

# **SCOPE OF WORK**

## 1 Purpose of the Project:

**A. Remote monitoring and control** of Teesta Barrage and Head Regulator Gates of two off-taking canals at both ends comprising design planning supply installation testing trial commissioning, operation, training and five years extended O & M warranty through a state-of-the art communication based Supervisory Control and Data Acquisition (SCADA) systems including repair, maintenance & overhauling of electro-mechanical barrage components, rust removal treatments and epoxy painting of gates and other structural steel members located at Gazoldoba within P.S Mal & Rajgunj in District Jalpaiguri of West Bengal under Teesta Barrage Project, Irrigation & Waterways Department, Government of West Bengal.”

A real-time, computer-based SCADA system and a state-of-the art communication network shall provide remote and automatic control operation of the gates, for their logical, reliable and precise operations

**B. Safety, Security, Operation, Training & Maintenance** of entire Automation system within initial defect liability guarantee period of 12 months from date of commissioning which is to be continued for a further five years as extended warranty of automation equipments and installations including operation & maintenance and security.

The concept of implementation on which the present technical specifications and special conditions are based intends to combine the advantages of modern data collection platform, data storage, processing and data communication technologies with the requirements of high availability and sustainability. Preference will be given to robust, reliable technology. Data collection sites may be located in remote areas and shall require annual maintenance only, so the selection of equipment and civil design shall consider this aspect. The cost of servicing a real time data network shall exceed the cost of the purchase several times over the life of the network. It is, therefore, of central importance to the Authority that the network will have the greatest possible reliability, thus minimizing the maintenance to the extent possible. Special protection against environmental factors is often justifiable, even at high initial costs.

## 2 Background:

Teesta barrage structure is located at village Gazoldoba across river Teesta at 9.6 mile (15.5 km) downstream of Sevoke Railway bridge, under Block & P.S Mal on the left bank and Block & PS Rajganj in District Jalpaiguri, in the State of West Bengal. (Latitude: 26°45'7.34"N, Longitude: 88°35'13.44"E)

River Teesta originates from a Himalayan glacier in the neighboring State of Sikkim which flows for about 138 km through a narrow gorge and then passes through further 171 km in the plains crosses international border to meet the river Brahmaputra in the district of Rangpur in Bangladesh.

Teesta Barrage Project (Phase-I) initially proposed creation of irrigation potential of 922 Th.Ha benefitting the five districts of Jalpaiguri, Alipurduar, Coochbehar, Darjeeling, Uttar Dinajpur along with power generation of 67.5 MW from canal falls, and also providing drinking water. Around 200 Thousand Ha of irrigation potential has already been created. The Teesta Barrage main weir structure under Teesta Barrage Project Authority of Irrigation & Waterways Department was constructed in the year of 1984. M/S Hindustan Construction Company executed the civil works of the main Barrage portion and M/S Jessop & Co. Ltd. constructed the barrage proper, head regulator gates on both right as well as left ends, which have been made operational since 1985.

## 3 Teesta Barrage technical features:

Teesta Barrage has following components:

1. Spill way bays:-
  - (a) No of bays:- 33
  - (b) Width of each bay:- 18.25 M
  - (c) Crest Level:- RL+110.35 M (G.T.S)
  - (d) Super flood level- RL+116.30M (G.T.S)
  - (e) Designed flood discharge:- 20,100 Cumec
  - (f) Height of each vertical gate:- 5.50 M
2. Under sluice bays without silt excluder:-
  - (a) No of bays:- 8
  - (b) Width of each bay:- 18.25 M
  - (c) Crest Level:- RL+109.00 M (G.T.S)
  - (d) Height of each vertical gate:- 6.85 M
3. Under sluice bays with silt excluders :-
  - (a) No of bays:- 4
  - (b) Width of each bay:- 18.25 M
  - (c) Crest level of the top of the tunnel:- RL+110.825 M (G.T.S)

(d) Height of the vertical gate :- 6.85 M

4. Silt excluder tunnels:-

(a) No of tunnels per bay:- 6

(b) Opening size of each tunnel: 2.50 M (wide) x 2.05 M (height)

(c) Floor level of the tunnel:- RL+109.00 M ( G.T.S)

**Details of right bank main canal (Teesta Mahananda Link Canal Head Regulator)**

Crest Level: RL+111.25m

Width of each vent: 6.1m x 4.55m

No. of vents: 13

F.S.L.: 114.00m

B.L.: 110.114m

Design discharge: approx. 300.00 cumec

F.S.D.: 3.886m

**Details of left bank main canal (Teesta Jaldhaka Main Canal Head Regulator)**

Crest Level: RL +111.25m

Width of each vent: 6.1m

No. of vents: 4

F.S.L.: 113.90m

B.L.: 110.20m

Design discharge: approx. 84.29 cumec

**Barrage Bridge**

Length: 924m

Width of roadway: 7.3m

Footpath on both sides: 1.5m

Top level of road: 119.60m

Capacity of Gantry crane: 20 MT

Capacity of Monorail crane: 4 MT

Lifting speed of gate: 0.3m/min

As per **Teesta Barrage Operation Manual** (To be modified by the Teesta Barrage Project Authority in due course), for passing river discharge above 2125 cumec, the entire spillway and under sluice gates will be opened fully. For discharge below 2125 cumec the following principles will govern operating of Teesta barrage gates:

- 1 At very low discharge, the all the barrage gates will be closed to keep the pond level at RL-114.30 M, to maintain required supply in the off-taking canals, TMLC and TJMC.
- 2 With the increase in discharge, first the silt excluder tunnels will be opened to pass on surplus water beyond the requirement of the canals.
- 3 As the discharge increases the spillway gates and the under sluice gates are opened gradually to pass on the surplus water beyond the canal requirements.
- 4 When the discharge reaches 2125 Cumec all the barrage gates will be fully opened.
- 5 For partial opening all the gates are operated simultaneously.
- 6 The operation of spill way and under sluice gates are to follow the pattern required to guide the downstream out flow to act for river training purpose.

