commissioning team will not participate, for example:

- Visual inspection,
- Conformity check / Installation check,
- Instrument calibration,
- Bolt tensioning and flange management,
- Cable test (continuity and insulation measurements),
- Piping Flushing and Hydro-testing,
- Piping Spools Reinstatement after hydrotest,
- ATEX Inspection.

The Commissioning team will however endeavour to monitor the following Mechanical Completion activities:

- PSV's calibration re-testing,
- Piping internal cleaning,
- Piping Gross Air Leak tests,
- Pipework final overall reinstatement,
- Machinery alignment,
- Vessel internal inspection.

8.4 WORKSITE Mechanical Completion Execution

The CONTRACTOR shall be responsible for completing the identified Mechanical Completion tasks to be executed at WORKSITE and SITE, in accordance with the approved PROJECT procedures.
The Mechanical Completion tasks consist of the following main activities:

- Conformity checks on items to verify compliance with the Project requirements,
- Static / de-energized tests on item to verify their compliance and quality,
- Instrument calibration,
- Implementation of a Flange Management System in coordination with bolt tensioning and gross air leak testing,
- Piping / vessel cleaning and flushing/blowing activities,
- Piping and vessel Gross Air Leak Tests,
- Clearance of punch list items blocking the progress to the next stage of Commissioning,
- ATEX Inspection,
- Mechanical Completion Dossier compilation and issue.

CONTRACTOR will assign and deploy a dedicated Mechanical Completion team for conducting the planned check and test activities required to achieve the RFC status on all Sub-systems.

A Mechanical Completion Coordinator, reporting directly to the Construction Manager, will be assigned to coordinate the Mechanical Completion activities and interfaces with Construction and Quality Control Project teams members in performing his duties.

8.5 WORKSITE Commissioning Execution

CONTRACTOR shall timely provide a team of experienced and qualified personnel to manage and perform at WORKSITE the Commissioning related activities, including relevant tasks as for instance:

- Participate in coordination meetings with other PROJECT functions,
- Coordinate Vendors' activities and mobilization,
- Witness Mechanical Completion critical activities as necessary, such as piping flushing and cleaning or gross air leak test.

CONTRACTOR Commissioning team will be structured to perform the activities defined in the chart illustration in Figure 8.

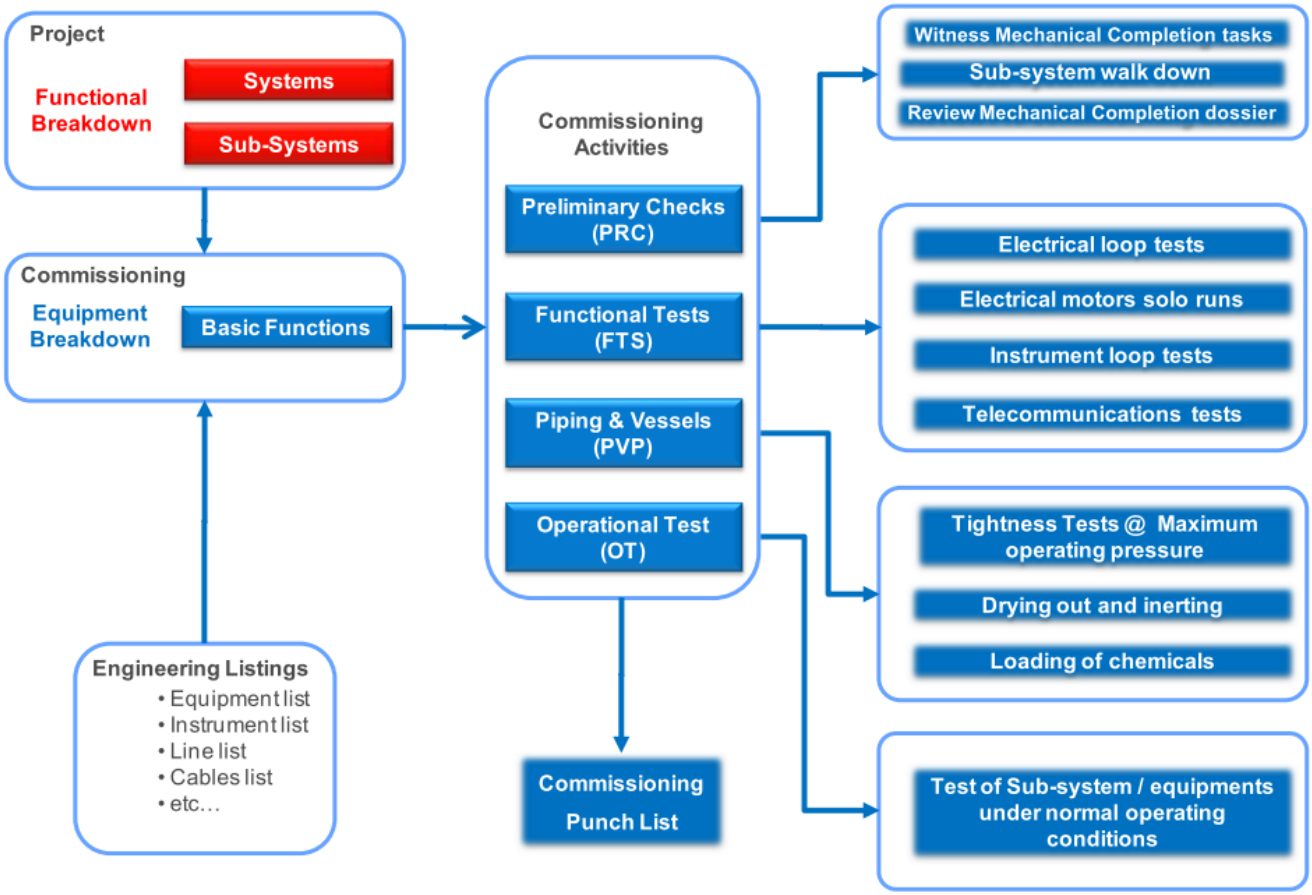


Figure 9: Commissioning Activities Breakdown

CONTRACTOR Commissioning team shall progressively take control over the Mechanical Completion team of the installation on Sub-system basis upon the acceptance of RFC status as resulting from the outcomes of the Tri-Parties Walkdown (ref. to workflow described in Figure 10).

The Commissioning activities at WORKSITE shall be arranged and managed at sub-system level and performed, under the responsibility of CONTRACTOR, to a maximum extent possible to minimize the commissioning operations on SITE (offshore).

For each Sub-system (where applicable and feasible in relation to the technical and/or operational constraints), the Commissioning tasks shall include:

- Preliminary checks to assess the completeness and compliance of Mechanical Completion tasks and equipment to PROJECT requirements,
- Functional tests on each basic function to prove the proper functionality by using test tools under valid calibration certificate,
- Piping and vessel preparation with e.g. tightness tests (leak tests) and inerting as necessary to prove ability of the systems to safely receive the process fluids / hydrocarbons / hydrogen and preserve the PLANT during the post-WORKSITE commissioning period,
- Operational Tests on specific equipment / Sub-system – System or group of, to prove readiness to operate continuously,
- Clearance of punch list items blocking / impacting the safe introduction of fluids / hydrocarbons / hydrogen,
- Hand-Over Commissioning Dossier compilation and issue.

CONTRACTOR shall commission the utilities systems, and of their operational test having them operationally tested in sufficient time in advance to allow for the commissioning of the process and other systems. CONTRACTOR shall operate and maintain such utilities systems for the purpose of commissioning until the hand over to COMPANY of the PLANT.

