**Acceptance Testing Procedures for Real Time Data Acquisition Systems (RTDAS)**

**Technical Assistance and Management Consultancy (TAMC)**

**Document Control**

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**Acronyms and Abbreviations**

ARG Automatic Rain Gauge

AWLR Automatic Water Level Recorder

BBMB Bhakra Beas Management Board

CGWB Central Ground Water Board

CHP Customer Hold Point

CMC Consultancy Monitoring Committee

COC Certificate for Conformity

CPCB Central Pollution Control Board

CPMU Central Project Management Unit

CWC Central Water Commission

CWPRS Central Water and Power Research Station

DCP Data Collection Platform

DRS Data Retrieval System

DVC Damodar Valley Corporation

DWLR Digital Water Level Recorder

ERS Earth Receiving Stations

eSWIS Online Surface Water Information System

FEWS Flood Early Warning System

GOI Government of India

GPRS General Packet Radio Service

GSM Global System for Mobile Communications

GW Groundwater

IA Implementing Agencies

ID Inner Diameter

IMD India Meteorological Department

IP Ingress protection

ISO Indian Standard Organization

ISRO Indian Space Research Organization

M&E Monitoring and Evaluation

MIS Management information Systems

MoWR, RD & GR Ministry of Water Resources, River Development & Ganga Rejuvenation

MWL Maximum Water Level

NABL National Accreditation Board for Testing & Calibration Laboratories

NESAC North-East Space Application Centre

NIH National Institute of Hydrology

NHP National Hydrology Project

NLSC National Level Steering Committee

NPMU National Project Management Unit

NRSC National Remote Sensing Centre

NWIC National Water Informatics Centre

OD Outer Diameter

OEM Original Equipment Manufacturer

Pa Pascal (unit of pressure)

PIP Project Implementation Plan

RTDAS Real Time Data Acquisition System

SCADA Supervisory Control and Data Acquisition

SoI Survey of India

SPMU State Project Management Unit

TBRG Tipping Bucket Rain Gauge

UT Union Territory

WB World Bank

WRD Water Resources Department

WRIS Water Resources Information Systems

# General Considerations

## Introduction

This document describes the procedures to be followed for acceptance testing for Real Time Data Acquisition Systems (RTDAS) installed under the National Hydrology Project.

The inspection of the RTDAS shall be carried out to check whether the RTDAS systems are in conformity with the approved Technical Specifications and shall be in line with the inspection and test procedures laid down in the Technical Specifications and the General Conditions of the contracts. The following test procedure shall be applied for the inspection and testing of equipment.

After manufacturing and integration of all RTDAS equipment, the vendor shall test and inspect all equipment and prepare the summary test report in conformity with the contract specifications. The Vendor has to send this test report to the Purchaser along with his letter seeking for the inspection of RTDAS equipment. Upon receipt of the factory test reports, the Purchaser or its representative shall arrange for a pre-dispatch inspection test of any or part or all the equipment prior to issuing the dispatch clearance.

In cases where the supplies are received from abroad, the purchaser may waive the pre-dispatch inspection. However, the inspection and dispatch clearance by the Purchaser or the waiver thereof shall not prejudice the right of the Purchaser or its consignee to test the equipment/goods upon receipt at destination.

If the equipment fails to meet the contract specifications during inspection, whether at pre-dispatch stage or upon receipt at final destination, the supplier shall take immediate steps to remedy the deficiency or replace the defective equipment to ensure that all supplies meet with the specifications specified in the contract.

For pre-dispatch inspection testing the following tests will be conducted on a 10% sample of RTDAS systems from a lot of every 50 systems. Depending upon the quality and the results, the sample percentage may be reduced or increased by 5% with mutual understanding.

## Test instruments required

The following instruments are required for testing the RTDAS equipment:

|  |  |  |
| --- | --- | --- |
| **SN** | **Instruments Name** | **Range and Resolution** |
| 1 | Power Supply Unit | 0 to 18 V (adjustable) with 10 Amp. |
| 2 | Digital Multimeter | Minimum 4½ Digital Multimeter with feature for voltage and current measurement |
| 3 | Measurement Tape | 1. 5 mts with resolution of 1mm 2. Minimum up to 20 mts with resolution of 5 mm |
| 4 | Water Measurement Flask | 200 ml with resolution of 1 mm |
| 5 | Test Jig | As per the standard test procedure |

## Reports prior to Pre-dispatch Acceptance Testing

The following are the documents that are required to be made available by the vendor during pre-dispatch acceptance testing and the checks to be performed.

1. **List of Equipment**

The list of hydro-met equipment shall include the manufacturer’s details, make and model numbers of all equipment (i.e. data logger, transmitters, sensors, battery, solar panel, power supply units) to be supplied under the project as per Form-1 - List of Hydro-Met Equipment. The make, model numbers and photographs of all equipment are to be checked with the proposed / quoted equipment in the vendor’s proposal. Any deviation observed is to be noted in the remark column of List of Hydro-Met Equipment (Form-1).

1. **Factory Test and Calibration Certificates**

The Manufacturer’s Factory Test and Calibration Certificates are required for all hydro-met equipment (i.e. data logger, transmitters and hydro-met sensors). This Factory Test and Calibration Certificates should mention the accuracy, measurement range, operating temperature and humidity range to the hydro-met equipment.

1. **Environmental Tests** (for two RTDAS Systems)

* Temperature Test over entire specified temperature range of -5ºC to +60ºC
* Humidity Test at +40ºC, 95% RH for 4 hours

The environmental tests should be carried out on a sample of **two (2)** RTDAS integrated systems (i.e. the complete system integrated with data logger, transmitter and sensors). During this test the battery and the rain gauge sensor may be kept outside the environmental chamber.

1. **Integration and Burn-in Test**

The Burn-in Test will be carried out on all the RTDAS systems for 72 Hours in the natural temperature conditions.

