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| Section VI. Schedule of Requirements |

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1. List of Goods and Delivery Schedule

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *[The Purchaser shall fill in this table, with the exception of the column “Bidder’s offered Delivery date” to be filled by the Bidder]* | | | | | | | |
| **Line Item**  **N°** | **Description of Goods** | **Qty.** | **Unit** | **Final Destination (Project Site)** | **Delivery (as per Incoterms) Date** | | |
| **Earliest Delivery Date** | **Latest Delivery Date** | **Bidder’s offered Delivery date [*to be provided by the bidder*]** |
|  | Hand Held Devices for Communication with Data Loggers as specified in Section 3.1 of the Technical Specifications | 5 | Nos. | As specified in Section 3.27 – “Station Categories” of the Technical Specifications | The deliveries shall be completed within 4 months from the date of signing of agreement | The deliveries shall be completed within 6 months from the date of signing of agreement |  |
|  | Rugged Notebook Computers as specified in Section 3.2 of the Technical Specifications | 5 | Nos. | -do- | -do- | -do- |  |
|  | Precipitation Gauge (Rain Only Sites) as specified in Section 3.3 of the Technical Specifications | 16 | Nos. | -do- | -do- | -do- |  |
|  | Precipitation Gauge (Rain and Snow) as specified in Section 3.4 of the Technical Specifications | 21 | Nos. | -do- | -do- | -do- |  |
|  | Water Level (Bubbler) as specified in Section 3.5 of the Technical Specifications | 10 | Nos. | -do- | -do- | -do- |  |
|  | Water Level (Radar) as specified in Section 3.6 of the Technical Specifications | 18 | Nos. | -do- | -do- | -do- |  |
|  | Water Level (Stilling Well/Float/Encoder) as specified in Section 3.7 of the Technical Specifications | 11 | Nos. | -do- | -do- | -do- |  |
|  | Temperature Sensors as specified in Section 3.8 of the Technical Specifications | 33 | Nos. | -do- | -do- | -do- |  |
|  | Relative Humidity Sensors as specified in Section 3.9 of the Technical Specifications | 12 | Nos. | -do- | -do- | -do- |  |
|  | Wind Speed/Direction Sensors as specified in Section 3.10 of the Technical Specifications | 12 | Nos. | -do- | -do- | -do- |  |
|  | Atmospheric Pressure Sensors as specified in Section 3.11 of the Technical Specifications | 12 | Nos. | -do- | -do- | -do- |  |
|  | Solar Radiation Sensors as specified in Section 3.12 of the Technical Specifications | 12 | Nos. | -do- | -do- | -do- |  |
|  | Data Logger as specified in Section 3.13 of the Technical Specifications | 78 | Nos. | -do- | -do- | -do- |  |
|  | Snow Depth Sensors as specified in Section 3.14 of the Technical Specifications | 27 | Nos. | -do- | -do- | -do- |  |
|  | Snow Water Equivalent – Snow Pillows as specified in Section 3.15 of the Technical Specifications | 9 | Nos. | -do- | -do- | -do- |  |
|  | Power Supply as specified in Section 3.16 of the Technical Specifications | 78 | Unit | -do- |  |  |  |
|  | Automatic Cableway Gauging System as specified in Section 3.17 of the Technical Specifications | 8 | Nos. |  |  |  |  |
|  | ADCP River Discharge Measurement as specified in Section 3.18 of the Technical Specifications | 5 | Nos. | -do- | -do- | -do- |  |
|  | ADV Velocity Measurement as specified in Section 3.19 of the Technical Specifications | 6 | Nos. | -do- | -do- | -do- |  |
|  | Electronic Current Meters as specified in Section 3.20 of the Technical Specifications | 6 | Nos. | -do- | -do- | -do- |  |
|  | Electronic Test Meters as specified in Section 3.21 of the Technical Specifications | 6 | Nos. | -do- | -do- | -do- |  |
|  | INSAT Transmitters as specified in Section 3.22of the Technical Specifications | 78 | Unit | -do- | -do- | -do- |  |
|  | Earth Receive Station (ERS) and Software as specified in Section 3.23.1ofthe Technical Specifications | 1 | Unit | -do- | -do- | -do- |  |
|  | Data Management Computer and Software as specified in Section 3.23.2 of the Technical Specifications | 1 | Unit | -do- | -do- | -do- |  |
|  | Software for RT-DSS Centre as specified in Section 3.23.3 of the Technical Specifications | 1 | Set | -do- | -do- | -do- |  |
|  | Wireless Transmitters | As per requirement to minimize recurring cost of INSAT data communications, with the use of these, to combine data at a single point, then employing INSAT transmitter from there. For bid evaluation only the quoted unit price will be considered. The actual quantity may, however, differ at the time of installation of the system. | Unit | -do- | -do- | -do- |  |
|  | Radio Transmitters | -do- | Unit | -do- | -do- | -do- |  |

**Note: Bids offering delivery period of more than 12 months (Supply, Civil Work, Installation and Integration shall be treated as non-responsive**

1. List of Related Services and Completion Schedule

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Service** | **Description of Service** | **Quantity1** | **Physical Unit** | **Place where Services shall be performed** | **Final Completion Date(s) of Services** |
|
| **1.** | Data Reception at ERS & Integration in the Network of the Category I station as specified in 3.27.1 of the Technical Specifications | 1 | No. | RT-DSS Center at Chandigarh | 12 Months |
| **2** | Installation of sensors at Category II stations as specified in 3.27.2 of the Technical Specifications. | 10 | No. | Sites as given under Category II stations in 3.27.2 of the Technical Specifications. | 12 Months |
| **3.** | Installation of Automated Rain Gauge Stations under Category III stations as specified in 3.27.3 of the Technical Specifications. | 16 | No. | Sites as given under Category III station in 3.27.3 of the Technical Specifications. | 12 Months |
| **4.** | Installation of Automated Full Climate Stations at Category IV stations as specified in 3.27.4 of the Technical Specifications. | 12 | No. | Sites as given under Category IV station in 3.27.4 of the Technical Specifications. | 12 Months |
| **5.** | Installation of Snow Water Equivalent – (Snow Pillow) Stations at Category V stations as specified in 3.27.5 of the Technical Specifications. | 9 | No. | Sites as given under Category V station in 3.27.5 of the Technical Specifications. | 12 Months |
| **6.** | Installation of Automated Water Level Recording Stations at Category VI stations as specified in 3.27.6 of the Technical Specifications. | 44 | No. | Sites as given under Category V station in 3.27.6 of the Technical Specifications. | 12 Months |
| **7.** | Installation of Data Collection from Powerhouses at Category VII stations as specified in 3.27.7 of the Technical Specifications. | 6 | No. | Sites as given under Category VI station in 3.27.7 of the Technical Specifications. | 12 Months |
| **8.** | Civil Works for all the stations as specified in section 3.27 of the Technical Specifications | -- | No. | Sites as given under Category II to VII station in 3.27.2 to 3.27.7 of the Technical Specifications | 12 Months |
| **9.** | Warranty Period | -- | Year/Month | The entire DAS network for all the components | Two years after acceptance of the DAS network by BBMB |
| **10.** | Transportation charges: The Supplier is required under the Contract to transport the Goods to such place of destination in the Purchaser’s country, including insurance and storage, as specified in the Contract, shall be arranged by the Supplier, and related costs shall be included in the Contract Price. | -- | Lump sum | Specified place of final destination within the Purchaser’s country, defined as the Project Site. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **11.** | O&M Period | -- | Year/Month | The entire DAS network for all the components | Three years after completion of two years warranty period for the DAS network for which bidders will provide tentative rates while submitting proposals & a separate contract will be entered into at the time of Handing over of the system. |
| **12.** | Establishing Rating curves | -- | Year/Month | At sites as per requirement | 12 Months |
| **13.** | Integration of Wireless or radio transmitters with INSAT transmitter | -- | Nos. | At sites as per requirement | 12 Months |
| **14.** | Integration of All the Weather Stations to Data Center of BBMB, Chandigarh | -- | Nos. | At sites as per requirement | 12 Months |

**Note: Bids offering delivery period of more than 12 months (Supply, Civil Work, Installation and Integration shall be treated as non-responsive & the bidder are requested to inspect the sites before quoting.**

* 1. Personnel Requirement (Form to be submitted by the bidder)

BBMB requires a minimum of the following personnel at the following sites to be supplied by the supplier

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sr. no.** | **Site** | **Description** | **No. of personnel** | **Man day’s charges** | **BBMB staff requirement** | **Remarks** |
| 1 | Data Centre | One computer specialist trained in the operation of the ERS and data processing software, one assisting computer scientist to help in the support of the Data Centre, two hydrographers for monitoring the quality control software, managing rating tables, and developing network operational status reports. | **4** |  |  | **The hydrographers are required from 1st April to 30th September every year.** |
| 2 | Nangal | Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations. | **5** |  |  |
| 3 | Rampur | Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. | **2** |  |  |
| 4 | Pooh | Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations. The office space at Pooh will be arranged by BBMB. | **5** |  |  |
| 5 | Talwara | Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations. | **5** |  |  |
| 6 | Pandoh | Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations. | **5** |  |  |

* 1. Training Requirement (Form to be submitted by the bidder)

The bidder is expected to provide an outline or table indicating the contents of each of the required courses. The table shall describe the specific topics to be covered for each day of the training period. The **training program is to be included with the bid.** The bidder is responsible for the salaries of the training instructors and all training materials. **The costs of travel, transportation and per diem for the trainees shall be borne by the Purchaser. The venue for the training shall be decided mutually by the supplier with BBMB & arranged by BBMB but all other expenses such as training material, stationery, media, etc. will be borne by the supplier.**

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **DESCRIPTION OF TRAINING** | **CHARGES** |
| **1** | Training in general equipment operation and maintenance procedures will be provided by a four-week training course as well as by on-the-job training. The bidder is required to have hydro meteorological equipment specialists (4 staff weeks). The training is for BBMB staff or designates. The four week training will be conducted in two lots each of two weeks. The training should be in modules with refresher courses occurring over the contract period. Course topics will include sensor calibration, data logger configuration, data downloading, data retrieval, collection, compilation, processing, maintenance requirements, and procedures for equipment configuration, installation, site testing and commissioning. An additional course will be conducted in the theory and practice of discharge measurements, and development of rating curves. The training course will be organized in Chandigarh or project centres, which will be decided mutually by the supplier & BBMB. On-the-job training will be provided by the supplier in conjunction with the installation of hydrologic stations, conducting discharge measurements and during the course of maintenance at BBMB’s choosing. The venue for training will be provided by BBMB. |  |
| **2** | In addition to the general training, the bidder is to provide training for technicians responsible for the operation and maintenance of electronic and other equipment. Combined two week training by two Equipment Specialists (of different specialization) for up to 20 technicians must be provided, as a minimum. Course topics will include sensor calibration, data logger configuration, data down loading, maintenance requirements, O&M and procedures for equipment configuration, installation, site testing and commissioning. |  |

* 1. Annual Maintenance Contract (Form to be submitted by the bidder)

The supplier will undertake the Operation & Maintenance (O&M) of all stations/components of the network during the warranty & contract performance period of two years after commissioning & final acceptance of the system and for another period of three years following the contract performance period. BBMB will enter into a 3-year separate contract for AMC/O&M support for all stations/components with the supplier and the bidders will provide the price for the same in this bid itself.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **AMC Period** | **Responsibility** | **AMC Services** | **Charges** |
| **1** | First year of the 3-year AMC/O&M contract | Bidder will be fully responsible in the 1st year of AMC period with BBMB staff observing | AMC/O&M support contract shall refer to the complete meteorological network, and proper functioning of the ERS and Data Centre including the hardware and software components. Assistance and troubleshooting will be provided for all necessary maintenance, servicing, testing, and recalibration operations. |  |
| **2** | Second year of the 3-year AMC/O&M contract | Bidder and BBMB will be jointly responsible, though the bidder will have ultimate responsibility |  |
| **3** | Final year of the 3-year AMC/O&M contract | BBMB will have primary responsibility for O&M, handling all emergency and preventive maintenance field visits, with the bidder joining BBMB to reinforce procedures and assisting with general technical support. |  |

* 1. Incidental Services

The details of the incidental services (supervision, training, operation & maintenance) as required in terms of the contract are listed below and explained in the Technical Specifications.

1. Performance or supervision of the on-site assembly and/or start-up of the supplied **Goods**;
2. Furnishing of appropriate hardware, system design and programming services required for development and/or maintenance of the supplied **Goods**;
3. Furnishing of tools required for assembly and maintenance of the supplied **Goods**;
4. Furnishing of detailed operations and maintenance manual for each appropriate unit of supplied **Goods**;
5. Performance or supervision or maintenance and repair/replacement of the supplied **Goods**, for a period of five years beyond the date of commissioning, provided that this service shall not relieve the **Bidder** of any warranty obligations under this contract;
6. Software updates and bug fix services for the software originally developed by the **Bidder** during the period of warranty and subsequent maintenance. For the third party software packages supplied updates shall be provided during the warranty period & AMC period also.
7. Training of BBMB’s personnel, in assembly, start-up, operation, maintenance, and repair of the supplied **Goods** at the stations to be decided by BBMB.
8. All cost related to the installation and maintenance at the sites will be the responsibility of the **Bidder**. BBMB will however provide office space at all the DAS Sub-centers for the **Bidder**’s technicians. BBMB will also provide space for the storage of spare parts at these locations. A maximum of 8 technicians will have office space at these locations.
   1. Site Preparation and Installation Clause
9. BBMB will provide details of the installation sites before the scheduled installation date to allow the Bidderto perform site inspection and construction of suitable structures before the installation of the hardware.
10. The location of antenna and sensors will be decided by the respective Site Engineer-in-charge depending on the site and river flow conditions.
11. The Biddershould complete the required works at the site for proper installation of the equipment before receipt of the equipment.
    1. Bid Price and Contract Price

Bid price - Cost of all items that would be added for price comparison and evaluation.

Contract Price - Cost of all items of contract performance payable under the contract

The bidder shall quote the price for the following items:

1. Goods listed in Requirement of Goods Table headed “1. List of Goods & Delivery Schedule” in this section above. The price shall be inclusive of tools required for repair & maintenance (excluding spare parts) of the supplied Goods and a detailed operations and maintenance manual for each appropriate unit of the supplied Goods. Refer Price Schedule 1 or 2 or 3.
2. Cost of normal-usage spare parts estimated for three (3) years of operation of the system after Warranty period of two years from the date of issue of Final Acceptance Certificate. This shall include such items of spare parts, which the Contractor believes, that would be required during the initial period of operation (3 years). High-value spare parts, such as entire components, shall not be included in this list. The cost of normal-usage spare parts for a period of 3 years shall be added to the bid price for bid evaluation and shall also be part of the contract price. Refer Price and completion Schedule 5.
3. The contractor shall separately provide a complete list of spare parts with rate and hold it valid for ten (10) years from the date of issue of Final Acceptance Certificate and shall be obliged to supply such spare parts at such rates as and when orders are placed during this period, for which the payment shall be made on performance of supply. The contractor is not required to supply these spare parts during the period of contract and this shall neither be included in the bid price for evaluation nor in the contract price.
4. Transportation Charges as per terms and conditions of the Contract.
5. Cost of services for Installation and Commissioning including on the job training during installation and commissioning as per terms and conditions of the Contract inclusive of the cost of daily remuneration (all allowances, cost of communication, etc included), travel cost (cost of travel, transit, visa, etc.), accommodation, etc for each of the Contractor’s personnel. The Contractor shall estimate this cost, which shall be added to the bid price for bid evaluation and shall also be part of the contract price. Refer Price and completion Schedule 5.
6. Cost of services for Training Purchaser’s Personnel for operation and maintenance of the system as per terms and conditions of the Contract inclusive of the cost of daily remuneration (all allowances, cost of communication, etc included), travel cost (cost of travel, transit, visa, etc.), accommodation, etc for each of the Contractor’s personnel and also of any training material. The Contractor shall estimate this cost, which shall be added to the bid price for bid evaluation and shall also be part of the contract price. Refer Price and completion Schedule 5.
7. Cost of organizing the training specified in Para 5 and 6 above such as cost for hiring premises and working lunch will be borne by the Supplier andincluded in the schedule 5. All other charges will be borne by the Purchaser.
8. Cost of Operation and Maintenance (part facilities) for the remainder of the contract period after Operational Testing till final acceptance as per terms and conditions of the Contract inclusive of the cost of daily remuneration (all allowances, cost of communication, etc included), travel cost (cost of travel, transit, visa, etc.), accommodation, etc for each of the Contractor’s personnel. The Contractor shall estimate this cost, which shall be added to the bid price for bid evaluation and shall be part of the contract price. Refer Price and completion Schedule 5.
9. Cost of Operation and Maintenance for a period of two years during Warranty period from the date of issue of Final Acceptance Certificate as per terms and conditions of the Contract inclusive of the cost of daily remuneration (all allowances, cost of communication, etc included), travel cost (cost of travel, transit, visa, etc.), accommodation, etc for each of the Contractor’s personnel. The Contractor shall provide an O&M plan and shall estimate this cost at current prices indicating the rates and the total cost. This cost shall be added to the bid price for bid evaluation, and shall be included in the contract price. Refer Price schedule 4.
10. Cost of Operation and Maintenance for a period of three years after Warranty period of two years from the date of issue of Final Acceptance Certificate as per terms and conditions of the Contract inclusive of the cost of daily remuneration (all allowances, cost of communication, etc included), travel cost (cost of travel, transit, visa, etc.), accommodation, etc for each of the Contractor’s personnel. The Contractor shall provide an O&M plan and shall estimate this cost at current prices indicating the rates and the total cost. This cost shall be added to the bid price for bid evaluation, but shall not be included in the contract price. The contractor shall be obliged to execute a separate O&M contract before Final Acceptance Test, if offered by the Purchaser. Refer Price schedule 6.

