CASE STUDY : AMR for enabling Online Availability Based Tariff System in a Power Generation Company

CLIENT : An ISO Certified Power Generation Company in India with installed capacity close to 2000 MW

INTRODUCTION

The client is a State Government run Power Generating Company in India with total installed capacity of close to 2000MW. The company set up a state of the art Generation Control Centre (GCC) with connectivity to three of its Thermal Power Stations to continuously monitor on-line Plant Parameters and Plant Performance for Optimization of input cost and UI revenue maximization. For the same, it intended to create an Online ABT (Availability Based Tariff) System. The ABT parameter of generation units, various grid interface points and internal reference points were captured by the energy meters at the respective points and was updated automatically to the GCC through Kalkitech's intelligent AMR Solution. This AMR data was further intended to enable the central monitoring of generation and dispatch of energy to various feeders at different plants. This helped the Generation Control Centre to advise individual stations so that revenues are maximized and UI revenue is optimized.

The AMR solution involved Kalkitech's SYNC 2000-Data Concentrator Unit (DCU), and SYNC 5000- Meter Data Acquisition System (MDAS) from which the data of different thermal power stations is taken by the online ABT monitoring tool – Kalkitech ELTRIX located at the GCC.

CLIENT REQUIREMENTS

The client required the following parameters to be monitored actively as part of their Plant Performance Monitoring and ABT systems:

- Current Period Average Frequency
- Current Period Forward Active Energy
- Current Period Reverse Active Energy
- Current Period Forward Reactive Energy
- Current Period Reverse Reactive Energy
- Previous Period Average Frequency
- Previous Period Forward Active Energy
- Previous Period Reverse Active Energy
- Previous Period Forward Reactive Energy
- Previous Period Reverse Reactive Energy
- Cumulative Active Energy Import/ Export at midnight
- Cumulative Reactive Energy High and Low

KALKITECH SOLUTION

Solution Architecture

The supplied system had a redundant set of servers and workstation at the Generation Control Center (GCC) running the Online ABT monitoring software. The GCC system was connected to the plant level Online ABT monitoring systems at the three power stations that are been monitored. The plant level systems were connected to the GCC system via dedicated leased line between GCC and each plant, with backup provided by a VSAT link constituting a Wide Area Network (WAN).

