Mechanical Completion Philosophy

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1.0 Scope

This Procedure describes and clarifies the requirements for FAT and Mechanical Completion before delivery to Client (DG6, Ref Project Handbook) and our role and responsibility during the following phases in a project (Fabrication, Hook-up, MC and commissioning, up to the point of transfer of ownership from commissioning to operation).

It is essential that this procedure is adhered to in order to secure that all of Eureka`s contractual requirements are met and that Eureka retain sufficient control of all activities from the point that our equipment leaves Sørumsand until it is commissioned and in operation. As a general rule, Eureka shall have a representative on the fabrication site from the day the equipment arrives including all remaining phases until it is in operation. Eureka personnel should preferably be an integral part of fabrication contractors MC organization at the fabrication site during fabrication, hook-up and MC and in contractor`s and/or Clients commissioning team during commissioning, depending on who is responsible for commissioning.

It is vital that Eureka`s requirement during abovementioned phases are included in the contract (PO) to avoid incorrect installation and testing that may invalidate the pump warranty.
2.0 Stage-Gate Description

The stage –gate process for the completion phases is shown schematically in Fig 2.1( reference is also made to the Project Handbook) Definition of DG6 and DG7 is given in the Project Handbook.

MC complete ;

✓ Unit essential complete for start-up operation and test run. All major work is completed

Commissioning complete/Hand-over to operation;

✓ Functions are tested and verified against its objectives and specifications and ready to hand-over to operation.
3.0 Completion Principles by Eureka and its sub-suppliers

3.1 Overall goal

The overall goal of FAT, Mechanical Completion and preservation at Sørumsand is to verify that the equipment/system is designed and built to fulfill its purpose and specified requirements, including preservation prior to delivery permitting the equipment/system to arrive at fabrication yard undamaged.

For Eureka it is important to establish mechanical completion packages in accordance with contract requirements in order to facilitate an orderly and effective project in subsequent phases after the goods are shipped from Sørumsand (during completion at the fabrication site and later during commissioning onshore or offshore).

It is also essential that all requirements related to Eureka's delivery, including Eureka's roles and responsibilities during fabrication, hook-up and mechanical completion at the fabrication site and during commissioning are specified in the purchase order.

This to ensure that Eureka equipment and systems are installed according to Eureka's specifications and that the clients receive adequate operational checkout by Eureka.

It is important to emphasize that adequate control of activities related to Eureka deliveries during these phases is a prerequisite for the guarantee obligation to remain enforceable.

When DG6 is crossed, an internal transfer of responsibility will take place from Sørumsand to OSS (DG7).

3.2 Completion phases

3.2.1 Preparation phase (see also section 3.0 in Project Handbook)

In this phase the following is carried out:
- Define mechanical completion and preservation requirements.
- Coding structure and system breakdown.
- Completion requirements to sub-suppliers (MC and FAT)

3.2.2 Execution (ref section 4 in Project Handbook)
Engineering phase;

✓ MC Package definition.
✓ Finalize all check lists for sub-suppliers (FAT and MC).
✓ Finalize all procedures and check lists for the assembly phase at Sørumsand.
✓ Finalize all procedures and check lists for the FAT at Sørumsand.

Procurement phase;

Sub-suppliers shall execute MC and FAT and preservation as specified in the purchase order. The completion shall be documented as part of Eurekas completion system which leads up to hand-over to Eureka.

Assembly/Test Phase;

Eureka shall perform FAT, MC and preservation as specified in purchase order/contract documents. The completion is documented as part of the completion system which leads up to hand-over to the company.

3.3 Common requirements

This standard shall be used as a basis for preparing plans, procedures and documentation for FAT, Mechanical completion and preservation.

3.4 Documentation

Eureka’s MC system shall be used to document all completion activities (Assembly, MC and FAT)
All check/test records shall end up in a status OK-PA-PB.

3.5 Project Completion System (Pims)

Eureka’s electronic based system for administration of Mechanical completion and Punch List Register, shall be used. That shall also apply for Eureka’s sub-suppliers.

4.0 Factory acceptance Test

4.1 Introduction
FAT is done to make sure that the equipment and/or system works as intended before shipment in accordance with applicable specifications, regulations, drawings and contract requirements.

FAT to be performed at Sørumsand shall be based on Eureka’s own procedures and checklists and shall be approved by the client prior start FAT.

FAT performed by Eureka’s sub-suppliers shall be based on the sub-suppliers testing procedures, and shall be approved by Eureka before the start of the FAT.

4.2 Pre- FAT

The FAT procedure shall be prepared well in advance of the FAT. This procedure should be reviewed and approved by the product owner within Eureka and the project manager including the client. A schedule shall be prepared for the FAT showing all timing and sequence of testing.

Much of the test requirements are routinely identified as part of the project specifications, which must be referenced or included in the test plan or confirmed as part of a verification checklist.

