CASE STUDY : Centralised Generation Control Room

CLIENT NAME : State owned large Generation Company in India
PROJECT TITLE : Generation Control Room
YEAR OF EXECUTION : 2009

ABSTRACT

The solution was implemented for a state owned Generation Company which has a diverse generation portfolio of Coal fired, Gas fired and Hydro-run generating plants. The client generates power for one of the state located in central region of India with an area of more than 3 lakh sq km. Client's requirement was to employ a well managed generation solution with an provision to drill down to a plant level generation. Plants were commissioned over a span of 40 years i.e. from 1960’s to 2000 and were operating with varied technologies of different vendors making the integration process complex and difficult to achieve.

The mandate was to create a seamlessly integrated generation management solution. This will integrate data from different generation units to a common platform at the plant level. Data from all the plants will be integrated onto an enterprise level platform at the corporate level. Relevant operation and revenue optimization will be supported both at plant and corporate levels. The project was undertaken phase wise starting from communication infrastructure development, solution development and implementation.

REQUIREMENT SUMMARY

Client has more than 50 generating units totaling to about 10,000 MW of power generation with a diverse portfolio of coal fired, gas fired and hydro run power plants operating across the state. These power plants were commissioned over a period of time. The equipments and control systems were supplied by different OEM vendors like Yokogawa, Alstom, Siemens, L&T, GE and Honeywell. In few of the cases, the equipment providers had discontinued support to the platforms supplied.

To manage and control the complete generation portfolio, it was essential for the client to monitor the generation at the enterprise level. So client’s requirement was to set up a Generation Control Centre at corporate headquarters. The key functions required in GCC were integration, top to bottom drill down facility, regulatory compliance for grid participation, revenue maximization by minimizing operational costs, and optimal load allocation between thermal & hydro power plants. Client also intended to implement ABT mechanism with precise regulatory compliance.
KALKITECH SOLUTION

The complete solution can be classified into two parts:
1. Integration to a common platform
2. Plant Level & Enterprise Level Optimization

- **Integration to a common platform**
  Generation Control Center communicated with the plant for accessing specific information and combined it with the information received from Load Dispatch Center. High availability architecture using Storage Area Network ensured retention of information and considerably reduced the possibilities of down times.

Kalkitech’s SYNC protocol converters and data concentrators were used while deploying communication systems. The diagram below represents the overall system architecture.

---

**Plant Level Communication:**

All power plants have local SCADA server, Oracle 10g database and lease line connectivity. The plant parameter data was captured from different units by SCADA Data Acquisition System using LAN and consolidated data was stored at plant level oracle database as well as HQ-GCR level central oracle database by using lease line connection.
HQ Level Communication:

The power plant parameter data along with the processed data (performance data) from each plant was replicated to central database in HQ-GCR at predefined regular intervals by using lease line connection. The servers at GCR location was provided with box-level redundancy and configured in high availability mode. In case of database crash at any plant, the plant data is restored from HQ-GCR. A built-in disaster recovery was provided in the system.

- **Plant Level & Enterprise Level Optimization**

  I. **Plant Level**

  Main functions at plant level include:
  
  i. Acquisition of analog and digital data from respective plant and its units
  ii. Online performance monitoring and calculations for each plant
  iii. Continuous check of limit violations and status change for the identified parameters
  iv. Online and historical trending of identified plant parameters
  v. Economic load dispatch
  vi. Availability based tariff optimization
  vii. Offline data configuration into the system
  viii. Generation of identified reports
  ix. Maintenance of the online as well the historic data of data points pertaining to the GCR location.

  Below are the modules implemented at the plant level:

  i. **Plant Performance Monitoring module**

  PPM package was supplied with many inbuilt features like tracing and replacement of bad quality data and online simulation. PPM module carried out efficiency calculations like boiler heat rate, turbine heat rate, and auxiliary equipment efficiency of various equipments for each unit at plant level.
ii. **ABT module**

Data from Special Energy Meters (SEM's) was acquired and transferred to Generation Plant Monitoring System (GPMS) server. ABT related data like declared capacity (DC), scheduled generation (SG), actual generation and frequency, from server was made available both at plant level and at Enterprise level. The GPMS sent plant data like generation capacity, fuel reserves, maintenance and outage details to Generation Control Room. Based on the data received, Generation Control Room recommends economic load dispatch instructions to GPMS such that overall cost of generation is minimized. The schedule was made for 96 blocks of 15 minutes each. ABT solution consolidated the information and sent plant generation capacity for next day to LDC/ System integrator.
ABT Module displayed the schedule given by LDC against the actual export of the plant to the grid. Solution enabled operator to monitor the slippages and ramp up the generation to maximize the UI incentives. The generation data was uploaded to the ABT server and was available online.

ABT application performed the energy accounting and billing. Various charges like Capacity Charge receivable, Energy Charge receivable, Incentives receivable, UI Charge payable/receivable, mis-declaration charges payable and revision charge payable, were calculated by the solution for each plant individually. Generation schedule was sent to MOD module for further processing.
iii. Merit Order Dispatch module

After receiving generation schedule from LDC, the MOD module computed the cost of generation for each unit. Further the module arrived at optimal load distribution of different units by using the fuel cost curves.

The optimization algorithm of MOD package was executed in line with user specified constraints, Auxiliary constraints and maintenance constraints.
iv. **Alarm and Event Display**

Solution has a warning system in which an alarm occurs when the value of an analog point crosses the pre-defined alarm units. Alarm data is logged and displayed for diagnosis.
II. Enterprise Level

All power plants were connected to the centralized generation control centre at the client’s headquarters.

In GCR, processed data was identified and collected from respective plants. Data acquired was analyzed for performance monitoring. Limit violations and status changes for the identified parameters were continuously monitored.

The diagram below represents the software architecture of GCR. The main modules of the GCR system at HO were GCR – GUI Engine, GCR – ABT engine, GCR – Performance engine and GCR – Reports engine.
**GCR – GUI Engine**

The GUI Engine runs on the GCR Server. This component allowed user to access the results of the performance calculation, MOD and ABT Modules in a user friendly graphical interface. In addition, it provides user interface in the form of trends and charts for critical process points. This component enabled data entry by authorized users/ operators required for plant level calculations. Data validation, manual substitution and system configuration is a part of the GUI.
### GCR – ABT Engine

The ABT Engine runs on the GCR Server. ABT engine empowered the user to define tariff calculations depending upon the regulatory changes. In addition, ABT optimization engine has the ‘what-if’ capability for the plant operator to simulate different scenarios and forecast possible outcome.

### GCR – Performance engine

This component carried out efficiency calculations like boiler heat rate, turbine heat rate, auxiliary equipment efficiency and cost of generation. Calculations were done for each generating unit. In case of failure of the Plant server, performance engine at GCR acts as back up.

### GCR – Reports Engine

This component empowered user to generate customized reports. Reports can be configured for daily, monthly or on demand generation.
BENEFITS

- Synchronized and integrated GCR solution
- Open centralized solution platform for seamless integration and future enhancements
- Quick Turnaround time
- Time saving, energy saving, cost effective measures by application, cost calculation impact resulting in lower cost and higher revenues for the client
- Error free power plant operations
- ABT implementation
- Increase in UI incentives
- Exhaustive reporting