8.6 Commissioning Team Organization Chart

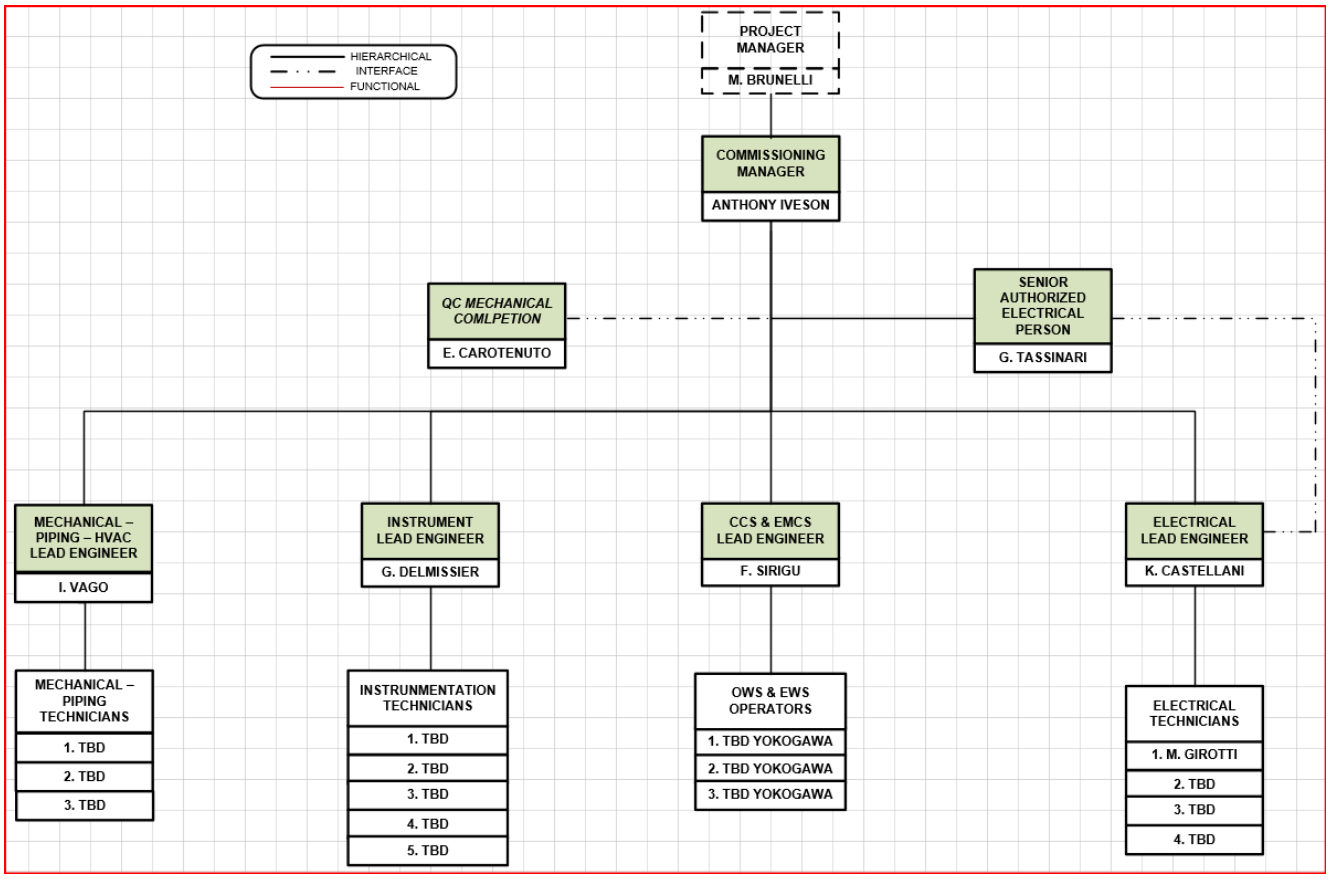


Figure 11: Commissioning Org Chart

With reference to the above Commissioning Organization Chart, four discipline lead engineers will be assigned to manage all specific commissioning activities, while a dedicated resource will be assigned to manage the electrical switching and isolation tasks (SAEP).
In order to assure commissioning priorities alignment between Construction and Mechanical Completion departments, an interface will be created between CTR Commissioning Manager and the QC lead responsible for management of Mechanical Completion activities.

8.7 Special Precautions during WORKSITE Mechanical Completion and Commissioning Execution

8.7.1 Mechanical Completion Special Precaution – Critical Valves

A valve is considered critical when its loss of tightness implies operational, maintenance and / or safety issues during operation.
Critical valves shall be subject, at yard reception prior to their installation, to a specific inspection that a proper preservation has been carried out in accordance with the Vendor's recommendations.

8.7.2 Mechanical Completion Special Precaution – Safety Relief Valves

Set pressures and valves seals of Pressure Relief valves (safety valves, safety relief valves, pressure safety valves, thermal or temperature relief valves, thermal or temperature safety valves, as applicable), including CONTRACTOR vendor package valves, shall be re-calibrated on a certified test bench and certificate issued prior to the expiry of the calibration certificates until the BLPH sail-away.

CONTRACTOR by implementing the preservation measures shall ensure a proper preservation is carried out on Safety Relief Valves at WORKSITE in accordance with the Vendor's recommendations.
This activity will be executed and coordinated by CONTRACTOR Mechanical Completion team, as part of the instrument calibration task falling under Mechanical Completion (see Appendix 1).
CONTRACTOR Commissioning team will witness test results ensuring the correct completion and validity of associated test certificates prior to proceed with Commissioning activities requiring pressurization of connected systems.

8.7.3 Commissioning Special Precaution – Leak Test

Among the Commissioning tasks, Leak Detection Test is essential to prove and assure the readiness of the pipework and vessels circuits to receive and contain the process fluids / hydrogen.

CONTRACTOR shall apply at WORKSITE a leak test method using N_2/He (1%He) at maximum operating pressure to those systems processing flammable gas or hydrogen regardless of their operating pressure, and the selection process of leak test method is amended as described in below Figure 8.
The Leak Tests at Maximum Operating Pressure (Tightness Tests) will be subcontracted to Specialized Leak-Testing Subcontractor that CONTRACTOR had successfully employed in past projects when such types of activities were required and shall be executed in accordance with the requirements stated in the dedicated PROJECT document (ref. [6]). Reference is also made to "Commisisoning Strategy section 7.3 for detail.

CONTRACTOR shall apply at SITE an initial GALT test on all hydrogen piping and storage systems, successively once demonstrated that no issues will have been observed after transportation and offshore installation the permanent work will be gradually pressurised with hydrogen, and a full working pressure service test will be performed.