The rating curves of the following for different water levels on the upstream side and for different gate openings are furnished in the operation Manual of Teesta Barrage (To be modified by the Teesta Barrage Project Authority in due course)

- (a) For Head Regulators.
- (b) For Spillways
- (c) For Under Sluice gates without Silt Excluder
- (d) For Under Sluice gates with Silt Excluder
- (e) For Silt excluder tunnels

Teesta barrage gates are operated 24 X 7 for 365 days with critical operations required to manage flood season, feeding of irrigation canals on both banks by diversion of discharge through Teesta Jaldhaka Main Canal and Teesta Mahananda Link Canal for Irrigation, Hydel Power generation and drinking water supply through TMLC. The operation of barrage gates have assumed a critical proportion after construction of a series of NHPC Teesta Hydel project Low dams on the upper reaches resulting in wide fluctuation in inflow over short intervals. The river outflow release data provided by NHPC at TLDP-IV is to be integrated with the Master Controller server for display in monitor on real time basis through GPS/GPRS communication.

45 no. of vertical main Gates of Teesta Barrage, 13 no. of Head Regulator Gates of Teesta Mahananda Link Canal (TMLC) and 4 no. Head Regulator Gates of Teesta Jaldhaka Main Canal (TJMC) are at present operated electrically with rope drum hoist system with added provisions for operating manually by lever handles through chain sprocket mechanism as and when required.

With the advent of modern technology, time is ripe to upgrade the operational methodology of this strategically located Teesta Barrage, which may be utilized to regulate sharing of Teesta Water through sophisticated and precise automated

operation and control system of downstream barrage outflow as well as suitably divert discharge of river through Head Regulator gates of Teesta Jaldhaka Main Canal (TJMC) & Teesta Mahananda Link Canal (TMLC) for irrigation, hydel power generation and drinking water usage.

Thus considering the hazards of manual operation of about 1 km long barrage, it is proposed that the Teesta Barrage gates be operated through **Supervisory Control and Data Acquisition** (SCADA) system by **Programmable Logic Controller** (PLC) from adjoining **Teesta Barrage control room (BCR)** already existing (To be upgraded into SCADA-PLC-BCR) on right end of Barrage bridge to ensure correct, precise and scientific operation on a real time basis and successfully meet all ends.

#### 4 Broad objectives of the project:

- A. The implementation concept of the specifications is primarily to seize advantage of the advancements made in modern technologies of data processing, flow measurement techniques, information management, data storage, communication and telemetry with the operational requirements of Teesta Barrage and head regulators. The automation is to develop ability to detect extreme situations, faster access to data and response time, consistency and objectiveness in measurement, and ability to perform automatic quality monitoring. Preference shall primarily be given to robust and reliable established technology suitable and sustainable against vagaries of nature. It is of central importance that the data acquisition network has the greatest possible reliability and maintainability. Special protection against environmental factors is required.
- B. Mechanical and electrical maintenance renovation and repair of all 45 no. of Teesta Barrage fabricated structural steel vertical gates, 13 no. of Head Regulator structural steel gates of TMLC (Teesta Mahananda Link Canal) and 4 nos. of Head Regulator structural steel gates of Teesta Jaldhaka Main Canal, including structural steel gantry cranes and stop log Gate/s .
- C. Efficient operation and monitoring of all the 62 nos. of Gates for Teesta Barrage, TMLC & TJMC Head Regulators, whether individually or in groups, using state of the art automation system viz. SCADA, PLC, ARMAC etc. along with display of the real time gate positions, water levels and discharges and other relevant information at the Barrage Control Room (BCR), situated adjacent to the Barrage and monitoring from other stations. The transition from manual to remote control system can lead to a discontinuity in the measurement record if the process is not specified and managed carefully. Therefore, it is to be ensured that in case of failure of the new system, the existing old system shall remain operative.
- D. Each field data collection mode will measure and transmit data to the Barrage Control Room (BCR) every 15 minutes. BCR shall collect the field data and store it after quality controls. There shall be instantaneous indication of discharge through gate openings (Barrage & off-take canals Head Regulator gates), through appropriate hydraulic gate discharge equations.
- E. Display of gate opening positions of all 62 no. of gates, in absolute amount (in meters) and in percentage terms, upstream and downstream water levels and silt content levels of river water at locations according to (C) and total discharge through Barrage and TMLC on computer screen as well as on 110" LED screen monitors display units at the Barrage Control Room (BCR). The actuators can be controlled manually or remotely from the BCR through the PLC based control panel. Status of gate opening is to be displayed on computer as well as 110" LED screen monitors display unit simultaneously with suitable colour indicators at Master Controller Server at BCR and two other Monitoring Stations. Three (3) nos. station switches are also to be displayed for movements of gates, such as RAISE, LOWER or STOP with distinct night vision colours. There should be provision for computer text printing facility for generation of reports for all three (3) stations.
- F. As gate unit apparatus are to be connected to the BCR through cable network, the design of cable network should involve minimum cable contents; i.e the local control panel may club a group of gates for operation. Gate mounted end of travel limit switches shall be installed to provide contact closure on reaching gate fully open and gate fully closed positions. Switches at the fully open and fully closed positions shall be used to check the gate position measurement and to force correct indication when the gate is in the fully open and fully closed positions.
- G. Transmission of the same contents of the Display Unit at BCR are to be displayed on 110" LED screen-monitor display unit as per specification at other two dedicated Monitoring Control Rooms at Jalpaiguri (Central Flood Control Room) and at Siliguri (office of Chief Engineer, Teesta Barrage Project) through INSAT/VSAT, to be used for monitoring purposes. Actual Operation of Teesta barrage and both TMLC and TJMC head regulator gates are to be controlled, monitored, operated from Master Controller Server at the BCR at Gazoldoba on Teesta Barrage. Currently the manual operations are conducted solely from Control Room at Gazoldoba.
- H. The application of INSAT Tele-metering and Supervisory Control (Owned by ISRO under Govt. of India) communication collection system is a key component in the sustainability of the SCADA network. The use of INSAT communication will provide for the transmission of data from anywhere in the area, including areas where other

means of telemetry, such as mobile phone networks, would not be otherwise available. The equipment and conditions for installation of the telemetry system in the Teesta Barrage Project, including INSAT by the contractor shall include the design, manufacture, factory testing, deliver to site, installation (including the associated interface wiring/termination), commissioning and site acceptance testing, supply of mandatory spares, training and documentation. PLC based control panels, monitoring system hardware and software shall interface and be fully integrated and tested with the INSAT based communication network, to be provided and established. The functional requirements are given in respect of each major component of the system. The contractor shall ensure that the fundamental requirements stated in this document are not compromised in any manner, whatsoever. Unlicensed wireless communication devices are required to be certified for use in India by the competent authority.