The Burn-in Test should be carried on the integrated system (i.e. the complete system integrated with the data logger, transmitter and sensors). To start the test, switch ON the power supply. The data logger of the RTDAS system will read data as the data input from sensor simulator. The same data shall log into the data logger memory. The RTDAS will transmit the logged data and the same data parameters will be measured and recorded in the test report.

The Vendor also is required to provide the details of the procedure followed during the manufacturing /integration of RTDAS systems, like inward inspection of all the raw materials including the sensors, data logger, modems and all other components. The vendor also should provide the inspection report of internal quality inspection at various assembly stages, testing stage and integration stages to get the quality product.

For the Pre-dispatch Acceptance Test the following tests will be conducted on a 10% sample of RTDAS systems from a lot of every 50 systems. Depending upon the quality and results the sample percentage can be to 5% with mutual understanding.

**List of pre-dispatch acceptance tests for RTDAS systems:**

1. **Integrated functional test for Data Collection Platform (DCP)**
2. Power consumption and Power Supply Test
3. Data logger Functional Test
4. INSAT and GSM & GPRS Functional Test
5. **Transmission link testing**
6. **Integrated functional test for hydro-met sensors**
7. Tipping Bucket Rain Gauge (TBRG) sensor
8. Radar Water Level Sensor
9. Air Temperature and Relative Humidity Sensor
10. Wind Speed and Wind Direction Sensor
11. Atmospheric Pressure Sensor
12. Solar Radiation Sensor
13. **Sensors:** Manufacturer’s calibration test results of the sensors for the cross reference.
14. **Data Logger:** Manufacturer’s functional and interfaces Test report for the cross reference.

# Pre-dispatch Acceptance Test for Data Collection Platforms (DCP)

## Integrated functional test for Data Collection Platforms

A Data Collection Platform (DCP) is an integrated system which consists of a data logger with INSAT, GSM or GPRS telemetry modem, Battery, Charge Controller, etc. installed in the weather-proof enclosure. A DCP should have plug-in connectors for connecting Solar panel, Antennas and Sensors. The Data Collection Platform (DCP) is the heart of a RTDAS system and needs to be tested thoroughly. Hence the vendor should conduct all possible tests to ensure the best quality and consistent working of the DCP. During the testing benchmark-level checks will be conducted as per the Test Data Record (Form-2A)

**Integrated Test Procedure**

1. Make the connections of the charge Controller unit with the data logger and INSAT, GSM or GPRS transmitter.
2. Set the voltage to 12V on power supply and connect to the power supply / charge controller module.
3. With the help of a digital multi-meter, measure the voltages at the data logger ports and note this reading in the Test Data Record (Form-2A).
4. In addition, measure the voltage to the transmitter when the transmission ‘ON’ mode is activated from the data logger and note this reading in the Test Data Record (Form-2A).
5. Connect the current meter in series with the power supply and measure the Data logger and complete RTDAS Quiescent mode current. Also measure the current in continuous transmission mode and note this reading in the Test Data Record (Form-2A).
6. Connect the current meter in series with the data logger power supply and measure the current drawn by the data logger when the Display is ON and in quiescent mode. Note this reading in the Test Data Record (Form-2A).
7. Repeat steps 3 to 6 for the power supply voltage to 10.5V and 14.5 V.
8. Connect the power supply in reverse polarity and check whether the RTDAS system takes current. If it is a shunting diode it will take more current. If it is a series diode it will not take any current. Note down the observation in the Test Data Record (Form-2A).
9. Connect the power supply in the correct polarity to the solar panel port and verify whether the supply voltage is in the range from 9.5 to 15 Volts and note the low voltage cut-off and maximum charging voltage. Note down the reading in the Test Data Record (Form-2A).
10. Note down the power supply module serial number and its physical condition.

**Data logger functional test**

1. Observe and check the data logger test report certified by the manufacturer as per his standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the data logger physically and verify the various input ports like SDI-12 for sensor, Serial Port for sensor, Pulse Input Port, Port for PC Configuration, Port Telemetry, External Display Port, etc. provided to the data logger as mentioned in the contract document. Note down the observations in the Test Data Record (Form-2A).
3. Check the size of the Internal Memory for Data storage. For this the vendor shall give a demonstration as per his standard test procedures or provide documentary proof (like technical data sheet of the particular module/component used in the data logger) Note down the observations in the Test Data Record (Form-2A).
4. Check the GPS synchronisation and time format of the data logger and note down the observation in the Test Data Record (Form-2A).
5. Check the provision for setting configuration parameters like Station ID code, Measurement Interval, Gain, Offset & Datum (for Individual sensor), Tx. time for INSAT and GSM/ GPRS, FTP server configuration, mobile number of data center, etc. using the data logger keypad, Laptop & GSM/GPRS telemetry. If the required feature is provided, then note ‘Yes’ in the Test Data Record (Form-2A).
6. Check the sensor reading in live data and logged data and note down the observation in the Test Data Record (Form-2A).

## GSM & GPRS modem functional test

1. Observe and check the whether the GSM & GPRS modem is provided as an internal or external module. The vendor needs to provide the Factory Test and Calibration Certificates as per the required accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check all the parameters mentioned in the Test Data Record (Form-2A) and note down the observation.

## INSAT Transmitter functional test

1. Observe and check whether the INSAT transmitter is provided as an internal / external module. The vendor needs to provide the Factory Test and Calibration Certificates as per the required accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the provision for setting Carrier Frequency, Carrier Settability, Output Power parameters from the data logger and note down the observation in the Test Data Record (Form-2A).
3. Check all the parameters mentioned in the Test Data Record (Form-2A) and note down the observation.

## Antenna functional test

1. The Vendor needs to provide the Factory Test and Calibration Certificates as per the required accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check all the parameters mentioned in the Test Data Record (Form-2A) and note down the observation.

