16.2.4 Factory Acceptance Test (FAT)

The factory tests shall be conducted on all the equipment to be supplied under the project. FAT[8] shall include, but not be limited to the following, appropriate to the equipment being tested:

a) Verification of all functional characteristics and requirements specified.

b) Inspection and verification of all construction, wiring, labelling, documentation and completeness of the hardware

Arrangements shall be made to carry out the tests for pluggable NIC modules integrated into three different meter makes, including the make(s) of meter being supplied by the AMISP. The slot for plugging the NIC modules in the meter shall conform to this specification. The FAT shall be carried out on the meter and/or DCU integrated with the NIC modules. If any on-line communication failover has been agreed between the Utility and the AMISP, tests shall be carried out to check a seamless failover of communication. The three makes of meters shall be checked with NIC modules for all type of communication technologies selected for the project.

Before the start of factory testing, the QA/QC Manager shall verify that all changes applicable to the equipment have been implemented, type test certificates and Data Exchange Protocol Certificates (as per sampling criteria specified) are available. As a part of the factory tests, unstructured testing shall be performed to enable proper verification of operation of the equipment under conditions not specifically tested in the above structured performance test. All special test facilities used during the structured performance test shall be made available for use during unstructured testing. On the approval of the QA/QC Manager, The Project Manager of the AMISP to inform the schedule of PAT to Utility as soon as finalised, with changes, if any. If the Utility so desires, it may choose to witness the FAT at its own cost.

16.2.4.1 Factory Test Requirements

a) The database displays and the report formats developed for the central system by the AMISP shall be demonstrated and verified at the start of factory testing.

b) All Field Device, AMI functions, communication & networking systems as well as performance shall be tested and demonstrated.

c) The AMISP shall also carry out testing of the standard protocol implementation for successful integration before the FAT starts.

[8] It is expected that the FAT for equipment supplies shall happen in phases of delivery. For this a test cum development system environment shall have to be created for the AMI system, with the HES, MDM and Database application servers installed in the target cloud data centre. This test / development system environment shall be separate from the production environment and shall continue to serve the purpose of development system beyond the FAT phase, for the total duration of the project

d) All hardware and software associated with AMI Systems shall be staged and completely tested with simulated data at the AMISP's facility.

e) For smart meters, the FAT shall be governed by the Routine and Acceptance tests as laid out in IS 13779 and IS 14697.

f) The Tests and Inspection Manager of the AMISP is responsible for conducting all factory tests.

g) Each of the factory tests described below (i.e., Routine & Acceptance Test of Smart Meters, the hardware integration test, the functional performance test, and the integrated system test, unstructured tests) shall be carried out under factory test stage.

16.2.4.2 Sample Routine & Acceptance Tests for Smart Meters

h) These tests for Smart Meters are in addition to the Type Test requirements specified under clause 9.2.1 and the Routine and Acceptance tests that the AMISP will carry out as a part of their FAT procedure.

i) The sample Routine and Acceptance tests as per IS 13779 and IS 14697 shall be performed in a third-party NABL accredited laboratory. The Utility shall have the authority of selecting the samples (in accordance with IS 13779 and IS 14697) for carrying out the Routine and Acceptance Tests. The AMISP shall be obliged to undertake these tests at their own cost. The conformity requirement shall follow IS 13779 and IS 14697 as the case may be.

j) The AMISP shall be responsible for packing, handing over the material to the respective labs and ensuring transportation of the material directly from the manufacturer's location to the Labs for testing and delivering the material to site after successful test results are obtained. The AMISP shall be obliged to undertake all expenditures that shall be incurred towards packing, transport, inspection, testing charges etc.

k) The lot wise testing shall be as per following methodology:

1. Sample Routine & Acceptance Tests shall mandatorily be carried out for the 1st lot through NABL Accredited Lab, before installation commencement. and thereafter the same can be done at discretion of utility on subsequent lots on random basis not exceeding a total of 6 times (i.e. 1 random sample test per 10,000 lot).

11. In addition to the above, the utility reserves the right to carry out accuracy tests, in line with the above guidelines, in their own Meter testing Laboratory for each lot. The sample size for such test would be [5%] of the smart meters of each lot.

l) The material clearance for installation / commissioning of the lots under the inspection shall only be issued post successful test results from the labs are provided to the Utility by the AMISP.

m) Failure oflnspection/Testing

1. In case a meter fails in the test, the whole offered lot would be rejected and complete lot of meters under inspection will be required to be replaced by the AMISP, at its own cost.

11. If in subsequent inspection of the new lot, the meter again fails the inspection, then the meter shall be rejected, and vendor/sub-vendor shall also be blacklisted.