A document set shall be prepared that can support the testing and serve as a reference for the test results, including:

- Contract specifications and copies of all references called out in the specification.
- All drawings for the project, including drawings received from other vendors that describe interfaces.
- Detailed testing check list, including pass/fail criteria.

- A list of all relevant test documentation, certificates etc. from sub-suppliers. The purpose of this documentation is to verify that all parts/systems (electrical motor, diesel engine, generator, gear etc) have been tested and duly certified.

A pre-test checklist shall be completed before the FAT can commence.

4.2.1 Safety

Activities related to FAT may pose different hazards from those encountered in the normal run of production work. Client and sub-suppliers as well as own employees may
be at increased risk during this period, particularly when moving heavy equipment in and out of the test station and during testing of high voltage motors and machinery. Equipment and conductors that carry high voltage warrant particular safety requirements and procedures. Therefore, all critical test related activities shall be reviewed in a timely manner by competent personnel who should identify hazards, assess their risk and decide on necessary mitigating controls and procedures. A job safety analysis shall be made of all tasks that might expose workers to hazards associated with electrical equipment and lifting/moving of heavy equipment.

From time to time Eureka may appoint specialist personnel either from within its own organization or from sub-contractors, consultants etc., to join the site team. Such personnel should be regarded as if they were full site team inspectors/members and as such should be guided by the agreed HSE requirements. All personnel must be extremely vigilant during this period whilst systems are individually and collectively being tested.

4.3 FAT

During the FAT, Eureka’s product owner, and the project manager shall, as a minimum be present. Normally also representatives from the client side and critical sub-suppliers are present during the acceptance test.

The FAT shall be done per Eureka approved procedure; these could include functionality testing, regulatory testing and verifying and documenting proper performance of equipment and systems. Ad hoc testing may be required to define any non-conformities revealed by testing. Any non-conformities shall be compiled into the MC punch list, including time to complete. Results of testing shall be fully documented in a Final Acceptance Testing and Final Adjustment Report. The report shall include dates of testing, test equipment utilized, person performing tests, tests made, specified or manufacturer provided comparative acceptable test results, actual test results, corrections made and results of retesting for each piece of equipment of component tested.

5.0 Mechanical Completion (DG6)

5.1 Introduction

This chapter forms the basis for the execution and documentation of mechanical completion activities at Sørumsand, both before and after the FAT (including MC at sub-suppliers premises) up to and including DG6.
5.2 Documentation for a MC Package by Eureka

The MC package shall consist of a MC Certificate, a MC Status Index and a Punch List Register.

A Mechanical Completion Certificate (MCC) is a form completed by Eureka after all MC is carried out. The MCC is the cover sheet for each MC package. A MC package shall when signed by Eureka’s sub-suppliers be ready for start assembly at Sørumsand. A MC package shall when signed by Eureka (and verified by the client) be ready for shipment to the fabrication yard, or any other places specified in the contract. The Check Records (CR) are the forms on which Eureka record the results of all checks, Inspections and tests carried out for each individual item. A Punch List Register (PLR) shall be prepared by the Eureka along with the MC activity. In addition, a Mechanical Completion Check Record (MCCR) shall be prepared listing all activities to be performed related to Eureka’s delivery at the fabrication yard and in the commissioning phase where Eureka has a role and /or responsibility.

5.4 Carry Over Work Register (COWR)

The Carry Over Work Register lists all punch items that the client accepts as cannot be completed before the goods leave Sørumsand.. The COWR is used for the release of the work from Eureka and will as such be an input to the scheduling and planning of outstanding work to be performed during later phases. The COWR Item Number and cross reference to the Punch List Register/Check Records shall be given. COWR work shall be marked up on drawings or sketches as applicable and be included in the records. COWR Material Status List (MSL) and marked up drawings/instruction shall contain sufficient information for job setting in later phases.

5.5 Typical Mechanical completion activities

Mechanical completion activities for Eureka deliveries includes checking of production, assembly and installation work.

**Mechanical**

- Visual inspection for complete and correct installation.
- Internal inspection of tanks and vessels.
- Alignment.
- Load testing of lifting equipment
- Flushing.
✓ Bolt tensioning.
✓ Dimension control.
✓ Preservation.

**Electrical**
✓ Visual inspection for complete and correct installation.
✓ Insulation and continuity testing of cables.
✓ Insulation testing of generator, transformers and motors, panels, distribution board etc.
✓ Earthing checks.
✓ Static check of switches and control devices.
✓ Battery preparations.
✓ Lighting and socket outlet checks.
✓ Area completion.
✓ Heat tracing.
✓ Preservation.

