



Exploration & Production

GENERAL SPECIFICATION

STRUCTURAL

GS STR 455

Subsea production systems integration principles

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1. Scope

The purpose of this document is:

- To provide general guide-lines concerning the Integration testing activities for subsea production systems
- To give additional recommendations to the [API 17 A](#) section 8 Operations (8.2 Equipment Integration Tests) and [ISO 13628-1](#) section 7 (7.2, 7.3 and annex C).

Prior to offshore installation, the adequacy of the equipment must be thoroughly verified in order to ensure the success of the operation.

Each item of equipment undergoes an extensive Factory Acceptance Test (FAT) before leaving the factory.

All the necessary items are added and brought together and then the whole production stations are tested.

This activity is defined as the Integration. It encompasses all the work performed between the FAT's and the offshore installation.

The scope of this specification is to define the principles and objectives for the integration testing of subsea production and/or manifold stations, templates, modules, connections and tools.

2. Reference documents

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

Choice of reference documents

Where national regulations exist, their provisions and those of the standards and codes to which they refer shall apply, supplementing or amending the provisions of this document.

If there are no national regulations covering all or part of the subject of this document, the reference documents shall be strictly applied, as supplemented by the provisions of this document.

Recognition of reference documents

Only the main reference documents are mentioned; the CONTRACTOR shall be responsible for complying with all secondary reference documents dealing with the subject of this document.

Standards

Reference	Title
ISO 13628-1	Part 1: General requirements and recommendations (section 7, 7.2, 7.3 and annex C)

Professional Documents

Reference	Title
API 17 A	Recommended practice for design and operation of subsea production systems (section 8 Operations 8.2 Equipment Integration Tests)

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

The provisions of this document shall be applied in the light of the supplementary documents supplied by COMPANY, including:

- Country specificity appendices
- Job specification
- Data sheets
- Articles and conditions; list of tasks
- Quality assurance provisions.

Reference	Title
GS STR 451	Design and operation of subsea production systems. General requirements and recommendations

3. Objectives of the integration

Without minimising the other phases of the project, the integration is of utmost importance for the result of the underwater installation since the items of equipment once installed on the sea bottom cannot be modified to have them fitting with each other.

The main goals of integration are:

- To verify the adequacy of the design by demonstrating the fit, interchangeability and integrity of the equipment interfaces
- To verify and optimise the necessary underwater installation procedures, to prepare for eventual production by carrying out pre-production commissioning tasks.

The basic assumption for the integration testing is that each item of equipment received at the integration site complies with the specifications and that verification has been documented during FAT.

The integration testing represents the only possibility to verify that independently accepted items (i.e. by FAT) will combine successfully with each other before installation takes place. In addition, such a test permits:

- To train the installation personnel
- To check the installation procedures
- To correct minor short comings or malfunctions in the equipment revealed during the integration tests.

4. Definition of main phases

The work to be performed during the integration testing can be broken down in five phases:

- Equipment completion
- Trial fitting
- Onshore commissioning
- Procedure verification and personnel training
- Shallow water tests.

All available parts of this integration work will be implemented on the actual equipment while the remaining part of already installed equipment will be performed on the testing equipment (test station and/or jig).

4.1 Equipment completion

Each item of equipment (module or unit) shall be completed as far as possible at the MANUFACTURER's workshop. However, some components provided by other companies (like: cables, instrumentation, connectors) are not planned to be installed before the delivery of the equipment at the integration yard in order to avoid damaging these components during handling and transport or due to different delivery time. These components will thus be installed during the integration testing period at the most convenient time before the final commissioning.

4.2 Trial fittings

This kind of test must be performed on the actual equipment. The stations will be partly assembled and the verification that all the items will fit each other, shall be done taking into consideration:

- The interchangeability of the components
- The worst conditions (for example tilt of wellhead, misalignment during installation, etc.).



Special attention must be paid to the planning considering equipment which need to be installed early:

- Template (when relevant)/wellhead/tubing hanger/X-mas tree
- X-mas tree/control pod
- X-mas tree/tree cap
- X-mas tree/workover riser
- Template/Manifold
- Template/Lines termination unit/manifold
- Template/Umbilical termination unit
- Intervention and running tools to all components.

On the Manifold Station, the interfaces are limited to:

- Template/Manifold
- Template/Manifold termination units (all kind of termination included)
- Manifold/Modules (pig trap, killing, flowmeter, etc.)
- Retrievable inserts (valve, choke, etc.)
- Intervention and running tools to all components.