- I. Installation, commissioning of four PTZ Night vision Cameras with NVR GW Security 16CH independent PoE 10MP NVR 4TB Network at suitable points to view the entire Teesta Barrage and both end Head Regulator gates and connected with other two monitoring stations at Siliguri and Jalpaiguri through INSAT/VSAT.
- J **SYSTEM INTEGRATION:** The bidder shall design, manufacture including make necessary purchases, install and complete the fully functional facilities in accordance with the EPC contract. On completion, the facilities should be entirely retrofitting for the purpose for which they are intended, as defined in the RFP-EPC Agreement.

It may be noted that system integration shall necessitate integration of hardware and software, system of 62 gates and related operational accessories, measuring instruments, SCADA system, their remote monitoring and control. Contractor shall execute system integration for operations of Teesta Barrage Project, which necessitate integration of all supplied computers and peripherals, hardware and software, communication networks, measuring instruments, interfacing SCADA, databases/historian, operational computational models, remote control, monitoring etc. The contractor shall have to accomplish all network requirements to ensure total compatibility, integration-ability, inter-change-ability and inter-operation-ability for various equipments and services for whole network installed.

The contractor shall submit detailed system integration configuration diagrams. The contractor shall specify system integration tests proposed to be carried out as a part of the technical bid submitted. The tests shall be such that the performance of the system as a whole commencing from the sensors and extending to the complete SCADA integration gets involved in the test plan. The System integration tests shall be carried out after completion of factory acceptance of the individual component. All those components that do not pass the system integration tests and undergo modifications shall be passed again through factory acceptance testing before using them for repeat system integrating tests.

- K. **System Redundancy:** All field PLCs/RTUs will send the data through wireless communication or otherwise to a centralized Main SCADA server at Barrage Control Room (BCR). High availability system with appropriate redundancy provisions for critical components like, communication networks, I/O servers, Historians, RAID drives, application software shall ensure minimum down time. It is proposed to have two such servers with redundancy so as to have uninterrupted operation in case of failures of hardware and/or software. This station will have an engineering workstation for entire SCADA system.

The redundancy arrangements in hardware and software shall ensure that entire Teesta Automation computing and communication systems operate smoothly and uninterruptedly during and after the occurrence of any disaster. Redundancy in hardware and software shall be applied so as to simultaneously address two aspects of disaster preparation – i.e. proactive prevention and reactive recovery. Before a disaster occurs, redundant components can mitigate the potential risks by working as backup facilities and thus preventing the disastrous consequences in advance. After the occurrence of a disaster, Project operations can be quickly restore functions and processes back to normal by substituting redundant components for the primary but disabled parts while they are being repaired and restored. A disaster recovery plan should be programmed with internal control and security that focuses on quick restoration of critical processes. When there are operational failures due to natural or man-made shall be laid in consultation with Engineer-in-charge before completion of project.

- L. Maintenance shall be an integral part of system that has the challenges of unattended operation in remote, exposed areas. The corrective maintenance will be required for data collection issues, whether they may be component failures or due to environmental issues. The preventative maintenance is required for all system components as well as the infrastructure in place to house the electronic data collection components.
- M. Data communication should be through INSAT under ISRO based on the crucial nature of the data. In case of temporary outage, the GSM/GPRS communication system would become operative, so that in any eventuality no data is lost. The contractor will be responsible for making all licensing arrangements for the sites requiring INSAT/GSM/GPRS. The Technical Specifications consist of the installation of the real time data acquisition system. This may include an INSAT station, which shall be able to receive data from appropriate Indian satellite. This shall include the design, manufacture, factory testing, deliver to site, installation (including the associated interface wiring/termination), commissioning and site acceptance testing, supply of mandatory spares, training and documentation. Data Collection Platforms (DCP), monitoring system hardware and software shall interface and be fully integrated and tested with the new INSAT Master station to be provided and established. The Ground Station Antenna to receive earth observation products of rainfall and climate with allied equipment and relevant software needs to be installed at BCR.