**Instrument**
✓ Calibration and testing of instruments prior to installation.
✓ Visual inspection for complete and correct installation.
✓ Insulation and continuity testing of cables.
✓ Cleaning, flushing, pressure and leak testing of pneumatic and hydraulic tubing.
✓ Adjustment of control, alarm and shutdown settings.
✓ Loop testing.
✓ Function testing of control systems.
✓ Function testing of field instruments.
✓ Hot oil flushing of instrument tubing.
✓ Area completion.
✓ Preservation.

**Piping**
✓ NDE carried out.
✓ Welding procedures.
✓ Flushing of pipework.
✓ Chemical cleaning and testing of pipework.
✓ Preservation 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.
✓ Hydraulic tubing.
✓ Bolt tensioning.
✓ Pipe supports completed.
✓ Insulation.
✓ Flow coding.
HVAC (applicable for containers)
- Visual inspection for complete and correct installation.
- Cleaning of ductwork.
- Leak testing of ductwork.
- Alignment checks.
- Mechanical functions checks of equipment.
- Preservation.
- Flow coding.

Safety
- Visual inspection for complete and correct installation.
- Preservation.
- Area completion.

Mechanical completion of non-operational systems
- Mechanical completion of non-operational systems includes completion status and checks on area basis. Disciplines included structural, surface protection, insulation, fireproofing and architectural.

Structural
- Visual inspection for complete and correct installation.
- QC documentation.
- NDE carried out.
- Welding.
- Load testing of lifting lugs and monorails.

Surface protection, Insulation and Fire proofing
- Visual inspection for complete and correct application.
- Thickness checks carried out.
- Adhesion checks carried out.
- Preservation.
- Insulation.
- Painting.
- Fire proofing.

Architectural (applicable for containers)
- Visual inspection for complete and correct installation.
- Preservation.
- Doors.
6.0 Transfer of project from Sørumsand to Client (DG6) and OSS(DG7)

6.1 Introduction

Immediately after acceptance of DG6 (transfer of ownership from Eureka to Client), responsibility within Eureka will be transferred from Sørumsand to OSS (DG7).

In order for OSS’s commissioning team to familiarize themselves with the equipment, they will be assigned to the Sørumsand assembly & testing team minimum a month prior to DG7. When the goods leave Sørumsand, member(s) from OSS’s commissioning team will then follow the package through all remaining phases until hand-over to operation(client) offshore.

At that point, the responsibility within Eureka will be transferred to Eureka’s Key Account Manager(KAM).

6.2 Shipment and Storage

Preservation and Packing of Eureka equipment shall contain uniform instructions/guidance pertaining to;

✓ Inspection and verification(before shipment) of preservation, quality, quantity, packing, marking and loading to ensure damage free transportation/shipment.(One representative from the client shall be present during the inspection activities)

✓ Inspection and verification (at the receiving end) of unloading operations, confirmation of shipment( check all parts against the packing list to make sure nothing is missing), storage, preservation, damage during transportation, and stock location control .Even though the equipment is made up of heavy steel parts, it is a piece of machinery and it is essential that it’s parts be handled with care. One representative from Eureka shall always be present during these inspection activities.

Sound principles of warehousing shall be practiced in the storage of equipment to assure protection of the equipment.

In order to prevent distortion of skidded equipment, all skids shall be in contact with the floor and the weight shall be evenly distributed. In case repair to skids and/or equipment including preservation touch-up is required due to damage during transportation. This
shall be done prior to locating the equipment in the storage facilities. Requirements to be specified in the purchase order.

6.3 Installation of Eureka Equipment at Fabrication Site

Installation of Eureka supplied equipment and systems at the fabrication site shall contain uniform instructions/guidance pertaining to;

- Handling of the various components. Handling must be carried out by specialized personnel to avoid damage to the pump and persons involved.
- Methods and guidelines that Eureka have outlined to the specific site circumstances and pump design features in each particular installation.

Failure to comply with recommended procedures may void the warranty.

Eureka personnel shall always be present during critical installation activities according to pre-defined requirements. Requirements to be specified in the purchase order.

6.4 Mechanical Completion at Fabrication Site

Mechanical completion activities at fabrication site shall verify correct installation of Eureka equipment and systems and that all components are physically complete and all inspection, testing and documentation requirements have been completed.

It is highly recommended that Eureka personnel are present during the final MC punch out of own equipment and systems. The assistance requirements shall be specified in the purchase order.

6.5 Commissioning/hand-over to operation

When the unit is mechanical complete it is handed over to commissioning (normally that is the client). The objective of the commissioning phase is to safely and economically bring utilities, production and export systems into service and to achieve a handover of these systems to producing operations while demonstrating their performance within the specified design criteria.
As for the mechanical completion activities referred to in section 5.4, Eureka personnel should be present during commissioning and start-up activities concerning Eureka equipment and systems. Eureka personnel will assist the commissioning team in developing and detailed start-up plans including checkout procedures for own equipment. This to assure that procedures guidelines and start-up procedures are followed and verified by specialized personnel. Commissioning assistance during this phase shall be specified in the purchase order.