The contract price shall include the (1) cost of goods to be supplied, (2) cost of normal-usage spares required for the operation of the system for three years after final acceptance, (3) cost of services for installation & commissioning in terms of conditions of contract, (4) cost of training services (5) cost of O&M of part facilities from OT to Final Acceptance and (6) Cost of Operation and Maintenance for a period of two years during Warranty period from the date of issue of Final Acceptance Certificate. [Price Schedule 1 to 5]

The Bid price shall include the (1) cost of goods to be supplied, (2) cost of normal-usage spares required for the operation of the system for three years after final acceptance, (3) cost of services for installation & commissioning in terms of conditions of contract, (4) cost of training services (5) cost of O&M of part facilities from OT to Final Acceptance, (6) Cost of Operation and Maintenance for a period of two years during Warranty period from the date of issue of Final Acceptance Certificate and (7) Cost of Operation and Maintenance for a period of three years after Warranty period of two years [Price Schedule 1 to 6]

3. Technical Specifications

RT-DSS Project

The objective of the RT-DSS project of BBMB is a Real Time Operational DSS in BBMB, incorporating a state-of-the-art Data Acquisition System (DAS) and advanced communication system, for real time operational management of the Bhakra and Beas Reservoirs in an integrated manner. The RT-DSS will integrate the real time DAS with real time data from external sources (for example weather forecasts, satellite data), flow forecast modelling, optimization tools, and analysis and decision support tools in a single IT system designed for ease of use by operators.

The main features of the RT-DSS are:

* Comprehensive database
* Comprehensive facilities for integrated presentation of the dynamics of the hydrology and water resources of the basin
* Advanced analytical hydrologic and water resources models
* Predictions of the future hydrologic state of the catchment, river system and water related infrastructure
* Optimised control options for reservoir management

The domain of the RT-DSS is the area of the basins of the Beas and Satluj Rivers from the upstream limits, including the area of the Satluj in Tibet, to the downstream controls of BBMB at Nangal on the Satluj and Pong on the Beas. The DAS will monitor the catchment and rivers within India, and canals downstream to the state contact points.

## Objective of DAS

The objective of the DAS is the provision of accurate and timely monitoring data of the Bhakra-Beas system for analytical and predictive analysis supporting key decisions on reservoir operations.

Key features of the DAS are:

* Comprehensive data coverage – parameters, space, time
* Robust automated technology with independent power supply
* Teletransmission of data – wireless satellite relay downloaded in real time in Chandigarh
* Central data processing – RTDSS Centre
* Data available at BBMB Project Offices and on hand held devices – available for wider dissemination
* Integrated with other players – IMD, CWC, SASE, NTPC, SJVNL, JP Associates hydropower projects etc.
* Complemented by real time remote sensing

For all the system components, the supplier will give training courses to the BBMB operators so that they will be capable of conducting all functions concerned with operation, maintenance, expansion and upgrading of each system component. Long term software and hardware support will also be provided.

**GENERAL**

## Introduction

The project relates to the Satluj and Beas river basins of the Indus. BBMB has been mandated to manage water resources of these rivers for serving partner states of Punjab, Haryana and Rajasthan, and also to Chandigarh and Delhi. The basins are inter-connected and include Bhakra Reservoir on the River Satluj, Pong Reservoir on the River Beas, and Pandoh Reservoir for diverting a portion of the runoff from the Beas River into Bhakra Reservoir.

Large volumes of water are stored in the form of snow in the Himalaya. The seasonal snow accumulation in the winter months and melting of this seasonal snow in the summer months is a regular phenomenon contributing to snowmelt runoff. This constitutes an important part of the annual inflows to the Bhakra Reservoir, and to a lesser extent into Pong Reservoir.

Management of the regional water resources was aided by a hydrometeorological network operated by BBMB. To date observations are made manually. Measurements consist of snowfall, rainfall, river stage/discharge, minimum/maximum temperature, relative humidity, atmospheric pressure, wind speed/direction, solar radiation and evaporation. Data is transmitted manually through 22 wireless stations spread over the Satluj and Beas catchment areas. Water resource data is communicated to the project centres at Nangal, Sundernagar, Talwara, and the corporate centre at Chandigarh. This data is transmitted on an hourly basis 24/7 during monsoons and on an hourly basis on one shift in other seasons. Data from stations that are not on wireless is delivered by post or through messengers.

The modernization of the BBMB network will automate the collection of all data and provide real-time transmission using INSAT. This modernization will include the upgrade of the legacy hydrometeorological network including river stage/discharge, climate, rainfall/snowfall, and various hydrometeorological measurements made at various plants such as Bhakra and Pong Dams. In addition, stations will be established to monitor snow pack through the measurement of snow-water equivalent and snow depth.

A critical component of this modernization project is the overt collaboration between BBMB and other entities operating hydrometeorological measurement systems in the Satluj and Beas river basins. Measurement platforms operated by IMD, CWC, and SASE, NTPC, SJVNL, JP Associates, etc. will either be used directly or augmented with instrumentation that BBMB finds useful in operating and optimizing the RT-DSS which is simultaneously under development..

## Climatic and Hydrological Context

A prominent feature of the Satluj and Beas river basins is the ascending complex terrain attributed to the Himalaya. The upper watershed of the Satluj within India is dominated by snowmelt runoff, which in the lower portions of the Satluj and almost the entire Beas river basin is dominated by a rainfall runoff process. The snow accumulation periods are the winter months with snow accumulation greatest in the months of January and February. The monsoon season can begin as early as June and last through September, and contributes the majority of the annual precipitation in both basins.

Statistical studies of precipitation indicate little correlation of accumulated amounts regardless of the distance between stations. Even stations within a few kilometers do not present any meaningful correlations. This suggests a rainfall process dominated by convective precipitation rather than the more gradual accumulations and generally highly correlated totals attributed to purely orographic precipitation. This in fact suggests a need for a more dense precipitation monitoring network.

Correlations during snow accumulation periods were not able to be properly evaluated because of the lack of stations in true snow accumulation regions. It is expected that the snow accumulation is more consistent over a larger area. One caveat to this interpretation of the past data and ensuing statistical analysis is the absence of quality control and quality assurance procedures. The automation of the data collection and regular automatic transmission of data will address at least some issues concerning data quality.

## Design Principles

The following basic principles have been applied to the design of the DAS network.

#### **Meteorological Network**

* merge existing BBMB and new IMD raingauges and climate stations
* BBMB snow gauges (SWE and depth) upgraded to include precipitation (liquid and solid) and temperature
* IMD raingauges above 2,000m upgraded to include SWE and temperature
* Uniform set of climatic parameters and sensors applied to all BBMB climate stations
* A limited number of additional remote and high altitude gauges measuring precipitation, temperature and snowpack depth and water content
* Ground stations complemented by remote sensed data (precipitation, snow cover and land temperature), including Satluj Basin in Tibet

#### **River, Reservoir and Canal Network**

* On Beas and BSL, all existing BBMB discharge and water level gauges upgraded
* On Satluj mainstream, most existing BBMB gauges are drowned by hydropower projects - new discharge measuring sites established upstream of the Spiti confluence on the Satluj and the Spiti – existing site at Rampur retained
* DAS supplier will provide a discharge measurement unit equipped with Automatic Cableways,ADCPs, current meters and floats - discharge measurements directed by BBMB
* New discharge measurement sites downstream of BBMB powerhouses
* Dams belonging to private power developers monitor reservoir water level and discharges through power tunnels, and spillway (and flushing) gates – signals telemetered by BBMB
* CWC discharge measuring site at Sumdo on Parachu integrated into BBMB DAS
* Downstream Contact Points monitored for water level and discharge

## General Technical Concept

### **Capacity and Implementation Constraints**

Currently, BBMB performs all tasks directly related to the collection of hydrometeorological data. This effort includes taking hourly readings, performing stream discharge measurements, and relaying this information to various data collection centres. The people engaged for the collection of data need to be trained on maintaining the automatic measurement equipment and data collection and relay system. Even though BBMB maintains a few automatic sensors, it was decided to have the installation and maintenance provided under contract as part of the tender for supply and services for the modernization of the hydrometeorological system in the Satluj and Beas river basins.

BBMB intends taking over the maintenance of the entire hydrometeorological network in second year of the two years warranty period after the commissioning & acceptance of the new DAS and a further maintenance period, which will last for three years.

BBMB will also provide parallel staffing to that being provided by the supplier, with appropriate qualifications and experience. The BBMB staff will be further trained in all facets of the DAS by the supplier, will review maintenance procedures, and audit the new hydrometeorological system and bring deficiencies to the attention of the supplier charged with maintaining the network. This will assure the quality of the operation and maintenance of the network and provide BBMB a DAS team which is well conversant with of the system. The BBMB staff will work with the DAS staff with the capacity to absorb both the formal training to be provided, and to learn from working alongside the supplier’s staff throughout the warranty and maintenance periods.

### **General Approach**

The implementation concept on which the present specifications are based combines the advantages of modern data storage, processing and transmission technologies with the requirements of sustainability in the Himalaya.

Preference is given to robust, reliable technology. Some of the high altitude precipitation gauges and snow pillows will be located in very remote areas and should require annual maintenance only. Access to these areas during the monsoon and the snow season will make any maintenance visits prohibitive. It is of central importance that the BBMB data acquisition network has the greatest possible reliability and maintainability. Special protection against environmental factors is required.

Where possible, the bidder should combine data from stations in close proximity using wireless, radio transmissions to a single point, then employing the INSAT transmitter from there. For instance, if there is a river stage station within line-of-sight of a precipitation gauge the bidder will combine the sensors on one platform for transmission to INSAT. This will minimize the number of INSAT transmitters which will reduce the recurring cost for the use of INSAT data communications.

Maintenance is an integral part of any system, and a system that has the challenges of unattended operation in remote, exposed areas requires a well thought out approach to maintenance. Corrective maintenance will be required for component failures. To minimize corrective maintenance and to increase the performance of the monitoring network, a well-organized preventive maintenance plan will be required. Preventive maintenance is required for all system components as well as the infrastructure in place to house the electronic data collection components. It is recognized that the task of maintaining a monitoring network is often grossly underestimated. This leads to reduced life expectancy of the equipment, and possibly the collection of misleading data during the period of operation. A strong maintenance plan will be the foundation to sustaining the BBMB monitoring network operation over the expected lifetime of the technology, which is considered to be 10 to 15 years.

The application of the INSAT data collection system is a key component in the sustainability of a hydrometeorological network in the Himalaya where terrain is complex and where there will be several very remote stations. The use of INSAT will provide for the transmission of data from anywhere in the Himalaya, including areas where other means of telemetry, such as mobile phone networks, would not be otherwise available.

The Technical Specifications cover the equipment and conditions for the installation of the telemetry system in the Beas and Satluj river basins of interest to BBMB. This includes an Earth Receiving Station, which shall be able to receive data from INSAT/Kalpana 3 data relay transponder as well as the data relay terminal (DRT) of future INSAT systems, instrumentation and associated data loggers. This shall include the design, manufacture, factory testing, delivery to site, installation (including the associated interface wiring terminal), commissioning and site acceptance testing, supply of mandatory spares, training and documentation.

Data loggers, monitoring system hardware and software shall interface and be fully integrated and tested with the new Earth Receiving Station to be provided and established. The functional requirements are given in the technical specifications in respect of each major component of the system. The supplier shall ensure that the fundamental requirements stated in this document are not compromised.

**Scope of Work**

The supplier shall be required to provide any or all of the following services:

1. Supply, installation, testing, commissioning, including all civil, mechanical, electrical works etc. for real-time data acquisition network for BBMB and also establishment of satellite telemetry and associated systems.
2. Perform on-site assembly, start-up of the supplied Goods.
3. Establish an ERS (hardware and software) in Chandigarh. This will include providing a computer server for the software, and a colour laser printer. Tasks will include the installation, configuration, and operation of the DAS Centre for one year.
4. Establish a DAS Centre in Chandigarh. This will include software and hardware to collect, display, and provide automatic data quality control prior to making the information available to the RT-DSS. Equipment will include a computer server, and a colour laser printer. Tasks will include the installation, configuration, and operation of the centre for one year.
5. Supply data logger programming and downloading devices, such as laptops and Personal Digital Assistants (PDAs) to perform the function of maintaining data loggers and the data acquisition network in general.
6. Supply the tools required for assembly and maintenance of supplied Goods.
7. Supply a detailed operation and maintenance manual for each appropriate unit of supplied Goods.
8. Supply mandatory spares.
9. Provide classroom and field training to BBMB personnel. This includes operation and maintenance procedures to be carried out at the field stations.
10. Provision for Warranty services for two years after all components in the system have been commissioned;
11. A guarantee by the manufacturer that all equipment being provided will have maintenance support for a minimum of ten years after the commissioning of the equipment;
12. Maintenance services extending 3 years beyond the end of the Warranty services: in the first year the bidder will provide all maintenance services, the second year will be joint maintenance by both BBMB and the bidder though the bidder will have official responsibility. The third year BBMB will provide all maintenance, with the bidder providing on-site personnel to help resolve questions or issues on maintenance while being performed by BBMB.
13. Stream gauging services at all sites to develop a stage-discharge relationship. These stations are identified in the table of water level stations.
14. Coordination with the consultant employed by BBMB for developing RT-DSS for reservoir operations.

**Overview**

## Introduction

The transition from manual to automated observations can lead to a discontinuity in the measurement record if the process is not specified and managed carefully. The benefits of automation include cost effectiveness, high frequency data, better ability to detect extremes, deployment in hostile remote locations, faster access to data, consistency and objectiveness in measurement, and ability to perform automatic quality monitoring.

All sites/instruments should conform to the extent practical with WMO guidelines. The bidder should, in consultation with BBMB (who will be responsible for obtaining land use rights), locate new stations in conformity with the guidelines. Where existing stations do not conform to the guidelines, the bidder should propose an alternative site, to be agreed with BBMB.

Each remote station will transmit data to the ERS on a regular hourly basis (data will be measured every 15 minutes for rainfall and every 60 minutes for other parameters, and will be telemetered once in every hour). The ERS shall collect the field data, store it and then pass the data to the data centre and then after quality controls on to the RT-DSS and long term data storage.

The remote station shall hold the data for at least one year, and shall record the latest data by replacing the oldest data.

## Classification of Remote Stations

There are seven categories of stations that will be part of the RT-DAS. These categories have been devised to make the needs of the RT-DAS more straightforward than compiling all of the stations in one category. The seven categories of stations are listed below, and are further referred to in the Section 3.27.

The seven categories of stations are:

**Category I** Cooperator Stations for Data of Reception

**Category II** Cooperator Stations with additional sensor(s)

**Category III** Automated Rain Gauge Stations (ARGS)

**Category IV** Automated Full Climatic Stations (AFCS)

**Category V** Snow-Water Equivalent Stations (SWES)

**Category VI** Automatic Water Level Recording Gauge Stations

**Category VII** Data Collection from Powerhouses

**Functional Description and Equipment Arrangements at Remote Stations**

### **Category I – Cooperator Stations for Data Reception**

This category consists of Automatic Rain Gauges (ARG) and Automatic Weather Stations (AWS) that are operated by IMD or other cooperator. Stations that are of interest to the hydrological assessment in the Beas and Satluj will be collected by the INSAT ERS located at RT-DSS Centre in Chandigarh, and relayed to the RT-DSS upon reception. The supplier is not responsible for the installation, operation and maintenance of these stations, but only programming the ERS to collect the data, and then pass it on to the RT-DSS. A list of these stations is provided in Section 3.27. BBMB will coordinate with the operating agency to obtain the decoding specifications so that the data can be received, decoded, and made available to the RT-DSS.

### **Category II – Cooperator Stations with additional sensor(s)**

This category is similar to Category I in that this group of stations is operated by another agency, being IMD, CWC, SASE, or some other cooperator, or is operated jointly, i.e. by BBMB and IMD. Additional sensors (as given in Section 3.27.2) will be installed at the cooperator stations through this tender. The sensors will fall under the same warranty provision, with the warranty extended for three years during the maintenance portion of this contract.

