CASE STUDY : Monitoring & Energy Accounting System, SLDC CSPTCL

CLIENT NAME : State Load Dispatch Centre – Chhattisgarh State Power Transmission Co Ltd, Raipur

PROJECT TITLE : Monitoring & Energy Accounting (MEA) System

IMPLEMENTATION DETAILS

Country : Raipur, India
Duration of the project : One year
Key Platforms : Visual Basic 6.0, Java
End Customer : CSPTCL

INTRODUCTION

After formation of Chhattisgarh state in November 2000, Chhattisgarh State Electricity Board (CSEB) was formed in December 2000. After 8 years of existence, in December 2008 CSEB was reorganized into five (5) companies in accordance with Electricity Act-2003. The five companies formed are Chhattisgarh State Power Holding Co Ltd, Chhattisgarh State Power Generation Co Ltd, Chhattisgarh State Power Transmission Co Ltd, Chhattisgarh State Power Distribution Co Ltd and Chhattisgarh State Power Trading Co Ltd.

As on 2008, CSPTCL had a huge transmission portfolio with 7276 Ckt Km of EHT Lines, 66709 Ckt Km of HT Lines, 89577 Ckt km of LT lines, EHV transformation capacity of 7638 MVA and 62 EHV sub-stations. To realize the vision of reliable, affordable and quality power for all in Chhattisgarh state, it was imperative for CSPTCL to use its assets efficiently. In view of the same, CSPTCL wanted to implement a Monitoring and Energy Accounting (MEA) system for the state. CSPTCL floated an open tender for this project and subsequently Kalkitech won the tender through bidding process.

CLIENT REQUIREMENTS

The entire project work was broadly divided into two phases:

Phase-I: Supply, installation, testing & commissioning of MEA system for all the ABT meter consumers spread over the state of Chhattisgarh.

Phase-II: Fetching of data on demand from ABT meters and report generation on monthly basis in compliance to the requirement of CSERC.
In Phase-I, the performance of the system was to monitor 30-50 ABT metered consumers for a period of 3 months from the date of commissioning. As per the client requirement, the order for Phase-II could be given only after performance in Phase-I was found satisfactory. In Phase-II, the data of ABT meter had to be fetched from the port provided on the meters existing at Open Access/ HT consumer's premises i.e., data should be collected online on real time basis and used for monitoring & energy accounting purpose. In addition to installation, testing & commissioning of the system, successful bidder had to operate & maintain the system for a period of two years from the date of commissioning.

**SOLUTIONS**

**PHASE-I**

Scope of Phase-I can be broadly classified into design, development, supply, errection & commissioning. Phase-I comprised of below steps:

i. MEA with intelligent ABT meter reading system of each Open Access (OA) consumer
ii. Data Centre at SLDC, Raipur
iii. Data handling & treatments from the ABT meters/ AMRs
iv. Server, UPS and printers at Data Centers
v. SIM cards for work station
vi. Integration of MEA server with SLDC website
vii. Two years of O&M of total project from the date of FAT

Phase-I was implemented in four stages:

i. **System Study**

A detailed state-wise survey and analysis was carried to find out the complete OA requirement for CSEB. This included discussion with all the stakeholders such as generation companies, transmission company (CSEB), distribution circles, CPP's, IPP's, distributed power generation operators and EHT consumers in the state. Details regarding each correspondent as well as summary of interaction with them were prepared. At the end of this stage, a detailed survey report of the system was prepared. Parameters such as capacity, cost, priority, flexibility, location, voltage levels, availability and preparedness for each potential OA customer in the state was incorporated in this report.

ii. **Project/ Consultancy Report**

A report was prepared stating the operational, contractual and technical recommendations for OA implementation in Chhattisgarh. This report listed out short term, midterm & long term vision, objectives and imperatives for the state. For each applicant for the wheeling facility, the procedure, steps and associated timelines for participating in OA scheme was listed out. Revenue mechanism for participating in the OA scheme was listed out considering different operating circumstances such as injection & drawl voltage levels, duration, and flexibility and transmission network availability. Also, invoicing and settlement mechanism was listed out for each class of transaction. Technical details regarding actual implementation for OA participation, procurement requirement, vendor specification, etc was also covered in the scope of the consultancy report. UI pool organization along the lines prescribed by the central, zonal and state energy regulatory commission's as well as in compliance with WRLDC procedures was finalized. The consultancy report was finalized after arriving at concurrence with respective regulatory authorities, CSEB officials as well as important stakeholders in the OA mechanism.
iii. Software specifications

A software specification document was prepared detailing the required interfaces and integration mechanisms for different components in the OA. Various aspects such as functional requirements, communication requirements, hardware requirements, performance requirements, interface requirements, integration requirements and storage requirements were listed out. Perspectives of generation companies, transmission utility, distribution companies, load dispatch centre, power trading entities and regulatory authorities were taken into account while listing out the software requirements specification. Energy optimization portal was specified in the software specifications.

iv. Software design, development & implementation

This stage involved design, development, enhancement, retrofitting, configuration, implementation and training for the solution. Solution was not developed from scratch but rather was integration & enhancement of existing solutions with new development wherever necessary. A modular approach was adopted while developing fresh components to ensure minimum lead time and maximum reusability. Compliance with open standards and integration mechanism was advocated to ensure future compatibility and scalability of the solution.