- N. **Telemetry**-The data communications employed on SCADA network will use a combination of INSAT communication and GSM/GPRS radio communications. INSAT satellite communications will be placed at all sites for real time data communication with backup communication from GSM/GPRS. All stations have had in-situ radio path survey, where a mobile phone signal was detected, and/or a line-of-sight path to the INSAT confirmed. It will be the responsibility of the contractor to confirm radio path and mobile network coverage. The recommended data communication technology is finalized tentatively. Telecommunications and data collection platforms can be expensive combining sensors from measurement points into single data collection platforms and radio transmitter to reduce the cost of the network is the key.
- P. **River Water Level (stage) and River Discharge Stations** - This data collection stations that will measure river stage and transmit this data to data center BCR, as case may be. These stations will use INSAT data communication and simultaneously use by GSM/GPRS data communications. The contractor will provide all civil works for these stations, including a gauge house to protect the equipments from theft as well as environmental effects such as insect/rodent infestations or water intrusion. The water level measurement technology will either be made from a bubbler system, radar sensor or a stilling well/float encoder principal. River Water level recording stations will require a gauge house, defined as a suitable building/gauge house to provide the protection of the equipments from both the environment and tampering.
- Q. **Teesta barrage Water Level and Outflow Discharge Stations** - This category describes data collection stations that will measure barrage pond water elevation and transmit this data to BCR. The Contractor will provide all civil works for these stations, including a Gauge House to protect the equipments from theft as well as environmental effects such as insect/rodent infestations or water intrusion. The water level measurement technology will be a Radar system non-contact type. The data of barrage gates, TLMC and TJMC canal water level and discharge flow measurement sensor need to be combined together if possible and common data collection point and communication system may be used.
- R. **Measurements of Teesta Barrage Gate Opening** – Here the sensors placed on gates of barrage and canals are to measure gate openings. The measured gate opening will be used along with water elevation to determine accurate discharge past the gates. The contractor shall also be required to collect the information necessary to calculate discharge past the gates in real time, though this calculation can be made as part of computations at BCR immediately upon receipt of the data from either INSAT or GSM. The Contractor shall propose measurement options for gauging such flows as an alternative to monitoring gate sensors. The Contractor shall be responsible for all civil works related to the installation of the sensor, though plans for civil work must be approved by the Authority prior to the acquisition, installation and commissioning of the sensor. Regardless of the sensor solution, the flows past the gates must be accurate to the actual flow.
- S. **TLMC and TJMC canal Water Level (stage) and Canal Discharge Stations:** The discharge past the canal gates at head of main canal or at cross regulator or at head of regulatory can be measured by providing gate sensors and level sensors at upstream and downstream of gates or the contractor shall propose measurement options for gauging such flows as an alternative to monitoring gate sensors (e.q. providing side looking ADCP or combination of level sensor and movable ADCP. This data will be communicated to data center using INSAT/VSAT as well as GSM/GPRS communication.
- T. **Barrage Control Room (BCR) as Master Controller Data Center** - The objective of establishing of the Master Controller Data Center at BCR is to ensure that the high quality data collection, compilation, processing and analyses are available for producing high quality data by installation of Industrial grade computer work station (BCR) comprising the Master Controller Server to interface with discrete PID controllers such as Programmable Logic Controller to acquire data from the Data Loggers and operator/ remote control panel equipments from master controller on an open protocol such as MODBUS and PROFIBUS with desired high speed - Master Controller Server at the Barrage Control Room at Teesta Barrage at Gazoldoba with the System should be capable to run SCADA compatible software with all maximum potential functionalities with interface terminal for operator control and monitoring system. Master controller should have the facility for storing the data in local drive and communicated through suitable communication devices with antenna and tower for INSAT/ VSAT and GSM/GPRS to remote locations and BCR. Up to 110 inch LED (one single screen) monitoring screen/video wall interfaced with master controller to view the all the parameters and status of the system in text and graphical display, One laptop (i7 4th Gen) with all allied software and hardware accessories, Windows OS 10 or compatible integrated by SCADA, LASER digital scanner/printer, UPS, Modem, Routers/Ethernet switches, RAM and Hard Disc Drive. Antenna, USB ports etc.
- (1) Every water level data observing points will automatically barrage pond/river/canal/rainfall data/water level every 15 minutes and other measurements every 30 minutes and transmit the data. It will store this observed data in its memory and then transmit it in self timed manner in its prescribed time slot every 15 minutes.
  - (2) The data will be brought into an application server(s) which will perform quality control processing, data visualization function, as well as passing the data off to the SCADA. The transfer to the SCADA will entail creating XML data files in real time and placing them on a network directory.
  - (3) The application server(s) will also function as a tool to determine data collection points that are in need of maintenance and repair. Software will provide station outage reports and a summary of total hours of station outage for each station as well as the entire network, by day, month and year or any period of time of interest to the project Authority.
  - (4) A Firewall will be provided to prevent unauthorized access from the INTERNET and will be located between the public web portal and the application server(s).

- U. **Installation** - Installation of all data collection points, sensors and data center components shall be provided by the contractor. The contractor will be required to devise acceptable mounts for sensors, as sensor placement should abide by WMO convention as applicable or by standard hydrological practices, so as to ensure a good measurement as well as adequately securing the sensor from tampering and/or vandalism. The project Authority may inspect some or all equipments prior to installation to assure the products meet specifications. The Authority may also delegate this activity to a third party. Each station shall be commissioned by the Engineer-in-charge upon inspection of complete installation and functioning data collection activities. Installation shall be considered complete after System Performance and Acceptance Test (SPAT).
- V. **Operation and Maintenance** - The scope of work of the project comprises operation and providing security of all automation and related equipments and spares etc., initial defect liability guarantee (automation, electrical, mechanical, instrumentation, civil and all other subcomponents for a period of next one year (12 months) from the date of commissioning of the project. At the end of the afore said period, the contractor shall be bound to provide further extended warranty of all automation and related equipments and spares etc. only for a period of five calendar years ( 60 months). Provision is required to be kept in the automation system so that the installed SCADA-PLC systems can be repaired or upgraded by other agencies and companies (transfer of technology of maintenance to be made before the defect liability period of contract is over.

This operation and maintenance support contract shall refer to the complete real time data collection network, proper functioning of BCR, INSAT data collection, ground station antenna and data center including the hardware and software components. Assistance and troubleshooting will be provided for all necessary maintenance, servicing, testing and recalibration operations. The contractor will intervene with his personnel within the agreed dates, on site in case of damages 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 contractor will provide all equipment/computers, transportation and internet connectivity, necessary to maintain the network. Emergency maintenance shall be performed immediately upon notification of a motor/sensor/station outage. Preventative maintenance will be provided twice per year, once just prior to the monsoon season and once just after the monsoon season. The Supplier will provide monthly maintenance reports during the course of the maintenance period. The monthly maintenance reports will cite station and sensor outages, including the amount of time stations/sensors have been out of operation or incorrectly reporting.