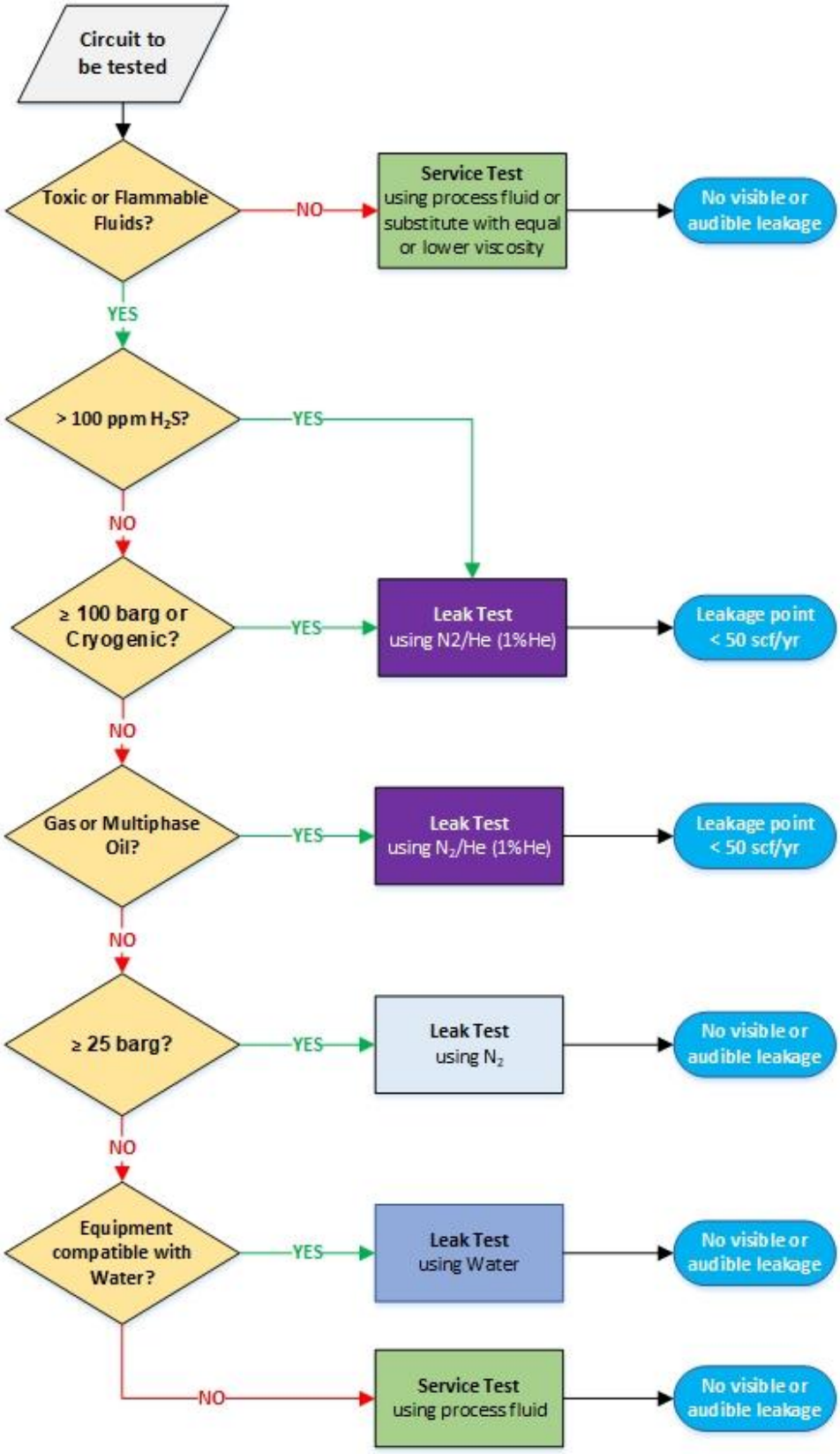


Table 8: Tightness Test Selection Method Breakdown

8.8 Witnessing

8.8.1 General

The visual verification and control of defined Mechanical Completion and Commissioning activities shall be carried at WORKSITE by COMPANY representatives.

The specific attendance and notification requirement to WORKSITE Mechanical Completion MANDATORY ONLY FOR CPI WORK SCOPES) and Commissioning activities to be witnessed by COMPANY and/or Third Parties are addressed in dedicated PROJECT Inspection and Test Plan (ITP) which identify for each activity the required witnessing level as per following section.

8.8.2 Witnessing Level

In compliance with PROJECT ITP, the following three levels of witnessing are defined:

- Level 1: HOLD (H)
  HOLD points are defined as points for which the formal approval of COMPANY is obtained in order to proceed with the activities. Consequently, activities assigned with a HOLD Point are not carried out until an inspection / surveillance activity is carried out COMPANY.
- Level 2: WITNESS (W)
  WITNESS points are defined as points that COMPANY may decide to witness and approve progress to subsequent activities as applicable. Consequently, should COMPANY not be present at the appointed time for a WITNESS Point, the activity is permitted to proceed.
  NB CONTRACTOR requires in all cases CPY signature on related ITR's.
- Level 3: MONITOR (M)
  MONITOR points are defined as points for which COMPANY may monitor activities, service, equipment or material, but where specific approval is not required for the activities to proceed.
  NB CONTRACTOR requires in all cases CPY signature on related ITR's.

8.9 Punch List Management

During the execution of the site activities of Mechanical Completion and Commissioning, all the discrepancies, damaged or missing items, malfunctions, missing documents, if not immediately corrected, shall be listed in the relevant Sub-system Punch List and uploaded into the Completions Management System, in order to record, track and follow-up the status of each raised Punch Item.

A Punch Item is considered a blocking point if it leads to a potential hazard for:

- Safety and operational aspects of the ongoing or upcoming activities in the completion process,
- Non-compliance with Project requirements,
- Missing requirement relevant to local rules and regulations.

The following cases and situations shall not be considered as Punch Items:

- Items relevant to ongoing construction and installation works not completed prior to Tri-Party Walkdown,
- Items which are part of additional works / requirements not covered by CONTRACT.

The management process to identify, classify, record, modify and clear the punch list items is described in the dedicate PROJECT document (ref. [19]).

CONTRACTOR shall also be responsible to timely add into the Completions Management System master punch list, all the outstanding punch list items raised during the Factory Acceptance Tests (FAT).

Each Punch Item shall be organized by Sub-system and divided into 3 different categories:

- Category A
  Punch Item considered as a blocking point for starting of commissioning activities on the relevant Sub-system. Category "A" Punch Items prevent the signature of RFC certificate and must be cleared before READY FOR COMMISSIONING CERTIFICATE.

  Typical Category "A" Punch Items: electrical cable defect, broken lighting fixtures, valve stuck in position, missing equipment or support, missing grounding/earthing, etc.

- Category B
  Punch Item considered as a blocking point for the first filling and start-up of the relevant Sub-system. Category "B" Punch Items prevent the signature of the RFSU certificate of the relevant Sub-system and must be cleared before READY FOR START UP CERTIFICATE.

  Typical Category "B" Punch Items: faulty transmitter, wrong logic sequence, non-achievement of design criteria during operational test, excessive vibrations on an equipment, missing critical vendor documentation or certification, missing tag, wrong labelling, etc.

In compliance with contractual provision and definition CONTRACTOR is required to clear all the punch list items identified during the WORKSITE phase which fall into categories A and B before formalizing a READY TO SAIL AWAY CERTIFICATE.

9. MECHANICAL COMPLETION AND COMMISSIONING PROGRESS MEASUREMENT AND REPORTING

The physical progress measurement system of Mechanical Completion and Commissioning activities, from engineering related deliverables and execution phase, shall be in compliance with the established method in place to monitor the PROJECT status and described in relevant document Project Controls Plan ref. 123A90-PML-PM-PL-00004.

In terms of reporting requirements, in addition to the formal Project reporting requirements, on a weekly basis an internal 2 week look ahead planning schedule shall be prepared by the CONTRACTOR Commissioning team and shared with COMPANY yard representatives.
Provision will be made for Skyline Reports for RFC's and RFO's.

10. HSSE REQUIREMENTS DURING MECHANICAL COMPLETION AND COMMISSIONING EXECUTION PHASE

The HSSE policy and objective related to MC, PC&C activities shall comply with the dedicated Project HSSE Management Plan, ref. 123A90-PML-QHSE-PL-00001.

For further information see related HSSE documentation and Commissioning Strategy doc. n.123A90-PML-COM-PRO-03007.

11. TEMPORARY WORKSITE EQUIPMENT

CONTRACTOR Commissioning team shall be responsible for identifying, coordinating and controlling all the temporary equipment, materials and tools required to perform the Commissioning tasks at WORKSITE.

Temporary equipment, such as diesel power generator sets, air compressors and dryers, reactive/resistive load banks and water pump skids shall be typically employed and made available at WORKSITE on a rental basis by specialized and trusted Providers available on the local market and that CONTRACTOR usually employs in his yard.

A description of the temporary equipment and facilities required for WORKSITE activities will be defined in a dedicated document "Commissioning – Temporary Equipment & Facilities" n. 123A90-PML-COM-SP-03014.

This will include any additional temporary materials required to perform the Commissioning tasks, namely first fills for equipment and machinery, clean water for process equipment related tests and special tools.