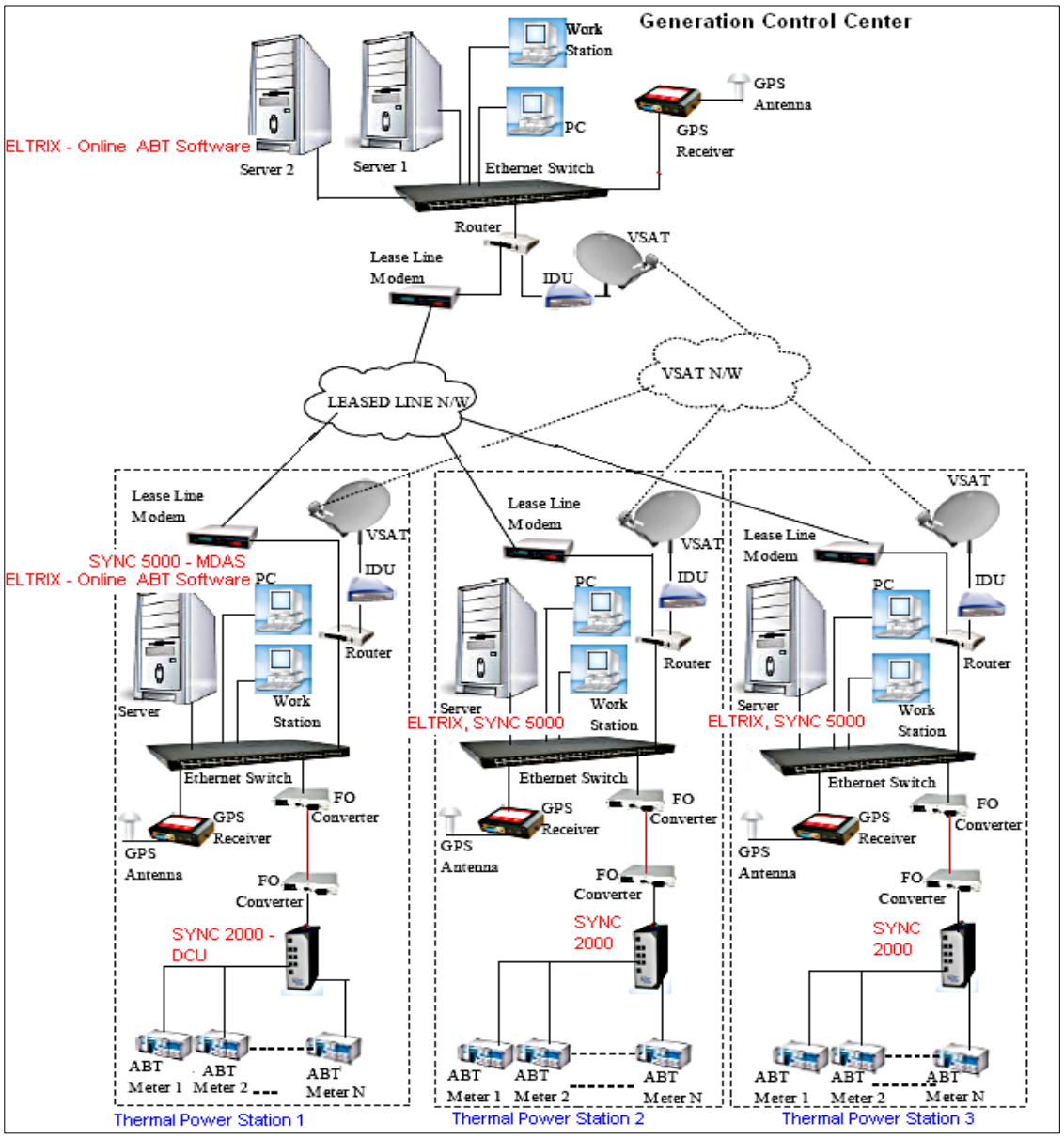


Figure 1: Architecture Diagram

Each plant level system is connected to the WAN via router. The router is configured to automatically switch between the leased line and VSAT. When the leased line connectivity is down the communication is switched to VSAT automatically by router and once the leased line connectivity is up the communication is routed back to leased line.

At plant level, the system consisted of a Server and Client workstation connected over a Local Area Network (LAN). Data from Energy meters at plant units and switchyard were acquired using Data Concentrator Units (DCUs) of model SYNC 2000. Meters are connected to the SYNC 2000 over RS485 multidrop links. Multiple SYNC 2000 Data Concentrators are connected to the network from different plant locations. Complete system is synchronized with satellite time using GPS time receivers at plant level and at GCC level. Both servers at GCC are connected to the plant level systems over the WAN. Operator workstation is connected to the server over local area network (LAN) at the GCC.

Communication Network Overview

The energy meters record the instantaneous and ABT parameters of all generation units, various grid interface points and internal reference points. The CT/PT connection required for the ABT meters were tapped from the existing CT/PT terminals for the various metering points. Metering points considered were Generator Terminal (GEN), Generator Transformer (GT), Unit Auxiliary Transformer (UAT), Station Transformer (STN), Inter Connecting Transformer (ICT) and Feeders. Meters were enclosed in control panels installed at the Unit control rooms and switchyard control rooms.

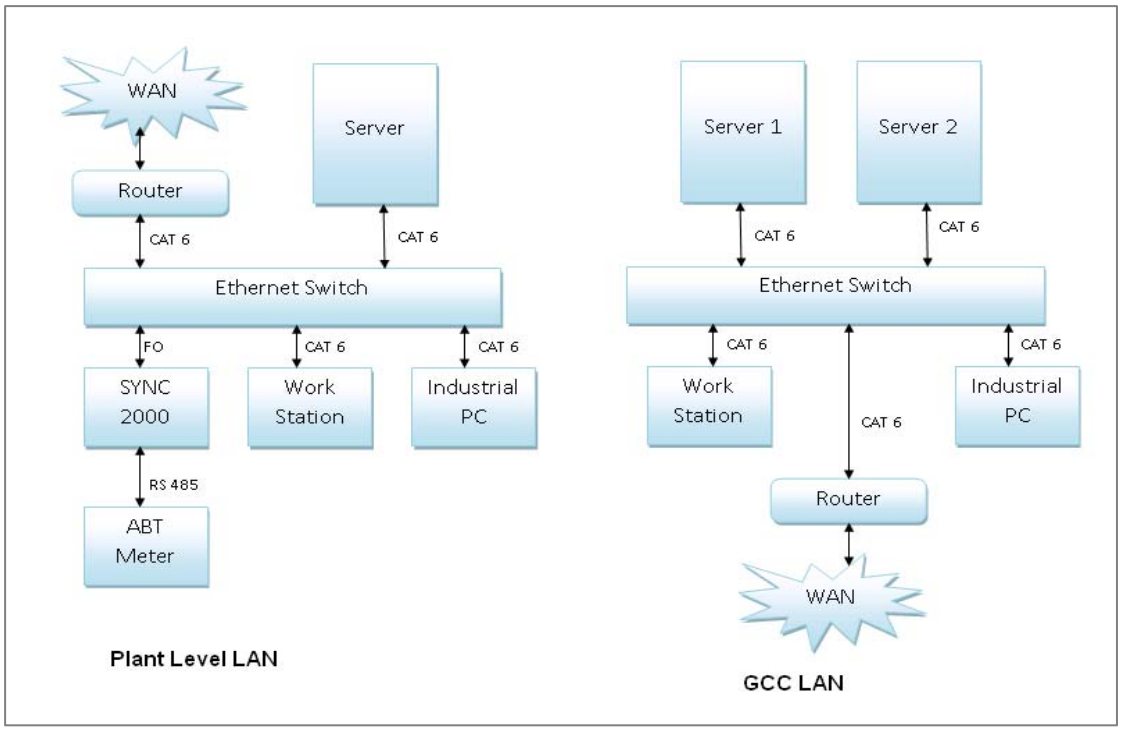
All the energy meters has RS485 interface and communicate on standard Modbus RTU protocol. Each metering panel had DCUs of model SYNC 2000 with multiple RS485 ports for connecting the meters. Meters are connected to SYNC 2000 in RS485 multidrop fashion. SYNC 2000 units from all locations in the plant are hooked up to the station level LAN either by Ethernet Cable or Optical Fiber Cable (OFC). OFC was used wherever the distance was more than 100 metres and Fiber Optic media Converters were used at the SYNC 2000 side and at the server/LAN side.