The annual operation and maintenance charges shall be quoted on a year-by-year basis for the five year maintenance period. The project "Authority" reserves the right to terminate the contract in full or in part at the end of any one year maintenance period. On hand over of the complete system to the Project Authority at the end of the 5 year operation & maintenance period, the contractor shall supply a manual specifying all faults experienced by the system together with an account of how such faults have been rectified. The objective is that the personnel of Teesta Barrage Project Authority will know from lessons learnt during the 5 years operation & maintenance period.

- W. **Training** - Training shall be provided by the contractor in several phases. The training shall be provided for the installation of equipments/main master controller station/sensors as well as operation and maintenance of the monitoring stations/sensors. The training shall include both classroom and field trainings. The Project Authority officials shall also be trained on the operation of the INSAT Station, GSM data collection station, Ground Station Antenna and data center, along with the data quality control computer. There shall be one week of training on the data collection platforms, communications, sensors etc. There shall also be field trainings which will include on-site training at Teesta Barrage site. There shall be one week of training on the operation and maintenance of the INSAT/VSAT and GSM/GPRS data collection station with a combination of classroom and hands-on training. There shall be one week of training for the data control computer function.
- X. Gate operation through SCADA-PLC systems and maintenance contract for a further period of 5 (Five) years and after initial defect liability guarantee period of one year from the date of commissioning of the project including extended warranty of all equipments and spares etc. till that period and also maintain safety and security of such equipments. Provision is kept in the automation system so that the installed SCADA-PLC systems can be repaired or upgraded by other agencies and companies (transfer of technology of maintenance to be made within the extended warranty contract period. **Provision for suitable up gradation of the utilized SCADA-PLC systems, modification required due to change in guidelines of gate operation in future, along with for further expansion through adding more SCADA features and more sensors is to be kept open in the system. Storage of data in encrypted data base and secured network, protected from all viruses and malwares in a secured server /cloud or any other secured suitable device for 50 years data retention.** All equipments shall conform to Indian standards and specifications and the electro-mechanical component and epoxy painting shall conform to BIS specifications. The contractor shall provide a O&M manual in four sets after completion of the work. The SCADA-PLC systems should be installed in such a manner so as not to create any hindrance to the periodical mechanical & electrical maintenance works of barrage and head regulator gates.

## **5 Broad requirements of mechanical & electrical works included in the Project:**

- A) **Maintenance of one no. central gear box and two no. end gear boxes of each gate of 45 nos. barrage main gate and 17 nos. head regulator gates including cleaning of gears & pinions bearings and lubricating with requisite quantity of grease, gear oil seals(for the required gear boxes).**
- Opening the central gear box cover removing the existing gear oil and cleaning the gear pinion shaft, bearing and all other ancillary components etc. by suitable means/ media to remove old gear oil/ grease, rusts and

other foreign contaminants. Greasing all the bearings with suitable volume pump with the supply of 3.50 Kg Servo Gem EP-2 or equivalent grease, maintain proper oil level by adding required quantity of Servo Gear H.P 140 or equivalent, refitting the cover in proper alignment including replacement of damaged nuts, bolts & washers etc.

- Opening the end gear box cover removing the existing gear oil and cleaning the pinion, shaft bearing, and all other ancillary equipments etc. by suitable means collecting the existing gear oil from the gear box housing for reuse (if suitable). Greasing all the bearings with suitable volume pump with the supply of 6 Kg. (approx.) Servo Gem EP-2 or equivalent grease refitting End gear Box housing with Servo Gear H.P 140 or equivalent to proper level cleaning and refitting the gear box cover with proper alignment including replacement of damaged nuts, bolts & washers etc.

**B) Maintenance of rope drums along with rope by applying rope compounding for each of the 45 no. barrage main gates & 17 no. Head Regulator gates.**

- Opening each rope drum cover and through cleaning the rope drum hoisting and bearing and entire rope from gate hinge to drum with necessary safety measures by adjusting the gate height and greasing with supply of approximate 1.5 Kg Grease (**Servo Gem EP-2**) or equivalent per rope drum end and cleaning thoroughly foreign particles and contaminants from entire wire rope with supply of 20 litres of thinner and coating with Servo Coat 140 or equivalent and refitting the same in proper alignment including replacement of nuts, bolts & washers etc. Work should be completed including cost of labour, scaffolding Servo Gem EP-2, Servo Coat 140 or equivalent, and Thinner etc.

**C) Maintenance of load rollers and repairing of bogie frame of each of the 45 no. barrage main gate.**

- Maintenance and repair of load roller after dismantling from bogie frame of the Barrage gate which should be cleaned properly by removing dust, rust, old grease and other foreign components with appropriate and greasing the gate components with suitable volume pump to make it perfect operating condition including supplying of requisite quantity of Servo Gem EP-2 or equivalent grease complete including scaffolding after necessary.

**D) Replacement of load roller bearings (32224) of damaged guide roller bearing with new one of each of the 45 no. Barrage Main Gates as per actual requirement.**

- Replacement of the Barrage gate load roller which should be replaced properly against damaged or broken bearing with replacement of oils seal / O-ring to make it perfect operating condition including supplying of requisite quantity of Servo Gem EP-2 or equivalent grease complete including scaffolding after necessary replacement of old and damaged bearing (32224) with proper necessary tools like bearing puller etc. and supplying & refitting of new approved make bearing in place properly.
- Replacement of damage gate guide roller bearings with a new one guide roller bearing properly.

**E) Maintenance Equalizer Pulley, in each of the 45 no. barrage main gates & 17 no. Head Regulator Gates.**

- Repair and maintenance of the Barrage main gate and H/R gates equalizer pulley which should be cleaned properly by removing dust, rust, old grease and other foreign components with appropriate and greasing the gate components with suitable volume pump to make it perfect operating condition including supplying of requisite quantity of Servo Gem EP-2 or equivalent grease complete including scaffolding after necessary.

