Power System Operation and Control C2

System Control Room Preparedness: Today and in the Future PS1

10479_2022

EXPERIENCE OF DEVELOPMENT AND IMPLEMENTATION OF SOMS (SYSTEM OPERATION MANAGEMENT SOFTWARE)

M.M. HASSAN*, Gurmit SINGH, P.S. PRAKASH, Gaurav SINGH, H K CHAWLA, N NALLARASAN
POWER SYSTEM OPERATION CORPORATION LIMITED (POSOCO), INDIA

Motivation

- Northern Regional Load Despatch Centre (NRLDC) carries out monitoring and operation of Northern grid in India along with associated functions round the clock with the help of state-of-the-art SCADA and IT systems. real time co-ordination instructions among control centres to facilitate switching of Grid elements, HVDC and SVC set-point optimization, generation and loading management to maintain reliability of the Grid were communicated over telephone/e-mail. Expansion of grid with renewable integration and resulting operational challenges comprehends the need for automation of these functions.
- SOMS was designed and developed to overcome the above challenges. The paper discusses the experience with development, implementation, benefits, unlocking values and the way forward to operational intelligence

Challenges Faced

- Directions for switching operations of power system elements are issued by NLDC/RLDCs in the form of unique operational codes.
- Due to the very large number of players in the Indian grid, including generators and transmission licensees, a huge number of requests are received on a daily basis in real time for switching operations for different purposes.
- Prior to the introduction of SOMS, all requests were received over mail and telephonically. This, coupled with passing instructions for reactive power control and other instructions for smooth system operation, posed a huge stress on the system operator.
- During load crash scenarios, the demand for operational code increases considerably, as a lot of directions are issued for safe and secure grid operation.

Northern Regional Grid of India

- India is a geographically and climatically diverse country, ranging from tropical in the South to alpine in the Himalayan North having humid weather and sustained winter snowfall. The adverse and sudden change of weather conditions in short span of time causes sharp changes in demand and grid voltage.

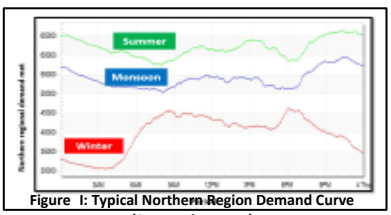

Figure I: Typical Northern Region Demand Curve (Seasonal Pattern)

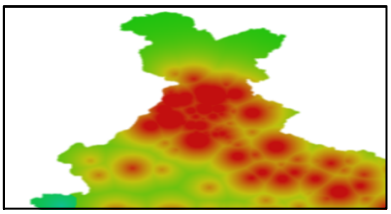

Figure II: Typical High Voltage scenario

Load Crash scenario

- The Northern Region (NR) experienced a demand crash during the evening hours of 10th June 2021 on account of thunderstorms and lightning accompanied by gusty wind. In 5 hours and 21 minutes, the load dropped by 5687 MW.
- The measures to control the impact of load crash implemented by shift operators necessitated an increase in directions issued (~25% increase). These instructions are passed on in a prompt manner to the constituents for speedy implementation.

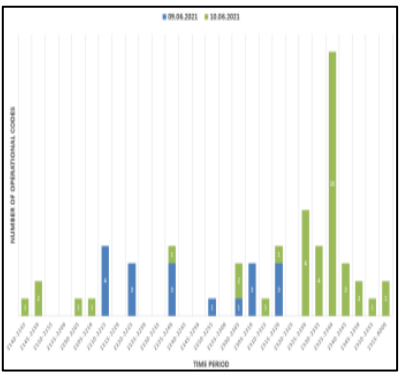

Figure III: Number of Operational Codes Issued during Load Crash

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Challenges addressed through SOMS

- SOMS acts as a platform for all switching operations, instructions for loading management, reactive power management, frequency management, power-order of HVDCs and any other instructions for facilitating smooth operation of the grid. All requests and corresponding operation codes are being exchanged between control centres without using voice communication in a transparent manner. All events are timestamped to ensure transparency and accountability.

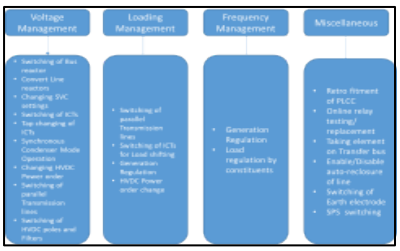


Figure IV: Segregated operational heads of SOMS

First time charging module

- SOMS offers a complete workflow for the first time charging of elements to the indenting utility. All the relevant steps, such as request for charging, submission and scrutiny of documents, and consent from the concerned departments (SCADA, metering, and protection) are stored with a time stamp on the portal, which can be tracked by the indenting utility for further co-ordination for timely charging of the elements. Finally, the utilities may request the charging of the respective element through the integrated code management module.

