GENERAL SPECIFICATION

SPECIFICATION

FOR

MECHANICAL COMPLETION, COMMISSIONING & INTEGRATED TESTING

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Neptune Energy Netherlands B.V.

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1.0 **SCOPE**

This specification covers the requirements for mechanical completion, commissioning and integrated testing for Neptune Energy projects. This specification shall be used during the commissioning phase for Greenfield and Brownfield projects.
2.0 **GENERAL SPECIFICATIONS, STANDARDS AND CODES**

The requirements of the standards, codes and supplemental specifications listed below shall be met unless specially excluded by this specification and specifications referred herein.

All installations/ equipment specified herein shall conform in design, material and performance with the latest editions (with amendments) of the following General Specifications, Standards, Codes and Regulations current at time of order placement.

### 2.1 GENERAL SPECIFICATIONS

- **101** Specification of Administration of Drawings “Drawing Control”
- **102** Specification for Production of Documents
- **103** Supplier Document Requirements (SDR)
- **104** Laws, Regulations, Codes and Standards
- **502** Piping Fabrication and Pressure Testing
- **504** Standard Pipe Supports
- **518** Insulation of Piping and Equipment
- **525** General Specification for Painting and Coating
- **541** General Construction of HVAC Installations
- **610** General Specification for General Construction of Electrical, Instrumentation and Telecommunication Installations
- **613** Specification for Electrical & Instrumentation General Details & Hook-ups


### 2.2 STANDARDS AND CODES

- Dutch rules for working environment (ARBO arbeidsomstandighedenwet)
- Dutch Mining Act (Mijnbouwwet)
- Directive 1999/92/EU (ATEX 153), Minimum requirements of improving the safety and health of workers potentially at risk from explosive atmospheres.
- Directive 2014/30/EU, Electro Magnetic Compatibility (EMC)
- EU, Certification conform European Rules, including ‘CE’ marking.

### 2.3 CERTIFICATION

Equipment located in hazardous areas shall be certified in compliance with the ATEX directive. Only equipment with certification issued by notified bodies will be accepted.
3.0 GENERAL

3.1 DEFINITIONS

Brownfield Projects and modifications on a platform who take place offshore.
Calibration Comparison against approved standards and subsequent adjustment, in order to meet the manufacturer’s specifications and/or system’s functional requirements.
Company Neptune Energy
Contractor Party to whom the fabrication, installation, hook-up and commissioning are assigned.
Greenfield Projects and modification for a platform which are build onshore and later installed offshore.
Inspection Examination of equipment for any physical defect or damage; verification that it meets specifications and that its installation is satisfactory.
Loop A combination of one or more interconnected instruments arranged to measure and/or control a process variable.
May An acceptable course of action
Shall A mandatory requirement
Should A preferred course of action
Supplier The firm of person(s) contractually responsible to Company for the assembly, performance and quality of the equipment described herein.
Test To determine whether the equipment functions in the manner expected.

3.2 ABBREVIATIONS

AFC Approved For Construction
AKI Accreditatie Keurings Instelling
ARBO Arbeidsomstandighedenwet
ATEX Atmosphères EXplosibles
CCR Central Control Room
CE Conformité Européenne
C&E Cause & Effect
DAR MECO Discipline Acceptance Record Mechanical Completion
DAR TECO Discipline Acceptance Record Technical Completion (Commissioning)
D&ID Ducting & Instrumentation Diagram
EMC ElectroMagnetic Compatibility
ESD Emergency Shut Down
FAT Factory Acceptance Test
KVI Keuring Van Ingebruikname
MCAC Mechanical Completion Acceptance Certificate
MCT Multi Cable Transit
MECO Mechanical Completion
NoBo Notified Body
PA Items must be completed prior to Commissioning (MECO phase)
PB Items that may be completed after Commissioning or Start-up
PC Items outside scope that may be completed after Start-up without hindrance to production.
PES Programmable Electronic Systems, Microprocessor based, programmable systems (for example: Programmable Logic Controllers (PLC), Distributed Control Systems (DCS))
PFD    Process Flow Diagram
P&ID  Process & Instrumentation Diagram
SAT   Site Acceptance Test
SDR   Supplier Document Requirements
TECO  Technical Completion
4.0 **MECHANICAL COMPLETION, COMMISSIONING & INTEGRATED TESTING**

Commissioning of an onshore (greenfield) or offshore unit (brownfield) is a time consuming and complex process. A structural approach is a necessity for a successful project. How exactly the activities should be carried out is left to Company. There will be dependencies between different packages. It is required by Company that the equipment is to be tested ‘as installed’ condition.