**F) Replacement and refitting of rubber seals for 45 no. Barrage main gates & 17 no. H/R gates.**

- Supply, fitting and fixing of neoprene bottom rubber seal (Flat type) as per IS: 14566 : 2004 of Teesta Barrage Gates (size 18.75M (L) x 89 mm (W) x 24 mm (T)) after removal of old and damaged rubber seals including disposal (as directed by E.I.C) from gate bottom plate with a painted seal plate by required size of nuts and bolts.
- Supply, fitting and fixing of L Type neoprene side rubber seal (L type) as per IS: 14566 : 2004 of Teesta Barrage Gates (size 90 X 74 X 20) after removal of old and damaged rubber seals from gate side plate (two sides) with painted a seal plate by required size of nuts and bolts.

**G) Maintenance and repair of guide springs for each of the 45 nos. of barrage main gate.**

- Supplying and fixing of guide spring after removal of old broken guide springs from gate plate and painting of seal plate along with the nut bolts.

**H) Maintenance and repair of plumber blocks for each of the 45 nos. of barrage main gates & 17 nos. H/R gates.**

- Opening the plumber block cover of the main driving shaft cleaning the same to remove dust, rusts etc. by suitable means including changing the damaged felt, brass bush refitting the cover after refitting the Servo Gear H.P 140 or equivalent to desired level.

**I) Replacement of damaged oil seals for each Teesta Barrage main gates & H/R gates.**

- Dismantling the driving shaft from central gear box to end gear box and taking out driving pinion shaft after dismantling the end gear box cover and all other components as required including supplying of labours etc.



- Taking out the old and damaged oil seals & Bearing 6217 from the pinion shaft after dismantling flange coupling fitted with the pinion shaft with the help of heavy duty Jack/ Hydraulic Jack or any other means (This work should be done in a well equipped workshop).
- Refitting the special double leaf type new oil seal & Bearing (2 Nos. 6217), if necessary, and flange coupling with the pinion shaft after inserting one packing and polishing of seal journal of the shaft in proper position and alignment.
- Reassembling the pinion (after fitting new oil seal & bearing) shaft after including jointing of the driving shaft, end gear box cover and any other accessories to complete the job.
- Supply of Oil Seal for End Gear Box.

**J) Replacement of bearing no. 6217 Z type for each gate with supply, fitting and fixing for end gear boxes.**

**K) New supply of shop manufactured 4 no. of segments (2 no. bottom segment and 2 no. other) of fabricated structural steel stop logs(as per drawing) including installation, painting and maintenance of existing 31 nos. of stop logs for the Teesta barrage main gates.**

- Carrying the each segment of stop log from its piers to suitable working place (near the stair way of Main barrage) and placing to the wooden platform and placing the same in to the piers after changing the worn out rubber seals.
- Supply and fixing of neoprene bottom rubber seal (Flat type) as per IS: 14566 : 2004 of Stop Logs (size 20.0 M (L) x 89 mm (W) x 24 mm (T)) after removal of old and damaged rubber seals from gate bottom plate with painting of seal plate.
- Fixing of rubber seal with Galv. Bolts with nuts of 16 mm dia. (length 70 mm & 100mm) (GKW make) including supply of check nut of 16 mm dia.
- Supplying of Galvanized Spring washer of 60 mm ID, extra thick quality with 63 mm dia. check nut suitable for fitting.
- Supply fabrication with materials tools & plants including transportation from workshop carriage to site and erection of eight new structural steel segments comprising one unit of stop log of Barrage including rubber seal fittings, preparation, installations complete.

**L) Complete Replacement of wooden block for stop logs (4 no. of each existing units) of barrage main gates.**

- Supplying of seasoned Sal Wooden block at Teesta barrage stop logs.  
Supplying M.S nut & bolt with washer for fixing the wooden blocks at Stop Log units.
- Supply fabrication with materials tools & plants including transportation from fabrication yard to size and erection of one segment of existing stop log including removal of damaged submerged segment of stop log.

**M) Chequered plate units**

- Dismantling and removal of damaged or worn out chequered plate as and where required over the trestle bridge and supplying, fitting & fixing of new plates with painting.

**N) Maintenance of 3 no. gear boxes of gantry crane units**

- Opening the gear box covers removing the existing gear oil and cleaning the pinion, shaft bearing, and all other auxiliary equipments etc. by suitable means collecting the aged gear oil from the gear box housing for reuse (if suitable). Greasing all the bearings with suitable volume pump with the supply of 6 Kg. (approx.) Servo Gem EP-2 or equivalent grease refitting Gear Box housing with Servo Gear H.P 140 or equivalent to proper level cleaning and refitting the gear box cover with proper alignment including replacement of damaged nuts, bolts & washers etc.

**P) Repair and rewinding of gantry crane main motor**

- Complete rewinding of the burnt out motor of Teesta Barrage Gantry Crane after dismantling the damaged motor from its original position, Removal of burnt out stator winding of the same, rewinding of the motor by supplying of copper wire of adequate gauge, heat varnishing the same, and re-fitting it to its original position maintaining all safety precautions.
- Varnishing, and heating the following types of motor with supply of 3.0 litre varnish/ per motor. After dismantling the motor from its plate and refitting the same after proper overhauling in position and checking the motor operation at load. This work includes replacement of damaged nuts, bolts & washers (if any), connecting the motor with its panel board and carriage of motor to Companies workshop and back to site.

**Q) Supply of new generator set for the gantry crane unit of main barrage**

**R) Changing of glass sheet for the gantry crane control cabin**

- Supplying, fitting and fixing of the 5mm transparent acrylic sheet for windows for the crane operator cabin of gantry crane.

**S) Changing of wire rope for the gantry crane**

- Supplying, fitting and fixing of steel wire rope of 13 mm diameter, construction of 6x37, steel core, 1960 tensile designation, conforms to IS specification 2266:2002(Table no-3).

**T) Repair & maintenance of driving motor for each of the 45 no. main gates & 17 no. of H/R Gates.**

- **Heat Varnishing :**

Varnishing, and heating the following types of motor with supply of 1 litre varnish/ per motor. After dismantling the motor from its plate and refitting the same after proper overhauling in position and checking the motor operation at load. This work includes replacement of damaged nuts, bolts & washers (if any), connecting the motor with its panel board and carriage of motor to Companies workshop and back to site.

