Table of Contents

1.0 TESTING, ADJUSTING, BALANCING AND COMMISSIONING REQUIREMENTS 3
1.1 GENERAL 3
1.2 INSPECTION AND TESTING PLAN (ITP) 4
1.2.1 Final Acceptance Test 6
1.2.1.1 Pump Factory Performance Test 6
1.2.1.2 Switchboard Inspection and Test 6
1.2.2 Delivery Stage 7
1.2.3 Installation Stage 8
1.2.3.1 Visual Inspection 8
1.2.3.2 Testing 9
1.2.4 Functional Performance Test 10
1.2.4.1 Switchboard and Power Supply 11
1.3 COMMISSIONING 12
1.3.1 Handing Over Documents 12
1.3.2 System Familiarization Program 12
2.0 TESTING INSTRUMENTS AND ACCESSORIES 13

List of Table

Table 1 : Sample of Inspection and Testing Plan 5
Table 2: Verify and Inspection 7
Table 3: Visual Inspection of Wet Riser System 8
Table 4: Test List in Installation Stage 9
Table 5: Wet Riser Inspection and Test List 10
Table 6: Switchboard and Power Supply Inspection and Test Requirements 11
Table 7: Testing instruments..... 13

1.0 TESTING, ADJUSTING, BALANCING AND COMMISSIONING REQUIREMENTS

1.1 GENERAL

This section specifies the requirements for all testing, adjusting, balancing and commissioning (TABC) of mechanical works to be carried out under the contract. The objectives of TABC are;

i. To verify the delivered materials are as per approved specification and good physical condition.

ii. To verify the installation works are carried out in accordance to specification and good engineering practises.

iii. To verify the performance in terms of functionality, safety, maintainability and operational ability of the installed equipment/systems meet the specified design intention through a series of tests and adjustments.

iv. To ensure all test results are systematically recorded and verified prior to system commissioning.

TABC works are divided into four stages as the following;

i. Final Acceptance Test

ii. Delivery stage.

iii. Installation stage.

iv. Functional Performance Test stage.

Contractor shall submit Inspection and Testing Plan (ITP) of TABC works to be carried out in accordance to with this specification to Superintending Officer (S.O) for review and approval.

1.2 INSPECTION AND TESTING PLAN (ITP)

ITP shall consist of;

i. List of All TABC Requirement

All TABC works with specific scope and boundaries shall be clearly stated at every stage of TABC works and comply with the regulation of Jabatan Bomba dan Penyelamat Malaysia and document contract. Sample of Inspection and Testing Plan as per Table1.

ii. TABC Work Schedules

TABC work schedules shall be integrated into main project schedules.

iii. Method Statements

TABC method statements shall consists of TABC procedures, responsibility, necessary tools, measuring equipment and accuracy, consumables and acceptance criteria. Type of test required is listed in Schedule of Inspection and Testing.

Method statements and acceptance criteria for all equipment installation stage inspection and functional performance testing shall be endorsed by manufacturer or manufacturer's valid representative.

Acceptance criteria shall be stated as per Schedule of Design Requirements, technical specification or any applicable standards.

ITP shall be updated for any changes and resubmitted to S.O/S.O's representative for approval.

Prior to the commencement of the TABC works as per approved ITP, contractor shall issue Request for Inspection and Testing (RFIT) to the S.O. During the TABC, contractor shall have his supervising foreman and mechanics available to aid in testing and to perform any adjustments as directed. The TABC works shall be carried out under the direction of experienced personnel and witnessed by S.O or S.O's representatives. No subsequent installation works shall proceed without S.O approval of the test result.

Depending on the specific demands of individual installation, S.O's Representative may require additional or substitute testing works in regard to any elements in the installation other than those indicated in this specification.