All commissioning activities must be recorded in Company’s electronic Commissioning system ([http://engie.ixplanta.com](http://engie.ixplanta.com)). The Commissioning system is an information management system created for recording Mechanical Completion, Commissioning and Integrated Testing of Company’s existing and new installations. It allows Company to keep an accurate record of all documents during Mechanical Completion, Commissioning and Integrated testing phases.

4.1 **RESPONSIBILITIES**

The responsibilities of all parties involved with the Commissioning of installations during the Mechanical Completion, Commissioning and Integrated Testing phases. Commissioning is meant to detect and solve any design and/or construction irregularities, this is to avoid any changes during start-up. As a result, it is necessary for all parties to sign the corresponding test sheets for acceptance of the delivered materials and/or work.

Parties involved during Mechanical Completion, Commissioning and Integrated Testing can be:

- Supplier for the SAT of a specific installation;
- Company Construction and Commissioning (project) team;
- Company production representative;
- Company authorized electrical and or instrumentation engineer for switching of electrical installations and control systems.

Tasks to be carried out during Mechanical Completion, Commissioning and Integrated Testing by parties mentioned above:

**Vendor representative**
- Commissioning of the specific installation in cooperation with Company’s representative;
- Inspection protocol to be issued and signed off;
- Issuing service report.

**Company’s offshore supervisor**
- Supervision of the Mechanical Completion phase;
- Signing off all inspection records;
- Permits.

**Company’s onshore site team representative**
- Coordinates the commissioning with vendors;
- Is responsible that the commissioning of the project is performed in accordance with the appropriate specifications and drawings;
- DAR and Loop sheets to be filled in and signed off.
- Signing off all vendor documentation (timesheet, service report, inspection protocol etc.)

**Company’s production representative**
- Advises and assists during the commissioning of the project;
• Inspection protocol and the corresponding test sheets/drawings to be signed off.

**Company’s commissioning engineer**

• Commissioning;
• Calibration and testing of equipment;
• Signing off all test documentation and drawings.

**Company’s authorized electrical/instrumentation engineer**

• The electrical/instrumentation engineer is authorized by Company to operate the electrical installation and control systems during commissioning;
• The electrical/instrumentation engineer is responsible for the work permits needed for the works being executed during the commissioning.

4.2 MECHANICAL COMPLETION (MECO)

All equipment is installed in accordance with the engineering design documents (AFC revision), codes and standards. Hydro tests are part of the MECO Phase. The MECO test certificates and DAR Sheets are filed in Company’s Commissioning system.

Mechanical Acceptance is the inspection and acceptance of the installation. All equipment irrespective of where they may have been calibrated, manufactured or tested shall be physically checked.

Mechanical completion is completed when construction of equipment and piping has been demonstrated as physically complete. Static tests are limited to non-energised tests like cold alignment of shafting for motors, engines and generators. Typically, the Mechanical Completion may result in a punch list with a number of outstanding items that must (PA) or may (PB/PC) be rectified before any actual testing and commissioning can commence. The evidence (DAR Sheets) should be verified during the MECO stage, so that there are no surprises before commencing commissioning and integrated testing. Failure to do so may jeopardize the safety of such activities.

Mechanical completion activities include checking of fabrication and installation work. The activities shall include but not be limited to:

**Mechanical:**

• Internal inspection of tanks and vessels
• Alignment;
• Load testing of lifting equipment;
• Hot oil flushing;
• Bolt tensioning;
• Dimension control;
• Preservation;
• Leaktest of tanks and vessels.

**Electrical:**

• Insulation and continuity testing of LV cables;
• Insulation testing of generator, transformers and motors, panels, distribution board etc.;
• Earthing checks;
• Visual check of switches and control devices;
- Lighting and socket outlet checks;
- Heat tracing;
- Preservation.

**Instrumentation:**
- P&ID check
- Flow direction check
- Location check
- Accessibility check
- Insulation and continuity testing of Instrumentation/ data cables;
- Earthing checks;
- Cleaning, flushing, pressure and leak testing of pneumatic, process and hydraulic tubing;
- Preservation
- Pneumatic, Hydraulic and/ or Process Hook-up check.