The supplier will be responsible for performing field installation or maintenance of this equipment. The suppliers will install these sensors at these stations of the cooperating organization in a manner and protocol established by the BBMB Engineer-in-charge. The supplier will provide technical support to the cooperating organizations and otherwise assist these organizations in bringing these sensors online. The supplier will provide all parts for the installation of these sensors, including cross-arms, brackets, bolts, clamps, cabling, and other ancillary equipment related to the sensor however, data logger & transmitter of the cooperator will be used for which BBMB will establish required protocol. Stations that fall into this category, along with the sensors that will be added to the station, are identified in Section 3.27.2. The specifications for these sensors are provided within the Equipment Specifications of this document. There will be no station civil works required by the supplier for these stations. BBMB will have an agreement with IMD and other cooperators for the installation, operation and maintenance of joint stations, in which details of the cooperation will be set out.

### **Category III – Automated Rain Gauge Stations**

This category describes new data collection stations and upgraded existing stations that will be ARG or enhanced ARG stations. BBMB has identified additional hydrometeorological stations that will be installed as new data stations with INSAT radio telemetry. The stations will measure precipitation along with parameters such as temperature and snow depth as identified in Section 3.27.3. The specifications for these sensors are provided within the Equipment Specifications of this document. Stations higher than 2,000m with elevation, AMSL will be equipped with all season precipitation gauges, while gauges below 2,000m with elevation, AMSL can utilize the tipping bucket rain gauge as specified within the Equipment Specifications of this document.

The rain gauge will be mounted 0.8 to 1m above the ground in rain only locations (below 2,000m with elevation, AMSL ) and will be located in such a way that WMO guidelines on exposure are followed (i.e. structures, trees cannot be closer than twice the difference between the orifice height and the height of the object). In the case of precipitation gauges located above the snow line, the orifice will then be located at least one metre above the probable maximum depth of snow.

**Category IV – Automated Full Climate Stations**

BBMB will be upgrading all existing FCS to provide automatic measurement of the following parameters:

* Temperature
* Relative Humidity
* Wind Speed
* Wind Direction
* Precipitation
* Solar Radiation
* Evaporation (derived parameter)

The data loggers will be able to use these parameters and compute derived parameters such as minimum/maximum thresholds, wind run, and other parameters that are calculated from the existing network. The stations that will be automated to AFCS are provided in Section 3.27.4. The specifications for these sensors are provided within the Equipment Specifications of this document.

The sensors must have complete exposure to the parameter that it is being measuring, and should follow WMO guidelines for the placement of such sensors.

The AFCS will need to be located near by to the existing FCS without interfering with the measurements of the FCS or the AFCS. The FCS will be maintained by BBMB during a period of inter-comparison, and relinquished at some time that BBMB decides. The FCS will continue to be maintained and monitored by BBMB, while the AFCS will in installed and maintained by the supplier. Land acquisition will be arranged by the BBMB Engineer-in-charge, while the bidder will carry out all civil works required for establishing an AFCS.

A stainless steel or powder coated metal instrument box will be provided by the bidder to mount the data logger, INSAT satellite transmitter, batteries, solar charger, batteries, and lightening discharge protection device. The antenna and solar panel can be mounted on one of the poles supporting the stainless steel instrument box. The instrument box must be waterproof. Connections to the enclosure must be made in such a way as to prevent insects and other pests from entering the enclosure. Since the FCS and AFCS are located in populated areas, security fencing will be provided by BBMB.

The bidder will provide all civil works for these stations including the enclosure or building for housing the equipments. A typical arrangement for AFCS is shown in the photograph in figure 3.1.



***Figure 3.1: Typical civil work arrangement for automated full climate stations (AFCS)***

**Category V – Snow-water Equivalent (SWE) Stations**

SWE stations are common in areas where there is a significant contribution to runoff from the snow-melt process. The SWE is determined from ‘snow pillows’ which measure the weight of the snow pack resting above the snow pillow. The snow pillow measurement will be made from four stainless steel tanks plumbed together. Each tank will measure at least 150cm by 120cm for a total coverage of 3m by 2.4m (figure 3.2). This is also known as the California Cooperative Snow Survey (CCSS) pillow design which differs from the typical Natural Resources Conservation Service (NRCS) in that the NRCS snow pillows are rubber rather than stainless steel, and the volume of fluid needed for the CCSS pillow is only a fraction of that needed for the NRCS snow pillow. These stations will also measure precipitation (liquid and solid), snow depth and air temperature and will be accompanied by a shelter which will house the pressure transducer and electronics. The SWE stations will include sensors for precipitation (liquid and solid), temperature and snow depth.

****The bidder shall propose instrument shelter designs, though the CCSS and NRCS typical structure designs are acceptable. The instrument shelter, usually a modified A-frame structure, will be constructed near the snow sensor to provide a weatherproof enclosure for both the instrumentation used to measure SWE and also the automatically reporting INSAT data collection and relay system. The structure should be designed to be in harmony with nature and thus will not appear alien when installed in remote areas of the basin. The sites that have been nominated as SWE stations are provided in Section 3.27.5. The specifications for these sensors are provided within the Equipment Specifications.

***Figure 3.2: Stainless steel four pillow installation in a typical meadow environment***

Snow-water equivalent stations will require a structure that will allow operation and maintenance during deep snow conditions. A typical structure would be tall enough such that the entire building would never be covered in snow, and that an access door above the height of maximum snow depth would be available for entry into the building without digging snow. Figure 3.3 shows a precipitation gauge, a snow depth sensor, and the snow pillow, accompanied by a tower where the transmitting antenna is mounted.

***Figure 3.4: Typical snow pillow instrument shelter, with rain gauge attached to building. Snow depth sensor and snow pillow also depicted.***

### **Category VI – Automated Water Level Recording Stations**

BBMB will be updating and adding water level measurement sites.  The water level technology to be employed consists of bubbler, stilling well float or ADCP (Automatic Doppler Current Profile), for open channel with no bridge.  Down-looking radar will be used at sites that provide an open channel with a bridge.

The bidder shall be required to repair or establish several cableways as indicated in Section 3.27.6 Category VI.  The bidder shall also be required to maintain these cableways through the duration of the contract, including the warranty period as well as the three year maintenance period.  The cableways can either be retrofitted for manual discharge measurements from a cable car or as a bank operated cableway system.

In all instances there will need to be a gauge house that will serve to protect the equipment. The gauge house design must be both economical and capable of serving to protect the equipment from both the environment and interference from the local population. The bidder will propose installations that will not only provide protection to the data logger and transmitter, but also provide protection to the sensor. The bidder will provide diagrams of typical gauge houses, cable runs, and sensor mounting to be used with canal sites, open channel bridge sites, and open channel sites.

A permanent bench mark shall be established at each site, tied to the national datum, and the water level records will be related to the bench mark. Staff gauges shall be provided by the bidder and installed at every stream gauging site.  The bidder will also be responsible for repairing and if necessary replacing the staff gauge through the warranty period and the three year maintenance period.

Section 3.27.6 identifies the water level recording station locations that will be equipped with water level monitoring equipment and telemetry. The sites are identified in a manner so that the stations receive a bridge mounted radar sensor, a bubbler sensor, a stilling well float encoder or an ADCP. The specifications for these sensors are provided within the Equipment Specifications of this document.

Stations in this category that are open channel sites will require discharge measurements, except for canal stations. The bidder will develop a stage-discharge relationship for every open channel site, and maintain the stage discharge table throughout the lifetime of the contract, which not only includes the two year, which is the warranty period, but the following 3-year maintenance period. Measurements will be made a minimum of eight times per year, during the monsoon season, and 20 times during the first year in order quickly to establish rating curves at all unrated rivers reaches. Rating peak discharges will be a priority, and coordinated with the BBMB Engineer in Charge. All river cross section surveys will extend above the maximum water level, and be related to the national datum.

Manual discharge measurements will be made with either portable ADCP/ADV or typical current meters.  Stream-flow conditions may warrant the use of floats to determine the surface velocity, which will be applied to determine discharge. Floats will be provided by the bidder to measure in situations where the ADCP, ADV, or current meter cannot make accurate measurements.

The project will require four ADCP and four ADV, and the necessary equipment to measure from a bridge or cableway.  The supplier will be required to build a cableway to make the ADCP measurement at sites where bridge measurements are not possible.  It is acceptable to use bridge measurements within 1km of the water level measurement stations provided there is no tributary side flow.  Newly established stations will follow the WMO recommendations for new station sites. The approval of BBMB will be required for all newly established sites.

Time Series database software such as KISTERS, HYDSTRA, or AQUATICINFORMATICS (AQUARIUS), or similar software will be acquired by the bidder. All stage-discharge data will be processed through this software and corrected to provide a complete and accurate historic record. The bidder will explain the process of data collection and correction through these software packages so that expertise in performing this type of work can be evaluated. This will be a qualification for all bidders. Preference will be made to software that has recurring maintenance/licensing fees, and for which long term support is assured, provided the technical capabilities are adequate for the task.

Rating tables will be developed after every discharge measurement and provided to BBMB. The discharge table will include the stage in 5mm increments and corresponding discharge values over the entire span of observations. The discharge table will include stage-discharge values for peak flow, using extrapolation based on the full surveyed river section if discharge measurements do not include the peak flow.

Water level recording stations will require a gauge house defined as a suitable building to provide protection of the equipment from both the weather and tampering. An example of a suitable building is provided in figure 3.5. The gauge house for a water level measuring station does not need to be contained within a secondary security fence, because there will be no sensors outside the building except for the water level station. All cabling will be run within conduit, including the coaxial cable for the satellite transmitting antenna. No wire shall be exposed, and vulnerable to tampering.



Figure 3.5: Acceptable gauge house showing an example of a secure building.



***Figure 3.6: Typical arrangement of radar sensor for bridge sites***

***Figure 3.7: Typical arrangement of radar sensor for bridge sites***

### **Category VII - Data Collection from Powerhouses**

There are many stretches of the rivers that have hydrogeneration facilities. BBMB will make agreements with all hydrogeneration operators, sharing the data that is collected by the facility owner. The data will generally be collected in the respective powerhouses where the flow is calculated for discharge passing through generation as well as discharge from spillway and flushing gate structures on the associated impoundment.

The powerhouse operators will generally be providing proportional electronic signals in the form of 4-20mA signals. The data logger installed by the bidder will take these signals, convert the 4-20mA signals to discharge and reservoir elevation, and transmit the data through the INSAT satellite. The task of getting the signal from the powerhouse will require the bidder to suggest a method to take the signal from the powerhouses, which often are deep underground, to a point where the transmission to INSAT can be made. Provision for equipping the powerhouses with data collection and telemetry will be provided as part of the bid. BBMB will facilitate arrangements for installation with the individual operators.

Section 3.27.7 lists the powerhouses that will be fitted with data collection equipment. The specifications for sensor inputs and data logger capabilities to perform this type of data collection are provided within the Equipment Specifications of this document.

The data logger and ancillary equipment will be located within the powerhouse, the location of which will be agreed upon between BBMB and the powerhouse operator. The INSAT antenna will need to have line-of-sight to the INSAT satellite. Any data collection related equipment placed at the powerhouse will be coordinated between the BBMB Engineer-in-charge and the supplier prior to the commencement of work. The Engineer-in-charge will be the focal point for coordination with the powerhouse operator.

### **Functional Description of Earth Receiving Station**

One Earth Receiving Station (ERS) shall be established at the BBMB RT-DSS Center in Chandigarh. BBMB will provide an uninterruptible power supply, a suitable location for the antenna dish and space to install the ERS data collection computer. The ERS will be used to receive all INSAT transmissions before passing the information on to a secondary processing function which will perform the quality control, web based data visualization, while handing the data off to the RT-DSS. The ERS will be able to collect any message being transmitted through INSAT and should be able to receive 1000 stations in real time. The supplier will provide all services to establish power to the ERS and put the system on an INTRANET. The supplier will provide all civil works related to the installation of the antenna, including cabling, wiring, or other such infrastructure required to operate the ERS.

#### **Functional Description of Data Centre**

The objective of establishing a Data Centre in Chandigarh is to ensure that high quality data collection, compilation, processing and analyses are available for making sound water management decisions.

The Data Centre will receive hourly and event data on a real-time basis from the ERS, storing all raw data collected on a computer server. The server will make real-time and historical data available to the RT-DSS. The space for the Data Centre will be provided by BBMB. Processing capabilities for this function will be provided by the supplier. The details of the Data Centre and the function of the hardware and software are provided in the specifications of the Data Centre.

Figure 3.8 provides a system block diagram of Data Centre components that will be provided by the supplier under this contract. Components include ERS, Data Acquisition System server for the collection, quality control, and relay of information to the RT-DSS. This infrastructure includes all networking devices to connect the equipment via INTRANET to the RT-DSS.

The BBMB Web Portal will be from the RTDSS Centre, and is not part of this contract. The DAS supplier will have no involvement in developing the BBMB Web Portal. The supplier will have responsibility in developing a software tool to view the data, which will include ad-hoc graphical queries, ad-hoc data reports, including daily and monthly summaries of all data collected, along with tools for quality control. The data flow will be as follows:

1. Each DCP will automatically measure precipitation every 15 minutes and other measurements every 60 minutes, and transmit this measurement every hour. It will store this observed data in its memory and then transmit it in self timed manner in its prescribed time slot every hour.
2. Random transmissions based on meeting data thresholds may be requested by BBMB.
3. The overall probability of data reception for the system will be 95% or better.
4. The ERS will be installed at the RT-DSS CENTRE in Chandigarh. Data will be received from all DCPs of interest to BBMB regardless of the DCP owner.
5. The data collected by the ERS will be processed by the data processing software.
6. The processed data will be stored locally in the data processing centre and made available to the RT-DSS in an ASCII flat-file format that will include the station identifier, time, date, measurement interval, and parameter tag.
7. For the purpose of compatibility, the supplier shall coordinate with the consultant employed by BBMB for development of RT-DSS, including database management system.

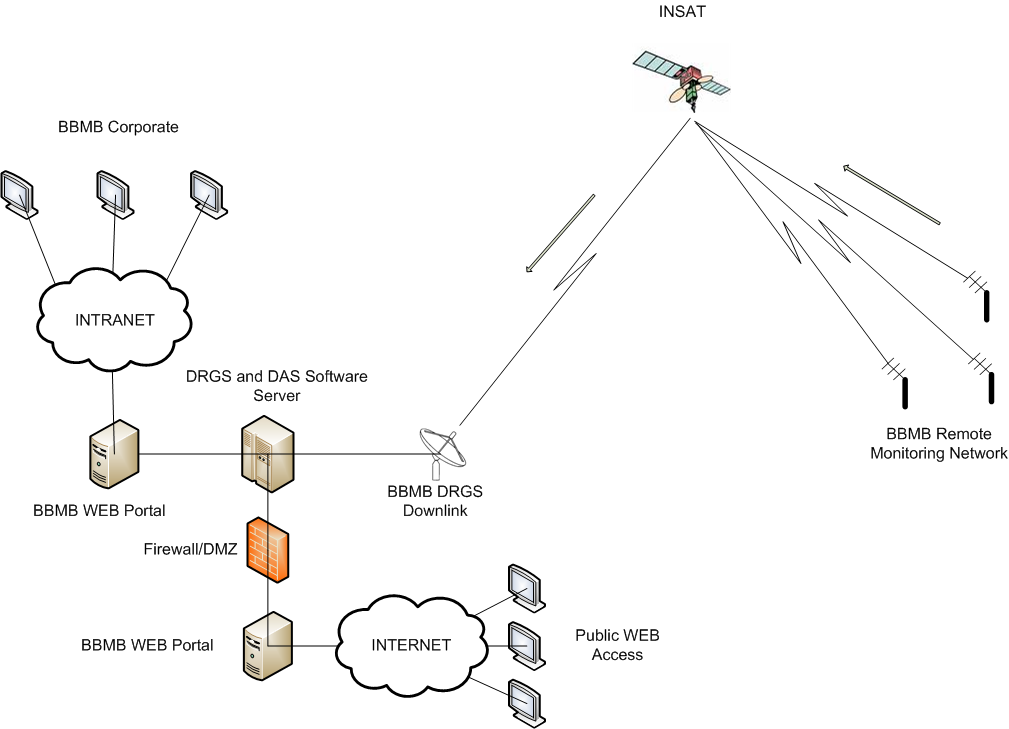


Figure 3.8: Schematic diagram of data flow for BBMB Data Collection Network

## General Specification

All goods and materials to be incorporated in the supply have to be new, unused, and of the most recent or current models, and incorporate all recent improvements in design and materials unless provided otherwise in the contract.

Wherever reference is made in the Technical Specifications to specific standards and codes to be met by the goods and materials to be furnished or tested, the provisions of the latest current edition or revision of the relevant standards or codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified will be acceptable.

## Bid-Related Requirements

A project execution plan has to be provided after award of contract, including system design block diagrams, a list of critical engineering activities, a manufacturing and delivery schedule, the proposed training program, as well as guidelines and standards for civil works.

In order to ensure operational sustainability, both the training program and a 3-year operation and maintenance support for the remote stations as well as the data centre are required as part of the bid.

## Shipping and Delivery

The supplier shall furnish BBMB a complete program of delivery for the equipment, and shall provide revisions to this program as and when necessary.