The MDAS- SYNC 5000 run at the station LAN level and collects meter data from the SYNC 2000 data concentrators and transfers the data to Online ABT software, ELTRIX. The station level LAN is built on star topology. All nodes in the network viz. server, workstation, personal computer, printer and SYNC 2000 has unique IP addresses. All these nodes communicated with a speed of 10/100/1000 Mbps. This plant level network connected to the WAN via network router.

At the GCC level the LAN comprised of two servers, workstation and a personal computer. Each node in the network has a unique IP address. All these nodes can communicate with speed of 10/100/1000 Mbps. This network connects to the WAN via network router.

All the three plants are connected to the GCC over a WAN using leased line connection. Also a backup connectivity is provided and is based on VSAT. The data exchange between the plant and GCC happens primarily via the leased line and in case of connectivity problem in the leased line; the data exchange will be routed via the VSAT connection.

The leased line connection between the plant and GCC is provided with MPLS mechanism. The plant location and the GCC have a bandwidth of 2Mbps each to communicate in the MPLS network. The VSAT connection is of 20 kbps line which is scalable to a bandwidth of 64 kbps and has an uplink and downlink speed of 20kbps at plant level and GCC level.



KEY HARDWARES /SOFTWARES USED

ABT Meters

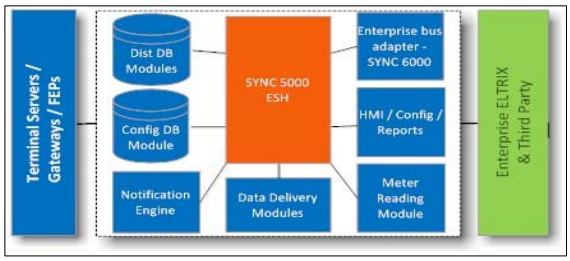
ABT meter is used for measurement of active energy and average frequency in interval of 15 minute blocks. The active and reactive energy measurement was carried out on 3 phase 4 wire principle. Primary measurement is from CT and PT. The active and reactive energy measurement for both import and export were considered for 15 minute blocks and were converted into net energy import/ export. The meter also calculates cumulative active/ reactive energy at midnight. The net active/ reactive energy and average frequency of each 15 minute block and cumulative active/ reactive energy at midnight data captured are stored in meter for 35 days.

Kalkitech SYNC 2000 - DCU

SYNC 2000 is a data concentrator unit which communicates with multiple energy meters and make the data available to the master systems in a LAN. SYNC 2000 has 6 serial communication channels to which meters were connected in point to point or multidrop fashion. Capabilities of SYNC 2000 included optional modem card and IO board for applications like substation protocol converters, data loggers, low end data concentration, multi-protocol mapping, industrial complex meter gateway, building automation with all major open standards as well as select proprietary protocols support. SYNC 2000 was used to capture data from the ABT meters installed at various interface points and this data was transferred to SYNC 5000.

Kalkitech SYNC 5000 - MDAS

SYNC 5000 is a Meter Data Acquisition System (MDAS) that acts as the Communication module for the Online ABT software. It provided the required interface between DCUs SYNC 2000 and the ABT software. It further helped in the configuration of individual energy meters with respect to the power station locations and maintains the collected meter data in local database. The MDAS was also key in sending time synchronization commands to SYNC 2000 units to synchronize the meters subsequently.