**Piping:**
- NDE carried out;
- Welding procedures;
- Removal of all items subject to damage during flushing, cleaning and pressure testing;
- Flushing of pipework;
- Chemical cleaning and testing of pipework;
- Drying of tested pipework;
- Reinstatement of all items after testing;
- Final inspection of pipework;
- Test ISO’s and P&ID’s showing the extent of each pressure test;
- Leaktest of all piping systems;
- Hot oil flushing of pipework or instrumentation tubing;
- Bolt tensioning and pipe support completed;
- Insulation/ personal protection correct installed.

**HVAC:**
- Cleaning of ductwork;
- Leak testing of ductwork;
- Alignment checks;
- Mechanical function checks of equipment;
- Preservation;
- Flow coding.

**Safety:**
- Preservation;
- Flow marking.
- Safety layout/ escape routes check
- Visual check of escape means.

**Structural:**
- QC documentation;
- NDE carried out;
- Welding;
- Load testing of lifting lugs and monorails.

**Surface protection, insulation and fire proofing:**

- Thickness checks carried out;
- Adhesion checks carried out;
- Preservation;
- Insulation;
- Painting;
- Fire proofing.

**Architectural:**

- Preservation.

### 4.3 COMMISSIONING (TECO)

This phase describes the functional testing of all components within a system. All individual components are energized, pressurized etc., in order to allow functional testing of a system. Leak test and static Cause & Effect tests are part of the Commissioning phase.

Commissioning can be divided into three main activities:

- Commissioning preparation;
- Commissioning execution;
- Commissioning documentation and handover.

Establishing Commissioning packages, according to the system break down, early in a project shall be carried out, in order to establish fabrication/ installation priorities and milestones. Commissioning packages are essential in order to achieve an early Commissioning completion.

The preparatory work shall consist of activities such as:

- Development of commissioning organisation;
- Development of system break down (sub system);
- Commissioning packages;
- Commissioning spare parts check.

In the Commissioning phase it will be verified that the installed equipment and systems are working as intended and that the requirements for the various equipment/ system functionally are met.

For effective Commissioning, it is important that the testing and commissioning of the different skids/ packages and equipment are given the right priority so they happen in the right sequence/ order. Very little commissioning can be performed without hydraulic ring line, power system, cooling water, pneumatic systems and other utilities being functional and working properly. It is a general principle that commissioned equipment is not dismantled or modified after testing and commissioning of the equipment/ system is completed. Once the equipment/ systems are commissioned it is good practice to have a close out meeting where the commissioning procedures are signed, by Company, Contractor and/ or Supplier, and outstanding punch items are agreed.
The Commissioning Team is responsible for signing off all relevant documents within scope of project, such as, but not limited to:

- Adjustment of control, alarm and shutdown settings;
- Loop testing;
- Function testing of control systems;
- Function testing of field instruments.

4.4 INTEGRATED TESTING

Integrated testing is a collective term for testing and commissioning of more than one system (a collection of systems, sub-systems and equipment packages) to ensure compliance with project requirements. Many systems on board are integrated with other systems in one way or another. However, in this context, integrated testing is meant to cover the following but not limited to:

- Complete functional testing of systems across equipment boundaries;
- Final adjustment of alarm-limits, measuring instruments;
- Serial interface testing between plant/CCR DCS, ESD, F&G system, visualisation and third party system.

As a result of the integration testing, it is good practice to have a close out meeting where the test results are signed, by Company, Contractor and/ or Supplier, and outstanding punch items are agreed.

The Commissioning Team is responsible for signing off all relevant documents within scope of project, such as, but not limited to:

- C&E
- P&ID
- Control narratives
- RATS List

4.5 HANDOVER

Interim Handover
This handover shows that all life support and utility systems are operational. The MECO phase is covered so that production knows we can safely start the Commissioning phase without introducing hydrocarbons.

Ready for Start-up Handover
This phase covers that Commissioning without hydrocarbons has been finalized. This includes Loop testing, static C&E etc. By handing this handover, we show that the platform/ project is ready to start-up.

