IT applications in Power Distribution - UPCL's agenda for reforms

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Abstract

The Indian Electricity Act 2003 has ushered an era of power reforms in the country. The Act envisages major reforms in the Power Sector in the field of power generation, transmission and distribution. The Act invokes the philosophy of liberalization, competitiveness and commercial motive for business survival. While encouraging private sector participation in power generation, transmission and distribution, the Act seeks to distance the regulatory responsibilities from the government to the regulatory commissions. Information Technology has the potential to contribute significantly in the power reforms process, particularly in the area of revenue management, outage management, distribution management, consumer relationship management (CRM) and T&D loss reduction.

Uttaranchal Power Corporation Limited (UPCL) is having approximately 9 lac consumers under Domestic Light & Fan, Commercial, Industrial, Irrigation, Water Works and Public Lighting categories. With the objective of improving revenue collection, minimizing losses, correct energy accounting and efficient consumer services, UPCL has planned for major IT initiatives, including the ambitious GIS based electrical network mapping, consumer database indexing and computerized Online billing, Spot billing and Conventional Billing. The paper deals with the various IT applications in Power distribution, with reference to UPCL's agenda for reforms

IT philosophy in UPCL

1. Adoption of open architecture in selecting HW/ SW for proper integration
2. Consistent infrastructure to support collaboration, communication and interoperability
3. Adaptive network based on standard protocols to meet the changing requirements
4. Authentication and authorization based access to the network, independent of location 5. Robust and scalable architecture to support large volume of transactions
5. 3-tier architecture for easy modifications of business rules and quick deployment
6. Platform-independent application components for easy migration to new platforms

IT applications in Distribution: UPCL's initiatives

Customer database indexing

1. Creation of customer database linked to DT (for LT customers) and linked to feeder for HT customers. The customer database contains all the important attributes of the customer (e.g. Customer ID, Address, meter no., contact details, etc)
2. All customers are given a unique identification no. The information of the customer's network connectivity is maintained in the database. This is important because customer's electrical connectivity changes frequently with expansion of electrical network, but not the customer identification.
3. This customer database is linked to assets database for the purpose of defining his electrical connectivity.
4. All network elements are identified and a database is created. All the technical attributes of the equipment are recorded in the database.
5. This asset database is linked with customer database for the purpose of defining electrical connectivity of the customers.
6. The asset database has a GUI tool where all the child components are shown as subset of the parent. When a parent is selected the entire child components can be seen in the left pane.
7. In case of network reconfiguration where some components are electrically connected to a new parent component, then all such child components can be dragged and dropped to the new parent component. The database gets immediately modified to show new electrical connectivity.
8. The entire electrical network is mapped over a GIS map having sufficient resolution to identify an HT or LT line. When the DT is selected, then all the LT lines connected to that DT and customers connected to respective LT line are shown.
9. The database & related software generates a color graphic map of the network with the facility for zooming, resizing and scrolling.

SCADA System

1. All new 33/11 KV substations and DTs are equipped with remote data transmission capability.
2. The SCADA system at S/S collects all the energy/ power flow and other system parameters. This information may be transmitted to central server for centralized monitoring.
3. The information collected by SCADA can be used for load flow study, reliability index calculation (customer hour linked to Feeder/ DT) and system planning. The load information of DT/ Feeder helps in reducing outages and system planning based on actual data helps in system reconfiguration and improvement.

Metering, Billing & Collection (MBC)

Metering

1. Meters with AMR facility are planned for all HT Customers and large LT Industrial/ Commercial customers
2. The feeder meter/ DT meter and consumer meter data can be captured directly via a communication interface (RS 232C/ 485 or GSM radio link) on an MRI or HHC.

Billing

1. The data entry for billing is planned at Substation/ Sub-division connected to the main server at Circle HQ, which hosts the customer database and entire bill related information. The bill processing and printing can however be done locally.
2. The billing system software is designed to suit the existing billing practices with a provision to migrate to the best business practices.
3. The software shall be capable of validating meter data and correct inconsistencies
4. The software shall be capable of generating various MIS reports as required by the UPCL or SERC

Collection

1. The software shall incorporate various modes of payment by customer e.g. by cash/ cheque or through bank.
2. On line payment gateway of designated banks and credit card payments can be used. 3. All sorts of MIS reports can be generated as required by UPCL or SERC.
3. Software should monitor disconnection of the defaulted customer and payment/ non-payment of bills by disconnected customers.
4. Software should also monitor temporary disconnection and dismantling on the request of customer.

Energy Audit

1. The software shall interact with billing module, customer database & substation DAS for DT wise energy auditing and feeder load balancing.
2. Software shall be intelligent enough to understand network reconfiguration and accordingly compute ATC losses during energy audit.
3. The software shall have built in algorithm to calculate estimated technical loss based on network parameters and power flow through feeders.
4. The software shall identify areas of high losses and generate exceptions.