The key functionalities of the solution are:

i. Scheduling

As per the ABT norms, each day is split into 96 fifteen minute blocks. All operations such as declaration, scheduling, dispatch, monitoring and accounting is performed within this 96 block matrix. Solution automates the submission of capability for each generating plants and submission of drawal schedule for each beneficiary of the state to enable
SLDC to prepare the generation and drawal schedule. It also takes care of issuing of real time dispatch/drawal instructions and rescheduling if required, along with the commercial arrangement for the deviations from schedules. Different perspectives of load dispatch centre, generating stations and load centres in the scheduling cycle are captured in the ABT scheduling functionality.

![ABT Scheduling](image)

**Figure 2: ABT Scheduling**
ii. Energy Accounting

ABT meters present in the field were of different manufacturers. Kalkitech solution have the capability of providing ABT with different meter manufacturers, i.e., with universal protocol. Initially, in the Phase-I, the meter data was brought to the server offline i.e., by taking MRI of the meters and transferring the file. The energy meter MRI data was made available for accounting only on monthly basis. In Phase-II, online data transfer was done.

![Energy Accounting](image)

Figure 3: Energy Accounting

iii. Reporting

Real time reporting was done in the form of trends & graphs generated based on the data stored in the local database. Standard reports based on energy meter data, schedule, declarations, revenue calculation, UI charges, min/ max/ average values were made available in the ABT management solution. Reports were available both in tabular & graphical formats. All reports were web enabled and hence could be accessed from the browser. The solution empowered user with report builder to create and deploy custom reports based on the historical database for the ABT management solution.
Training was conducted for the operating personnel for proper utilization of the implemented solution.
PHASE – II: Fetching of data on demand from the ABT meters and the report generations on monthly basis in compliance to the requirement of CSERC.

![Energy Meter Drawal](image)

**Figure 5: Energy Meter Drawal**

The principal objective of the software solution was to provide the SLDC with an effective tool to maintain energy data in computerized environment, aid in energy data administration, and enable them to get the data directly from the meters at SLDC without any manual intervention with the installation of modems and DCS's.
The main functions of the solution include:

- Meter data collection from remote meters
- Meter data import from xml files
- Schedule data from xls, txt files
- Creation of master database
- Data validation, estimation & editing
- Configuration of various meter parameters like meter configuration, virtual meter configuration and UI rate.
- GUI development for graphical display of ABT meter data's like data trending, charts.
- Predefined reports
- Report generation tool
- Exporting report to user defined format like pdf and xls.
- Open access calculations
- Tariff calculations – Energy charges, capacity charges realization based on availability, UI charges, REC, incentive calculation based on PLF & TSC (Transmission Service Charge). The formula given by CSERC & CERC is used for calculations.
- Security/ Authentication at various levels.

**Software Architecture of MEA solution**

The ABT compliant energy meter data is fetched to main database, through GSM/ GPRS modems as the mode of communication, as MRD files. These files are converted to xml files using meter manufacturer's proprietary software by the user. Data in xml files are read by the ABT data driver (data import module) and validated in line with validation, estimation and editing rules as practiced in AMR solutions worldwide. The raw and the validated data are then stored in database. The validated data is used for calculations. The software provides user friendly options to systematically group ABT energy meters details and at the same time provides maximum security.

![Software Architecture Diagram](image-url)
Hardware Architecture

The hardware architecture for MEA solution at CSPTCL is as given below:

An arrangement of dual redundant servers runs in hot-standby configuration. These servers were configured & designed for a high availability requirement. The two servers were connected with 2 KVA UPS and printers. The client desktop PC's was connected with 0.5 KVA UPS.
The remote meters were communicated over GSM network using GSM/ GPRS modem. The meter end modem was connected to the meter with the help of optical cable. The server end modem was connected to industrial PC which acted as the Data Concentrator Unit (DCU). The DCU was in the same network of MEA server-client network. The Industrial PC was connected to the server end modem through its COM port. The application in the Industrial PC invoked the meter specific proprietary APIs. This API helped the server end modem to dial the meter end modem. The dialing number for the modem was configurable and the same configured number was used by the API to call the meter end modem. The meter end modem was set at auto-answer mode. The meter end modem was connected to the meter through the optical cable and it sent data fetch request and collected the data from the meter whenever the command was sent from the API via server end modem. Dialing and data collection from meter was handled by the meter proprietary APIs as per the MIOS regulations.
The meter end modem was physically connected to meter using Optical cable which had optical sensor at the meter end and RS232 connection pin at modem end. The server end modem was physically connected to the Industrial PC using RS232 communication cable. The server end modem and the meter end modem were connected over wireless GSM network at the time of data collection.

Power supply for the server end modem was given from a separate power source. The power supply for the meter end modem was given from the source used for the auxiliary power supply of meter.

**KEY FEATURES**

- **Security** - User based restricted access was provided.

- Tariff calculation engine module - The advantage of the tariff calculation engine was the capability to maintain tariff versions. This allowed multiple versions of the tariff structure to be maintained in the system. When invoice had to be generated for a previous time period, the tariff structure applicable at that time was used by the system rather than the current structure.

- Calculation of UI charges, reactive energy charges, energy charges, availability, PLF, capacity index, capacity charges & its realization, Incentive based on PLF calculations and Transmission Service Charge (TSC).
KEY BENEFITS

- Critical system monitoring: Grid frequency, load, generation, drawl, etc
- Energy accounting of state in accordance with ABT
- Flexibility to modify tariff calculations to comply with revision in CERC/ State ERC guidelines
- Expense minimization & Increased productivity
- Reduced monotonous labor & cycle time
- Reduced manual intervention & errors
- Flexibility, scalability and accuracy to handle various scenarios in changing regulatory affairs
- Reduction in IT infrastructure cost for future enhancements
- Standard & Customizable reports

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