Temporary equipment related to Hydrogen Systems will be detailed within specific documentation to be approved by local City Fire Brigade.

12. VENDORS ASSISTANCE

12.1 Vendors Assistance at WORKSITE

CONTRACTOR shall be responsible within his onshore scope of WORK to identify, define and provide all SUBCONTRACTORS and VENDORS assistance that is required for the completion of the WORK up to topside sail away.

With respect to VENDOR assistance for offshore (SITE) Commissioning, Start-Up and Performance Tests, CONTRACTOR's scope of WORK will comprise the few remaining activities that will not be possible to complete during the onshore phase (for example, installation and commissioning of the sea water lift pumps P-50001A/B).

The Vendors field representatives will be managed exclusively by CONTRACTOR Commissioning team during execution phase of WORKSITE Commissioning phase, by defining mobilization and follow-up on WORKSITE, management of changes/modifications and eventual contentious issues in cooperation with Procurement and Expediting Managers.

The list of equipment that will require the respective Vendor's assistance at WORKSITE is hereafter provided:

- 66 kV Switchgear (only PreComm activities)
- 6.6 kV Switchgear
- Power Transformers
- 400V LV Switchboards
- 230V LV Distribution Boards
- 230V UPS AC & DC
- ICSS System (PCS, SIS, F&G, EMCS)
- Water Treatment System
- Compressed Instrument Air System

- Nitrogen Generation System
- Navigation Aids
- Crane
- Leak Testing

With regards to Company Provided Items, CPY will be directly responsible for management of its vendors, CONTRACTOR will be responsible for providing assistance.

12.2 Vendors Assistance at SITE

CONTRACTOR shall be responsible within the scope of WORK to identify, define and provide all SUBCONTRACTORS and VENDORS assistance that will be required for the completion of the WORK up to final handover at SITE.

The preliminary list of equipment that will require the respective Vendor's assistance at SITE is hereafter provided:

- 66 kV Switchgear (first energization activities)
- ICSS System (PCS, SIS, F&G, EMCS)
- Sea water lift Pumps
- Interface testing with grid operator
- Travel well leak/service testing

13. DOCUMENTS MARK-UP MANAGEMENT

The mark-up management process during the Mechanical Completion and Commissioning phases regarding changes to what had been defined in the detailed design phase or, deriving from Company's requirements, shall follow CONTRACTOR's established corporate instructions and procedures, notably:

1. Procedure no. O-ENG-4L-002 – E&I Documents and Mark-up Management
2. Procedure no. O-ENG-4B-008 – Field Mark-up Drawings Management, Piping

In particular, the following workflow diagrams shall apply to the Project.