During this phase, the ROV access and interfaces must be verified as well (Mock up ROV).

Note: When the same MANUFACTURER is involved, some of these tests can be performed in his facilities (system FAT or extended FAT):

- X-mas tree/tree cap
- X-mas tree/workover riser.

4.3 Onshore commissioning

The FAT includes already many of the conventional commissioning tasks. Therefore, it is mandatory to know the content of the FAT when preparing the commissioning tasks for the integration.

The onshore commissioning includes all the conventional commissioning not included in the FAT like overall hydrotest, verification of all the various loops and finally the functional verification of the various systems.

This phase should end up with a short endurance test simulating actual production conditions, including all possible sequences of valve operation.

The overall hydrotests of the stations require the presence of the actual manifolds while most of the other tasks can be performed on the test station or jig.

4.4 Procedures verification and personnel training

During the onshore integration testing the adequacy of the installation and intervention procedures must be verified carefully. This phase includes the following main steps:

- Verification of tools including the compatibility module/tool
- Verification of procedures for underwater work
- Training of tool operators.

All the procedures, including back up procedures, shall be verified and repeated until the operators (including the stand by one) succeed without external help.

4.5 Shallow water tests

The main goal of the shallow water tests is to check the adequacy of the approved installation procedures, including the complete sequence, as for example:

- Connect and disconnect wires
- Transfer module and tool inside the moon pool
- Lower
- Connect
- Test module after landing
- Retrieve tool
- Disconnect equipment.

All ROV tasks and Remotely Operated Tools (ROT) should be tested.

This test can be performed using either the actual installation vessel or a specific vessel.

The second goal of the water tests is to verify the behaviour of the equipment in the actual environment. The duration of the immersion shall permit the detection of any major tightness failure.

The shallow water tests are planned to include module installation, maintenance and retrievable as well as umbilical and pipeline connections.

The water depth will be selected in such a way that it should be an acceptable compromise with regard to representativity, accessibility and cost.

5. Ways and means

5.1 Integration specification

Integration will cover three main periods:

- Preparation
- Implementation
- Reporting.



5.1.1 Preparation

For each of the phases defined in par. 5 above, the work to be performed will be broken down in activities called Task. For each Task, a specific file will be carefully prepared. This file shall include:

- Description of the job (if necessary including detailed specification and/or test procedures)
- List of document to refer to
- List of material required with reference of purchase orders (including store part and consumable)
- List of mandatory equipment (test equipment, crane, etc.)
- Definition of resources
- Expected man-hours and overall duration
- Reporting form.

A task sheet will recapitulate all this information.

During the Integration preparation, the material necessary for the tasks will be ordered and an overall task procedure will be prepared in order to take into consideration the equipment delivery dates and the intervention of "specialists" involved. A task list will be kept updated with a special mention on tasks including tests.

5.1.2 Implementation

The integration yard(s) shall be organised in such a way that the work can be initiated by the yard, taking into consideration the time to mobilise resources, material, equipment, etc.

- Should a test fail several types of actions may have to be considered: The cause is easily identified and can be considered as of a unique nature; correct and repeat until successful
- In other cases, the problem shall be submitted to engineering evaluation in order to define corrective action, to be implemented before the failed test can be repeated, and ensure that said action will also be implemented on the other units if relevant.

All other modifications shall be submitted to engineering evaluation before implementation.

Procedures and forms shall be prepared accordingly.

5.1.3 Reporting

When a task is completed, the reporting form shall be filled in and forwarded to the main office with all the relevant documents for filing and/or treatment (as built drawing, preparation of shallow water test and installation, Quality Assurance/Quality Verification, etc.).



5.2 Test equipment

The utilisation of the test equipment must be limited and, as far as possible, it must be optimised. So far, the following test equipment has been identified as:

- One test station which will be used during the onshore commissioning, procedure verification, training and shallow water test phases as well as, during the production phase, for the maintenance of the components and tools
- One test jig for simulating the template/manifold during the verification of the procedures for the umbilical and pipeline connections.

A specific structure is preferred to a jig integrated in the test station because it gives more flexibility for the performance of the tests.

In addition to the test equipment described hereabove, other lighter test equipment could be useful for the FAT or for the maintenance of the system after starting up the production.