16.2.4.3 Hardware Integration Test

The hardware integration test shall confirm that the computer hardware conforms to this Specification and the AMISP-supplied hardware documentation. The hardware integration test shall be performed when the computer hardware has been installed in the AMISP's factory. The operation of each item shall be verified as an integral part of the system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. Equipment expansion capability shall also be verified during the hardware integration test.

16.2.4.4 Functional Performance Test

The functional performance test shall completely verify all features of the AMI Systems hardware and software. This shall mean the suit of application software shall be made to run on the actual CSP infrastructure integrated with the field level hardware components, using selected communication paths. As a minimum, the following items shall be included in the functional performance test:

n) Inspection of all equipment for conformance to drawings/document and satisfactory construction and appearance

o) Testing of the proper functioning of all software, including test cases with normal and exception user-entered inputs and responses

p) Simulation of local error and failure conditions

q) Verification that ultimate expansion requirements are met

r) Verification of data link interfaces with other Central systems

s) Verification of Field Device communication interfaces (with failover if any) and data link interfaces with other central systems. This shall include the tests of three makes of meters with different types of NIC modules.

t) Simulation of Field Device and data link communication errors and channel failures, including incorrect check codes and random channel noise bursts

u) Testing of all user interface functions, including random tests to verify correct database linkages

v) Simulation of hardware failures and input power failures to verify the reaction of the system to server and device failure

w) Demonstration of all features of the database, display, and report generators and all other software maintenance features. These shall include but not be limited to functional features like pre-payment calculations, billing determinants, tariff settings, energy audit, generation of NMS reports, data base maintenance functions etc.

x) Demonstration of the software utilities, libraries, and development tools

l) Verification that the computer system meets or exceeds performance requirements

m) Verification of the accuracy of hardware and software documentation via random tests

n) Sample check of meter calibration accuracy and testing of spare parts.

16.2.4.5 Integrated System Test

The integrated system test shall verify the stability of the system hardware and software after the functional performance test has been successfully completed. During the integrated system test, all functions shall run concurrently and all AMISP-supplied equipment shall operate for a continuous 100-hour period. This minimum level of activity may be augmented, by other activities that represent normal day-to-day operation of the system as long as these activities are conducted in accordance with the documentation provided with the system. These other activities may include, but shall not be limited to, database, display, and report modifications, software development activities, configuration changes (including user-commanded server and device failovers), and the execution of any function described in this Specification.

The integrated system test shall ensure that the computer system is free of improper interactions between software and hardware while the system is operating as an integrated unit. In case during the 100-hour period testing, un-commanded functional restart or server or device fail occurs the test shall be extended by 24 hours each time such a failure over occurs. Further the test shall not be conducted with the failed device.

16.2.4.6 Unstructured Testing

Periods of unstructured testing shall be allocated to allow AMISP to verify proper operation of the systems under conditions not specifically included in the test procedures. Unstructured testing shall be conducted in compliance with the following conditions:

y) A minimum of 25 percent of the actual test period shall be reserved for unstructured test of the system

z) The AMISP's Tests & Inspection Manager along with the QA/QC representative shall be present during unstructured test periods

aa) All simulation software, test cases, and other test facilities used during the structured portions of the factory tests shall be available for use during unstructured testing

bb) Unstructured testing shall not begin pnor to the start of the functional performance test

cc) Unstructured testing shall be allowed at the discretion of QA/QC Manager both at the end of a structured test segment and after completion of the functional performance test.

16.2.4.7 Dispatch of Material to Site

The Material Inspection Clearance Certificate (MICC) for all hardware shall be issued by Utility only after successful completion of FAT as per specification. For this the QA/QC Manager of the AMISP is obliged to submit a comprehensive FAT clearance report to the Utility. At least IO Field Devices for each protocol shall relate to each central system and the remaining Field devices shall be simulated in the factory test environment. The data exchange between central systems shall also be simulated in the factory test environment.

All Equipment Suppliers/OEMs to the project shall make use of categorized **Interim** Inspection Reports (CIP Clearance) from Utility to ship materials to site after completion of FAT. CIP shall be issued by the Utility subject to specific FAT report carried out under the responsibility of the QA/QC Manager. Categorized Interim Inspection Report with the lowest category would mean a complete failure of FAT and hence rejection of material. A category between the lowest and the highest, shall mean pending actionable points of minor nature, but material deemed fit for dispatch to site. The category of CIP shall be authorized by the QA/QC Manager and issued by the Utility. In case where CIP is authorized by the QA/QC Manager with the highest category (with no pending actionable points in FAT), the Utility shall issue a Material Inspection Clearance Certificate (MICC)