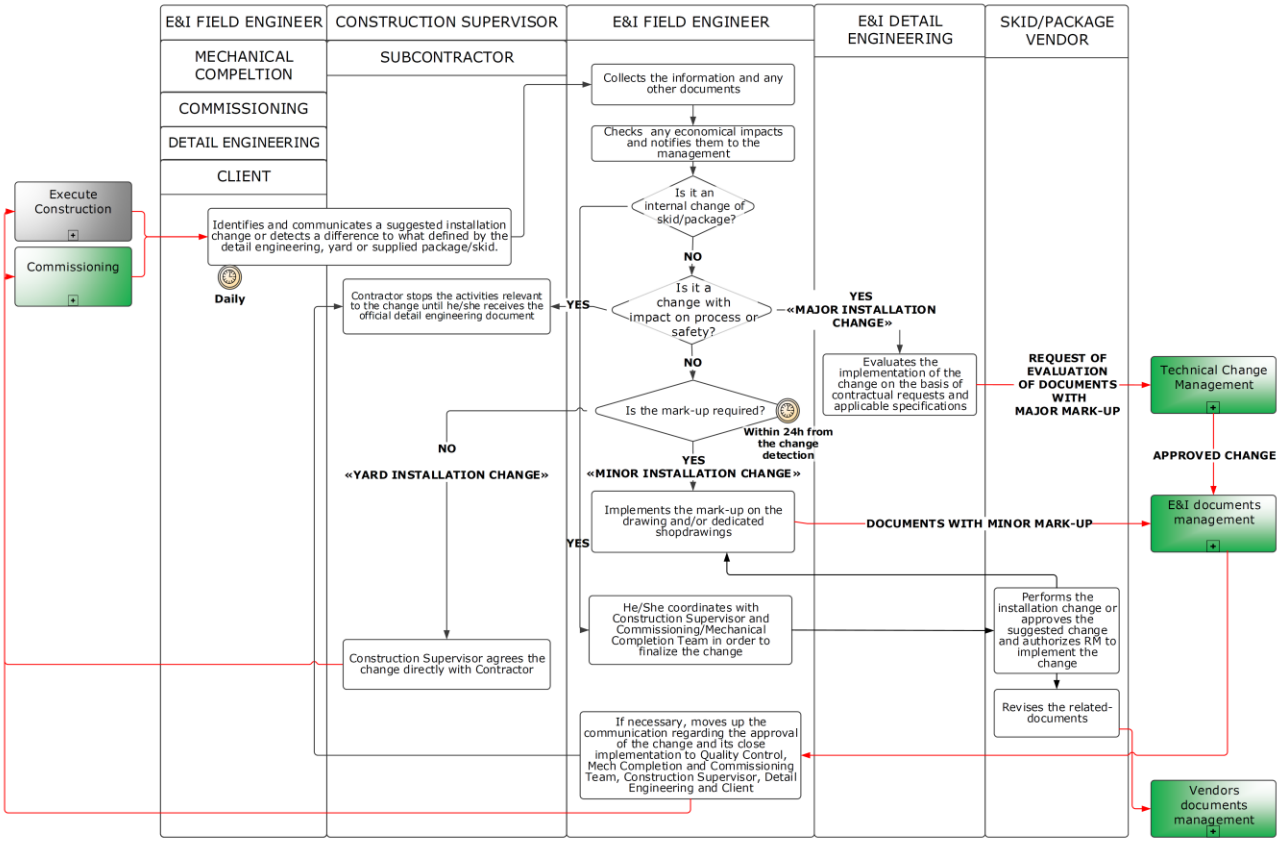


Figure 12: *Documents Mark-up Management Process*

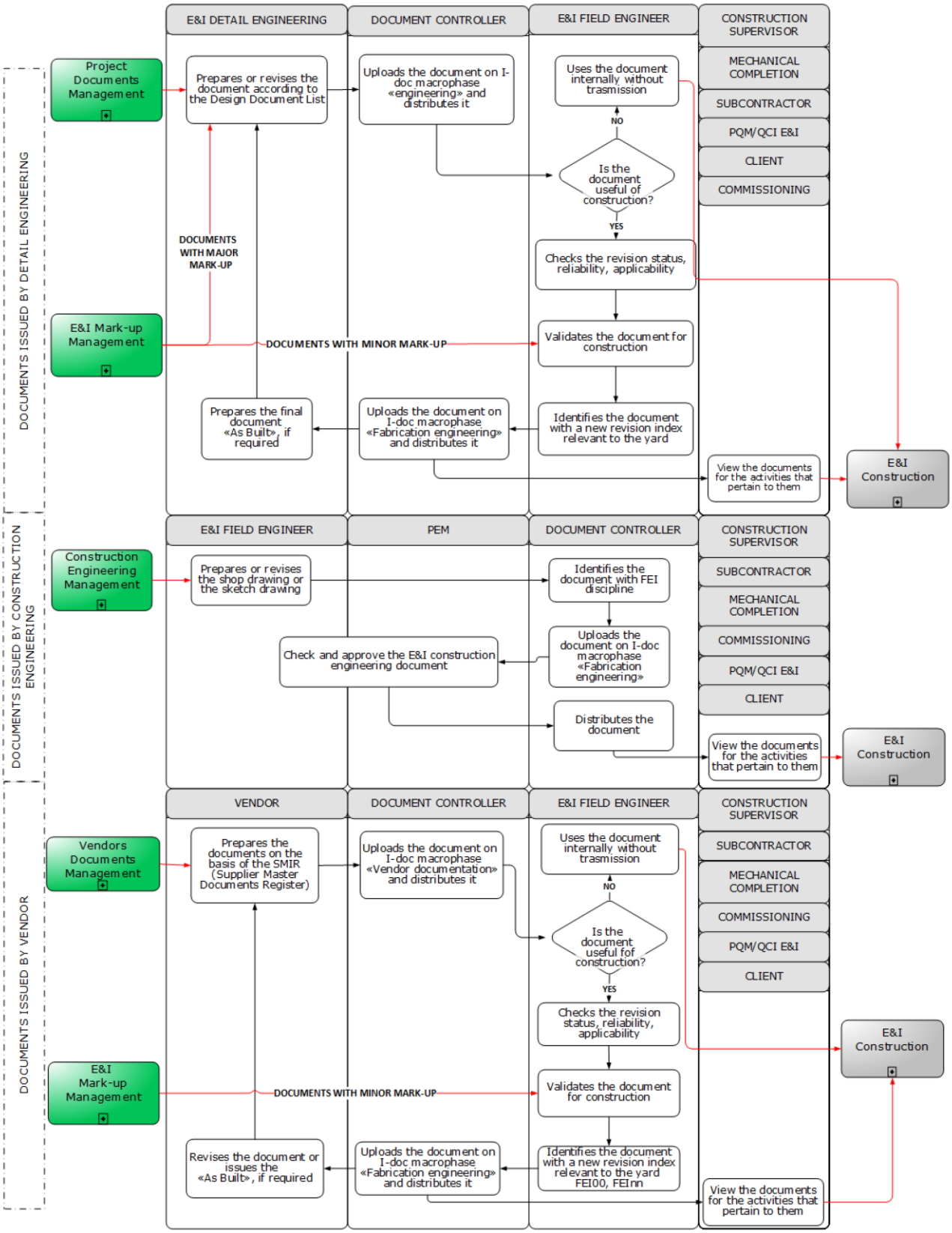


Figure 13: Documents Mark-up Management Process – E&I

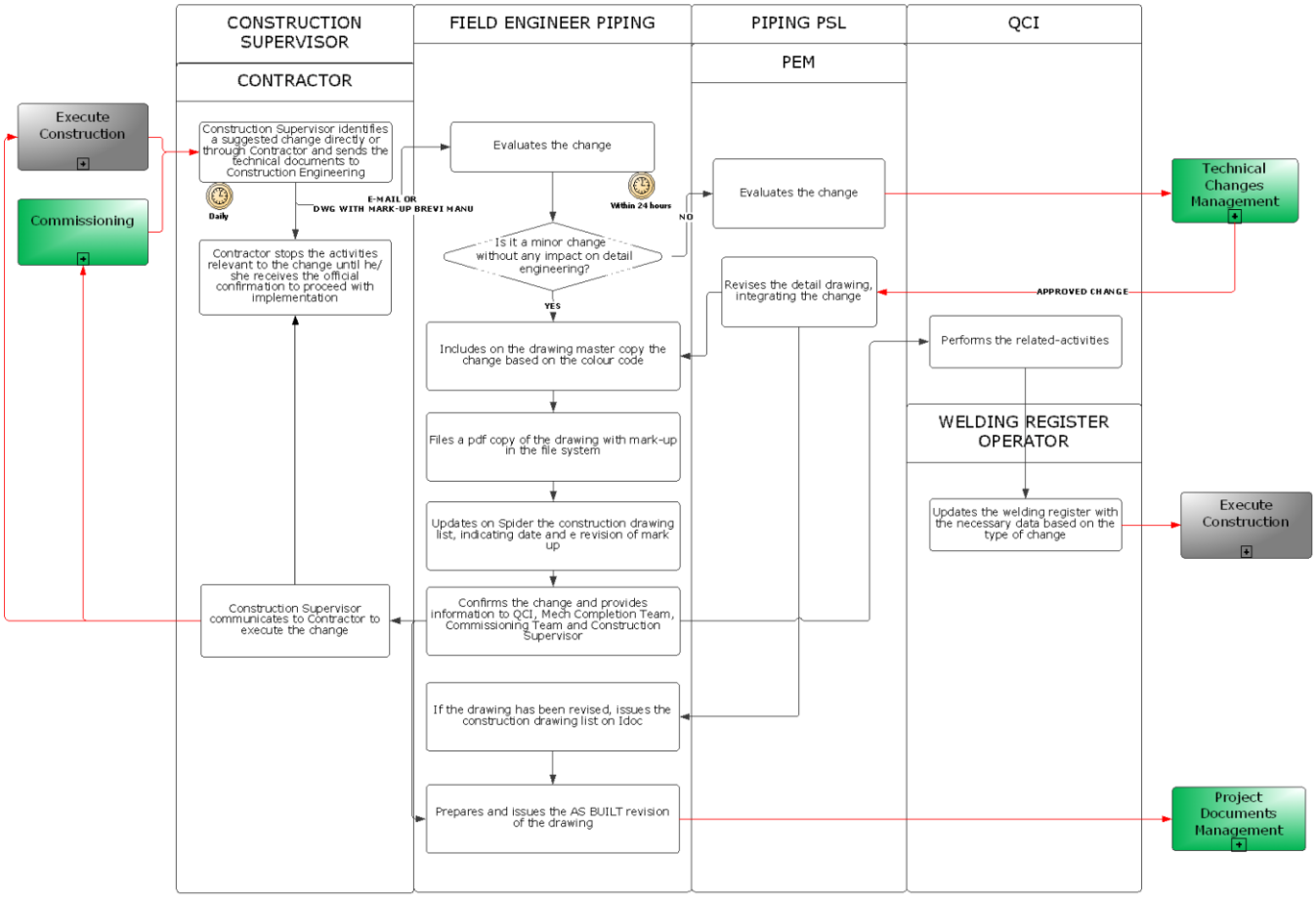


Figure 14: Documents Mark-up Management Process – Piping

14. INSTRUMENT OVERRIDES

During execution of Commissioning activities, there may be the requirement for some of the instrumentation controls to provide "overrides" within the systems which will enable the bypassing of an actuation device locally in the field. (e.g. provision of a temporarily forced command or bypass for a solenoid coil to enable an actuated valve to remain in its open or closed position).

According to the nature of the tests to be performed, temporary overrides can be software based within the integrated control system or hardwired into electrical auxiliary control circuits.

It is essential that at all times an up-to-date record be kept of all overrides that are in place and the bypasses that have been implemented. These will be logged, recorded and maintained by the Commissioning team. Implementation and control of the instrument override shall be comprehensively described in the applicable testing and commissioning procedures.
Reference is made to document number 123A90-PML-COM-LIS-03034 Inhibit – Override Register for traceability of respective actions.

15. NON-COMMISSIONABLE SYSTEMS

Some Systems and Sub-systems being non-functional by their nature, will not be subject to specific Commissioning tasks and thus are referred as non-commissionable.
Non-commissionable Systems and Sub-systems identified within PROJECT scope of WORK are listed as follows:

- SAFETY SIGNS
- LIFE RAFT
- FIRE EXTINGUISHERS
- STRUCTURES

16. PACKAGES

Further to the successful conclusion of respective vendor packages FATs, successive yard testing of CONTRACTOR provided packages, during the WORKSITE Mechanical Completion and Commissioning phase is summarized as follows:

A reduced WORKSITE Mechanical Completion scope with the aim of avoiding unnecessary duplication of checks and tests shall be accepted on the packages subject to the demonstration, through the Vendor / Supplier documentation, that the same checks and tests had been thoroughly and successfully performed at the supplier's or manufacturer's factory / workshop, and that nothing has adversely affected the result of the completed tests.