KW/HP: 2.2/3 Volt: 440Volt, Amp: - 6 Amp, 3 Phase, insulation: B, RPM: 720/750, Rating S1, make: GEC, Frame size: 132S

**U) Repair and maintenance of limit switch for each of total 45 nos. of main gates and head regulator gates.**

- Repair and maintenance of rotary type limit switch including supply of copper strips as per sample, and filling with the required quantity of Transformer Oil (Askaral or equivalent) and electrical connection after repairing, testing the limiting operation i.e. stop the motor at lowest point and highest position of the gate during lower & upper movement.

**V) Repair and maintenance of electrical panel board for each of total 45 nos. of main gates and 17 no. of Head Regulator Gates.**

- Replacement of old contactors from gate panel board including replacement of O/L contactor, On/ Off Switch, Fuses, Indicator Lamps, Raise & Lower Switches, Heater Coil etc. by Supplying and fixing New one as per proper rating, connecting them to the circuit and testing.

**W) Repair and maintenance of Electro-Mechanical brake system for each of total 45 nos. of main gates and 17 no. of Head Regulator Gates.**

- Repairing and maintenance of brake solenoid coil, brake plunger, and replacement of damage brake shoes with proper materials supply, fitting and fixing on existing frame.

**6 AUTOMATION & CONTROL:**

**A. Objectives of Automation of Teesta barrage & Head Regulator Gates**

The key feature of the Remote Control Automation of Teesta Barrage Gates, Head Regulator Gates of TMLC and TJMC through state of the art SCADA-PLC on an open protocol such as MODBUS and PROFIBUS to run the gates from control room located beside the Barrage structure also from local control panel located on top of the Trestle Bridge of barrage gate. The complete automation system could enable to monitor from remote stations i.e. Jalpaiguri and Siliguri on real time, viewed on monitors, even from Kolkata if required later through INSAT/VSAT from Teesta Barrage Control Room. This effort is for Design, supply, installation, testing, commissioning and operation of SCADA system based upon Programmable Logic Controllers for following functions:-

- (i) Complete automation (Automation control of Gate operations) of Teesta Barrage and H/R gates of TJMC and TMLC with PLC and RTU for monitoring and control of Barrage discharge through Auto mode and manual mode. In manual operation, control of gates will be through switch and starter from control room & also from local control panel on top of the Trestle bridge. **The manual option for operation of existing system should be kept alive for combating emergency operation in case of gross power failure at Teesta barrage site or otherwise due to sudden collapse of automated operation.**
- (ii) Monitoring of river and canal discharge of different gates. Acoustics Doppler flow measurement shall be performed at various points of the water course for updating the stage discharge relationship and calibration of barrage and head regulator gates. Where heavy siltation exists, river/canal profiles shall be determined using Acoustic Doppler Current Profiler (ADCP) at regular intervals of 10-15 days. Profiler ADCPs are proposed to perform these canal profiles.
- (iii) Each field data node shall have power supply (AC/DC/solar Power), data acquisition, data storage and transmission facility of PLC/RTU along with observation equipment. The data acquisition equipment shall have an interface with data communication equipment. The proposed data system shall have both data and voice communication with priority to data communication. Including transmission of data through SMS to the specified user. The canal gate automation software shall also provide actual water flow by as per example "FLOWCAL".
- (iv) The canal gate automation software shall also provide and will graphical display of all gate positions and discharge flowing. Application of graphical user interface shall enable display and generation of reports with statistical summaries.

- (v) The computer system installed at the control centres shall have facility to send emergency alarms, routine data as and when required by concern authorities on INSAT/VSAT network.
- (vi) Display and Monitoring of various gate positions, barrage pond levels, and various discharge values shall be available at Siliguri monitoring station and Jalpaiguri Flood Control Room cum monitoring station.
- (vii) Monitoring of rainfall through Digital Automatic rain Gauge fixed on top of BCR.
- (viii) Recording of above parameters and secured storage of records for analysis and availability of observed data for next 50 years and in web storage in Cloud etc..
- (ix) Real Time updating of acquired / calculated variables on web pages for information sharing with all authorised personnel.
- (x) Flood Alarm system with adequate time to response for Gate opening and operation.
- (xi) Monitoring the river Silt content levels near gates of barrage and both bank canals by transducers
- (xii) All above comprises the Automatic Reservoir Monitoring and Control Systems (ARMAC)

- B. The main items for control & equipments are to be supplied and installed under this section comprise the following:
- (i) RTU/PLC based remote control system, complete in all respects located at Barrage Top, for Control and operation of spillway gates and silt excluder gates.(Offer of the Bidder shall contain complete PLC-Master Controller on an open protocol such as MODBUS / PROFIBUS – integrated in the CPU/Server at the BCR with no additional gateway required.
  - (ii) Gate position, discharge (by say FLOWCAL Software or higher) indication and monitoring of all 62 gates.
  - (iii) Calculation and display of total discharge through spillway gates, H/R gates of TMLC and TJMC.
  - (iv) Radar based water level cum discharge measuring and indicating equipment along with warning System / Alarm at Barrage location.
  - (v) SCADA-PLC system complete in all respects including printers, 110" LED single screen/Video Wall etc.
  - (vi) INSAT/VSAT communications module with simultaneous backup of GPRS/GSM/wi-fi/RF for remote data communication.
  - (vii) Silt measuring transducer as per specification.
  - (viii) Digital Automatic Rain Gauge as per specification.
  - (ix) One Flood Alarm System as per specification.
  - (x) 4 (four) PTZ night vision cameras as per specification.