# Transmission Link Testing

1. Connect all the sensors to the Data Collection Platform (DCP) and transmit the data through the INSAT telemetry to the ERS in New Delhi /Jaipur /Bural and also through GSM / GPRS telemetry and note down the observations in the form for Transmission Link Testing (Form-2B).

# Pre-dispatch Acceptance Test for Hydro-Met Sensors

## Tipping Bucket Rain Gauge Sensor

1. Observe and check the test report certified by the manufacturer for Tipping Bucket Rain Gauge (TBRG) Sensors as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the material of the rain gauge body, rim of rain gauge and tipping bucket and note down the observation in the Sensor Test Data Record (Form-3A). The material should be a corrosion resistant metal (Stainless steel/ Aluminium).
3. Check the TBRG as per the general steps given below.
   * Pour some water through the inner funnel to wet the two bucket surfaces.
   * Using a graduated cylinder, take 314 ml (for a 200 mm diameter rain gauge) or 200 ml (for a 200 mm2 cross section) water and put it into a plastic bottle.
   * With the help of needle make a small hole at the bottom of the plastic bottle.
   * Put this plastic bottle on the TBRG in such a way that the water will slowly drain into the funnel over a period of 10 to 15 minutes. This volume of water is equal to 10 mm of rainfall.
   * After the water has passed through the rain gage, the tipping bucket should have tipped 20 times.
4. Check the rain gauge with a different quantity of water (as per the procedure given in step-2) data and note down the observation in the Sensor Test Data Record (Form-3A).
5. Check the provision for the spout filter and bird cage to prevent ingress of insects and debris and note down the observation in the Sensor Test Data Record (Form-3A).
6. Check the Type approval certificate from IMD / NIST.

## Radar/Ultrasonic Water Level Sensor

1. Observe and check the test report certified by the manufacturer for Radar/Ultrasonic Water Level Sensors as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the sensor parameters like Sensor Type, Measurement Range, Resolution and Beam Angle as per the manufacturer’s Factory Test and Calibration Certificate and data sheet. Note down the observation in the Sensor Test Data Record (Form-3B).
3. Check the sensor housing material and also the output interface used for the data logger interface and note down the observation in the Sensor Test Data Record (Form-3B).
4. Check the Radar/Ultrasonic Water Level Sensor as per the general steps given below.
   1. Take two water level sensors and integrate them with two different data loggers.
   2. Fix both water level sensors on one steel angle and install them at the highest level (around 10 mts above ground level) using proper mounting hardware. The sensors should be mounted in such a way that they have a direct vertical shot to the surface with no obstruction of their beams. The beam spread must be determined based on the manufacturer’s specification and the maximum expected distance to be measured at low flows.
   3. Configure the two data loggers and set the zero water level with MSL level (any test MSL value). Also measure the distance between the sensor and the ground level with a measuring tape and note down the observation in the Sensor Test Data Record (Form-3B).
   4. Interchange the water level sensors and data loggers with each other and repeat the reading (without making any change in the data logger settings). The reading in the both conditions should be same.
   5. Fix both water level sensors at the lower highest level (around 7 mts and 3 mts above ground level) using the same mounting hardware. Repeat steps (c) and (d) and note down the observation in the Sensor Test Data Record (Form-3B).

## Air Temperature and Relative Humidity Sensor

1. Observe and check the test report certified by the manufacturer for Air Temperature and Relative Humidity Sensors as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the sensor parameters like Sensor Type, Measurement Range, Resolution as per the manufacturer’s Factory Test and Calibration Certificate and data sheet. Note down the observation in the Sensor Test Data Record (Form-3C).
3. Check the Air Temperature and Relative Humidity Sensor as per the general steps given below.
4. Attach the Air Temperature and Relative Humidity Sensor and the calibrated reference sensors on a fixture at a distance of less than 5 cm apart from each other. If the calibrated reference sensor is not available, then another sensor of the same make and model from the same lot can be used as a reference sensor.
5. Configure the Air Temperature and Relative Humidity sensor with the data logger and note down the Temperature reading in the Sensor Test Data Record (Form-3C). At the same time measure the sensor output voltage using a digital multi-meter and note down the observation in the Sensor Test Data Record (Form-3C).
6. Repeat Step (b) for different temperature conditions like room temperature, low temperature (may be in front of an AC) and high temperature (may be in in front of hot air blower). Note down the observation in the Sensor Test Data Record (Form-3C).
7. Repeat Step (b) for different humidity conditions and note down the observation in the Sensor Test Data Record (Form-3C).

## Wind Speed and Wind Direction Sensor

1. Observe and check the test report certified by the manufacturer for Wind Speed and Wind Direction Sensors as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check whether the sensor parameters like Sensor Type, Measurement Range, Resolution are as per the manufacturer’s Factory Test and Calibration Certificate and data sheet. Note down the observation in the Sensor Test Data Record (Form-3D).
3. Check the Wind Speed and Wind Direction Sensor as per the general steps given below.
4. Attach the Wind Speed and Wind Direction Sensor and calibrated reference sensors on fixture at a distance of less than 10 cm apart from each other. If a calibrated reference sensor is not available, then another sensor of the same make and model from the same lot can be used as a reference sensor.
5. Configure the Wind Speed and Wind Direction Sensor with the data logger. Blow air using a table fan and note down the reading of both wind speed sensors in the Sensor Test Data Record (Form-3D).
6. Wind direction testing: Attach the Wind Speed and Wind Direction Sensor with the sensor notch aligned in Northern direction and blow air from the Northern direction. Note down the observation in the Sensor Test Data Record (Form-3D). Blow air from other directions (East, West and South) and note down the observation in the Sensor Test Data Record (Form-3D).