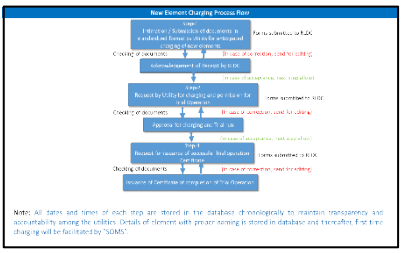


Figure VI: Process flow of First time charging Module in SOMS

Process Flow of SOMS Application

- SOMS is integrated with another application which is used for the processing of planned shutdowns through a common master database of generators and transmission elements.
- The Integrated process flow and recording of information in a chronological order with timestamp enables automated and query based customized MIS reports in minimal time. with another application which is used for the processing of planned shutdowns through a common master database of generators and transmission elements.

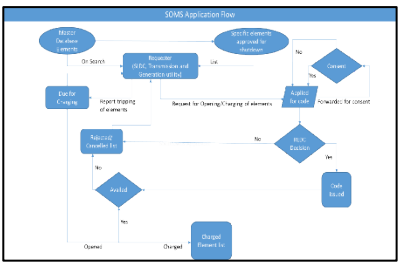
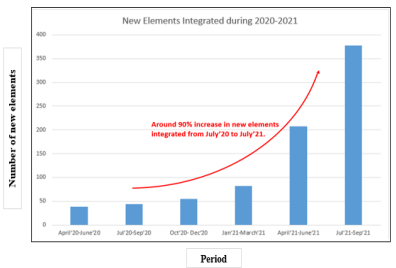


Figure V: SOMS Application flow

Renewable Energy Integration through SOMS

- A huge number of RE generators are being integrated into the grid to achieve GOI's goal of 500 GW of non-fossil fuel capacity by 2030. Through the development of the FTC module of SOMS, NRLDC has become capable of taking care of the timely facilitation of charging of huge upcoming networks for RE generators.



Note: The number includes only those elements whose switching operations are coordinated by NRLDC.

Figure VII: Elements integrated through First Time Charging Module in SOMS

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continued

Cyber Security

- Cyber security was taken as a major aspect while designing the core architecture of the SOMS application. The architecture involved the Web Application Firewall (WAF) in its core components that provide the functionalities to prevent unregulated access to the application and block any attempts meant to break the application's availability and flow of time-critical information.
- The adopted security framework filters out the top web application security risks like SQL Injection, cross-site scripting, bot attacks, brute force attacks, etc. The application firewall enables restricting users based on their IP addresses and geographic locations.
- To achieve bot prevention and unauthenticated access, attacker profiling and blacklists are maintained in the threat database, and suspicious login alerts are sent to the application log monitor to strengthen the authentication process and for further analysis.
- Malicious file uploads are blocked based on signatures and filtered based on file extensions.
- HTTPS requests received from the Application UI, which are filtered based on various filters and signatures in the web application firewall, are sent to the server side. All the requests and responses are in encrypted form using SSL encryption, which protects sensitive information and affirms the integrity.
- Furthermore, the disaster recovery (DR) site has been configured along with SCADA at ERLDC in case of major disruption.

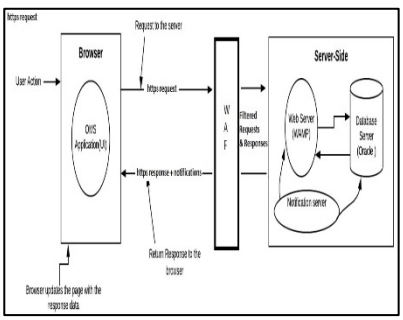

Figure VIII: Deployment architecture of the application

Conclusion

- With the development of SOMS, NRLDC and its constituents benefited largely because of the smooth communication of switching coordination with transparency. It is now possible to define and measure time-sensitive performance parameters related to request, issuance, and execution time for switching instructions, which was not feasible in manual record keeping. We are looking forward for further enhancements such as:
- Integration of SOMS with SCADA, System Studies, and Market Operation to enhance the situation awareness of system operators for effective decision making in real time.
- Implementation in upstream (NLDC/other RLDCs) and downstream (SLDCs/ALDCs) for standardisation of master database at national level and seamless exchange of information amongst all the concerned agencies.
- Enhancing the security, authenticity and availability of data by implementation through block chain technology.