**C. All protocol to be used should be Open ended one so that any other intelligent device can include/ exclude or communicate with the system without any protocol communication.**

The Project in itself shall be complete with all necessary auxiliaries such as primary elements (position transmitters, limit switches etc.), cabling etc., as well as frames, built-in and embedded parts including all spare parts and special tools required. All the equipment shall be of international & BIS specifications from well-known reputed manufacturers. Provisions for suitable up gradation of the SCADA-PLC system and modifications required in future due to change in guidelines of gate operation, along with for further expansion such as camera feed, adding more SCADA features and more sensors is to kept open in the system. Storage of data in encrypted data base and secured network from all viruses and malwares in a secured server of 50 years data retention is desired.

## **7 ANTI-RUST TREATMENT AND PAINTING.**

### **Painting of Barrage Superstructure, Main Gates, Head Regulator Gates other structural components including embedded parts.**

The life of barrage super structure, fabricated structural steel gates & other structural steel parts depend upon quality of protective coatings applied on it to protect it from seasonal weathering conditions. Superstructure of Teesta Barrage was commissioned in the year of year 1985. Painting of gates was done on a few previous occasions and at this moment is urgently required. Direct exposure to weather actions, constant exposure to dry & wet condition, submergence in river water, atmospheric, pollutants, dust etc. has been responsible for continuous damage to the MS structural steel plates and members, connections and joints. Teesta Barrage super structure and mechanical components requires appropriate coats of painting. The super structural submerged gate portions are susceptible to corrosion due to continuous under water condition. So applying appropriate protective coating of epoxy paints on metallic structural portion in entirety would substantially increase the barrage super structure life.

#### **Preparation of Steel surfaces for painting:**

Surface preparation with proper protection as per specified standards laid down in BIS code IS-14177 by shot/sand blasting (SA:2.5 STD /requirements given in IS code by compressor air jets and where ever required manually, mechanical cleaning, power tool cleaning, and then preparation of surface and applying **zinc based primer** two coats by mechanized airless spraying machine. Also, manual intervention for rust removal is necessary for various components. Final Painting of all structural & other spares and parts and all gates, embedded parts, stop log, gantry etc including its structural steel appurtenants:

Applying by mechanized means over prepared surfaces within specified time & procedure as per BIS code appropriate thickness of **Epoxy Paints** of two coats both under water submerged portions and exposed portions.

Cost & hire of Tools & Plants, paints, equipments & scaffolding, skilled & unskilled workmen, safety measures, technical supervision etc to be included in the offer bid to be executed as per BIS /ISO Good Practice for Industries provisions.

The approximate total surface area of barrage steel structural portion is **39,628 Sq.m**, on which protective coating should be applied by appropriate epoxy based paint in two or if required additional coats wherever necessary after applying zinc phosphate/based primer, and

The approximately total surface area of barrage gates portion is approx **30,079 Sq.m**, on which protective coating should be applied comprising epoxy based paints in two or three coats where ever necessary after applying zinc based primer coats on prepared surface.

#### **8 ANCILLARY CIVIL WORK & POWER DISTRIBUTION:**

The contractor is required to suitably modify the Barrage Control Room into a modern well furnished exterior & interior decorated BCR as well as the other two Monitoring Stations inclusive of all civil works and procurement of necessary furnitures, fittings and fixtures, and also upgrade the electrical power distribution system for the Master Controller Server BCR at Barrage site and also at Jalpaiguri and Siliguri monitoring and control statuaries. The control panel at BCR would be provided with additional Solar Power Supply with battery with all masts, mounts complete in all respects.

#### **9 EMERGENCY DISASTER MANAGEMENT & EXTENDED FIVE YEARS WARRANTY, O & M.**

Electrical Power distribution system modernization with provision to tackle cable faults and tripping of power supply for automated Gate Operation.

1. Existing 3-phase AC Electric Supply distribution to be revamped, upgraded.
2. In case of any fault or short fall in transmission or distribution of electric power, backup power will be retrieved from 3 source automatic control switch.
3. In case of tripping of AC power supply, the D.G set to start functioning by auto switch (existing DG set as well as a new DG set is to be procured and commissioned under this Project).
4. Provision of circuit breaker to be provided to protect equipments for monitors of gates due to faults/short circuits.
5. Separate lighting arrangement for Barrage & SCADA Control Room (BCR) and dedicated distribution network for Barrage Gates with provision for Solar Power with battery as per specification.
6. Safety against lightening / earthing.

#### **10 RESPONSIBILITY OF BIDDER**

The preliminary design and details contained in the bid Documents are based on limited information, the Authority of Teesta Barrage Project in the Irrigation & Waterways Department, Government of West Bengal could gather at the time of preparation of the bidding Documents. The bidders will be responsible to verify/ refine / propose changes to the schematic details shown in the bid Documents based on his own investigations and/or additional surveys, if required, at his own cost only to improve further the performance.

The bidder shall be fully responsible for the detailed engineering of the remote monitoring and control system for Teesta Barrage operational network (Teesta Barrage automation) interfacing with supervisory control and data acquisition (SCADA) system, which also includes repair/retrofitting of existing 62 gates and instrumentation required for control of gate. All data utilized in preparation of the bid shall be presented indicating the source of the data and also the basis for assumptions, if any.

The contractor shall be fully responsible for Supply, installation, integration, Testing and Commissioning of Remote Monitoring and Control System for Gate operations covering O & M for five years, which will start from date of taking over of work / mutually agreed date.

The bidder shall provide a detailed approach and methodology for Design, construction, installation & commissioning, and O &M including a CPM based Networking program chart. The bidder shall take into consideration all aspects of the project as his scope of work at the time of bidding, namely, though not restricted to:

- Survey Investigation
- Design & Architecture of Hardware & Software
- Supply, installation and commissioning of remote monitoring and Control System for Gate operations.
- Installation, testing and commissioning of motors and instrumentation required for gate control and other relevant systems which are not functional / available at the time of award of contract. Organizing power supply through electricity board and/or DG set will be Employer's responsibility
- Project Management
- Operation & Maintenance (O & M) of the remote monitoring a control system (Automation of Teesta Barrage) interfacing with SCADA system for a post commission period of five years.
- Quality control
- Environmental & social safeguards
- Security and risk coverage