The RFC status of the package sub-systems shall be reached when all Mechanical Completion activities, after integration / installation at site, have been successfully carried out, completed and logged in the Completions Management System database.

Scope of commissioning at WORKSITE of packages that have been comprehensively and successfully testing at Vendor's premises shall consist of:

- All works identified in the specific Package WORKSITE Inspection and Test plan,
- 10 % Functional Testing of the electrical and instrument Basic Function. Extent of spot checks shall be however based on the assigned criticality rating of the package and preliminary agreed with COMPANY,
- Full Functional Testing of all items for which a proper record is not available within Completions Management System database,
- Full Functional Testing of all Basic Functions involved in interfaces,
- Full Functional Testing of all the safety functions related to the machinery, process and HSSE items. This typically applies, but is not limited, to functions related to: Safety Instrumented System (SIS), Emergency Shut Down system (ESD), Fire & Gas System (F&G).

The RFO status of the package sub-systems are only achieved when all Commissioning activities after integration / installation have been successfully finalized, signed off and logged in the Completions Management Systems database.

With regards to Company Provided Items (CPI) Packages, CONTRACTOR acknowledges that each package will be delivered to yard by COMPANY complete with its own internal electrical distribution, control and safety systems equipment, consequently the operation of each package will be considered autonomous once all associated permanent interfaces defined in CONTRACTOR scope of works will have been connected.

COMPANY will retain full responsibility for its packages and will manage the internal Construction, Completions, Pre-Com and Comm activities, with the CONTRACTOR retaining an ownership for the overall safety of all commissioning scopes being carried out i.e. via the RM PTW system.
Final Start-Up and BLPH Integrated Testing activities will be managed by CONTRACTOR further to validation of readiness of each CPI package.

17. COMMISSIONING SEQUENCE

Commissioning activities will be conducted over the following main phases:

- 1. Yard Onshore Commissioning phase (Worksite)
- 2. Offshore Commissioning phase (Site)
- 3. Offshore Start-Up phase

  (outside of scope of this document, see Doc. n. 123A90-PML-COM-PRO-03022)

The Commissioning activities will be completed to the maximum extent possible, during the onshore phase of the project. Exceptions will be granted for those Sub Systems containing equipment that will only be possible to finalise offshore (for example, the submerged sea water lift pumps, subsea power and FO cables).

The Offshore phase will commence according to the priorities scheduled for the Hookup campaign and energization of the platform from a suitably rated temporary power source. Completion of any commissioning activities outstanding from the onshore phase will now be required.

The Start-Up phase will consist of the Commissioning and Operational activities related to the simultaneous functioning of all topside Systems and Subsystems, consequently involving the production, storage and consumption of hydrogen gas.

Further information will be detailed within dedicated documents:

- Worksite WEF (Work Execution Flow Scheme) Doc. N. 123A90-PML-COM-SP-03057
- Site WEF (Work Execution Flow Scheme) Doc. N. 123A90-PML-COM-SP-03058

17.1 Yard Onshore Commissioning Phase

The following steps describe the sequence of Onshore activities (Worksite).

17.1.1 Macro Groups Definition – Utilities, Control and Process Systems

The first commissioning phase will be performed in Contactor's construction yard based in Ravenna, Italy. The Systems and Subsystems scheduled to be fully pre-commissioned and commissioned onshore prior to sail-away have been identified, see document n. 123A90-PML-COM-LIS-03011 (ref. [3]).

The strategy for performing the Commissioning activities will be formulated according to a detailed breakdown of all "Key" Subsystems and specific items of equipment into groups of unique "Macro Utility

Systems" upon which the appropriate sequencing of commissioning priorities will assist overall planning, execution and monitoring of progress.
Consequently, the optimum sequence of related Construction and Mechanical Completion activities required to achieve timely energisation of these "Macro Utility Systems" must be consistent and aligned within Contractor's project management team to avoid risk of project schedule deviation from the critical path.

MACRO GROUP UTILITY SYSTEMS BREAKDOWN:

1. ELECTRICAL POWER AND DISTRIBUTION SYSTEMS (400/230V, 6.6kV, 66kV)
2. STRUCTURAL, HEATING, VENTILATION AND AIR CON SYSTEMS
3. AUTOMATION, CONTROL AND SAFETY SYSTEMS (PCS, SIS, F&G, EMCS)
4. UTILITY SYSTEMS
5. PROCESS SYSTEMS
6. COMPANY PROVIDED ITEMS (PACKAGES)

It should be noted that the Macro Utility Systems numbered 1. and 3. are to be considered as predominantly "sequential" in their respective sequence of energisations and Commissioning activities, they present a logical precursor for preparation and execution prior to initialisation of the remaining Macro Utility Systems.

Due to the fact that numerous dedicated commissioning teams will be operational for each discipline, the commissioning sequence motivates the multidisciplinary execution of activities in parallel.

Furthermore, the commissioning sequence will provide the reference for the corresponding sequence of construction and mechanical completion activities. The project schedule P6 will be updated to support the achievement of the commissioning sequence.

17.1.2 Energization of Electrical Power Generation Systems (Macro Group 1.)

Adherence to approved safety procedures and protocols prior to energising any items of equipment, or indeed performing any "hot works", completion of related subsystems mechanical completion activities, verification of Punch List Items status (absence of category "A" Punches), validation of earthing subsystems equipment installation, execution of Tri-Party Walk downs and approved and signed Permits to Work will be MANDATORY.

Initiation of Commissioning activities will be focused on the strategic energisation, function testing and the OTP execution of the low voltage switchboard SG-200N1. The low voltage switchboard will be installed inside technical room B-200.
Successive energizations will focus on the two AC UPS units installed inside the technical room B-300, and the single DC UPS unit installed inside the technical room B-100.

The low voltage switchboard is equipped with two distinct incoming power supply circuit breakers, consequently the energization will be performed in two separate phases (refer to electrical single line diagram doc. n. 123A90-DDL-EL-DG-20158);

- Phase 1: connection of temporary 400 VAC yard supply to JB-200E1,
- Phase 2: connection of temporary 6.6 kV yard supply to incomer SG-100D1.

Once both temporary yard power supplies will have been installed and associated equipment fully tested, it is expected that the low voltage 400 V supply will be the preferred choice to be utilized on a regular daily basis.

Only in case of higher power requirements or higher voltages constraints will the 6,6 kVAC supply be energized.

An important point of note follows regarding the energization of the Company Provided Items (CPI) packages;
An agreement has been confirmed between COMPANY and CONTRACTOR such that energization of each CPI package will be managed in two distinct steps.

The first will provide verification of related mechanical completion activities to allow the energization and consequently Pre-Com of auxiliary systems; for example low voltage power supplies for internal distribution boards, control panels, lighting circuits and HVAC equipment.

The second step, successively detailed under "Macro Group 6.", will define the milestone Ready for Start-Up (RFSU) prior to initiation of hydrogen production. Following an audit of the packages to achieve the Statement of Fitness (SoF) and RFSU certificates, the package will be fully energized, including the 6.6 kV transformers and interconnecting power cables in addition to synchronization with the yard 6.6 kV temporary yard power generation facilities.

17.1.3 Energization of HVAC Systems (Macro Group 2.)

CONTRACTOR HVAC systems will be pre-installed within each of the four prefabricated metallic technical rooms summarized as follows;

- B-100: HV-MV Switchgear Technical Room, SS 90-01
- B-200: LV Switchgear Technical Room, SS 90-02
- B-300: UPS Systems Equipment Technical Room, SS 90-03
- B-400: I/C&T Systems Equipment Technical Room, SS 90-04

Each of the technical rooms will be equipped with dedicated control panels for the respective HVAC equipment, together with independent distribution panels for internal lighting and small power services.