## Atmospheric Pressure Sensor

1. Observe and check the test report certified by the manufacturer for the Atmospheric Pressure Sensor as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the sensor parameters like Sensor Type, Measurement Range and Resolution, as per the manufacturer’s Factory Test and Calibration Certificate and data sheet. Note down the observation in the Sensor Test Data Record (Form-3E).
3. Check the Atmospheric Pressure Sensor as per the general steps given below.
4. Configure the Atmospheric Pressure Sensor with the data logger and note down the reading of the pressure sensor in the Sensor Test Data Record (Form-3E).
5. Apply pressure by blowing air in the vent tube of the pressure sensor and check the variation. Note down the observation in the Sensor Test Data Record (Form-3E).

## Solar Radiation Sensor

1. Observe and check the test report certified by the manufacturer for the Solar Radiation Sensor as per the manufacturer’s standard format. This Factory Test and Calibration Certificate should be as per the requirements in terms of accuracy, measurement range, operating temperature and humidity range mentioned in the contract document.
2. Check the sensor parameters like Sensor Type, Spectral Range, Measurement Range, and Resolution as per the manufacturer’s Factory Test and Calibration Certificate and data sheet. Note down the observation in the Sensor Test Data Record (Form-3F).
3. Check and note the threshold for the Solar Radiation sensor programmed in the data logger, the body material of the sensor and note down the observation in the Sensor Test Data Record (Form-3F).
4. Check the Solar Radiation Sensor as per the general steps given below.
5. Attach the Solar Radiation Sensor and a calibrated reference sensor on a fixture at a distance of less than 5 cm apart from each other. If calibrated reference sensor is not available than another sensor of the same make and model from the same lot can be used as a reference sensor.
6. Configure the Solar Radiation Sensor with the data logger and note down the reading of Solar Radiation in the Sensor Test Data Record (Form-3F).
7. Repeat step (b) for different Solar Radiation conditions like exposed to sun light, exposed to bulb light, covered completely (dark) and note down the observations in the Sensor Test Data Record (Form-3F).

# Site Acceptance Test for RTDAS Stations

In order to facilitate the site acceptance of the system by the staff in –charge of the site, the vendor should give a list of deliverables for each site to the respective site staff as well as to the Engineer in charge of the project. The list shall be verified by the respective staff in charge of the site and accordingly the staff will give a verification report whether all components have been delivered properly at the site. The vendor should complete the required civil works at the site for proper installation of the equipment before supplying the equipment to the site.

For the site acceptance test, the vendor shall give a check–list of all components and their functions. This checklist shall be prepared in consultation with the purchaser. This checklist shall indicate the tests to be conducted at the site and the results that are expected for each and every component that is to be installed at the site.

The following checklist has to be provided to each site.

* The Vendor should provide complete details including the make, model and serial number / ID of each equipment to be installed at each site.
* All civil works related to site should be complete. This includes foundations, masts, earthing, lightning protection and mounting devices on respective structures.
* Check the installation of the sensors. The location of the sensors and the related civil works should be decided depending on the site and the river flow conditions in consultation with the respective staff in charge of the sites and the Engineer-in-charge.
* Sensors and their accessories should be protected to minimize the chances of theft without compromising the basic principle and working of the sensors. Mortise locks should be used to avoid theft. Due care must be taken when modifying the installations. Under no circumstance the basic principle and working of the sensors shall be disturbed. Water level sensors should be mounted in such a way that they have a direct vertical shot to the water surface with no obstruction of their beams. The beam spread must be determined based on the manufacturer’s specification and the maximum expected distance to be measured at low flows. Provisions for easy access to the instrument for maintenance are to be made.
* Water level sensors should be configured to provide correct data on water level. The zero setting can be an arbitrary benchmark such as the bed level, bridge deck or any other permanent structure. The actual configuration against MSL is required in the next stage during the final acceptance.
* Meteorological sensors should be installed as per standard WMO guidelines. Meteorological sensors should be installed at a desired height of 10 mts on a triangular tower, as mentioned in the Technical Specifications.
* The rain gauge should be installed as per the guidelines mentioned with complete leveling using fish-eye bubble.
* The solar panel installation has to be checked. It should be in the correct direction, with proper elevation and azimuth.
* All sensors should be connected to a data logger with proper cabling and conducting. The wires and conduits should be properly tied and covered.
* All testing and calibration certificates, user manuals and other docmentation as applicable for the equipment should be supplied to the relevant Engineer-in-charge.
* The fencing should be complete at all sites mentioned in the BoQ.

# Acceptance Test for State Data Centre

The acceptance test for the State Data Centre will be conducted by the Purchaser or any other person nominated by the Purchaser, at his choice.

At the commissioning and final acceptance testing stage the data centre must fulfill all conditions mentioned in the Technical Specifications. The final acceptance testing stage will start with the final commissioning of the data centre as no remote RTDAS station can be accepted unless the data centre equipment like server, GSM & GPRS receiver, software, etc. is fully functional and starts receiving data from remote stations.

The following checklist will be applied for the acceptance testing of the State Data Centre:

* The server with a monitor and other equipment must be properly installed and configured with all usernames, passwords, firewalls and network configurations.
* The High Speed internet connection of 8 MBPS must be properly installed, configured and working.
* The printer and workstation are to be installed and configured for the network including all necessary software, genuine operating system, Microsoft Office license and antivirus.
* The data from remote sites is being received via GSM and GPRS t the State Data Center and via Satellite at the CWC ERS at New Delhi /Jaipur/ Burla and then to the eSWIS system.
* All software should be complete, and no missing modules/ sections will be allowed.
* A full time person is to be appointed for managing the data centre and the RTDAS system.
* The operators must be fully conversant with the equipment and calibration procedures, methods of operation and all facilities provided.
* The trainings as mentioned in the Technical Specification for the commissioning period are to be completed.
* The Data Centre acceptance test shall demonstrate the successful receiving of remote stations data at the State Data Center server. It shall include the data dissemination software indicating its full implementation as specified and trouble free operation of all modules for a period of 15 days operating on a 24 X 7 basis. An average data acquisition efficiency of 95% for the duration of the test period shall be considered as satisfactory.