The supplier shall be responsible, at his cost, for loading, transporting, shipping, customs clearance and unloading of the equipment to be supplied under the contract from the point of manufacture to the destination of delivery (BBMB Premises, Chandigarh). The transportation of equipment to field locations as per section 3.27 of the technical specifications for installation after receiving inspection shall also be the responsibility of the bidder as part of installation requirement. The bidder shall also be responsible for any storage of the equipment in Chandigarh during any interim period between supply and transportation to field locations for installation.

The supplier shall provide such packing of the equipment as is required to prevent its damage or deterioration during transit to its final destination.

## Installation Arrangements

### **Field Work**

Most roads in the Himalaya can be in bad condition and travelling times, even from the regional centres to the station locations, are long. In winter many regions (and in particular mountain locations) are inaccessible for extended periods. For this reason the system must be designed in such a way and the training component must be strong enough that equipment maintenance at remote stations can also be done by the client’s national staff, if required. Appropriate training courses shall be conducted by the supplier’s experts. Bidders will include details of the proposed training programs in their bids. All systems must be preassembled and an end-to-end test must be passed prior to installation.

### **Civil Works**

Civil works will be a part of this bid as specified in section 3.28 of the Technical Specifications. All the civil works for enclosures/buildings at the stations of BBMB will be carried out by the supplier as per BIS standard design & drawings and in accordance with the local conditions. However, Bidders shall furnish details and standard drawings of equipment mounting arrangements and installation to the employer. Bidders shall install lightning protection and power supply. The outer enclosures of security fencing, gates & locks etc. will be provided by BBMB.

### **Station Installation**

The Bidder will be fully responsible for the installation, commissioning and site acceptance testing of all measuring stations. Installation of all data collection stations, sensors and data center components shall be provided by the bidder. The bidder will be required to devise acceptable mounts for sensors, as sensor placement should abide by WMO convention as applicable or by standard hydrological practices. The bidder shall also devise acceptable mounts to the existing bridges that should take into account obtaining a good measurement as well as adequately securing the sensor from tampering and/or vandalism. The Purchaser may inspect some or all equipments prior to installation to assure the products meet specifications. The Purchaser may also delegate this activity to a third party. Each station shall be commissioned by the Purchaser upon inspection of complete installation and functioning data collection activities. Installation shall be considered complete when all stations have been commissioned and operating for a 30 day period with no break in service for any station/sensor longer than 24 hours.

## General Specifications

### **Specifications and Models Offered**

The specifications offered by the supplier will be part of the contract between BBMB and the selected supplier, and will be used by the inspection authority to verify compliance on delivery. All goods supplied shall be new, unused, and of the most recent or current models, incorporating all the latest improvements in design and materials used.

### **Geographical and Ambient Specifications**

All materials and equipment supplied under these specifications shall be suitable for being delivered, stored and operated under continental conditions with extreme changes of temperature between winter and summer and between day and night.

It is the bidder’s responsibility that the offered equipment/configuration be appropriate for the following locations and climatic conditions:

* Elevation : 300 to 5,000m
* Temperature range : -40° to +60°C (air temperature)
* Relative humidity range : 5 to 100%

### **Units**

Measurement units of all the equipment/systems to be procured shall be metric.

### **Station Autonomy**

The conditions and constraints of network operation in the Himalaya of India require long periods of station autonomy. The measuring stations shall offer capability for unattended operation for at least one year both in power supply and data logging capacities.

Mains power will not be available at any of the remote stations. If solar panels are used for power supply the capacity of the battery (12V DC, sealed, maintenance-free) must be sufficient for operation for at least 20 days without recharge and the data logger memory must be non-volatile. Longer autonomy will be required for certain components, as specified in the following sections.

### **Enclosures and Fencing**

All enclosures should withstand hostile environments and must be protected against vandalism. The door must be secured using a tamper proof lock. Additional security devices may be recommended. Outdoor enclosures will contain all instrumentation except solar panels and sensors. The required degree of protection is IP65 or NEMA4. A radiation shield of a double wall must protect the enclosure against excessive heating by radiation.

All the fencings required for BBMB stations (existing as well as new) will be constructed by BBMB in accordance with the latest specifications.

### **Lightening Protection**

All sensors, data loggers and other equipment shall be surge protected as required. Equipment for lightning protection, such as conductors and ground rods, are part of the station equipment to be supplied.

### **Data Loggers**

Data loggers must be based on a widely used model produced by a primary brand name and tested in a large number of installations and must have been in production for at least 2 years. All data loggers must have programmable data acquisition rates, a large and expandable data storage capability and low power consumption. Both the battery level and the solar panel voltage level must be logged in addition to the basic parameters.

The Data-Logger programming environment has to be simple, flexible, and be capable of integrated calculations of derived variables such as minimum, maximum, etc. There must also be an option to convert the input data detected in electrical units into engineering units using conversion formulas.

The input channel scanning must be programmable based on the following options:

* Time base
* On request
* Event based

The data loggers should have the ability to use multi-telemetry paths. While INSAT will be the primary telemetry path, the data logger shall be able to use GSM/GPRS, TCP/IP radio, METEORBURST, or ALERT radio as simultaneous telemetry path.

### **Accessories and Tools**

All accessories, tools and fixtures required for installation and dismounting/remounting of the equipment shall be treated as part of the supply for each type of equipment. Devices and instruments required for sensor re-calibration shall be offered separately.

### **Consumables**

The bidder shall provide an initial supply of consumables, for at least three years of operation, which shall be included in the cost of the equipment offered.

### **Documentation**

The bidder must submit full documentation, including user’s manuals and guidelines for operation and maintenance in English, for all equipment and software components supplied.

In addition a project-specific system operation manual has to be prepared, including

* Specific equipment layout
* A procedural handbook
* System block diagrams (logical connections)
* Wiring diagrams
* Interface specifications, including communication protocols and configuration modes
* Software licenses.

The manual shall be provided both as hardcopy (10 copies) and on CD-ROM (10 copies).

##### Equipment Specifications

3.1 Hand Terminal Devices for Communication with Data Loggers

This equipment will be provided to BBMB for eventual field maintenance, and shall be of the same type used by the supplier’s field maintenance team. The supplier will be responsible in providing their contracted maintenance staff communication devices in addition to these five units.

|  |  |
| --- | --- |
| One unit consists of a mobile hand terminal for two-way communication with data loggers, including software as well as all cables and other accessories.  **Number required: 5 mobile units** | |
| **Item** | **Technical specifications** |
| **Ambient conditions** | ambient temperature: -40 to +60 degrees C  relative humidity: 5–100% RH-arid climate  altitude: 300–5,000m |
| **Storage and communication unit for off-line data transmission** | functions: communication with data logger (read-out of measured values, adjustment of logger settings, control reading of actual value and time), temporary storage of data, transmission to PC  compatible with specified data logger  illuminated display  integrated memory (card), storage capacity minimum 32 MB  handling of data from minimum 5 measuring stations at the same time  RS232 interface  robust housing, protection IP65  including connection cables (data logger - hand terminal and hand-terminal – PC)  power supply for at least 8 hours of continuous operation |
| **Communication software** | Window based software  English language version  suitable for data logger communication and off-line data transfer to PCs  graphical and tabular data display for raw data control  export function for data transfer to other software packages |

3.2 Rugged Notebook Computers

This equipment will be provided to BBMB for eventual field maintenance, and shall be of the same type used by the supplier’s field maintenance team. These units will be used to program the data collection platforms and to access the Internet and review the data being collected by the visualization software. As they will be transported throughout the project area, they should be of the ‘rugged’ type.

The supplier will be responsible in providing their contracted maintenance staff with the equipment in addition to these five units.

**Number required: 5**

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| **Item** | **Technical specifications** |
| **Ambient conditions** | ambient temperature: -40 to +60 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 5,000m |
| **Hardware** | for field use, communication with data loggers (full communication and configuration functionality) and transmission units, temporary storage of data, graphical data quality control  input interface compatible with data loggers and telemetry equipment  with shock-mounted hard disk drive and flexible internal connectors  with outdoor-readable, anti-reflective LCD, 13” minimum  with sealed spill-resistant keyboard and touchpad  sealed case construction for dust protection  with Lithium battery pack, operation minimum 3.5 hours with spare battery.  power management: hibernation, standby  English keyboard + touchpad  Processor speed 2.0GHz minimum  4GB RAM minimum  160GB (minimum) hard disk capacity  with LAN connection  2 USB ports  with serial port and connections / adapters (if required) for interfacing with data loggers and telemetry equipment  with both mains and 12V power supplies /chargers  3-year warranty |
| **Software** | Windows operating system (Windows 7)  Standard MS Office software  English language version  With all software components installed, ready for use, as required for:   * + - * + communication with data loggers and sensors, all types supplied         + communication with telemetry system components         + display of control values, graphical data control |

3.3 Precipitation Gauge (Rain Only Sites)

1. Rainfall shall be measured using the tipping bucket method and shall be able to record cumulatively.
2. The rain gauge shall be of such a design that it operates reliably and accurately under prevailing environmental and weather conditions.
3. The rain gauge will be easy to operate and easy to calibrate.
4. The minimum expected operational lifetime shall be 15 years.
5. All openings of the rain gauge shall be covered with a screen to protect against insect infestations.
6. The gauge shall have leg adjusters to set the time horizontally.
7. A certified calibration test document shall be part of the delivery.
8. The rain gauge will have either a software process or a siphon system to eliminate over accumulation or under accumulation of precipitation.

This rain gauge is for use at sites at elevations less than 2,000m.

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -10 to +60 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 2,000m |
| **Precipitation sensor** | for measurement of rainfall  Tipping bucket rain gauge  Bucket capacity 1mm  Siphon system or software to eliminate the over accumulation or under-accumulation of precipitation based on rainfall rate  Synthetic ceramic coated brass bucket or equivalent  collecting funnel diameter 200mm minimum cast aluminium powder coated  0–500mm/hr +/-2% accuracy  Drain fitting to catch rainfall after passing through buckets  Contact system using dual reed switches with varistor protection  Insect covers on all openings  output interface: as required for data logger specified below |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |
| **Enclosure** | Ability to service tipping buckets without involving the re-levelling of the gauge. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.4 Precipitation Gauge (Rain and Snow)

(1)Rainfall shall be measured using total weight of precipitation.

(2)No heating mechanism shall be used to melt snow, but rather the use of antifreeze (propylene/glycol) will be used.

(3)The rain gauge shall be such a design that it operates reliably and accurately under prevailing environmental and weather conditions.

(4)The rain gauge will be easy to operate and easy to calibrate.

(5)The minimum expected operational lifetime shall be 15 years.

This precipitation gauge is for use at sites at elevations 2,000m and above.

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +60 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 2000 to 5,000m |
| **Precipitation sensor** | for measurement of both rainfall and snowfall, without heating  Storage gauge system equipped with an antifreeze reservoir.  Material: UV resistant plastic or corrosion resistant metal (aluminium, stainless steel), shock and vibration resistant.  capacity: min 1,000mm (water equivalent), with deep vertical walls to allow for snow accumulation  Design will allow for the measurement of precipitation that has collected on the inner walls of the gauge  collecting funnel area 314cm² minimum  accuracy ±0.2mm; 2% of intensity (over a period of 15 minutes), expected resolution 0.2mm  for weighing principle: drift-free sensor; influence of wind eliminated by appropriate software algorithm.  power supply 12V DC or switch rated for 12V DC  output interface: as required for data logger specified below |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |
| **Rating** | NEMA 4 |
| **Enclosure** | The components of the gauge shall be easily accessible for maintenance and replacement of parts, including but not limited to the strain gauge and other components required to perform the measurements |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.5 Water Level (Bubbler)

The bubbler system includes a non-submersible pressure transducer, automatic bubble system, orifice line and orifice.

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| **Item** | **Technical specifications** |
| **Site Conditions** | ambient temperature: -30 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 4,000m |
| **Input Power** | 11 – 15V DC |
| **Bubbling System** | Continuous bubbling system where bubbles are continuously produced thus keeping the line under pressure |
| **Average current Draw** | ≤ 25mA based on 60 bubbles/minute |
| **Range** | 15 PSI or the range of expected levels |
| **Air Drying System** | If an air drying system is used operation of the drying system shall be maintenance free for at least two years |
| **Accuracy** | 0.02% FSO |
| **Resolution** | 3mm @ 15 PSI |
| **Sensor Type** | Non-submersible transducer |
| **Output** | SDI-12 and 4-20 mA |
| **Purge** | Manual line purge |
| **Bubble Rate** | Programmable 30–120 bubbles per minute |
| **Enclosure** | The sensor and the bubbling mechanism shall be separate components to allow for the exchange of either the bubbler or non-submersible transducer. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station)  All accessories required for the operation of equipment, including, but not limited to adjustments and confirmation of the bubble rates |

3.6 Water Level (Radar)

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| **Item** | **Technical specifications** |
| **Site Conditions** | ambient temperature: -40 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 3,000m |
| **Power Input** | 10 – 15V DC |
| **Power Consumption** | Active < 20mA, Sleep < 10mA |
| **Range** | 1-30m  sensor mounting supports and other accessories as required |
| **Accuracy (linearity, repeatability, hysteresis)** | 0.03% FS or less |
| **Resolution** | 3mm or less |
| **Output** | SDI-12 |
| **Enclosure** | The radar shall be easy to dismount and replace in the event of malfunction.  The enclosure shall also be designed to dissuade or otherwise prevent unauthorized access.  All wire runs between the radar and the data logger shall be similarly designed. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station) |

3.7 Water Level (Stilling Well/Float/Encoder)

Several stations on canals downstream of Pong and Bhakra Dams have existing stilling wells. These stilling wells will be retrofitted with new shaft encoders, and float systems.

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| **Item** | **Technical specifications** |
| **Site Conditions** | ambient temperature: -40 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 3,000m |
| **Sensor Type** | Shaft Encoder with digital readout |
| **Resolution** | 3mm or less. |
| **Output** | SDI-12 |
| **Accessories** | Floats, graduated tapes (metric), wheel, counterweight, and cabling |
| **Enclosure** | Lockable (key) box provided by the supplier to be mounted within the gauge house. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.8 Temperature Sensors

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| --- | --- |
| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 5500m |
| **Range** | -40°C to +60°C |
| **Accuracy** | 0.3°C or better |
| **Resolution** | ± 0.1°C |
| **Sensor type** | Resistance Type |
| **Response time** | 10 seconds or better |
| **Connecting cable** | Cable length: 5m or the cables need to be long enough to be run continuously (without splicing) from the sensor to the data collection system. |
| **Housing for equipment** | protection IP68  Diameter max 80mm |
| **Accessories** | all accessories (fixing units, etc) as required |

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| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation and maintenance instructions in English (1 copy per station) |

3.9 Relative Humidity Sensors

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 5,500m |
| **Range** | 5% to 100% RH |
| **Accuracy** | ±3% or better |
| **Resolution** | 0.5% |
| **Sensor type** | Capacitive/ Solid State |
| **Response time** | 10 seconds or better |
| **Connecting cable** | Cable length: 5m or the cables need to be long enough to be run continuously (without splicing) from the sensor to the data collection system. |
| **Accessories** | all accessories as required |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation and maintenance instructions in English (1 copy per station) |
| **Housing for equipment** | protection IP68  Diameter max 80mm |

3.10 Wind Speed/Wind Direction Sensors

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +50 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 2,500m |
| **Sensor Type** | Ultrasonic (no moving parts) |
| **Range** | 0–65m/s for speed, 0–360 degrees for direction |
| **Accuracy** | The greater of 0.2m/s or 3% of reading for wind speed, +/-2 degrees for direction |
| **Response Time** | 10 seconds or better |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.11 Atmospheric Pressure Sensors

The atmospheric pressure sensor will measure station pressure once an hour. The data will be stored on the data logger and subsequently transmitted via INSAT.

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +50 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 2,500m |
| **Pressure sensor** | temperature compensated  range: 800 to 1100hPa or as determined by the station elevation  accuracy: ±0.5mb |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.12 Solar Radiation Sensors

The intent of this sensor is to measure global solar radiation. The sensor shall be temperature compensated. The sensor shall comply with WMO standards for making solar radiation measurements at climate stations. Solar radiation data will be transmitted once per hour via INSAT.