The precursor for the energization and commissioning of the respective HVAC systems will be the availability of the main electrical low voltage switchboard SG-200N1, subsystem SS 83-00.

17.1.4 Energization of Automation, Control and Safety Systems (Macro Group 3.)

The Automation, Control and Safety equipment, denominated PCS, SIS, F&G, EMCS, will be installed inside the prefabricated technical room B-400.

Prior to energization of any system or marshalling cabinets, CONTRACTOR commissioning team will ensure the operating status of the air conditioning equipment associated with the technical room.

The precursor for the energization and commissioning of the respective HVAC systems will be the availability of the following electrical subsystems;

- UPS AC UP-200F3, SS 84-10
- UPS AC UP-200F4, SS 84-20
- 400/230VAC Distribution Board DP-200N1, SS 83-20

The priorities for the related field devices to be installed and loop tested will be focused on finalization of all enclosed areas before open areas. Therefore, devices to be installed inside CONTRACTOR prefabricated

equipment technical rooms together with COMPANY CPI packages will be prioritized according to the individual final yard delivery dates. Specific details will be provided by the project schedule P6.

17.1.5 Energization of Utility Systems (Macro Group 4.)

The systems defined by this group are as follows:
- Instrument Air Package and Network
- Nitrogen Generator Package and Network
- Sea Water Intake System
- Water Desalination Package
- Crane

Specific details for the related water disposal brine discharge and electro chlorinated water networks will be provided by the project schedule P6.

The precursor for the energization and commissioning of the Utility systems will be the availability of the following electrical and instrumentation subsystems;

- 400VAC Switchboard SG-200N1, SS 83-00
- UPS AC UP-200F3, SS 84-10
- 400/230VAC Distribution Board DP-200N1, SS 83-20
- Process Control System, SS 87-10

17.1.6 Energization of Process & Process Support Systems (Macro Group 5.)

The systems defined by this group are as follows:
- Hydrogen Storage Header OUTLET
- Hydrogen Storage Vessels
- Hydrogen Vent Header and drum System
- Hydrogen Storage Header INTLET

The sequence of activities have been stipulated according to the constructability analysis prepared by the CONTRACTOR construction department (equipment and packages forecast delivery to yard dates).

The principal objective is to assure the correct sequence of mechanical construction activities related to the piping, vessels and valves, culminating with the execution of the leak tests managed directly by the mechanical commissioning team.

17.1.7 Energization of Company Provided Items (Macro Group 6.)

Commissioning sequencing and activities have been divided into two distinct phases;

- Phase 1: Individual CPI Package Performance Test (one package at a time)
- Phase 2: Integrated Test (all packages together)

The precursor for the energization and commissioning of the individual CPI packages will be the availability of all associated electrical, control, protection, utility and process systems on BLPH.

The CPI packages will be subject to a two-step approach to commissioning; the first will provide verification of related mechanical completion activities to allow the energization and consequently precommissioning

of auxiliary systems; for example, low voltage power supplies for internal distribution boards, control panels, lighting circuits and HVAC equipment.

The second step will correspond to the Phase 1 of activities to be performed according to the requirements of Macro Group 6.
Each CPI package will be subject to an audit which, upon successful conclusion, will authorize the signing of Statement of Fitness (SoF) and Ready for Start Up (RFSU) certificates.

It will then be possible to proceed with full package energization, including the respective 6.6 kV transformers and interconnecting power cables in addition to synchronization with the yard 6.6 kV temporary yard power generation facilities.

- BESS PACKAGE A-85000
- The package will have reached the final configuration with all batteries installed,
- All associated permanent topside systems will be available,
- The temporary yard 6.6kV power generation with load bank facilities will be available,
- Batteries charging in the permanent package configuration will be commissioned,
- Batteries discharging in the permanent package configuration will be commissioned (BESS synchronized with the temporary yard 6.6kV power generation with load bank facilities)
- Topside control and protection interfaces will be commissioned,
- EMCS & PCS will be commissioned.

- FUEL CELL PACKAGE A-80000
- The package will have reached the final configuration ready for the first pressurization of hydrogen,
- All associated permanent topside systems will be available,
- The temporary yard 6.6kV power generation with load bank facilities will be available,
- Power generation in the permanent configuration will be commissioned (BESS synchronized with the temporary yard 6.6kV power generation with load bank facilities, CONTRACTOR to provide a temporary source of Hydrogen)
- Control and protection interfaces will be commissioned,
- EMCS & PCS will be commissioned.

- ELECTROLYZER PACKAGE A-20000
- The package will have reached the final configuration ready for the first production of hydrogen,
- All associated permanent topside systems will be available,
- The temporary yard 6.6kV power generation with load bank facilities will be available,
- Control and protection interfaces will be commissioned,
- EMCS & PCS will be commissioned.

Phase 1 of individual CPI packages commissioning and start-up will now have been completed

The final conclusion of onshore testing will be achieved upon the successful completion of Phase 2: Integrated Test.

It is clear that execution of the Integrated Test will be facilitated to a large extent by the successful outcomes of the singular CPI package tests, i.e. the performance parameters of each individual package will have been validated.

The primary focus of the Integrated Test, with all packages and topside systems operating simultaneously, will therefore be the testing and validation of the project design modes of operation, summarized as follows;

MODES OF OPERATION

- MODE 0: IDLE
- MODE 1A: POWER IMPORT (Able to Charge)
- MODE 1A: POWER IMPORT (Not Able to Charge)
- MODE 2: HOT STANDBY
- MODE 3: POWER EXPORT
- MODE 4: COLD STANDBY
- MODE 4A: EMERGENCY (BESS Grid Forming)
- MODE 5: POWER OUT
- MODE 6: MAINTENANCE
- MODE 7: RESEARCH
- MODE 8: NONE

17.2 Offshore Commissioning Phase

The following steps describe the sequence of Offshore activities (Site).

It is understood that the offshore hookup, final commissioning and start-up campaign will be scheduled in accordance with the overall project schedule.

Assuming a successful conclusion the Onshore Commissioning Phase, only a limited number of construction, mechanical completion and commissioning activities will remain as part of the planned Offshore scope of works.

Further to topside installation, a detailed visual inspection of all installed items of equipment will be performed.

A temporary diesel power generator will be installed prior to sail-away to enable first energization of the electrical power and distribution systems.

Successive energizations will foresee the activation of lighting circuits, HVAC systems, Navaids and CCS & EMCS systems.

A significant majority of OTP's can now be completed for Offshore scope where no specific additional testing requirements will be foreseen (e.g. Electrical Distribution Switchboards, UPS, Instrument Air Compressors, etc.).

17.2.1 Final Systems Completions

The principal Systems where construction, mechanical completion and commissioning activities will be foreseen are summarized as follows:

- 66 kV Subsea Power Cable
- Subsea FO Cable
- Sea Water Intake System
- Hydrogen Piping Systems Leak Tests

17.2.2 Offshore Start-Up

The principal Systems where commissioning could not have been performed on shore are summarized as follows;

- HV 66 kV Gas Insulated Switchgear
- Power Transformer 7 MVA

Notwithstanding that the 6.6 kV Switchboard SG-100D1 will have been fully energized as part of the onshore scope of activities, it will not have been energized via either GIS switchgear HNA6-AFA70 or transformer TR-100AD1. Consequently, protection circuits and safety interlocks will require final testing and validation.

17.2.3 Offshore Final Integrated Test

Further to permanent energization of the topside from the wind farm via the 66 kV subsea cable, each CPI package will once again be subject to an audit which, upon successful conclusion, will authorize the signing of Statement of Fitness (SoF) and Ready for Start Up (RFSU) certificates.

It will then be possible to proceed with full CPI package energization, including the respective 6.6 kV transformers and interconnecting power cables in addition to synchronization with the wind farm via the 66 kV GIS HNA6-AFA70.