# Final Acceptance Test

The remote sites can be tested, commissioned and accepted in batches of at least 20% of the total number of sites. The data centre is commissioned along with the first batch of stations when the following conditions are met:

* Remote RTDAS station must have completed the first level site acceptance test.
* The water level stations are calibrated against MSL and providing correct data. The zero setting against the bed level or any other local benchmark will not be accepted
* The telemetry system using GSM & GPRS and INSAT are properly installed and tested.
* Days of continuous data is received at the data centre using GSM / GPRS and satellite based telemetry for at least 95 % of the up-time. During a period of fifteen (15) days, there shall be no occurrence of any malfunction in any component necessitating replacement or repairs. No malfunction, partial or complete failure of any part of the hardware or excessive heating of the equipment or other electro-mechanical malfunction or bugs in the software shall occur.
* All relevant documentation pertaining to the sites shall be handed over by the vendor to the Engineer-in-charge.
* The data shall be checked for correctness and validated using defined procedures. Wherever available, data shall be checked against manual observations.
* Site security mechanisms must be in place and the painting of masts, fencing, etc. must be completed at all sites.
* The satellite IDs, time slots and license, etc. for the sites are to be in place.

# APPENDICES

1. List of Hydro-met Equipment (Form 1)
2. Forms for Performance Testing
   1. Integration Test Data Record For Data Collection Platform (Form 2A
   2. Transmission Link Testing (Form 2B)
   3. Sensor Test Data Record
   * Tipping Bucket Rain Gauge (TBRG) sensor (Form 3A)
   * Radar Water Level Sensor (Form 3B)
   * Air Temperature and Relative Humidity Sensor (Form 3C)
   * Wind Speed and Wind Direction Sensor (Form 3D)
   * Atmospheric Pressure Sensor (Form 3E)
   * Solar Radiation Sensor (Form 3F)

## List of Hydro-Met Equipment (Form 1)

| **SN** | **Item** | **Qty** | **Manufacturer Details** | | **Make and Model** | **Remark** (if any deviation in make & model w.r.t quoted equipment) |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | Data loggers with 2 AI channels |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **2** | Data loggers with 8 AI channels |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **3** | GSM & GPRS Modem |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **4** | INSAT transmitter |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **5** | Automatic Rain gauge Sensor (ARG) |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **6** | Radar Water Level Sensor |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **7** | Air Temperature and Humidity Sensor |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **8** | Wind Speed and Direction Sensor |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **9** | Atmospheric Pressure Sensor |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |
| **10** | Solar Radiation  Sensor |  | Name Address |  |  |  |
| Phone  Fax |  |
| Email Website |  |

**Integration Test Data Record for**

## Data Collection Platform (DCP) (Form 2A)

|  |  |
| --- | --- |
| **Test Description : Integration Test** | |
| **DCP Model No. :** | **Date :** |
| **DCP Serial No :** | **Customer :** |

