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Challenges faced and solutions for Network modelling and implementation of State Estimator at Northern Regional Load Despatch Centre, India

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Abstract

The rapidly changing world of Power System Operations requires advanced, flexible & adaptive software solutions to ensure seamless Transmission Network operations. Thus, suitable tools are used to monitor, assess the security, analyze and optimize the System operations. The tool present at Control Centres to realise above tasks is termed as Energy Management Systems (EMS). State Estimator (SE) forms the front end of EMS system.It is responsible for providing a complete, accurate, consistent and reliable real-time scenario for analysis, control, and optimization of the system. Realization of SE at a control centre monitoring a wide and complicated power system is challenging several times. Major challenges for SE to function consistently are modelling of equipment, equipment operating modes, trade-off between telemetry and network expansion to include parallel network at lower transmission voltages, location of measurement in actual system vrs its location in the EMS model etc. This paper gives details of those challenges faced and their solutions during in course of implementation of EMS in Northern Regional Control Centre of India.

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Keywords:Energy Management System; State Estimator; Model Update; Model Processor; Performance Index

1. Introduction

Modern Power System Control centres operating as Load Despatch Centre are essentially equipped with State Estimator. The purpose of SE is to provide a complete complex voltage solution that is contiguous to real-time

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network conditions at all Network buses [1]. SE takes as input the real-time measurements like line power flows, bus voltages, Transformer taps, CB/Isolator status, load schedules, generation and user entries and provides an optimal state of system based on above measurements and assumed system model [2]. SE determines the estimate for the voltage magnitude and angles which best matches the unfiltered measurements information based on measurement redundancy. Once the system state and the system model is known, all the active and reactive power flows in the system can be computed, even if these flows were not measured originally. SE forms a reliable database of the system, on which security assessment functions can be reliably deployed in order to analyze possible contingencies and the required corrective actions.

The paper is organized as follows. Part I introduces the need of EMS system. Part II comprises basic system information of EMS system at Northern Regional Load Despatch Centre. It includes SE model update and processing, model and input data validation, modification of topology and network truncation, modeling of equipments and Network Parameter Adaptation. Part III comprises of Major issues being faced while implementing EMS and the solutions. Part IV comprises quantitative analysis of improvements shown by SE and future scope in context of new implementations that would further improve the output. The section talks about External Network Equivalency and Hybrid State Estimator and their anticipated affect on quality of SE output. Part V concludes the paper.

2. System Information and Modelling

Northern Regional Load Despatch Centre (NRLDC) is the apex body to ensure integrated operation of the power system in the Northern Region of Indian Power Grid. It is responsible for monitoring of system parameters and security, load/generation dispatch etc. for the whole region. The northern grid consists of transmission elements owned by individual transmission utilities that belong to central/state sector or private sector. State Load Dispatch Centres (SLDCs) are responsible for monitoring and dispatch of transmission elements at voltages lower than 220 kV that belong to respective state owned utilities (transmission and generation). It also co-coordinates with NRLDC to control and operationalize state owned transmission elements at voltages of 220 kV and above.

2.1 TNA Model Update/Processing:

TNA uses the Physical model made by Power System Resources organised around the Substation. Typical elements comprising Physical model are Busbar Sections, Generating units, Loads, Shunt/Series compensators, AC/

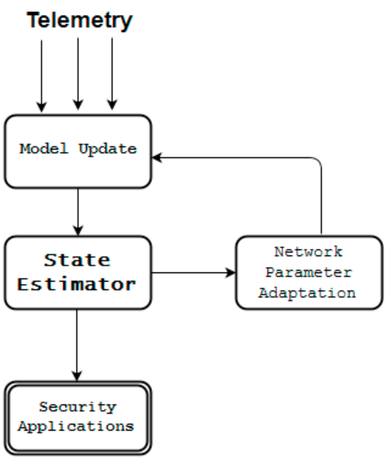

Fig. 1: Steps involved in Model Processing

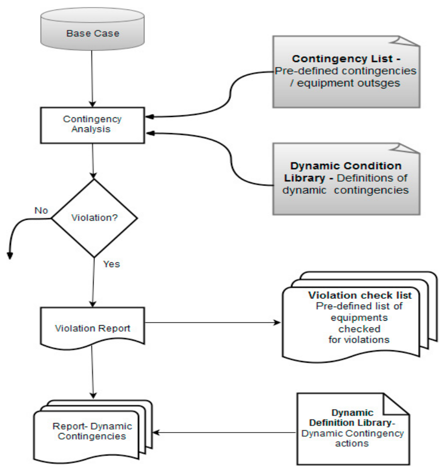

Fig. 2: Steps involved in RTCA