MIS

1. The requirement of MIS reports is basically in four categories
    a. Financial
    b. Operational Efficiency
    c. Customer Satisfaction
    d. Development/ Investment
2. The software shall allow access to data based on the level, role and responsibility of the user.
3. Data acquisition for MIS shall be without human intervention as far as possible. The data shall be collected only at the lowest level and in the standard formats.
4. In addition to pre-defined queries and reports, the software will have a graphical query builder where user can build his own ad-hoc query without having to know any programming language or query language.
5. The software shall have in-built functionality for intelligent decision-making.

New Connection

1. The procedure for issuing new connection shall be simplified and the software shall monitor the entire process from submission of application to first bill generation.
2. The application software shall be able to generate work order for inspection, estimate based on inspection report, demand order to customer and final installation instruction.
3. The software shall also check the load demand of the customer based on the floor area, locality, etc to validate customer's application and the capacity of the existing DT from where the customer is to be connected.

Back office Automation & Customer Management

1. The big commercial and industrial customers (both HT & LT) may be provided with meters with AMR facility for continuous monitoring and load profiling.
2. Domestic customers and small commercial customers may be provided with pre-paid meters.

Pre paid metering/ AMR for C&I customers

1. The big commercial and industrial customers (both HT & LT) may be provided with meters with AMR facility for continuous monitoring and load profiling.
2. Domestic customers and small commercial customers may be provided with pre-paid meters.

Call Center (IVR/ operator assisted)

1. A call center is planned for single window clearance of all types of customer complaint/ queries.
2. Starting from no power complaint, billing, payment and connection related complaint, the call center shall to cater to any customer complaint.
3. Call centers would essentially be a customer contact center to service all customers of UPCL.
4. The call center shall be properly integrated with back office operation and all system databases to satisfy immediate requirement of customers.
5. The maintenance management system shall also be integrated with call center.
6. With the establishment of call center, the public interaction of UPCL official will be reduced to great extent.

SCADA & Distribution Automation

1. The SCADA shall have two basic layers:
   - Client layer for man machine interface
   - Date server layer for handling process data and control activities
2. SCADA shall have a dedicated server with sufficient hardware/ software redundancy.
3. Strong communication backbone is a must for SCADA.
4. All the process parameters must be time stamped.
5. As the real time database used for SCADA is proprietary in nature, it shall have a data export facility to our RDBMS through an ODBC interface.
6. SCADA shall be fully scalable for adding more process variables or hardware.
7. The MMI of SCADA shall support multiple screens with a combination of synoptic diagrams and text. The diagram shall support graphical objects with links to process variables. These objects can be "dragged and dropped" from a library and included into a synoptic diagram.

8. The SCADA should provide trend charts. The trending may be real time or historical as defined by the user.

Maintenance Management & Asset Management

1. The maintenance management shall be integrated with SCADA, Distribution Automation and IVRS call center.
2. The software shall manage any planned and unplanned outages while reducing restoration timeframes and safeguarding workers and public.
3. The software should be able to group customer trouble calls by reverse tracing of electric topology and determining a common fault affecting a large number of consumers and therefore prioritize troubleshooting.
4. The software shall be able to tackle issues of work permit and safety clearances.
5. The software shall be able to generate Preventive/ Predictive maintenance schedules and track them till completion.
6. The software shall manage, coordinate and optimize field workforce for reducing outage time and cost.
7. After completion of work and entering the work completion statistics, the software shall maintain historical archiving of works completed.
8. The software shall help in planning and monitoring available resources. Based on this, the work schedule can be planned and work order shall be generated.

Load Forecasting & Network Planning

1. Load forecasting is a major activity of electric utilities. Utilities desire accurate estimates of maximum and minimum power demands for the next hour, day, week, month and season. Accurate forecasts can save considerable amount of money through correct scheduling of maintenance shutdowns.
2. A database for energy consumed and half hourly maximum demand of each feeder and S/s is to be created using Load forecasting software.
3. The software shall use advanced statistical methods such as artificial neural network or detailed engineering algorithms.
4. The software shall generate Spatial forecasting which is mainly about forecasting future load distribution in the entire area and Temporal forecasting which is dealing with forecasting load for a specific area.
5. The software shall generate Short-term load forecasting (STLF), for the day-to-day operation and scheduling of the power purchase.
6. The software shall generate Medium-term load forecasting (MTLF), for scheduling of power purchase and maintenance programs over a period of a few weeks.
7. The software shall generate Long-term load forecasting (LTLF), for system planning, covering a period of few years.
8. The software shall consider all the probable factors, which influences the electric power generation and consumption.
9. The long-term load forecasting can help in redesign/ reconfiguration of network, using GIS data.

Conclusion

The IT applications in Power Distribution, as explained above, cover the entire gamut of initiatives taken by UPCL on the road to reforms. The focus is on the improvement of distribution efficiency, better revenue realization through accurate and timely meter reading and bill collection, loss reduction through better control and monitoring of the distribution systems and improved customer services. In UPCL, Information Technology is perceived as an enabler to achieve these objectives