Table 1 : Sample of Inspection and Testing Plan

Stage	Inspection and Test Name	Scope and Boundaries	Responsibility	Method Statement	Test Form No	Expected Date
Final Acceptance Test	Pump Performance Test	Wet Riser Pump	Manufacturer	MS-ITP-01	TF-01	17-Jan
	Switchboard Test	Switchboard	Manufacturer	MS-ITP-02	TF-02	17-Feb
Delivery Stage	Visual Inspection	Wet Riser Duty, Standby & Jockey Pump	Contractor	MS-ITP-03	TF-03	17-Mar
	Measurement		Contractor	MS-ITP-04	TF-04	17-Mar
	Documentation (DO, QA etc.)		Contractor	MS-ITP-05	TF-05	17-Mar
Installation Stage	Flushing Test	Wet Rise Pipe	Contractor	MS-ITP-06	TF-06	17-May
	Leak Test	Pipe and fittings	Contractor	MS-ITP-07	TF-07	17-Jun
	Cable continuity and insulation Test	Power cable from incoming supply to control panel and from control panel to motor	Contractor	MS-ITP-08	TF-08	17-July
	Water Tank Inspection	Leveling (pump & tank), painting, leaking, ladder, electrode sensor, incoming pipe, outgoing pipe, scour pipe, balancing pipe, valves & Fittings	Contractor	MS-ITP-09	TF-09	17-Aug.
	Orientation of Equipment Inspection	Wet Riser Duty, Standby/diesel engine & Jockey Pump	Contractor	MS-ITP-10	TF-10	17-Aug
Functional Performance Stage	Pump start-up Test	Pumps, control panel, all switches and sensors, valves & fittings	Contractor	MS-ITP11	TF-11	18- Sept
	Wet Riser pump Functional Performance Test			MS-ITP-12	TF-12	18-Sept

1.2.1 Final Acceptance Test

Final Acceptance Test shall be conducted as per Schedule of Inspection & Testing Requirements and Schedule of Price of this tender document. The equipment shall be witness-tested at Original Equipment Manufacturer (OEM) premises before being delivered to site by not more than three (3) government's representative nominated by the Pengarah Kanan Cawangan Kejuruteraan Mekanikal, Ibu Pejabat JKR Malaysia, Kuala Lumpur.

The Contractor shall include in the tender all costs that will be incurred for the Final Acceptance Test at Original Equipment Manufacturer (OEM) premises including food, travelling (air fare, inland transport, airport taxes, etc) and hotel accommodation not lower than the current Malaysian Government rates for a period of not more than seven (7) working days not inclusive travelling days.

A factory test is understood to mean testing at a dedicated test facility, often at manufacturer's plant or at an independent and accredited test facility and to be agreed by the S.O.

Performance test method statement, test standard and acceptance criteria shall be submitted to S.O for approval prior to such testing. The manufacturer shall conduct the test, passes judgement of acceptance and produces a signed test report. All test report shall be submitted to S.O for approval. Manufacturer shall be responsible for any reworks and adjustment of the equipment if the test results fail to adhere to the agreed acceptance criteria.

1.2.1.1 Pump Factory Performance Test

Performance rating tests for the wet riser pumps shall be performed by the manufacturer to verify equipment performance against design specifications and compliance with the specification.

Performance rating test of duty and standby pumps shall comply of Malaysia standard heavy duty end suction pump MS2616:2015 Fixed Fire Fighting System, Fire pumps as per schedule of design requirement.

1.2.1.2 Switchboard Inspection and Test

Routine tests on the control panel (category 1: $I \leq 600A$ by Suruhanjaya Tenaga) shall be carried out before delivery to site. Routine tests shall include inspection and checking of wiring, electrical continuity of the protective circuits, connections and effectiveness of mechanical actuating elements and interlock. Test Results or Certificate duly certified by

Competent Person as in Electricity Regulations 1994 shall be issued for every switchboard supplied and installed.

1.2.2 Delivery Stage

All incoming material and equipment to site shall be verify by visual inspection, documentation and measurement that delivered items are comply with technical specification, as per approved materials and good physical conditions. Materials delivered to site shall be free from defects and adequately protected against site conditions.