| **SN** | **Parameter** | | | **Observations / Measured Reading** | | | | | | | | **Specifications** | **Remark** (OK / Not OK) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **DCP Current Consumption** | | | | | | | | | | |  |  |
| a | Data logger Input Voltage | | | **@ 10.5 V** | **@ 12 V** | | | | | | **@ 14.5 V** | 10 to 16 Volts |  |
| b | Voltage to transmitter (RF ON) | | |  |  | | | | | |  | 10 to 16 Volts |  |
| c | Current when Display ‘ON’ | | |  |  | | | | | |  | 300 mA (max) |  |
| d | Data logger Quiescent Current | | |  |  | | | | | |  | 10 mA (max) |  |
| e | RTDAS Quiescent Current | | |  |  | | | | | |  | 18 mA (max) |  |
| f | Current at GSM/GPRS Tx. ‘ON’ | | |  |  | | | | | |  | 250 mA (max) |  |
| g | Current at INSAT Tx. ‘ON’ | | |  |  | | | | | |  | 4.0A (Max) |  |
| **2** | **Charge Controller / Power Supply Unit** | | | | | | | | | | |  |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| a | Input Reverse Polarity | | | Yes / No | | | | | | | | Required |  |
| b | Max Charging Voltage | | |  | | | | | | | | 15.5 ± 0.3 Volt |  |
| c | Low Voltage Cut-off | | |  | | | | | | | | 10 ± 0.3 Volt |  |
| d | **Solar Panel** | | | | | | | | | | |  |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| Output Voltage (Without Load) | @ fully Covered | | | | |  | | | | | 0 ± 2 Volt |  |
| @ Exposed to sun | | | | |  | | | | | 21 ± 2 Volt |  |
| Output Voltage (With Load) @ Exposed to sun | | | | | |  | | | | | 12 V ± 2 Volt |  |
| **3** | **Data logger** | | | | | | | | | | | Internal or External |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| a | Analogue Inputs | | | No of AI Channels | | | | | |  | | 2 - AI channels |  |
| Resolution | | | | | |  | | Min 16 bit |  |
| Accuracy | | | | | |  | | ± 1 LSB |  |
| b | SDI Port | | |  | | | | | | | | 1-- SDI-12 |  |
| c | Serial Port for sensor | | |  | | | | | | | | 1- RS232 & 1- RS485 |  |
| d | Pulse Input | | |  | | | | | | | | 1 – Pulse Input |  |
| e | Port for PC Configuration | | |  | | | | | | | | Serial Port RS-232 |  |
| f | Port for INSAT Telemetry | | |  | | | | | | | | 2 Port for Telemetry |  |
| Port for GSM & GPRS | | |  | | | | | | | |
| g | External Display Port | | |  | | | | | | | | One Port |  |
| h | Internal Data Memory | | |  | | | | | | | | 8MB Flash memory |  |
| i | Key Pad Functions | | |  | | | | | | | |  |  |
| j | LCD Operation | | |  | | | | | | | |  |  |
| k | RTS synchronize with GPS | | | Date And Time: | | | | | | | | In IST format |  |
| l | User levels Permissions with Password protection | | | Access Levels -- | | | | | | | |  |  |
| m | Surge protection device for all interfaces of the data logger | | | | | | | | | | |  |  |
| n | Data Retrieval with USB pen Drive | | | | | | | | | | | Retrieval Data should be in standard GSM / GPRS format mentioned in bid /contract document |  |
| o | Data Retrieval using Laptop / PC through Serial port | | | | | | | | | | |  |
| p | Pooling of data via GPRS telemetry in defined format | | | | | | | | | | |  |
| q | Provision of automatic data transfer once GPRS/GSM communication retain | | | | | | | | | | |  |
| r | **Provision for setting configurations Parameters** | | | **Using data logger** | **Using  Laptop /PC** | | | | | | **Using  GSM/GPRS** |  |  |
| Station ID code | | |  |  | | | | | |  |  |  |
| Measurement Interval | | |  |  | | | | | |  | 5, 10, 15, 30, 60 min |  |
| Gain (for Individual sensor) | | |  |  | | | | | |  |  |  |
| Offset (for Individual sensor) | | |  |  | | | | | |  |  |  |
| Datum (for Individual sensor) | | |  |  | | | | | |  |  |  |
| Tx. time for INSAT | | |  |  | | | | | |  | (MM:SS) format |  |
| Tx. time for GSM/ GPRS | | |  |  | | | | | |  | (MM:SS) format |  |
| FTP server Configuration | | |  |  | | | | | |  | User ID, Password |  |
| Mobile number of data centre | | |  |  | | | | | |  | 10 digit Mobile number |  |
| s | **Observed Sensor Data** | | | **Sensor Name** | | | | **Live Sensor Data** | | | | **Lagged Sensor Data** |  |
| Rain Gauge | | | |  | | | |  |  |
| Water Level | | | |  | | | |  |  |
| Air Temperature | | | |  | | | |  |  |
| Relative Humidity | | | |  | | | |  |  |
| Wind Speed | | | |  | | | |  |  |
| Wind Direction | | | |  | | | |  |  |
| Solar Radiation | | | |  | | | |  |  |
| Pressure Sensor | | | |  | | | |  |  |
| **4** | **GSM & GPRS Modem** Internal / External | | | | | | | | | | |  |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| a | Communication Protocol for Data transmission (As per the Factory test result) | | | GPRS -- | | | | | | | | HTTP Post or FTP |  |
| GSM -- | | | | | | | | SMS to transmit data |
| b | Frequency range (As per the Factory test result) | | |  | | | | | | | | 3G & 4G  and Better |  |
| c | Interrogative Transmission of logged data | | |  | | | | | | | | Triggered by Data Center & event based |  |
| d | Test & Calibration Certificate | | |  | | | | | | | | Factory Test Report |  |
| **5** | **INSAT Transmitter** Internal / External | | | | | | | | | | |  |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| a | Carrier Frequency | | |  | | | | | | | | 402 – 403 MHz |  |
| b | Carrier Settability | | |  | | | | | | | | In steps of 100Hz |  |
| c | Output Power | | |  | | | | | | | | 3-10Watt, user settable |  |
| d | Certification | | |  | | | | | | | | ISRO and or IMD |  |
| e | Test & Calibration Certificate | | |  | | | | | | | | Factory Test Report |  |
| **6** | **Antenna** | | | | | | | | | | |  |  |
| **Make-** | | **Model-** | | | **Sr. No.-** | | | | | |
| a | Carrier Frequency | | |  | | | | | | | | 402 – 403 MHz |  |
| b | Polarization | | |  | | | | | | | | LHCP and RHCP |  |
| c | Mounting | | |  | | | | | | | | AZ and EL adjustment |  |
| d | Material | | |  | | | | | | | | Rust & Oxidation-proof |  |
| e | Test & Calibration Certificate | | |  | | | | | | | | Factory Test Report |  |
| **Tested by** | | | | | | | | | **Verified by** | | | | |

## Transmission Link Testing (Form 2B)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TEST DESCRIPTION :** | | | | | | | | | | | | | |
| **SERIAL NO :** | | | | **MODEL NO. :** | | | | | | **CUSTOMER :** | | | |
| **DATE :** | | | | | | | **Time : From To** | | | | | | |
| **Value at** | **1St Transmission** | | | | **2nd Transmission** | | | | **3rd Transmission** | | | | **Remark** |
| **Data logger  Tx. Data** | **GSM / GPRS  Received Data** | **INSAT  Received Data** | | **Data logger  Tx. Data** | **GSM / GPRS  Received Data** | | **INSAT  Received Data** | **Data logger  Tx. Data** | | **GSM / GPRS  Received Data** | **INSAT  Received Data** |
| **Station ID** |  |  |  | |  |  | |  |  | |  |  |  |
| **Time Code** |  |  |  | |  |  | |  |  | |  |  |  |
| **Battery** |  |  |  | |  |  | |  |  | |  |  |  |
| **Rainfall** |  |  |  | |  |  | |  |  | |  |  |  |
| **Rain Daily** |  |  |  | |  |  | |  |  | |  |  |  |
| **Water Level** |  |  |  | |  |  | |  |  | |  |  |  |
| **Air Temp.** |  |  |  | |  |  | |  |  | |  |  |  |
| **Rel. Humidity** |  |  |  | |  |  | |  |  | |  |  |  |
| **Wind Speed** |  |  |  | |  |  | |  |  | |  |  |  |
| **Wind Direction** |  |  |  | |  |  | |  |  | |  |  |  |
| **At. Pressure** |  |  |  | |  |  | |  |  | |  |  |  |
| **Sun Duration** |  |  |  | |  |  | |  |  | |  |  |  |
| **Tested by** | | | | | | | **Verified by** | | | | | | |