The Offshore Integrated Test, with all packages and topside systems operating simultaneously, will now be possible in the permanent final configuration.

18. PRESERVATION REQUIREMENTS

Safeguarding the integrity and functionality of equipment through the various phases the PROJECT is of vital importance for a successful and smooth achievement of Project milestones avoiding delay and downtimes related to the reliability of the equipment.

CONTRACTOR shall be responsible for defining and implementing dedicated preservation and maintenance measures and activities from storage of equipment at WORKSITE up to BLPH sail-away. The owner of this procedure shall be the CONTRACTOR Construction dept.

Preservation activities will be performed by CONTRACTOR Construction Department with the traceability by dedicated records sheets to be recorded in Completions Management Systems database. They will be based upon Vendors / Manufacturers documented recommendations, requirements and specifications, with the aim of assuring and preventing any degradation of the pipework, vessel and other main equipment items, at the various stages of the PROJECT, as follows:

- Following FAT testing and subsequent equipment transportation from Vendors workshop premises to the CONTRACTOR fabrication Yard,
- During the storage at CONTRACTOR fabrication Yard,
- During the execution of the construction activities,
- Following the completion of the Commissioning activities.

Packages, equipment items, large modules or even the complete BLPH may need to be temporarily preserved for a relatively short period of time.

CONTRACTOR will provide a dedicated Preservation Plan, covering the WORKSITE construction and commissioning phases, through Sail-Away of the topside to SITE installation, start-up and final operation.

19. APPENDICES

19.1 Appendix 1 – Activities Classification at WORKSITE

The below classification summarizes CONTRACTORS scope of work and provides a useful list of all main Mechanical Completion and Commissioning activities by discipline and major types of equipment.

	Mechanical Completion	Commissioning
ELECTRICAL		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Perform preliminary tests with equipment de-energised, including: ▪ Insulation resistance measurements ▪ Di-electric strength tests ▪ Loops and circuits cables continuity tests ▪ Earthing resistance measurements	X	
Control earthing network	X	
Fill in batteries with electrolyte (if cells supplied dry)	X	
Check installation of emergency and instrument power systems	X	
Check installation of electrical heat tracing	X	
Check direction of rotation of electrical motors		X
Modify connections if wrong direction of rotation		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 system		X
Start up and test power generation systems (when possible)		X
Carry out preliminary load test (when possible)		X
Energise Power Distribution Panels after completion of all tests		X
Carry out batteries' charge/discharge tests		X
Test battery chargers, inverters, UPS		X
Perform motors no load runs. Test motors ancillary equipment		X
Check temperature rise of motors, bearings, transformers, relays, when loaded (if possible), measure vibration level		X
Check operation of manual and auto controls		X
Check Essential, Normal and Emergency circuits lighting and intensities and autonomy		X
Energize installation of electrical heat tracing		X
Conduct main equipment Operational Tests where required		X
INSTRUMENTION		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Remove all fragile devices before hydro tests	X	
Perform required pressure tests on: ▪ Instrument take-off piping ▪ Air piping ▪ Air tubing	X	
Reinstall all fragile devices after pressure tests and flushing of the process lines	X	

Calibrate (means functional test) 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	
Install sealing fluids where required	X	X
Calibrate / operate all control valves, on/off valves, lubricate as required	X	X
Install all safety devices e.g. pressure relieve valve after testing	X	
Check and adjust all safety devices and seals where necessary, with Vendor if required	X	
Check instrument accessibility for removal, maintenance, routine field adjustment	X	
Calibrate all F&G detectors, loop test with F&G panel		X
Test marshalling relay boxes, programmable logic controllers, sequential operators and all numeric control systems		X
Carry out loop process instrumentation testing		X
Test shutdown systems, interlocks, and sequencers + alarms		X
Conduct main equipment Operational Tests where required		X
PIPING		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Check condition and quality of installation of gaskets and bolt types	X	
Install and check spring hangers, pipe anchors and guides	X	
Alleviate any excess piping stresses that may be imposed on pipes, compressors or pump flanges	X	
Install safety valves or temporary spool pieces during construction	X	
Remove all temporary supports, protections, bracings, sea fastening stops, that were installed to prevent equipment damage during shipping, storage and erection	X	
Check packing and packing materials and lubrication of valves; repack and lubricate if necessary	X	
Remove all critical valves prior to hydro-test and flushing activities	X	
Carry out hydrostatic test of piping	X	
Carry out piping water flushing or air blowing cleaning operations	X	
Perform chemical cleaning (where applicable)	X	
Set or check pipe anchors, guides, spring hangers and supports after hydro test. Provide cold and hot setting data	X	
Clean strainers after flushing	X	
Carry out Gross Air Leak Test (GALT)	X	
Provide and install all strainers, both temporary and permanent, spectacle blinds and temporary blanks required for commissioning		X
Supply and install line identification tags and signs, stencil lines for identification	X	
Test, set and tag all safety valves, then carry out safety valves final installation	X	
Remove as necessary and transport all safety valves to and from test facilities	X	
Supply car seals or locking devices for block valves and safety equipment	X	
Provide list and location of all blinds installed	X	X
Check and record position of all car sealed valves		X
Install car seals or locking devices on block valves and safety equipment		X
Fill in hydraulic unit and network with appropriate oil		X
Perform drying-out (where required)		X
Carry out Tightness test (HP leak testing)		X

Carry out inerting		X
VESSELS and DRUMS		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Clean out all vessels	X	
Carry out vessel's final inspection	X	X
Properly close-up all vessels, internal man ways and openings after final inspection is completed	X	
Carry out leak tests (Gross Air Leak Test)	X	
Inspect all drums for cleanliness and dryness before loading catalysts, etc.		X
Conduct main equipment Operational Tests as applicable		X
TANKAGE		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Install appurtenances	X	
Hydrostatic test tank and internal piping, and clean inside tank	X	
Clean inside tank	X	
Close manways	X	
Carry out tank final inspection	X	X
PUMPS		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Set and cold align pump and driver	X	
Couple pump to driver and perform alignment check	X	
Install temporary strainers in pump suction piping	X	
Check discharge flow dampers are correctly charged and installed	X	
Check pump gear box oil level		X
Run-in pump in recycle, check pump and motor operation and parameters (vibration levels, bearings temperature)		X
Check equipment noise levels		X
Charge lube oil, seal oil and oil cooling systems	X	
Carry out lube and seal oil systems flushing	X	
Make final hot alignment check		X
Conduct main equipment Operational Tests		X
DIESEL ENGINES		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's 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 required		X
Test run coupled unit and verify all operating parameters		X
Carry out noise measurement tests		X
Conduct Operational Tests		X
MISCELLANEOUS MECHANICAL EQUIPMENT		

Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Fill-in lube and hydraulic oil systems of lifting equipment		X
Load test all pad eyes	X	
Test lifting equipment in presence of Insurance Inspector or appropriate governmental authority		X
Conduct Operational Tests		X
FIRE-FIGHTING EQUIPMENT		
Check condition of equipment, quality of installation, and compliance with Project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Check storage locations of all extinguishers	X	
Function test of extinguishing agent skids in accordance with the approved procedures		X
Conduct Operational Tests of main commissionable equipment		X
HVAC EQUIPMENT		
Check condition of equipment, quality of installation, and compliance with project drawings, Manufacturer's instructions, safety rules, specifications and good practice	X	
Check alignment of motors/fans and drives	X	
Check that tension on belt drives is correct	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 pre-heaters 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 Operational Tests		X
LIFE SAVING EQUIPMENT		
Check condition of equipment, quality of installation, and compliance with project drawings, Manufacturer's 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 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	
Conduct Operational Tests WHERE APPLICABLE		X
RADIOS		
Check condition of equipment, quality of installation, and compliance with project drawings, Manufacturer's 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
Conduct Operational Tests as applicable		X

Table 9: Section 19.1 Appendix