1 Scope

This Examination Procedure is applicable for performance of FAT at the time of delivery inspection of a complete system based on programmable electronics.

2 Purpose

Based on the test plan the Manufacturer/Supplier shall verify

a) correct integration of modules, application software, tools and hardware for an entire system that meets the system specification.

b) functional interaction between the product and the simulated process.

c) used tools.

d) user documentation.

This Examination Procedure is a part of the validation according to IEC 60880, IEC 61508 or ISO/IEC 90003.

3 Method

Prerequisites

The Manufacturer/Supplier is responsible for creating an agenda

The Manufacturer/Supplier is responsible for creating test procedures and communicate them at least 2 weeks before FAT for the Purchaser's approval.

During the FAT it shall be possible for the Purchaser to make own checks and verifications.

The Manufacturer/Supplier is responsible for premises, test equipment and test documenting performed checks and verifications.

Before FAT, the equipment shall be set up and a complete inspection with respect of function and performance according to agreed configurations shall have been performed. The inspection shall be documented and available for the Purchaser.

The Manufacturer/Supplier is responsible to ensure that test staff is present.

When the documentation has been approved it shall be locked and shall not be changed without the process being backed up to the stage when development of the documentation had still not been completed. It will therefore be necessary to carry out a re-verification and handling in accordance with the Manufacturers/Supplier principles for documentation control.

The following checks shall have been done:

- Verification of system specification

- Verification of software specification (application software)

- Verification of the configuration of the software

- Circuit inspection on rack and cabinet level

- Complete function inspection (Integrated System Verification) done by the Manufacturer/Supplier in accordance with an inspection plan.

- FAT procedure, comprising testing methods and acceptance criteria, produced by the Manufacturer/Supplier, examined and approved by the Purchaser.

- The testing system shall have been calibrated. In addition, the simulation of process shall have been fully verified.

FAT is a part of the delivery inspection according to KBE EP-191.

Method

Parts of the complete test shall be repeated according to the approved FAT procedure and demonstrated to the Purchaser.

The fact that the Purchaser may have taken part in the FAT or other inspections does not relieve the Manufacturer/Supplier from his contractual commitments and responsibilities for the products quality.

As mentioned above, the FAT shall verify the correct implementation of the system requirements. The FAT instruction shall be written on the basis of the function specification.

The verification is done in accordance with the FAT testing procedure, which also includes acceptance criteria.

The product shall be influenced by static and dynamic simulation of input signals corresponding to normal operation, abnormal operation and initiating events.

Selected parts for repeated checks shall:

- Cover all signals and a number of values within the entire measuring range for each signal.

- Cover all majority logic (2/3 or 3/4) and other logic functions.

- Be done for all tripping and protection functions.

- Confirm that requirements regarding accuracy and response times are met.

- Confirm that defects in the product, a single defect or a combination of defects, result in correct action (safe state and alarm).

- Confirm that the system reacts in an expected manner to incorrect input signals.

- Cover any tools that are required to maintain the system.

To achieve the above, the FAT procedure shall at least include the following:

Check of elementary functions

- Check of logic functions

- Check of control functions (dynamic tests)

- Test of calculation algorithms (correctness, accuracy)

- Performance of prescribed periodic tests to verify readiness for operation

- Performance of normal and abnormal operator actions

- Performance of parameter adjustments

- Performance of normal maintenance work (card replacement, battery replacement)

Check of self-supervision

Verify any self-supervision of memory content, database content, program execution, data transfer, etc. Check of the correct functioning of the product.

Performance tests

Performance tests shall be done in two stages.

1. The system loaded as for normal operation in the plant

2. The system loaded with high load corresponding to an occurrence in the plant

The product shall be subjected to maximum loading by simulating the worst case and letting the necessary number of inputs change status at the same time, and in the expected sequence. In the latter case, measured values shall vary stochastically within their measuring ranges. Achievement of the specified performance of the product shall be verified.

As approval, at least the following shall be done and the requirements laid down shall be met.

- Verify response times and expected responses.

- Check that databases and software have not been incorrectly modified.

- Processor load and stack content are measured or calculated.

Defects in the product

Check that the system goes to a safe state and gives expected alarms for different fault cases.

Failures in connecting systems

Check that the product reacts correctly even if input signals are given invalid values or arrive in implausible combinations or sequences.

Analysis of degree of coverage

To assess the completeness of the tests, the proportion of the software executed during the test shall be analysed or logged. The aim is to verify that software is covered by the tests and to detect any unused parts of the software.

Check of communication interfaces

The purpose of the check is to verify that an interruption during the transfer of information is handled correctly and that the information that should have been transferred remains unaffected.

Check of tools

The functioning of programming tools used shall be verified. For example, when checking drawings and lists generated by the system, these shall be produced using the tool and compared with the system specification. When testing parameter changes, these shall be done using the tool, and the result shall be verified.

Check of effect of short power interrupts

The effect of short-term power interrupts shall be verified by testing.

Check done by the Purchaser

The Purchaser shall be given the opportunity to carry out his own tests.

4 Acceptance Criteria

Non-conformities with respect to the current requirements meant for FAT shall be documented in a non-conformity report and presented to the Purchaser. The Purchaser shall perform a judgment for every non-conformity and come to a decision if the test has to abort or continue. It shall be described in the report if the non-conformity shall be corrected before delivery can take place.

When the non-conformity has been corrected, the FAT shall be repeated. If it can be shown that the corrective action is limited and that the modularisation is so strict that the correction can only affect a certain delimited part of the software, it may be sufficient only to check that part. This is decided in consultation with the Purchaser. The reasoning shall be documented.

Check that:

− FAT for the equipment was carried out successfully

− Non-conformities has been documented and taken care of by the Manufacturer/Supplier or has been accepted by the Purchaser

− The result from performed FAT has been documented

5   Documentation

The Manufacturer/Supplier shall create a report of preformed FAT. The report shall as a minimum include the following:

- Inspected item (system, software etc.)

Product, designation or other identification shall be stated, as well the Purchasers order number.

- Examination procedure

Reference to test programs with checklists if any. Used tools and measuring instruments shall be identified.

- Result

It shall be evident that the item has met the requirements laid down.

- Open items and non-conformities

Open items shall be identified and listed. It shall be described, how, when and by whom the open items shall be closed in a non-conformity report

- The Manufacturer/Supplier and the Purchaser Representatives

Date and signatures by the examination team of the performed FAT.

- Approval

The document shall have been examined and approved according to the Manufacture/Supplier internal QA/QC – instructions and by the department responsible for quality. The report shall be signed by the Manufacture/Supplier and by the Purchaser if FAT carried out successfully

Other requirements according to documentation are specified in TBE 100:1 and KBE 100.