**Sensor Test Data Record for**

## Tipping Bucket Rain Gauge Sensor (Form 3A)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Tipping Bucket Rain Gauge Sensor** | | | | | | | | |
| Customer : | | | | Date : | | | | |
| Sensor Make : | | | | Data logger Make : | | | | |
| Sensor Model No. : | | | | Data logger Model No. : | | | | |
| **Sr.** | **Parameter** | | **Observations / Measured Reading** | | | | **Specifications** | **Remark (OK / Not OK)** |
| a | Diameter of the Rain gauge | |  | | | |  |  |
| b | Capacity | |  | | | | 250 mm/h or better |  |
| c | Resolution | |  | | | | 0.5 mm or better |  |
| d | Material | Rain gauge Body |  | | | | Corrosion Resistance Metal (Stainless steel/ Aluminium) |  |
| Rim of Rain gauge |  | | | |
| Tipping Bucket |  | | | |
| e | Enclosure for electronics | |  | | | | NEMA 4 or IP65 |  |
| f | Rain Gauge Sensor Reading in data logger | | **Quantity of water pour in Rain Gauge** | | | **Rainfall reading Data logger (mm)** | Reading should be within ± 2%, ± 2 mm accuracy |  |
| ml | | | mm |
| ml | | | mm |
| ml | | | mm |
| g | Protection from insects and debris | |  | | | | Rain gauge with spout filter and bird cage |  |
| h | Certification (Type approval) | |  | | | | IMD/ NIST |  |
| i | Test & Calibration Certificate | |  | | | | Factory Test Report |  |
| **Tested by** | | | | | **Verified by** | | | |

**Sensor Test Data Record for**

## Radar/Ultrasonic Water Level Sensor (Form 3B)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Radar/Ultrasonic Water Level Sensor** | | | | | | | | | |
| Customer : | | | | | Date : | | | | |
| Sensor Make : | | | | | Data logger Make : | | | | |
| Sensor Model No. : | | | | | Data logger Model No. : | | | | |
| **Sensor-A** Serial No. : | | | | | **Data logger -A** Serial No. : | | | | |
| **Sensor-B** Serial No. : | | | | | **Data logger -B** Serial No. : | | | | |
| **Sr.** | **Parameter** | | **Observations / Measured Reading** | | | | | **Specifications** | **Remark (OK / Not OK)** |
| a | Sensor Type | | Frequency -- | | | | | Radar/Ultrasonic |  |
| b | Range (As per data sheet) | |  | | | | | 35 meters |  |
| c | Resolution | |  | | | | | 3 mm or better |  |
| e | Beam angle (As per data sheet) | |  | | | | | Less than 16 degree. |  |
| d | Output Interface  (used for Datalogger interface) | |  | | | | | SDI-12 / RS485 /  4-20mA |  |
| f | Sensor Housing Material | |  | | | | (Stainless steel / die cast Aluminium / PVC / UV stabilized ABS with metal casing) | |  |
| g | Water Level Sensor Reading in data logger | **WL reading in Data logger** | | | | **Actual measured WL reading** | | Accuracy of the reading should be within ± 0.02% of actual Water level or less than ± 5mm  (at least test up to 10mts.) |  |
| **Sensor-A** | | **Sensor-B** | |
| Around ~ 10mts. | mts | | mts | | mts | |
| Around ~ 7mts. | mts | | mts | | mts | |
| Around ~ 3mts. | mts | | mts | | mts | |
| g | Water Level Sensor Reading by **interchanging** data logger | **WL reading in Data logger** | | | | **Actual measured WL reading** | | Accuracy of the reading should be within ± 0.02% of actual Water level or less than ± 5mm  (at least test up to 10mts.) |  |
| **Sensor-A** | | **Sensor-B** | |
| Around ~ 10mts. | mts | | mts | | mts | |
| Around ~ 7mts. | mts | | mts | | mts | |
| Around ~ 3mts. | mts | | mts | | mts | |
| h | Test & Calibration Certificate | |  | | | | | Factory Test Report |  |
| **Tested by** | | | | | **Verified by** | | | | |

**Sensor Test Data Record for**

## Air Temperature & Relative Humidity Sensor (Form 3C)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Air Temp & Relative Humidity Sensor** | | | | | | | | | |
| Customer : | | | | | | Date : | | | |
| Sensor Make : | | | | | | Data logger Make : | | | |
| Sensor Model No. : | | | | | | Data logger Model No. : | | | |
| **Sensor-A** Serial No. : | | | | | | Data logger Serial No. : | | | |
| **Sensor-B** (Reference) Serial No. : | | | | | |  | | | |
| **Sr.** | **Parameter** | | | **Observations / Measured Reading** | | | | **Specifications** | **Remark (OK / Not OK)** |
| a | **Temperature Sensor** Type | | |  | | | | Platinum resist. or better |  |
| b | Temperature Sensor Range | | |  | | | | -5 ⁰C to 60 ⁰C |  |
| c | Temperature Sensor Reading in data logger | **Temp. Sensor-A** | | | **Temp Sensor-Ref** | | | Accuracy of the Reading should be within ± 0.2 ⁰C with respective to each other |  |
| **Sensor O/P** | **Reading** | | **Sensor O/P** | | **Reading** |
| @ Temp < 5⁰C | mV | | ⁰C | mV | | ⁰C |
| @ Room Temp | mV | | ⁰C | mV | | ⁰C |
| @ Temp > 50⁰C | mV | | ⁰C | mV | | ⁰C |
| d | **Humidity Sensor** Type | | |  | | | | Capacitive /Solid State |  |
| e | Humidity Sensor Range | | |  | | | | 0 to 100 % |  |
| F | Humidity Sensor Reading in data logger | **RH Sensor-A** | | | **RH Sensor-Ref** | | | Accuracy of the Reading should be within 3% with respective to each other |  |
| **Sensor O/P** | **Reading** | | **Sensor O/P** | | **Reading** |
|  | mV | | % | mV | | % |
|  | mV | | % | mV | | % |
|  | mV | | % | mV | | % |
| g | Test & Calibration Certificate | | |  | | | | Factory Test Report |  |
| **Tested by** | | | | | | **Verified by** | | | |