SYNC 5000-MDAS

Kalkitech ELTRIX

The ELTRIX system has a built in integrated modular architecture having high flexibility and scalability to cater to the evolving nature of the regulations scenario. It has the following modules viz., Communication Module, Data Import Module, Database (with Data Validation), ABT Scheduling Module (with generation of Declared Capacity), Implemented Schedule, Tariff Modeling Module, and Tariff Module (with Tariff Calculations, GUI and Reports Module and Security Layer).

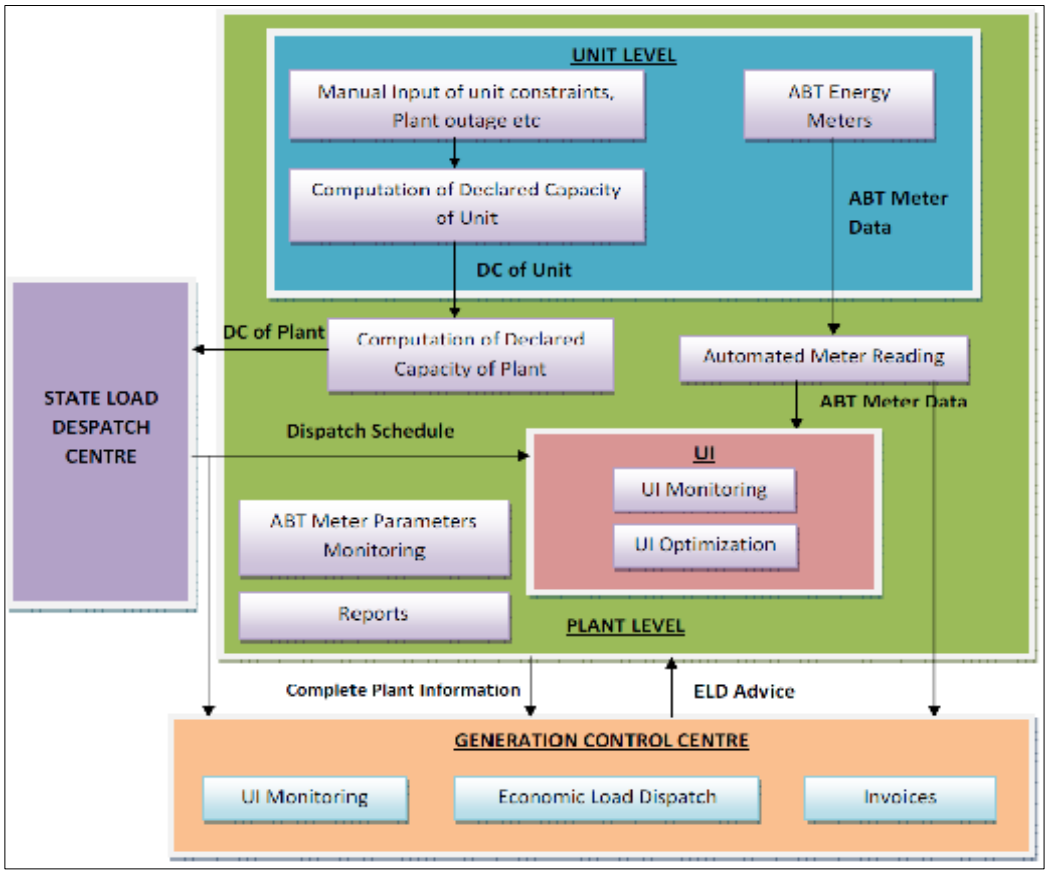


Figure 5: ELTRIX Modules

ABT related data (Declared Capacity, Schedule Generation, Actual Generation, and Frequency) was available to the client in the form of Tabular display/ trend/ report at plant level and at the GCC. Eltrix included features for entry of Declared Capacity and Scheduled Generation values at each plant by the client's authorized users. Data was also

logged for each time block to enable historical analysis. The operator then monitored the actual Ex-bus generation and frequency, and compared these values with schedule generation given by the State Load Dispatch Centre (SLDC) on-line. This enabled the client to match actual generation with scheduled values, in order to maximize revenue and run the plant efficiently.

CONCLUSION

Real time monitoring required for the Generation Optimization solution at the power plant was facilitated by the Automated Meter Reading (AMR) System. The data acquired from the ABT meters is taken through SYNC 2000 -DCU and sent to the MDAS -SYNC 5000. This MDAS further provided the raw data, which was worked on by the ELTRIX software to calculate the Plant Data like Generation, Auxiliary Consumption, Energy Balance, and UI against schedule to Generation Control Center. The GCC suggested Economic Load Dispatch Instructions to plant such that the overall cost of generation was minimized and revenue was maximized for the client.

READ MORE

- **Kalkitech AMR Solution:**

  http://www.kalkitech.com/offerings/solutions-amr
- **Kalkitech ABT Solutions:**

  http://kalkitech.com/offerings/eltrix