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -0 to +50 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 2,500m |
| **Sensor** | Pyranometer (CMP 11 or better) |
| **ISO Classification** | ISO First Class (Secondary Standard) |
| **Response Time** | 10 seconds or better |
| **Spectral Range** | 310–2,800nm |
| **Tilt Error** | +/- 0.2% at 1,000w/m2 |
| **Temperature Sensitivity** | +/- 1% (-10 to +40C) |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.13 Data Logger

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +50 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 5,000m |
| **Data logger** | well proven and widely used model, produced by a primary brand name and tested in a large number of installations. Provide manufacturer’s certificate that the model proposed has been in production at least 2 years  open design, operating with a wide variety of sensors  Flash memory 32mb of suitable size to store a minimum of one year of data for maximum configuration at greatest sample rates.  Data memory expansion with the use of either external memory (either USB or SD)  non-volatile flash memory (4GB) or similar for the storage of the data collection program. Data collection will restart automatically if power is interrupted.  Program memory size should be twice that needed to run the data collection program allowing for enough space to increase the data collection program  A/D resolution ≥16 bit  individual recording intervals for each sensor/parameter  Multi-tasking operating system-must log data and transmit at same time  Digital Display for viewing current data and setting values that will allow the viewing and adjustment of data without a computer or PDA.  power supply 12V DC, low current drain (quiescent ≤10.0mA)  monitoring of voltage level  internal battery backup for clock |
| **Evaporation** | Evaporation will be calculated from the meteorological parameters (precipitation, temperature, relative humidity, wind speed and direction, and solar radiation) and the application of the Penman Equation. The data logger shall calculate evaporation, store and transmit the data on a daily basis. |
| **Input/Output** | 8 analogue channels  8 digital input/output channels, 2 input for rain gauge impulses, 6 bidirectional  SDI-12, supporting a minimum of 20 devices, and 10 parameters per device.  3 input/output interfaces, one for the INSAT radio, one for the addition of GSM radio or other serial communication device, one for system programming and manual data collection to a notebook or a mobile storage unit such as a PDA. |
| **Software** | Windows software for system configuration / communication compatible with XP and Windows 7.  English language version  All required licenses included  Different user levels, system of user rights / passwords, access restricted to authorized personnel |
| **Accessories** | serial cable + adaptor (if required) for notebook connection  all accessories (fixing units, etc) as required |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation and maintenance instructions in English (1 copy per station) |

3.14 Snow Depth Sensors

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +50 degrees C  relative humidity: 5% to 100%, semi-arid climate  altitude:2000 to 5500m |
| **Sensor Type** | Ultrasonic with output compatible with Data Logger (i.e. 0-5V, 0-2.5V, 4-20 mA, SDI-12) |
| **Range** | 0 – 10m |
| **Accuracy** | .25% of measuring distance |
| **Response Time** | 10 seconds or better |
| **Accessories** | Sensor mounting support, cables (power and signal), and other accessories as required. |

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| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station). |

3.15 Snow-Water Equivalent (SWE) – Snow Pillow

A SWE sensor is also defined as a snow pillow. The stainless steel snow pillows are specified as they take less antifreeze than the larger rubber pillows, and thus will be easier to install. These tanks shall be tested for leaks prior to installation.

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +40 degrees C (air)  relative humidity: 5% to 100%  altitude: 2,000 to 5,500m |
| **All sensors** | power supply 12V DC  output interface: as required for data logger specified below |
| **Snow pillow** | measurement of snow water equivalent (mm)  consisting of liquid-filled pillow and a pressure transducer (or, alternatively, a system consisting of a standpipe, float and shaft encoder)  Four snow pillows per station plumbed together  total area min 7m² (80 sq ft)  tanks made from stainless steel by manufacturer experienced with fabricating snow pillow tanks (provide snow pillow manufacturer name and state experience building snow pillows, provide list of references)  range: 1,000mm water equivalent  pressure measuring accuracy: 1% full scale (10mm)  antifreeze solution for filling snow pillows  pipes and valves as required |
| **Accessories** | sensor cables (signal/power) for mounting on 6 meter tower  sensor mounting supports and other accessories as required  antifreeze solution (if applicable) for 3 winter seasons |

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| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation (including wiring diagrams) and maintenance instructions in English (1 copy per station) |

3.16 Power Supply

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| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -40 to +60 degrees C; (-40 to +40 for Snow Station)  relative humidity: 5% to 100%, semi-arid climate  altitude: 100 to 5,500m |
| **Solar power supply** | common power supply for data logger, sensors, and transmitter  12 V DC  solar panel as required for region, including mounting unit  including sealed battery  solar panel and battery must be sized according to needs of equipment provided and ensure at least two weeks full operation without recharge (one month of operation without transmission). The bidder must provide a power budget indicating how this requirement will be met.  including voltage / charge regulator  with battery test indicator  Special batteries for cold conditions shall be procured; underground installation for frost prevention should be considered. |
| **Lightning protection** | all devices for lightning / over voltage protection of sensors, data logger, transmitter and solar power supply equipment to be included, as required for the specific station configuration |
| **Accessories** | all accessories (fixing units, etc) as required  include battery chargers (in: 230V AC / out: 12V DC): |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation (wiring diagrams) and maintenance instructions in English (1 copy per station) |

## Discharge Measurement

3.17 Automatic Cableway Gauging System

All cableways shall use an automatic cableway gauging system. New cableways that are installed will accommodate the automatic cableway gauging system. The sites that have or will receive new cableways are listed in section 3.27.6. The automatic cableway gauging system shall have the capability of being shared among all cableways. In all, six automatic cableway systems will be required, while all cableways shall be retrofitted to accept the transportable cableway system.

The automatic cableway gauging system shall meet or exceed the following specifications:

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| **Item** | **Technical specifications** |
| **Site Conditions** | ambient temperature: -30 to +60 degrees C (air)  relative humidity: 5% to 100%, semi-arid climate  altitude: 300 to 4,000m |
| **Shared System** | The system shall perform river and stream discharge measurements from fixed cableways using either conventional Columbus type gauging weights and mechanical current meter or Acoustic Doppler Current Profiler (ADCP)  The system shall be operated from the bank of the river or stream using remote control  The system shall allow the current meter or ADCP to traverse the stream at user selected distances and user selected depths (in the case of the current meter).  Digital distances and depths shall be automatically recorded with a stream discharge computer in the field. |
| **Distance Measurement** | Horizontal distance and vertical depth shall be measured and recorded within or equal to 0.1m |
| **Remote Control** | The remote control shall allow for control up to 500m in range from the bank operated discharge point  Limit switches or other safety precaution shall be included to prevent damage to the hoist or horizontal traversing mechanisms  Motors shall be protected with electrical fuses to prevent motor overload. The fuses must be standard and available in India  The power source for the remote control device shall be by common batteries, such as C, D, AA, AAA  If radio frequency is used for remote control, the radio shall comply with the regulation for wireless devices in India |
| **Hoist** | Hoisting mechanism used to move discharge devices into the water shall be capable of using the 135kg weight, and all associated equipment used for making the discharge measurement  Hoist power requirements shall be provided by 12V DC batteries, and shall be commonly available in India |
| **Discharge Measurement** | Automatic cableway gauging system shall include a built in signal processor for current meters and ADCPs |
| **Discharge Computer** | Each automatic cableway system shall include a field computer that will be used to calculate discharge in the field |

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| **Software** | All software to process the discharge measurement and incorporate this measurement into the development of a rating table shall be included. Software shall be able to create discharge tables to be transferred to the data centre and on to the DSS. |
| **Tools and manuals** | Complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  Full documentation and maintenance instructions in English (1 copy per station) |

3.18 ADCP River Discharge Measurement

BBMB requires four ADCPs.  Three ADCPs will be down-looking systems that shall be used for manual stream gauge measurement.  The fourth ADCP will be a fixed in-stream side-looking application that will be installed on the Beas River downstream of Pong Dam.  The specifications of each ADCP are provided below.

The ADCPs will come with all accessories to make measurements from a bridge, boat, tag line, and from a cableway.  This includes a floating platform.  This equipment will be used by the supplier and serviced by the supplier for repair due to malfunction or other equipment breakdown.  This equipment will used by BBMB during the maintenance transition period, and stay in the possession of BBMB at the end of the maintenance contract.

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| **Item** | **Technical specifications** |
| **ADCP Type** | Down-looking ADCP for manual measurement of discharge |
| **Profiling Distance** | 0.3–10m |
| **Profiling Velocity** | +/-20m/s |
| **Velocity Accuracy** | 0.25% of measured velocity |
| **Velocity Resolution** | 0.001m/s |
| **Depth Range** | 0.3–10m of depth |
| **Depth Accuracy** | 1%. |
| **Depth Resolution** | 0.001m |
| **Discharge Distance** | 0.3–10m |
| **Computations** | All performed internally |
| **Accessories** | Floating platform for the ADCP  GPS for bottom tracking  All necessary tethers and taglines  Real-time display for instantaneous readings |

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| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation (wiring diagrams) and maintenance instructions in English (1 copy per station) |
| **ADCP Type** | Side-looking ADCP for continuous measurement of discharge on Beas d/s of Pong Dam |
| **Sampling Range** | 1.5–100m or as determined upon inspection of site |
| **Vertical Beam Range** | 0.2–15m |
| **Horizontal Beam Width** | 1.4 degrees |
| **Vertical Beam Width** | 3.8 degrees |
| **Depth Range** | 0.3–10m of depth |
| **Depth Accuracy** | The greater of +/-0.6 cm or 0.1% of measured depth |
| **Voltage Input** | 12V |
| **Power Consumption** | 20mA, though it is desirable if unit measures only during data logging in order to save power |
| **Accessories** | All mounting equipment, conduit for a secure installation along the river bed.  The bidder may suggest alternative solution that yields the same or higher accuracy and precision |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation (wiring diagrams) and maintenance instructions in English (1 copy per station) |

3.19 ADV Velocity Measurement

The acoustic Doppler velocity meter (ADV) will be used for velocity measurements in shallow water conditions that can generally be waded.  There will be six unit required with accessories needed to make measurements such as a display, wading rods, etc.  The ADV will be used by the supplier and serviced by the supplier for repair due to malfunction or other equipment breakdown.  This equipment will used by BBMB during the maintenance transition period, and stay in the possession of BBMB at the end of the maintenance contract.

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| **Item** | **Technical specifications** |
| **Profiling Distance** | 0.3–10m |
| **Profiling Velocity** | +/-4m/s |
| **Velocity Accuracy** | +/-1% of measured velocity, 0.001m/s |

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| **Velocity Resolution** | 0.0001m/s |
| **Input Power** | 12V DC nominal |
| **Environmental** | Operating temperature -5 to 40 C |
| **Depth Resolution** | 0.001m |
| **Tools and manuals** | complete tool kit for installation and routine maintenance giving full details (number of pieces and type)  full documentation (wiring diagrams) and maintenance instructions in English (1 copy per station) |

3.20 Electronic Current Meters

BBMB will require six sets of current meters with all accessories required to make discharge measurements over all ranges of flow encountered in the Satluj and Beas basins above and below Pong and Bhakra Dams.  Accessories include Price-type current meters or equivalent.  The current meters should be able to measure the entire range of flows, typical of measurements made by either Type AA or Pygmy current meters.  Weights for carrying out discharge measurements will include weights of 7, 15, 23, 34, 45, 68, 90, and 135kg.

There will be four sub-centres (Nangal, Talwara, Pandoh Dam, Rampur and Pooh) where measurements will be made, so each sub-centre will be supplied with equipment to take measurements over the entire range of flows.  There will be one spare sets of stream discharge measurement equipment provided as spares.  The bidder will provide the complete specifications of the equipment as part of the bid.

The current meters’ accessories will include wading rods, cranes, sounding weights, taglines and boats to take measurements from a bridge, cableway, boat or by wading. This equipment will be used by the supplier and serviced by the supplier for repair due to malfunction or other equipment breakdown.  This equipment will be used by BBMB during the maintenance transition period, and stay in the possession of BBMB at the end of the maintenance contract.

All Electronic Current Meters will be compatible for use with the automatic cableway gauging system.

3.21 Electronic Test Equipment

This contract requires 6 Digital Multimeters for general diagnostics and 6 Watt Meters for the testing of transmitted and reflected power. This equipment will be used by the supplier and serviced for repair due to malfunction or other equipment breakdown. This equipment will used by BBMB during the maintenance transition period, and stay in the possession of BBMB at the end of the maintenance contract.

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| **Item** | **Technical specifications** |
| **Digital Multimeter** | Fluke 789 Process Meter or Equivalent |
| **Watt Meter** | Bird Meter or Equivalent with 0–150 Watt Range |

3.22 INSAT Transmitter

The INSAT transmitter will be approved in advance by ISRO and IMD for use on the project, and will allow for the transmissions to KALPANA 3. The transmitter will be capable of reception by the ERS. The bidder will provide certificates of acceptance by ISRO and IMD as part of the bid package. The INSAT radio will be compatible with the data logger, and the rest of the equipment to be installed by the supplier.

3.23 Data Centre

3.23.1 Earth Receive Station (ERS) and Software

At this stage only one data processing centre is planned in Chandigarh.

The primary purposes of the data processing centre are:

* real-time reception and processing of data from the hydro-meteorological network (ERS)
* processing and analysis of hydro-meteorological data for station monitoring and maintenance (Data Management)

One Direct Readout Ground Station (DRGS) shall be installed in Chandigarh at the System Load Dispatch Centre. The ERS shall receive transmissions through the INSAT transponder, which is the same system that is used by IMD and CWC for hydrologic and meteorological data collection. The ERS will include all components necessary to make the ERS fully functional whether completely specified or not.

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| **Item** | | | **Technical specifications** |
| **Site conditions** | | | ambient temperature: -30 to +60 degrees C  relative humidity: 5% to 100% with condensation  altitude: 300m |
| **System characteristics** | | | flexible number of remote station data collection with the capability to collect all BBMB stations, IMD, CWC, and SASE stations transmitting in or near the BBMB watershed.  overall telemetry system performance better than 99.9% of error free data  minimum sustainability of the system when power failure occurs:72 hours: |
| **Hardware** | | | Dish, Receiver, Antenna, Cabling, and all other items necessary to have a fully functional ERS.  with front panel indicators for channel activity and diagnostics  PC processing with the capability to process 600 stations through INSAT. This will allow for growth in the event BBMB wishes to add more stations, or more co-operator stations.  Hot backup PC to allow for data collection in the event the main computer fails. Both main computer and backup computer shall be identical, and shall perform automatic operation in the event of failure of the first computer. |
| **INSAT Receive Dish** | | | Reflector Diameter meters – As appropriate for use with INSAT, and will be high gain so has not to be adversely affected by clouds, rain, or other meteorological/environmental conditions. The antenna shall be large enough in size to accommodate the entire range of expected signal strength as defined by ISRO.  Antenna Pedestal Type - Fixed EL/AZ antenna mount  Wind speed, operational/survival - 140 km/h or better  Environmental Conditions - -30 to +60 deg C, 5-100%RH  Lightning protection on all coaxial cables entering the building as well as at the power input line, including earth connection. Grounding will utilize Single Point Grounding technique. |
| **C-Band LNB Specifications** | As required and specified by ISRO for INSAT data collection | |
| **RECEIVER Specifications** | As specified by ISRO for use in data collection through the INSAT satellite that is being used by BBMB and the co-operators of BBMB that are collecting data in or in the vicinity of the BBMB catchment. | |
| **PC Specifications** | CPU and Memory - Pentium IV 3.0 GHz minimum or greater if required by ERS Software  Memory – 4 GB or greater if required by ERS Software. The RAM shall be provided that fully meets data collection and processing software requirements utilizing a maximum of half the RAM. If the RAM needed to meet this specification requires a 64-bit processor then the software shall be compatible with a 64-bit processor.   * Hard Disk - Hard disk size capable of storing 10 years’ worth of data in addition to all software components or 1 TB, whichever is greater. Hard disk shall include at a minimum RAID 1 technology, which means the disk space will be effectively doubled. * Monitor - A minimum of three computer screens that can be used to display screens from data collection and data processing processes. These screens will be a minimum of 21 inches and shall incorporate Flat Screen technology. Computer hardware will have the proper interface to use a minimum of four screens. * Keyboard and Mouse – The keyboard and mouse shall be wireless   Other Devices - CD/DVD RW+  Network – Giga Ethernet 10/100/1000Mbps (RJ45)  Interfaces - Serial, parallel, USB, 5V PCI Slot  Electrical - Supply Voltage: 230V, 450W   * Computer Form Factor - Rack mounting to house computer(s), data receivers, network devices as required by the DAS. The rack space available shall be twice that which is actually required for the equipment that is being offered.   Operating systems - Windows Server 2008 | |

|  |  |
| --- | --- |
| **Power Supply** | 230 V AC power supply  including line conditioner (voltage stabilization)  UPS equipment sufficient for automatic data backup procedure  including backup generator as required for full operation |
| **Software** | software for data processing, communications handling as well as control and customization of ground station operations  Decoding and routing of data from the ERS to the DSS node  Complete data collection diagnostics, including signal strength from each station, time of message reception, frequency as well as other indicators deemed necessary for ERS operation and remote data station data communication  Graphical and Tabular Data viewing facility   * Real-time as well as Historical Trending * Statistics (Minimum ,Maximum, Average, Standard Deviation, etc) * Equation and Rating table lookup capability * Graphs and Data exporting features * RDBMS PostGreSQL, ACCESS, or compatible * Data Exporting capabilities either in real-time, or in bulk * Automatic and Scheduled Reporting features   Diagnostic Reports |
| **Accessories** | including all necessary cables and connectors  including air conditioning equipment |
| **Documentation** | operators hand book and maintenance instructions for all parts of the system in English (3 copies)  full documentation (in English, 3 copies), including system block diagram and circuit wiring diagram |