**Sensor Test Data Record for**

## Wind Speed & Wind Direction Sensor (Form 3D)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Wind Speed & Wind Direction Sensor** | | | | | | |
| Customer : | | | | Date : | | |
| Sensor Make : | | | | Data logger Make : | | |
| Sensor Model No. : | | | | Data logger Model No. : | | |
| **Sensor-A** Serial No. : | | | | Data logger Serial No. : | | |
| **Sensor-B** (Reference) Serial No. : | | | |  | | |
| **Sr.** | **Parameter** | **Observations / Measured Reading** | | | **Specifications** | **Remark (OK / Not OK)** |
| a | **Sensor** Type |  | | | Ultrasonic sensor |  |
| c | Wind Speed Sensor Range (as per the Factory test result) |  | | | 0 - 60 m/s |  |
| d | Wind Speed Accuracy  (as per the Factory test result) |  | | | ± 0.5m/s or better |  |
| e | Wind Speed Resolution |  | | | 0.1m/s |  |
| f | Wind Speed Reading in data logger at different speed | **Wind Speed reading in Data logger** | | | Accuracy of the Reading should be at least within 2% with respective to each other |  |
| **Wind Sensor-A** | **Wind Speed-Ref** | |
|  | m/s | m/s | |
|  | m/s | m/s | |
|  | m/s | m/s | |
| g | Wind Direction Sensor Range (as per the Factory test result) |  | | | 0 - 360 Deg. |  |
| h | Wind Direction Accuracy  (as per the Factory test result) |  | | | ± 5 Deg. or better |  |
| i | Wind Direction Resolution |  | | | 5 Deg. |  |
| j | Wind Direction Reading in data logger with pointing the Notch at different position | **Wind Speed reading in Data logger** | | |  |  |
| North | Deg. | | | 0 ± 5 Deg. |
| East | Deg. | | | 90 ± 5 Deg. |
| South | Deg. | | | 180 ± 5 Deg. |
| West | Deg. | | | 270 ± 5 Deg. |
| k | Test & Calibration Certificate |  | | | Factory Test Report |  |
| **Tested by** | | | | **Verified by** | | |

**Sensor Test Data Record for**

## Atmospheric Pressure Sensor (Form 3E)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Atmospheric Pressure Sensor** | | | | | | |
| Customer : | | | Date : | | | |
| Sensor Make : | | | Data logger Make : | | | |
| Sensor Model No. : | | | Data logger Model No. : | | | |
| **Sr.** | **Parameter** | **Observations / Measured Reading** | | | **Specifications** | **Remark (OK / Not OK)** |
| a | Sensor Type |  | | | Temp. compensated |  |
| b | Range (as per the Factory test result) |  | | | 600 to 1100 hPa |  |
| b | Accuracy  (as per the Factory test result) |  | | | ± 0.2 hPa |  |
| c | Resolution |  | | | 0.1 hPa |  |
| h | Output Interface |  | | | SDI-12 / RS-232 / RS-485 |  |
| i | Atm. Pressure Sensor Reading in data logger at different conditions | **Atm. Pressure Sensor Reading in Data logger** | | |  |  |
| At normal Condition | hPa | | |
| Applying Air pressure | hPa | | |
| Removing Air Pressure | hPa | | |
| j | Test & Calibration Certificate |  | | | Factory Test Report |  |
| **Tested by** | | | | **Verified by** | | |

**Sensor Test Data Record for**

## Solar Radiation Sensor (Form 3F)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Description : Integration Test for Solar Radiation Sensor** | | | | | | | |
| Customer : | | | Date : | | | | |
| Sensor Make : | | | Data logger Make : | | | | |
| Sensor Model No. : | | | Data logger Model No. : | | | | |
| **Sr.** | **Parameter** | **Observations / Measured Reading** | | | | **Specifications** | **Remark (OK / Not OK)** |
| a | Sensor Type |  | | | | Silicon Pyranometer |  |
| b | Threshold Programmed in Datalogger |  | | | | 120 W/m² |  |
| c | Sensor Body Material |  | | | | Corrosion Resistance (SS / Aluminium) |  |
| d | Spectral Range (as per the Factory test result) |  | | | | 400nm to 1100nm |  |
| f | Range (as per the Factory test result) |  | | | | 0 - 2000 W/m² |  |
| g | Resolution |  | | | | 1 W/m² |  |
| h | Output Interface |  | | | | SDI 12/RS 485/  4-20 mA/ Analog |  |
| i | Solar Radiation Reading in data logger at different conditions | **Solar Radiation Sensor- A** | | **Solar Radiation Sensor- Ref** | | Accuracy of the Reading should be at least within 3% with respective to each other |  |
| Exposed to Sun Light | W/m² | | W/m² | |
| Exposed to Bulb Light | W/m² | | W/m² | |
| Covered Completely (Dark) | W/m² | | W/m² | |
| j | Test & Calibration Certificate |  | | | | Factory Test Report |  |
| **Tested by** | | | | | **Verified by** | | |