List of verify and inspection during delivery stage as per Table 2: -

Table 2: Verify and Inspection

Verify and Inspection	Description
Visual Inspection	• Good physical conditions • Free from defects • Adequately protected
Documentation	• Delivery Order • Quality Assurance • Technical Data
Measurement	• Size and dimension • Orientation of equipment and Plant Layout

1.2.3 Installation Stage

1.2.3.1 Visual Inspection

List of visual inspection and testing during installation as per Table 3;

Table 3: Visual Inspection of Wet Riser System

Inspection / Test Name	System/Component	Objectives
Visual inspection	Pumps House/Room	Verify that all wet riser pumps house/room components are installed as per approved shop drawings approved material list installation method statement and free from installation effects.
	Pump set	Verify the alignment of shaft, mounting, Inertia block & spring isolator
	Water Tank	Verify inlet pipe, capacity and tank compartment
	Piping	Verify types of pipe, protection and colour coding. Verify the length of pipework between alarm valve and water alarm gong
	Incoming Pipe	Verify inhibitors
	Flow Meter	Verify for pump dry running protection
	Flow Switch	Verify the numbers and functionality
	Wet Riser Hose compartment / Riser	Verify working space to swing the cradle, physical condition of hose cradle and landing valve
	Hanger and Supports	Verify hanger and supports as per drawing and technical specification
	Pipe Sleeves	Verify all the pipe sleeves with the right size.
	Fire Seal	Verify seal thru any floor, wall or partitions using non-combustible or fire resistant sealant material
	Breeching Inlet	Verify the types of breeching inlet

1.2.3.2 Testing

List of inspection and testing works during installation as per Table 4;

Table 4: Test List in Installation Stage

Inspection / Test Name	System/Component	Objectives
Hydrostatic Pressure Test	Pumps and Piping	Verify integrity of all pipe joints and fittings.
Pipe Flushing and Leak Test	Pumps and Piping	Verify integrity of all pipe joints and fittings, pipe internally clean and water quality are acceptable
Cable Continuity Test	Electrical Cabling	Verify cable continuity effectiveness

a. Hydrostatic Pressure Test

All pipes, valves, fittings, etc. shall be tested to operation of 14 bar or 1.5 times the working pressure whichever is higher for period of 48 hours. All tests shall be done in accordance to ASME B31.9.

During the pressure test, all welding joints, bends, fitting and valves shall be visual checked for any leaks or deformations for the entire piping system.

Pressure drop allowable not more than 5% from the tested value for the period of testing.

b. Pipe Flushing and Leak Test

All pipes shall be flushed before pressure test. Flushing will be done by a fresh potable water or dry compressed air wherever water flushing is not desirable to clean the pipe of all dirt, debris or loose foreign materials. No leakage of any kind will be permissible during testing. Flushing will be continued till the inside of the pipe is fully cleaned to the satisfaction of the S.O. Test reports shall be submitted to S.O after completion of flushing procedures. As a minimum, the test records shall contain detail of testing and the results.

c. Cable Continuity Test

Cable continuity test shall be performed on each power cable by ohmmeter method. Perform an acceptance test on cables, including terminations and joints, after cable system installation and before the cable system is placed into service. In accordance with

ANSI/IEEE 400, by means of direct voltage (dc) and recorded in the relevant testing form.

1.2.4 Functional Performance Test

All Functional Performance Test shall commence after all inspection and testing during installation stage has been completed. List of functional performance test as per Table 5:-

Table 5: Wet Riser Inspection and Test List

Inspection / Test Name	Objectives
Pump Operating Test	Verify the pump performance as per published performance data included pressure, flow rate, RPM, current and voltage.
Vibration and Noise Level Test	Verify the noise level is within permissible range
Testing of electrical wiring	Verify the continuity of power supply
Essential power supply for electric pump Inspection	Verify the continuity of power supply in the event of power failure.
Battery for diesel pump	Verify battery capacity as per design
Fuel storage for diesel pump	Verify the storage capacity as per design
Automatic operation of wet riser pumps (Duty and standby electric/diesel, jockey pump)	Verify the operation of the system as per design
The furthest and highest wet riser head performance test	Verify the operating pressure of pump as per design
Automatic Air Release Valve (AARV) test	Verify no air pocket in the pipe line
Pump start test	Verify the functionality and pump cut in/cut off using flow switch setting.

Detail method statement for testing shall be submitted conforming to the test requirements in this specification. All components shall be installed as per approved working/shop drawings, approved material list and free from defects.

1.2.4.1 Switchboard and Power Supply

List of Switchboard and power supply inspection and test name are listed in Table 6. Detail method statement for testing shall be submitted conforming to the test requirements in this specification. Only competent person as in Electricity regulations 1994 shall conduct the switchboard testing.