3.23.2 Data Management Computer and Software

|  |  |
| --- | --- |
| **Item** | **Technical specifications** |
| **Site conditions** | ambient temperature: -30 to +60 degrees C  relative humidity: 5% to 100% with condensation  altitude: 300-2,000m |
| **PC Specifications** | CPU and Memory - Pentium IV 3.0 GHz minimum or greater if required by Data Management Software  Memory – 4 GB or greater if required by Data Management Software. The RAM shall be provided that fully meets data collection and processing software requirements utilizing a maximum of half the RAM. If the RAM needed to meet this specification requires a 64-bit processor then the software shall be compatible with a 64-bit processor.   * Hard Disk - Hard disk size capable of storing 10 years’ worth of data in addition to all software components or 1 TB, whichever is greater. Hard disk shall include at a minimum RAID 1 technology, which means the disk space will be effectively doubled. * Monitor - A minimum of three computer screens that can be used to display screens from data collection and data processing processes. These screens will be a minimum of 21 inches and shall incorporate Flat Screen technology. Computer hardware will have the proper interface to use a minimum of four screens. * Keyboard and Mouse – The keyboard and mouse shall be wireless   Other Devices - CD/DVD RW+  Network – Giga Ethernet 10/100/1000Mbps (RJ45)  Interfaces - Serial, parallel, USB, 5V PCI Slot  Electrical - Supply Voltage: 230V, 450W   * Computer Form Factor - Rack mount. Please include computer rack with offer to house computer(s) data receivers, network devices as required by the DAS. The rack space available shall be twice that which is actually required for the equipment that is being offered.   Operating systems - Windows Server 2008 |
| **Power Supply** | 220V AC power supply  UPS equipment |
| **Software** | Hydrologic Time Series Data Base, including rating table workup  software for data processing, communications handling as well as control and customization of ground station operations   * Graphical and Tabular Data viewing facility * Real-time as well as Historical Trending * Statistics (Minimum ,Maximum, Average, Standard Deviation, etc) * Equation and Rating table lookup capability * Graphs and Data exporting features * RDBMS PostGreSQL, ACCESS, or compatible * Data Exporting capabilities either in real-time, or in bulk * Automatic and Scheduled Reporting features   Diagnostic Reports  The Data Management Computer will possess similar Data Management and related Software modules to the ERS  Alarms – Email, SMS Text, Fax user definable triggers to evaluate the following conditions   * Missing Station * Low Battery * Solar Power Failure * Data out of limits * Bad transmissions |
| **Data Processing** | automatic storage in the server database  conversion of raw data (eg voltages) to engineering units  data validation (eg data out of range, discharge less than zero)  database management for measurement data, maintenance data, configuration data, event logger  upload of data retrieved by portable computer / mobile unit into database  manual data input / editing  SQL tools for generation of queries  basic statistical capabilities  graphical visualization and presentation of data (eg hydrographs) for control purposes, with adjustable scales  printing of graphic and tabular output  pre-defined reporting capabilities  real-time data conversion (water level to discharge)  management of rating curves  data aggregation (eg hourly to daily data), determination of totals, maxima and minima |
| **Export Interfaces** | export function for data transfer to other software packages (eg ASCII format, Excel)  open, well-documented Application Programming Interface  sufficient database documentation and user rights to allow for integration of the software provided with a tailor-made hydrological software package to be developed for analysis, modelling and forecasting purposes |
| **Accessories** | all necessary cables and connectors  air conditioning The battery backup provided by the online UPS shall be 1hr at full load |
| **Documentation** | database structure must be well documented, including entity-relationship diagrams  operators hand book and maintenance instructions for all parts of the system in English (3 copies)  full documentation (in English, 3 copies), including system block diagram and circuit wiring diagram |

3.23.3 Software – Further Details

The bidder will provide software that will be operated at the Data Processing Centre in Chandigarh. The software will provide the following functions:

#### **Data Reception from ERS**

The bidder will provide software that will be used to collect data through the ground station. The software will be able to process this data and provide the data in the form of ASCII records to the DSS (a tagged format for ASCII records, such as SHEF or an XML format). This will be coordinated with the DSS operator.

**Quality Control Software**

Incoming data will be subjected to quality control procedures through a software package provided by the bidder. The quality control software will be used to screen incoming data for artifacts and flag data based on the following criteria:

* Minimum threshold
* Maximum threshold
* Change in data value over time

These thresholds will be changeable through a simple interface.

#### **Discharge Rating Curves**

Software will be provided for the development of discharge rating curves, and the real time computation of discharges from the real time water levels, such that both real time water levels and corresponding discharges are made available to the RTDSS for all discharge measurement stations. The software will facilitate updating rating curves, normally at the end of the monsoon period, but also earlier if a significant shift is detected in the course of the monsoon.

#### **Maintenance Tracking**

Software will be provided that tracks maintenance visits, and equipment failures by model and serial number, tracking equipment repairs through the supplier. Every piece of equipment provided to BBMB as part of this tender will be identified as to its location and operational condition and otherwise establish a chain of custody whereby BBMB can determine the locations of any piece of equipment that has a serial number at any time. Each piece of equipment will also have a repair history record as part of the data base that is used by the software provided by the bidder.

As part of the maintenance agreement the bidder will provide monthly reports to BBMB which will provide a review of the RT-DAS operational readiness, including a list of station/sensors that are not in operation, as well as a review of maintenance activities and repair visits.

The bidder will provide an example of how this form will look in the proposal.

The software to be provided by the bidder will include all functionalities required for the configuration, control and operation of all network components (sensors, data loggers, telemetry system). Features required at the data processing centre include real-time data decoding, processing and storing of incoming messages, database management, basic statistical, graphical and reporting capabilities as well as data conversion.

Specific software for hydro meteorological analyses, modelling and forecasting purposes is not part of this procurement process. The software provided by the bidder must be open for integration with the specialized software package to be developed and the bidder must provide sufficient database documentation and user rights for this purpose.

### **Installation**

The bidder will provide installation of all instruments, computer equipment, and software. This includes large items such as the DRGS and accompanying dish, all cabling and wiring, including that for electricity as desired by BMMB. The bidder will provide detailed plans for prior approval by BBMB.

3.27 Station Categories

The various Station Categories are as under

Category I Cooperator Stations for Data Reception

Category II Cooperator stations with additional sensor(s)

Category III Automated Rain Gauges (ARG)

Category IV Automated Full Climatic Stations (AFCS)

Category V Snow-Water Equivalent Stations

Category VI Automatic Water Level Recording Gauges

Category VII Data Collection from Powerhouses

The coordinates and elevations of the BBMB stations in the following lists have been verified by GPS, and are reasonably accurate. Cooperator station coordinates and elevations are less accurate and should be taken as indicative of the location. Local site conditions may require some relocation of the stations, which will be made in consultation with BBMB.

3.27.1 Category I – Cooperator Stations for Data Reception

The only requirement for bidder is for data reception from the ERS. Station ID, frequency, approval, etc, from IMD shall be provided by BBMB.

| **No** | **STATION** | **Latitude** | **Longitude** | **Elevation**  **(mAMSL)** | **Owner** | **IMD** |
| --- | --- | --- | --- | --- | --- | --- |
| **Beas Basin** | | | | | | |
| B.1 | Baggi | 31° 35' 8" N | 76° 58' 11" E | 848 | BBMB/IMD | ARG |
| B.2 | Baijnath | 32° 3' 1" N | 76° 37' 59" E | 960 | BBMB/IMD | ARG |
| B.3 | Bakloh | 32° 26' 59" N | 75° 55' 47" E | 1,016 | IMD | ARG |
| B.4 | Banjar | 31° 38' 44" N | 77° 20' 48" E | 1,353 | BBMB/IMD | ARG |
| B.5 | Bhandal | 32° 7' 47" N | 76° 12' 0" E | 652 | IMD | ARG |
| B.6 | Bir | 32° 13' 11" N | 76° 13' 11" E | 826 | IMD | ARG |
| B.7 | Chowki Ki Minar | 31° 46' 47" N | 76° 13' 48" E | 757 | IMD | ARG |
| B.8 | Churah | 32° 1' 11" N | 76° 5' 59" E | 441 | IMD | ARG |
| B.9 | Janjehli | 31° 30' 45" N | 77° 13' 38" E | 2,158 | BBMB/IMD | ARG |
| B.10 | Jawali | 32° 8' 48" N | 76° 1' 28" E | 436 | IMD | ARG |
| B.11 | Joginder Nagar | 31° 59' 27" N | 76° 47' 34" E | 1,223 | BBMB/IMD | ARG |
| B.12 | Kangra | 32° 6' 27" N | 76° 15' 46" E | 761 | BBMB/IMD | ARG |
| B.13 | Kataula | 31° 46' 47" N | 76° 58' 48" E | 1,187 | IMD | ARG |
| B.14 | Katrain | 32° 5' 59" N | 77° 8' 59" E | 1,587 | IMD | ARG |
| B.15 | Kullu | 31° 58' 10" N | 77° 5' 19" E | 1,397 | IMD | AWS |
| B.16 | Malan | 32° 7' 11" N | 76° 25' 12" E | 975 | IMD | ARG |
| B.17 | Mandi – Jhungi | 31° 43' 11" N | 76° 57' 0" E | 1,327 | IMD | AWS |
| B.18 | Palampur | 32° 7' 0" N | 76° 31' 58" E | 1,275 | BBMB/IMD | AWS |
| B.19 | Rohtang | 32° 21' 24" N | 77° 15' 16" E | 4,125 | SASE | - |
| B.20 | Sainj | 31° 43' 36" N | 77° 13' 29" E | 1,043 | BBMB/IMD | AWS |
| B.21 | Seo Bagh | 31° 58' 47" N | 77° 7' 47" E | 1,271 | IMD | AWS |
| B.22 | Sihunta | 32° 17' 59" N | 76° 4' 48" E | 908 | IMD | ARG |
| B.23 | Sujanpur Tira | 31° 50' 18" N | 76° 30' 40" E | 588 | BBMB/IMD | ARG |
| B.24 | Dharamsala | 32° 20' 59" N | 76° 18' 59" E | 4,048 | BBMB/IMD | AWS |
| **Satluj Basin** | | | | | | |
| S.1 | Baghi | 31° 16' 11" N | 77° 4' 12" E | 886 | IMD | ARG |
| S.2 | Bangana | 31° 40' 47" N | 76° 16' 47" E | 719 | IMD | ARG |
| S.3 | Barsar | 31° 32' 59" N | 76° 25' 12" E | 738 | IMD | ARG |
| S.4 | Bhaba Nagar | 31° 33' 49" N | 77° 56' 17" E | 1,651 | IMD | ARG |
| S.5 | Bharwain | 31° 47' 56" N | 76° 7' 26" E | 949 | BBMB/IMD | ARG |
| S.6 | Bilaspur | 31° 20' 32" N | 76° 45' 28" E | 501 | BBMB/IMD | AWS |
| S.7 | Dharampur | 30° 53' 59" N | 77° 1' 47" E | 1,539 | IMD | ARG |
| S.8 | Gagret | 31° 41' 22" N | 76° 4' 28" E | 458 | BBMB/IMD | ARG |
| S.9 | Ghumarwin | 31° 26' 59" N | 76° 41' 59" E | 651 | IMD | ARG |
| S.10 | Hamirpur | 31° 4' 11" N | 76° 31' 47" E | 277 | IMD | AWS |
| S.11 | Kahu | 31° 12' 43" N | 76° 46' 52" E | 526 | BBMB/IMD | ARG |
| S.12 | Kandaghat | 30° 58' 11" N | 77° 4' 47" E | 1,265 | IMD | ARG |
| S.13 | Kasauli | 30° 53' 59" N | 76° 58' 12" E | 1,699 | IMD | AWS |
| S.14 | Kothipura | 31° 16' 11" N | 76° 46' 11" E | 760 | IMD | ARG |
| S.15 | Kufri | 31° 5' 59" N | 77° 16' 11" E | 2,520 | IMD | AWS |
| S.16 | Kumarsain | 31° 14' 59" N | 77° 31' 12" E | 2,906 | IMD | ARG |
| S.17 | Mashobra | 31° 1' 11" N | 77° 1' 48" E | 1,041 | IMD | AWS |
| S.18 | Naina Devi | 31° 17' 56" N | 76° 32' 8" E | 985 | BBMB/IMD | ARG |
| S.19 | Nalagarh | 31° 1' 47" N | 76° 43' 47" E | 451 | IMD | ARG |
| S.20 | Narkanda | 31° 15' 25" N | 77° 27' 34" E | 2,724 | BBMB/IMD | AWS |
| S.21 | Reckong Peo | 31° 32' 20" N | 78° 16' 11" E | 2,378 | IMD | AWS |
| S.22 | Slapper | 31° 24' 40" N | 76° 51' 48" E | 524 | BBMB/IMD | ARG |
| S.23 | Tattapani | 31° 14' 59" N | 77° 4' 48" E | 702 | IMD | ARG |
| S.24 | Una | 31° 26' 59" N | 76° 16' 11" E | 363 | IMD | AWS |
| **Outside Beas and Satluj Basins** | | | | | | |
| O.1 | Amb | 32° 40' 47" N | 76° 40' 47" E | 3,449 | IMD | ARG |
| O.2 | Bharmaur | 32° 26' 59" N | 76° 33' 0" E | 1,733 | IMD | ARG |
| O.3 | Bhoranj | 30° 37' 11" N | 77° 37' 48" E | 1,718 | IMD | ARG |
| O.4 | Chamba | 32° 34' 48" N | 76° 7' 11" E | 845 | IMD | AWS |
| O.5 | Chelsea School | 31° 5' 59" N | 77° 10' 47" E | 2,337 | IMD | AWS |
| O.6 | Chhailla | 31° 1' 47" N | 77° 23' 59" E | 1,905 | IMD | ARG |
| O.7 | Choppal | 30° 55' 47" N | 77° 37' 11" E | 1,569 | IMD | ARG |
| O.8 | Dalhousie | 32° 31' 47" N | 75° 59' 60" E | 2,234 | IMD | AWS |
| O.9 | Dhaula Kuwan | 30° 31' 11" N | 77° 28' 48" E | 443 | IMD | ARG |
| O.10 | Fagu | 31° 7' 11" N | 77° 20' 59" E | 2,022 | IMD | ARG |
| O.11 | Jari | 32° 53' 59" N | 77° 13' 48" E | 5,690 | IMD | ARG |
| O.12 | Keylong | 32° 34' 11" N | 77° 1' 48" E | 3,009 | IMD | AWS |
| O.13 | Kotkhai | 31° 7' 11" N | 77° 31' 48" E | 1,593 | IMD | AWS |
| O.14 | Kukumseri | 32° 41' 59" N | 76° 31' 12" E | 3,985 | IMD | AWS |
| O.15 | Nahan | 30° 34' 11" N | 77° 16' 47" E | 672 | IMD | AWS |
| O.16 | Nauni | 30° 50' 59" N | 77° 1' 12" E | 1,090 | IMD | AWS |
| O.17 | Paontasahib | 30° 25' 47" N | 77° 25' 47" E | 453 | IMD | ARG |
| O.18 | Rajgarh | 30° 43' 47" N | 77° 28' 48" E | 1,406 | IMD | ARG |
| O.19 | Rohru | 31° 13' 11" N | 77° 45' 0" E | 1,907 | IMD | ARG |
| O.20 | Tikrigarh | 32° 46' 47" N | 76° 8' 59" E | 1,201 | IMD | ARG |
| O.21 | Udaipur | 32° 43' 11" N | 76° 4' 12" E | 1,253 | IMD | ARG |
| O.22 | Shimla (CPRI) | 31° 5' 59" N | 77° 1' 12" E | 1,196 | IMD | AWS |

3.27.2 Category II – Cooperator Stations with additional sensor(s)

These rainfall stations will receive additional sensors as indicated in the ‘Remarks’ column. The installation of these sensors will be the responsibility of the supplier, however, all the permissions for installation of these sensors including use of the instruments including transmitters, data loggers, etc. of IMD at these stations will be provided by BBMB. The supplier will integrate these stations in the BBMB DAS network and all the data from these stations will be received at RT-DSS Centre of BBMB at Chandigarh. Spare equipment will be 10% of the total number of units (sensors, cables etc).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **STATION** | **Latitude** | **Longitude** | **Elevation (mAMSL)** | **IMD** | **Remarks** |
| **Beas Basin** | | | | | | |
| B.1 | Dehra Gopipur | 31° 52' 22" N | 76° 13' 13" E | 443 | ARG |  |
| B.2 | Larji | 31°43' 8" N | 77°12' 46"E | 1,049 | ARG |  |
| B.3 | Manali | 32° 14' 3" N | 77° 11' 18" E | 1,843 | ARG | Add Snow Depth |
| **Satluj Basin** | | | | | | |
| S.1 | Moorang | 31° 36' 0" N | 78° 26' 50" E | 2,472 | ARG | Add Snow Depth |
| S.2 | Nichar | 31° 33' 7" N | 77° 58' 34" E | 2,225 | ARG | Add Snow Depth |
| S.3 | Pooh | 31° 45' 59" N | 78° 34' 44" E | 3,108 | ARG | Add Snow Depth |
| S.4 | Rampur | 31° 26' 24" N | 77° 37' 40" E | 987 | ARG |  |
| S.5 | Sangla | 31° 25' 14" N | 78° 15' 44" E | 2,780 | ARG | Snow Depth |
| S.6 | Sarahan | 31° 30' 34" N | 77° 47' 34" E | 2,144 | ARG | Snow Depth |
| S.7 | Suni | 31° 14' 43" N | 77° 6' 53" E | 701 | ARG |  |
|  |  |  |  |  |  |  |