These activities are performed under the supervision of the Commissioning Team and witnessed by the Production Department. When all required documents are signed, a Ready for Start-up Handover will be prepared and signed by all parties involved and stored in Company’s Commissioning System.
After this document has been signed, hydrocarbons are introduced to the platform/project and the dynamic C&E test will be performed under supervision of dedicated production crew with assistance of the Commissioning Team. Results of these integrated tests will be signed by all parties involved and stored in Company’s Commissioning System.

**Final Handover**
When the project is finalized and after the run in period and the punch list has been cleared or items have been handed over to the Production Department a Final Handover will signed by all parties involved.

The final main activity of commissioning is to prepare the Final Handover document to the Asset NL departments. The handover shall contain a certificate and other documents agreed with the Asset NL Departments, which as a minimum should consist of:

- Completion certificate (signed by both parties)
- Commissioning results from Company’s Commissioning System (piping, loops and C&E results)
- Punch list
- KVI
5.0 **INSPECTION AND TEST ADMINISTRATION**

The commissioning project team will make sure that all related AFC project documents are available, such as, but not limited to:

- Equipment Index, with system break down integrated;
- Line List
- AFC drawing package

5.1 **BASIC REQUIREMENTS**

The following documentation shall be available before the start of Mechanical Completion, Commissioning and Integrated testing.

1) A plan of all activities, including a critical path diagram, prepared from a detailed estimate of the man-hours and apparatus required in the total inspection, test and calibration task.

2) Regular updates of the critical path diagram to reflect current progress. Company or Contractor shall be completely responsible for the follow up of the plan of activities.

3) A Curriculum Vita to verify competent personnel.

4) The facilities (on and offshore) and test equipment shall be adequate to maintain the agreed time schedule while maintaining specified standards for quality and accuracy.

5) List of exceptions to the job specifications:

- Identification of faulty instruments;
- Components and materials
- Replacement or acceptable repair of defective items;
- Rework or modification of unacceptable installations
- Calibration certificates
- FAT reports

6) Mechanical Completion (MECO)

The delivery of the project documents, to show Mechanical complete status has been achieved. Project documents expected:

- System break down (the dividing of the work based on the P&ID’s), all related test documents need to have the system breakdown on it as well;
- Mechanical Completion DAR Sheets using Company’s template;
- One punch list with all PA/ PB and PC items, using company’s template;
- Mechanical Completions Acceptance Certificate’s per system, according to system break down.

The Mechanical Completion DAR Sheets shall be verified by Contractor, Construction Team and/ or Company in the following way:
7) Commissioning (Technical Completion (TECO))
The delivery of the project documents to show, TECO status has been achieved is part of Commissioning Team's scope of work. Same system break down as mentioned before (point 7) shall be used.

Project documents expected:

- Instrument Loop Diagrams
- Key documents (with static C&E)
- Commissioning (TECO) DAR Sheets, using Company's template.

The Commissioning DAR Sheets and drawings shall be verified Company in the following way:

- Commissioning Team submits completed DAR Sheets for verification, when the critical punch items (PA) are solved;
- TECO DAR Sheets need to be signed by the Commissioning Team and verified by a Production representative.
- The remark version of the AFC Instrument Loop Diagrams, RATS List and Key documents need to be signed by the Commissioning Team and verified by a Production representative.

8) Integrated Testing
The delivery of the project documents to show, Integrated testing has been completed is part of Commissioning Team's scope.

Signed project documents expected:

- Dynamic C&E Diagrams
- RATS List
- Control Narratives

9) Piping Documentation
In order to demonstrate that the piping is installed as per design (P&ID), the following sheets are generated and authorised by the Offshore Construction Crew:

- Pressure Test Sheet
- Mechanical Completion Sheet
10) Company's Commissioning System
The Contractor, Construction Team and Commissioning team must send all signed documents/drawings to ixplanta@neptuneenergy.com
Documents will be sent in an orderly way:

- Per system (use system break down)
- AFE/PEF and system as subject of the e-mail

11) Timesheet and Service Report of site activities
Every supplier onshore and offshore needs to fill out a service report on which Company is informed about the activities performed. Timesheets need to be handed over separate from the service reports. Each service report and timesheet needs to have a clear cost code present (AFE or PEF number). In case of performing work on multiple cost codes Company needs a timesheet per cost code. No supplier/contractor is allowed to leave the worksite before handing over a service report.