Table 6: Switchboard and Power Supply Inspection and Test Requirements

Inspection and Test name	Description
Switchboard General Inspection	• Verify physical switchboard components are as per specification. • Check for tripping setting and system trip • Check for wiring, motor insulation and record data. • Check for cable terminal tightness. • Check for equipment and panel grounding connection. • Check for any sign for cable heating. Cable temperature shall be measured and verify against IEEE standards for temperature rise during full load. • Check for voltmeter and ammeter function and accuracy record running voltage and ampere. • Check for control circuit function as intended. • Check for contractors, relays, ACB, MCCB, MCB, type, size and ratings as per specification.
Power Supply Test	• Verify that power supply parameters are within permissible range, safety protections are in place and physical condition of switch board and cabling works are acceptable as per specification and approved shop drawings. • Verify rotation of equipment/phase sequencing according to manufacturer recommendation • Verify phase protection relay installation and function. • Switching from normal electrical to essential supply
Overcurrent and Earth Fault Protection	• Circuit breaker and Earth Fault Protection calibration and discrimination shall be conducted and coordinated between electrical contactors. • Circuit breaker and Earth Fault Protection shall be tested against simulated leakage current. • Inverse definite minimum time (IDMT) tripping delay shall be selected/programmed suitable for equipment starting overloading preventing nuisance tripping during starting.

1.3 COMMISSIONING

Commissioning includes achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.

All completed test forms and test summary shall be submitted to S.O/S.O's representative for final review and approval. Having satisfied that all appropriate tests have been conducted and the performance of the installation meet the design objectives; S.O representative will issue or recommends to the S.O for the issuance of Certificate of Practical Completion (CPC).

1.3.1 Handing Over Documents

After issuance of Certificate of Practical Completion, contractor shall submit all related project handing over documents as the following;

a) Test Report complete with fully verified Inspection checklist and Test Forms.
b) Defects List
c) Operation and Maintenance Manual which includes
    - *Manual/Standard Operating Procedures*
    - *Preventive Maintenance Schedule and Manual*
    - *Equipment/Product Engineering Data.*
    - *Operation set point (cut in/ cut off pressure, flow rate etc.)*
    - *Switchboard overload setting and set points*
    - *Contractor and manufacturer contact details*
    - *Circuit Diagrams*
    - *Inventory List*
d) As-Built drawings
e) Schedule of System Familiarization Program to end users.

1.3.2 System Familiarization Program

In-class and practical System Familiarization Program shall be conducted to the personnel nominated by S.O within one (1) month of issuance of Certificate of Practical Completion. Program shall focus on:

- Overview of design concept and objectives
- Operation instruction & competency requirement
- Maintenance procedures
- Critical operating parameters monitoring

Emergency response & safety procedures and

- Jabatan Bomba dan Penyelamat Malaysia requirement and procedures.

Contractor shall submit program modules and materials to S.O for approval prior to commencement of training. Particulars of trainee shall be recorded and send to S.O for records.

2.0 TESTING INSTRUMENTS AND ACCESSORIES

All permanent sensors and gauges use for measurement of pressure and flow shall be factory calibrated and all calibration certificates shall be submitted to S.O prior to testing works.
The contractor shall provide all necessary testing, calibrating instruments and labour required for the testing, adjusting, balancing and commissioning of the complete fire fighting system installed under the contract.

The contractor shall also allow for any necessary replacement of parts in order to achieve the conditions specified in the drawings and specification.

Testing instruments specification shall be as but not limited to Table 7:-

Table 7: Testing instruments

Measurement	Type	Accuracy
Ampere	Clamp meter (instantaneous) Power/Energy logger (continuous)	*2.0% ± 5 digits (45-65Hz)*
Voltage	Clamp meter (instantaneous) Power/Energy logger (continuous)	*1.5% ± 5 digits*
Combined power, ampere, voltage, power factor and Energy	Power/Energy logger (continuous)	*Active Power: ±(1.2% of reading + 0.005% of range) (For PF≥0.99); ±(1.2% of reading + 7 x (1-PF) + 0.005% of range) (from 0.6 PF to 0.98PF)*
RPM Motor tester	Tachometer	0.05% ± 1 digits