3.27.3 Category III – Automated Rain Gauge Stations

Some of these new rainfall stations shall receive additional sensors as indicated in the Remarks column. Spare equipment will be 10% of the total number of units (data logger, sensors, cables).

| **No** | **STATION** | **Latitude** | **Longitude** | **Elevation (mAMSL)** | **Remarks** |
| --- | --- | --- | --- | --- | --- |
| **Beas Basin** | | | | | |
| B.1 | Bhuntar | 31° 53' 14"N | 77° 8' 56"E | 1,095 | Add Temperature |
| B.2 | Madana | 31° 45' 20" N | 77° 22' 59" E | 2,131 | New station - add Temperature, Snow Depth Sensor |
| B.3 | Pulga | 32° 0' 47" N | 77° 26' 58" E | 2,440 | New station - add Temperature, Snow Depth Sensor |
| **Satluj Basin** | | | | | |
| S.1 | Bahli | 31° 22' 17"N | 77° 38' 48"E | 2,285 | Add Temperature, Snow Depth Sensor |
| S.2 | Chitkul | 31° 20' 59"N | 78° 25' 0"E | 3,327 | Add Temperature, Snow Depth Sensor |
| S.3 | Daslehra | 31° 24' 56" N | 76° 32' 56" E | 562 |  |
| S.4 | Ghanauli | 31° 1' 33" N | 76° 35' 22" E | 293 |  |
| S.5 | Giabong | 31° 46' 24” N | 78° 26' 44” E | 2,926 | Add Temperature, Snow Depth Sensor |
| S.6 | Jangi | 31° 36' 15” N | 78° 25' 0” E | 2,721 | Add Temperature, Snow Depth Sensor |
| S.7 | Kilba | 31° 31' 0" N | 78° 8' 14" E | 1,988 | Add Temperature |
| S.8 | Kuddi | 31° 25' 28"N | 76° 49' 40"E | 515 |  |
| S.9 | Lohand | 31° 10' 31" N | 76° 34' 14" E | 288 |  |
| S.10 | Namgia | 31° 48' 30” N | 78° 39' 30” E | 2,903 | Add Temperature, Snow Depth Sensor |
| S.11 | Phancha | 31° 35' 45" N | 77° 43' 54" E | 2348 | Add Temperature, Snow Depth Sensor |
| S.12 | Purbani | 31° 35' 23" N | 78° 18' 29" E | 2,482 | Add Temperature, Snow Depth Sensor |
| S.13 | Rupi | 31° 36' 20" N | 77° 50' 27" E | 2339 | Add Temperature, Snow Depth Sensor |

**3.27.4** **Category IV –** **Automated Full Climate Stations**

Spare equipment will be 10% of the total number of units (data logger, sensors, cables).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | **STATION** | **COORDINATES** | | **Elevation**  **(mAMSL)** | **Present BBMB Status** | **Remarks** | |
| **Beas Basin** | | | | | | | |
| B.1 | Fatehpur | 32° 5' 51" N | 75° 56' 18" E | 469 | Climate |  | |
| B.2 | Harsar | 32° 5' 50” N | 76° 2' 27” E | 427 | Climate |  | |
| B.3 | Pandoh Dam | 31° 40' 21" N | 77° 4' 4" E | 893 | Climate |  | |
| B.4 | Pong Dam | 31° 58' 13"N | 75° 56' 47" E | 460 | Climate |  | |
| B.5 | Nangal Chowk | 31°55'48.209"N | 76°6'37.3"E | 415 | Climate | |  |
| **Satluj Basin** | | | | | | | |
| S.1 | Berthin | 31° 25' 11" N | 76° 38' 55" E | 668 | Raingauge |  | |
| S.2 | Bhakra Dam RL1700 | 31° 24' 56" N | 76° 26' 5" E | 554 | Climate |  | |
| S.3 | Brahmani | 31° 25' 45” N | 76° 29' 56” E | 513 | Climate |  | |
| S.4 | Kalpa | 31° 32' 27" N | 78° 15' 31" E | 2,662 | Climate | Add snow depth sensor | |
| S.5 | Nangal | 31° 23' 50” N | 76° 22' 21” E | 369 | Climate |  | |
| S.6 | Raipur Maidan | 31° 19' 59” N | 76° 23' 29” E | 331 | Climate |  | |
| S.7 | Rakchham | 31° 23' 31” N | 78° 21' 20” E | 3,132 | Climate | Add snow depth sensor | |

3.27.5 Category V – Snow-water Equivalent (SWE) Stations

These stations will include precipitation (liquid and solid), temperature and snow depth sensors. Spare equipment will be 10% of the total number of units (data logger, sensors, cables). Three complete spare pillow sets will be included in the bid. These spares will be maintained throughout the warranty and maintenance periods of the contract.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No** | **STATION** | **Latitude** | **Longitude** | **Elevation (mAMSL)** | **Remarks** |
| **Satluj Basin** | | | | | |
| S.1 | Chitkul ITBP | 31° 18' 24"N | 78° 30' 49"E | 3,728 |  |
| S.2 | Chumar | 32° 40' 49"N | 78° 33' 49"E | 4,472 | CWC data logger & transmitter |
| S.3 | Jalori | 32° 21' 49"N | 77° 14' 49"E | 3,912 |  |
| S.4 | Kaza | 32° 13' 25"N | 78° 4' 11" E | 3,618 | Existing IMD Transmitter Include sensors for AFC |
| S.5 | Lossar | 32° 26' 25"N | 77° 44' 59"E | 4,091 | Existing IMD Transmitter |
| S.6 | Malling Dogri | 31° 53' 20"N | 78° 39' 38"E | 4,538 |  |
| S.7 | Mulling Baba | 31° 44' 9"N | 77° 59' 47"E | 3,591 |  |
| S.8 | Tabo | 32° 7' 51"N | 78° 23' 11"E | 4,207 | Existing IMD Transmitter |
| S.9 | Tso Morari | 32° 57' 31"N | 78° 16' 0"E | 4,526 |  |
|  |  |  |  |  |  |

3.27.6 Category VI – Automated Water Level Recording Stations

Sites at which discharge measurements are to be taken and rating curves developed are denoted Q. Other sites are for the measurement of water level only. Discharges may be taken from a bridge if close to the site, or from a cableway to be installed as indicated. Spare equipment will be 10% of the total number of units (data logger, sensors, cables).

| **No** | **Stations** | | | | | | **Latitude** | **Longitude** | **Elevation mAMSL** | | | **Discharge Site** | | | **Remarks** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Satluj** | | | | | | | | | | | | | | | | |
| S.1 | | Khab | | | | | 31° 49' 24" N | 78° 40' 15" E | | 2,625 | | | | Q | | Radar from bridge |
| S.2 | | Rampur | | | | | 31° 26' 24" N | 77° 37' 40" E | | 987 | | | | Q | | Bubbler, upgrade cableway |
| S.3 | | Bhakra Reservoir | | | | | 31° 24' 56" N | 76° 26' 5" E | | 554 | | | |  | | Upgrade existing encoder/tape/float |
| S.4 | | Olinda | | | | | 31°24' 52"N | 76°24' 48"E | | 366 | | | | Q | | Radar from skew bridge u/s, upgrade cableway |
| S.5 | | Nangal Pond | | | | | 31° 22' 52" N | 76° 22' 3" E | | 350 | | | |  | | Upgrade existing encoder/tape/float |
| S.6 | | Nangal Hydel Channel Head | | | | | 31° 22' 52" N | 76° 22' 3" E | | 350 | | | |  | | Upgrade existing encoder/tape/float |
| S.7 | | Anandpur Hydel Channel Head | | | | | 31° 22' 52" N | 76° 22' 3" E | | 350 | | | |  | | Upgrade existing encoder/tape/float |
| S.8 | | Leo | | | | | 31° 51' 47" N | 78° 36' 18" E | | 2,869 | | | | Q | | Bubbler, new cableway |
| S.9 | | Sumdo | | | | | 32° 3' 9" N | 78° 37' 10" E | | 3,137 | | | | Q | | Bubbler, new cableway |
| S.10 | | Baspa Reservoir | | | | | 31° 25' 27"N | 78° 15' 29"E | | 2,569 | | | | Q | | Jaypee Site – bubbler, new cableway |
| S.11 | | Kuddi | | | | | 31° 22' 42" N | 76° 47' 49" E | | 544 | | | | Q | | Radar from bridge u/s of existing site |
| S.10 | | Kahu | | | | | 31° 12' 43" N | 76° 46' 52" E | | 526 | | | | Q | | Bubbler, new cableway |
| S.12 | | Nihan | | | | | 31° 24' 34" N | 76° 40' 23" E | | 576 | | | | Q | | Radar from bridge |
| S.13 | | Ballu Raina | | | | | 31° 24' 49" N | 76° 36' 35" E | | 561 | | | | Q | | Radar from bridge |
| S.14 | | Dalsehra | | | | | 31° 24' 56" N | 76° 32' 56" E | | 562 | | | | Q | | Radar from bridge |
| **Beas** | | | | | | | | | | | | | | | | |
| B.1 | | | | Manali | | | 32° 14' 3" N | 77° 11' 18" E | | 1,843 | | | | Q | Radar from bridge | |
| B.2 | | | | Bhunter | | | 31° 53' 14" N | 77° 8' 56" E | | 1,095 | | | | Q | Bubbler, new cableway 60 downstream of the existing suspension footbridge | |
| B.3 | | | | Pandoh Spillway | | | 31° 40' 21" N | 77° 4' 4" E | | 893 | | | | Q | Radar from canal wall u/s tunnel | |
| B.4 | | | | Pandoh | | | 31° 41' 13" N | 77° 2' 44" E | | 847 | | | | Q | Bubbler, new cableway | |
| B.5 | | | | Mandi | | | 31° 42' 47" N | 76° 56' 0" E | | 752 | | | | Q | Radar from bridge | |
| B.6 | | | | Nadaun | | | 31° 47' 21" N | 76° 20' 50" E | | 465 | | | | Q | Radar from bridge | |
| B.8 | | | | Pong Reservoir | | | 31° 57' 41" N | 75° 57' 2" E | | 484 | | | |  | Upgrade existing encoder/tape/float | |
| B.10 | | | | Bhunter | | | 31° 53' 37" N | 77° 8' 49" E | | 1,103 | | | | Q | Bubbler, cableway on existing BBMB site on Parvati river | |
| B.11 | | | | Sainj | | | 31° 43' 36" N | 77° 13' 29" E | | 1,043 | | | | Q | Radar from bridge | |
| B.12 | | | | Tirthan | | | 31° 43' 21" N | 77° 13' 38" E | | 1,043 | | | | Q | Bubbler, new cableway | |
| B.13 | | | | Bakhli | | | 31° 39' 28" N | 77° 5' 28" E | | 940 | | | | Q | Bubbler, new cableway | |
| B.14 | | | | Juni | | | 31° 40' 4" N | 77° 3' 21" E | | 853 | | | | Q | Radar from bridge | |
| B.15 | | | | Sukheti | | | 31° 42' 3" N | 76° 56' 38" E | | 799 | | | | Q | Radar from bridge | |
| B.16 | | | | Jawali | | | 32° 8' 48" N | 76° 1' 28" E | | 436 | | | | Q | Radar from bridge | |
| B.17 | | | | Guler | | | 32° 4' 34" N | 76° 6' 11" E | | 438 | | | | Q | Radar from bridge | |
| B.18 | | | | Nagrota Surian | | | 32° 0' 20" N | 76° 9' 23" E | | 432 | | | | Q | Radar from bridge | |
| **BSL** | | | | | | | | | | | | | | | | |
| L.1 | | | | Baggi | | | 31° 35' 8" N | 76° 58' 11" E | | 848 | | |  | | Radar from canal bridge d/s | |
| L.2 | | | | Balancing Reservoir | | | 31° 32' 31" N | 76° 53' 0" E | | 890 | | |  | | Radar on canal wall u/s of reservoir | |
| **Channels** | | | | | | | | | | | | | | | | |
| C.1 | | | Lohand | | | 31° 10' 31” N | | 76° 34' 14” E | | | 288 | |  | | Existing stilling well with mechanical float gauge | |
| C.2 | | | Tailend Nangal HC | | | 31° 10' 26" N | | 76° 34' 13" E | | | 278 | |  | |
| C.3 | | | Ropar Headworks | | | 30° 59' 17" N | | 76° 31' 2" E | | | 266 | |  | |
| C.4 | | | 120000 RD (Barwala) | | | 30° 36' 42" N | | 76° 20' 1" E | | | 269 | |  | |
| C.5 | | | 390000 RD (Narwana) | | | 30° 25' 42" N | | 76° 20' 50" E | | | 260 | |  | |
| C.6 | | | 160000 RD | | | 30° 6' 56" N | | 76° 44' 11" E | | | 247 | |  | |
| C.7 | | | Madhopur Headworks | | 32° 22' 1" N | | | 75° 35' 58" E | | | 347 | |  | | Existing stilling well with no automatic gauge | |
| C.8 | | | Harike  Headwork | | 31° 8' 34" N | | | 74° 56' 56" E | | | 206 | |  | |
| C.9 | | | Firozpur  Headworks | | 30° 59' 21" N | | | 74° 33' 13" E | | | 197 | |  | |

* + 1. Category VII - Data Collection from Powerhouses

These stations will incorporate a tap into the existing SCADA in the powerhouse, and transmission of the signal via surface relay to the satellite. Spare equipment will be 10% of the total number of units (data logger, sensors, cables).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **STATION** | **Latitude** | **Longitude** | **Elevation (mAMSL)** | **Owner** | **Remarks** |
| **Satluj Basin** | | | | | | |
| S.1 | Baspa PH | 31° 25' 48" N | 78° 14' 26" E | 2,533 | Jaypee | Existing SCADA |
| S.2 | Karcham Wangtu PH | 31° 32' 41"N | 78° 0' 39"E | 1,150 | Jaypee | Existing SCADA |
| S.3 | Nathpa-Jhakri PH | 31° 33' 49" N | 77° 58' 48" E | 1,526 | SVJNL | Existing SCADA |
| S.4 | Kol PH | 31° 23' 6" N | 76° 52' 19" E | 653 | NTPC | Existing SCADA |
| S.5 | Rampur PH | 31° 26' 24" N | 77° 37' 40" E | 987 | SJVNL | Existing SCADA |
| **Beas Basin** | | | | | | |
| B.1 | Larji PH | 77° 12' 41"E | 31° 43' 10"N | 1,000 | HPSEB | Existing SCADA |
|  |  |  |  |  |  |  |

3.28 Civil Works

All the Civil works for buildings, enclosures, structures, etc. will be the supplier’s responsibility. Bidders shall furnish details and standard drawings of equipment mounting arrangements and installations. Bidders shall also provide detailed instructions regarding the requirements for lightning protection and power supply as well as recommendations for security arrangements needed for systems and sensors installed in open areas (eg fencing, locks, etc).

All enclosures should withstand hostile environments and must be protected against vandalism. The door must be secured using a tamper proof lock. Additional security devices may be recommended. Outdoor enclosures will contain all instrumentation except solar panels and sensors. The required degree of protection is IP65 or NEMA4. A radiation shield of a double wall must protect the enclosure against excessive heating by radiation.

All sensors, data loggers and other equipment shall be surge protected as required. Equipment for lightning protection, such as conductors and ground rods, are part of the station equipment to be supplied.

The contractor will provide detailed drawings & specifications of each station before execution, which will be approved by BBMB.

However, the outer enclosures including security fencing, gates, locks, etc. will be constructed by BBMB at all the locations. For fencing, chain link fence with barbed wire will be used and the contractor will recommend design & specifications as per requirement.

The contractor will provide typical lay out drawing along with specifications for civil works & security fencing for each category of stations as given in TS 3.27.

3.29 Training Component

### **Training Program**

The bidder is required to provide an extensive training program for the system. The training set forth in the following sections is a minimum requirement and the bidder should propose any additional training that he considers critical for long term success of the system operations.

The bidder is expected to provide an outline or table indicating the contents of each of the required courses. The table shall describe the specific topics to be covered for each day of the training period. The training program is to be included with the bid.

The bidder is responsible for the salaries of the training instructors and all training materials. The costs of travel, transportation and per diem for the trainees shall be borne by the Purchaser.

**Training in General Operation**

Training in general equipment operation and maintenance procedures will be provided by a four-week training course as well as by on-the-job training. The bidder is required to have hydro meteorological equipment specialists (4 staff weeks). The training is for BBMB staff or designates. The four week training will be conducted in two lots each of two weeks. The training should be in modules with refresher courses occurring over the contract period.

Course topics will include sensor calibration, data logger configuration, data downloading, data retrieval, collection, compilation, processing, maintenance requirements, and procedures for equipment configuration, installation, site testing and commissioning. An additional course will be conducted in the theory and practice of discharge measurements, and development of rating curves.

The training course will take place in Chandigarh. On-the-job training will be provided by the supplier in conjunction with the installation of hydrologic stations, conducting discharge measurements and during the course of maintenance at BBMB’s requirement.

### **Specialist Training for Maintenance Technicians**

In addition to the general training, the bidder is to provide training for technicians responsible for the operation and maintenance of electronic and other equipment. Combined two week training by two Equipment Specialists (of different specialization) for up to 20 technicians must be provided, as a minimum. Course topics will include sensor calibration, data logger configuration, data down loading, maintenance requirements, O&M and procedures for equipment configuration, installation, site testing and commissioning.

3.30 Operation and Maintenance

The bidder will provide the cost for operation and maintenance of all newly installed equipments, including instrumentation at monitoring stations, DRGS, computer systems, and software. The maintenance will require plans for both preventive maintenance as well as corrective maintenance. Maintenance will be performed as quickly as possible considering the technical staff limitations.

The technical staff will include three field technicians who will be trained on the operation of all subsystems and be capable of repairing all equipments provided through this tender. BBMB will provide sufficient office space for the contract technical staff to establish a Main O&M Working Office, a maintenance depot, and a supply depot. The office will be located in Chandigarh. The bidder will provide all other necessary equipment for the technical staff, including 4WD vehicles to perform maintenance, mobile phones, and tools. The bidder will also be responsible for the recurring expenses of this equipment.

3.31 Personnel Requirement

There will be five maintenance sub-centres and the Data Centre that will require personnel to be provided by the supplier. Space will be provided by BBMB at all the five maintenance sub-centres, along with the Data Centre in Chandigarh. The concept of the sub-centres is to reduce travel time to a given remote station in the event there is an outage and to be responsive to the need to make discharge measurements required to maintain the stage-discharge rating curve.

Though the space and power supply is being provided by BBMB at the sub-centres, the supplier is required to provide internet connectivity, computers, office supplies, desks, chairs, and cabinets required to perform the maintenance activities. BBMB will provide the office equipment and connectivity at the Data Centre in Chandigarh.

BBMB requires a minimum of the following personnel at the following sites to be supplied by the supplier:

**Data Centre** One computer specialist trained in the operation of the ERS and data processing software, one assisting computer scientist to help in the support of the Data Centre, two hydrographers for monitoring the quality control software, managing rating tables, and developing network operational status reports.

**Nangal**  Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations.

**Rampur** Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract.

**Pooh** Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations. The office space at Pooh will be provided by BBMB.

**Talwara** Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations.

**Pandoh** Two instrument/data collection technicians fully trained on the operation and maintenance of equipment provided in this contract. Three hydrographers, each capable of performing stream gauge measurements and operating and maintaining remote stations.

The hydrographers will not be required to make stream gauge measurements from 1st October through 31st March of each year. Stream gauge measurements to establish and update the discharge rating curves will be ordered by the BBMB Engineer-in-charge, and will be carried out approximately eight times during the rainy season, including during peak flood events, but may be performed more often on newly established river gauging sites so that a stage-discharge relationship can be quickly established.

The Data Centre staff may be required to work alternating schedules to provide support during periods of flood, as directed by the Engineer-in-charge.

3.32 After Sales Service

### **Local Partner**

The bidder is required to establish a partnership with a local company for the purpose of developing an in-country technical support base during and after the project implementation phase.

3.33 Operation and Maintenance

The bidder shall be responsible for Operation and Maintenance of all stations/components during the two-year warranty period after the “network” has been commissioned and accepted by BBMB.

A 3-year contract for O&M support shall be provided by the bidder separately and the contract price for the O&M will be quoted alongwith this bid, however, the O&M will commence after the two-year warranty period. During the first year of the 3-year contract, operation and maintenance will be performed by the bidder with BBMB staff observing.  During the second year of the 3 years, operation and maintenance will be performed jointly by the bidder and BBMB, though the bidder will have ultimate responsibility.  In the third and final year, BBMB will have primary responsibility for operation and maintenance, handling all emergency and preventive maintenance field visits, with the bidder joining BBMB to reinforce procedures and assisting with general technical support.  The concept of this plan is to have BBMB staff progressively trained in the operation and maintenance of the network.  This process will also be applied to stream gauging stations.

This operation and maintenance support contract shall refer to the complete meteorological network, and proper functioning of the ERS and Data Centre including the hardware and software components. Assistance during troubleshooting will be provided for all necessary maintenance, servicing, testing, and recalibration operations.

The bidder will intervene with his personnel within the agreed dates, on site, in case of damage or malfunctioning of equipment or software, and will proceed to the investigation of the cause and search for a prompt solution to ensure proper working of the system.

The other requirements for O&M will be as under: -

1. Maintenance services for equipment and other related accessories like cables, etc, shall be provided by the **Bidder** during the period of warranty. The price for this service should be included in the bid. After the warranty period, annual maintenance and repairs of the entire system (comprising of those components and group of remote stations forming part of the acceptance certificate) consisting of equipment and civil works including supply of spares for the next 36 months will be done by the **Bidder**.
2. For the remaining remote stations, which have not been accepted as a part of the acceptance certification for BBMB, and which for instance require replacement with another sensor or component, the replacement will be subject to new acceptance testing. The annual maintenance contract for such stations shall be incorporated in the group of remote stations as per clause 1 above for successive blocks of the annual maintenance contract.
3. **Bidder** shall set up new offices at all the DAS Sub-centers at the space provided by BBMB. The **Bidder** will also operate and manage the Data Centre at Chandigarh and will also set up offices with space provided by BBMB.
4. The annual maintenance charges shall be quoted on a year-by-year basis after the warranty period, for a total of three years.
5. BBMB reserves the right to terminate the contract in full or in part at any time.
6. All equipment maintenance, repairs, replacement will be borne by the **Supplier** during the three year maintenance period.
7. It is expected that the average downtime of an item will be less than half of the maximum downtime (ie defined as number of days for which an item of equipment is not usable because of inability of the **Supplier** to repair it). The maximum downtime for any item is taken as 90 days. In case an item is not usable beyond the stipulated maximum downtime the **Supplier** will be required to replace equipment and infrastructure such as cableways and instrument shelters.

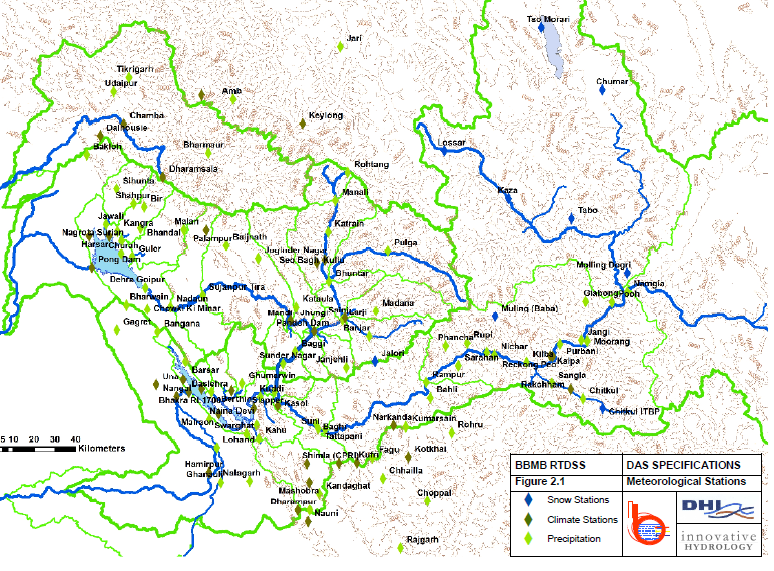
3.34 Spares

1. Spares should be provided to cut down the length of time required for maintenance, and periods of long outages. The supplier should maintain a 10% spare stock, ie 10% of the total installed base for that piece of equipment, including data logger, sensors, cables, etc. The supplier will identify the critical equipments for uninterrupted operations of the DAS and keep one set as spare to ensure reliability/sustainability of the system. However, these spares will not be a part of the 10% spares indicated above. Computers and associated computer equipment and software will require spare stock.
2. The stock of spares will be tracked in the routine maintenance reports submitted by the supplier.
3. The supplier shall carry sufficient inventories to assure ex-stock supply of consumables and spares at the facilities provided by BBMB. The supplier shall ensure availability of after sales service for a period of at least ten years including the warranty period.

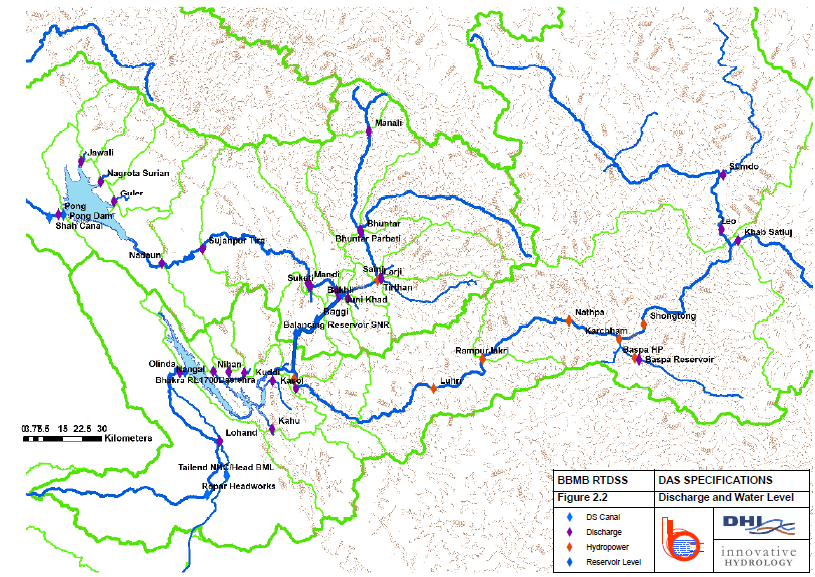
3.35 Grounding and Surge Protection

All systems shall require Single Point Grounding (SPG) to protect the equipment from Electromagnetic Pulse (EMP) surge and lightening damage. SPG is recognized as the most important part of any lightning protection system. Radio Frequency antenna shall be protected from power surge entering the Data Collection Platform and sensors with the use of a proven surge protector. Diagrams showing the application of grounding and surge protection, with model, make, and manufacturer is required as part of the bid package.

4. Drawings

Maps showing the locations of the Meteorological Stations and the Discharge Stations are also attached herewith as pdf file format.

*Meteorological Stations of Beas & Satluj Basins as Proposed in DAS Network*



***Discharge & Water Level Stations of Beas & Satluj*** *Basins* ***as Proposed*** *in DAS Network*

5. Inspections & Tests

1. BBMB and DHI or its representative shall have the right to inspect and test the Goods to confirm their conformity to the contract specifications at no extra cost to BBMB. BBMB shall notify the bidder in writing, in a timely manner, of the identity of any other representatives retained for these purposes. Travel related expenses of the inspection team will be borne by the purchaser. Costs of all tests and inspections shall be borne by the Bidder.
2. The inspections and tests may be conducted on the premises of the bidder or its subsupplier(s), at point of delivery, and at the Good’s final destination. If conducted on the premises of the bidder, or its subsupplier(s), all reasonable facilities and assistance, including access to drawings and production data, shall be furnished to the inspectors at no charge to BBMB or DHI.
3. Should any inspected or tested Goods fail to conform to the specifications, BBMB may reject the Goods and the bidder shall either replace the rejected Goods or make alterations necessary to meet specification requirements free of cost to BBMB.
4. BBMB’s right to inspect, test and, where necessary, reject the good after the goods’ arrival in India shall in no way be limited or waived by reason of the Goods having previously been inspected, tested, and passed by BBMB/DHI or its representative prior to the Goods shipment from the country of origin. Nothing shall in any way release the bidder from any warranty or other obligations under this contract.
5. The inspection of the Goods shall be carried out to check whether the Goods are in conformity with the technical specifications attached to the contract agreement and shall be in line with the inspection/test procedures laid down in the Technical Specifications. Complete hardware and software as specified in the contract should be supplied, installed and commissioned properly by the supplier prior to commencement of acceptance tests.
6. In the event of the hardware and software failing to pass the acceptance test, a period not exceeding two weeks will be given to rectify the defects and clear the acceptance test, failing, which BBMB reserves the rights to get the equipment replaced by the bidder at no extra cost to BBMB.
7. Before the Goods and equipment are taken over by BBMB, the bidder shall supply operation and maintenance manuals together with drawings of the Goods civil works and equipment. These shall be in such detail as will enable BBMB to operate, maintain, adjust and repair all parts of the works as stated in the Technical Specifications.
8. The manuals and drawings shall be in English, and in such form and numbers as stated in the Technical Specifications.
9. Unless and otherwise agreed, the Goods and equipment shall not be considered to be completed for the purpose of taking over until such manuals and drawings have been supplied to BBMB.
10. The bidder shall provide complete documentation of hardware, all subsystems, operating systems, compiler, and system software. This documentation will include proof that all software was legally purchased as well as providing the software licenses. The bidder shall also indemnify BBMB against any levies/penalties on account of any default in this regard.
11. Acceptance Certificate: On successful completion of acceptability test, receipt of deliverables etc, and after BBMB is satisfied with the working on the system, the acceptance certificate will be issued as identified in the following:
    1. Acceptance Certificate for a **Remote Station** shall be issued on successful completion of site acceptance tests. The acceptance test will be conducted by the purchaser or any other person nominated by the purchaser, at its option. Site acceptance test shall be carried out in two stages. The first stage of acceptance will be based on preliminary inspection of the equipment supplied with respect to the required and supplied components such as sensors, DCU with the weatherproof enclosures, batteries (charger/regulator), gauge apparatus with enclosures and sensors, INSAT transmitter, INSAT satellite antennae, solar panel and mounting hardware, including all associated accessories.

Second stage of site testing shall be undertaken for a period of 30 days following successful completion of the commissioning to prove the equipment and the interconnecting cable installation and to ensure that all operators are fully conversant with the equipment and calibration procedures, methods of operation and all facilities provided by software. During the period of 30 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 hardware or excessive heating of motors or other electro-mechanical equipment or bugs in the software should occur. All the software should be complete and no missing modules/sections will be allowed. The supplier shall maintain necessary log in respect of the results of the tests to establish to the entire satisfaction of the purchaser, the successful completion of the test specified. An average data acquisition efficiency of 99.5% for the duration of test period shall be considered as satisfactory. The testing schedule will be agreed to by both the parties during performance of contract. In this stage a regular comprehensive check of functioning of all the components will be made. On conclusion of site acceptance, all relevant documentation pertaining to the site shall be handed over by the supplier to the representative of the purchaser.

* 1. Acceptance Certificate for **ERS** shall be issued on successful completion of ERS acceptance tests.

For the purpose of testing and certification activities, the supplier shall first establish ERS and carry out such tests and demonstrations to obtain clearances from Indian Space Research Organisation (ISRO) and India Meteorological Department (IMD) for compatibility and suitability of the supplied ERS hardware and software in operation with INSAT series satellites in the frequency and power parameters recommended by ISRO and IMD.

The acceptance tests for ERS equipments shall be detailed by the supplier as a part of technical bid and the same may be accepted with or without modifications by the purchaser.

Acceptance Certificate shall be issued on receipt of acceptance certificates of at least 95% or the remote stations.

The Inspections and tests shall be conducted at: on the premises of the Supplier or manufacturer or its Subsupplier, at point of delivery, and/or at the Goods’ final destination as indicated in the “Supply of Requirements’ of the Bid document.

**5.1 Completion Schedule**

The supplier shall be responsible for installation and set up of all field stations as per Categories in Section 3.27.1 to 3.27.7 of the Technical Specifications and commissioning of the Entire System including the training of the BBMB staff as specified in the Technical Specifications. The supplier shall be responsible for transport of goods from the destination of delivery, i.e., BBMB premises, Chandigarh to the final place of installation (Field Locations) as part of installation requirement. There shall be a Factory Acceptance Test, a Receiving Inspection, an Operational Testing of each lot and a Final Acceptance of the Entire System as defined in the Technical Specifications. The schedule of Inspections / Testing, Installation & Commissioning shall be as follows:

| **Delivery, Installation & Completion Schedule** | | | | |
| --- | --- | --- | --- | --- |
| **S.**  **No.** | **Description of Service / Activity** | **Equipment (Quantity)** | **Place where services shall be performed** | **Completion time schedule from date of effectiveness** |
| 1 | Factory Acceptance Test | As per Section VI i.e. “Schedule of Requirement” | At Supplier’s / Manufacturer’s premises | Within one month of confirmation of readiness of specific equipment by the Supplier |
| 2 | Receiving Inspection | BBMB, Chandigarh | Within 15 days of the notice of the supplier for arrival of the factory accepted equipment at the port of destination |
| 3 | Installation of remote stations | Field Locations | Start installation as per agreed schedule within 30 days of the accepted equipment at the Main Depot at Chandigarh |
| 4 | Operational Testing & Acceptance of the Installed Equipments | Within 30 days of notice of the installation of equipment at site |
| 5 | Final OT & Final Acceptance | On complete & successful installation of the entire DAS network |
| 6 | Operation & Maintenance | Entire System | O&M sub center, RT-DSS Center, Chandigarh & Field Locations | After completion of warranty & contract performance period of two years after commissioning & final acceptance of the system |