ABSTRACT

The main objective of this research is to develop an effective Web-enabled service-oriented architecture for making the power system analysis in a completely secure, distributed, platform-independent and language-independent environment. The service orientation of different power system applications like load flow analysis, contingency ranking and economic load dispatch has been proposed and implemented.

In order to satisfy the requirements of a highly distributed environment, to maintain the level of legacy and transparency in power system applications, to store and update the data collected from a heterogeneous environment, and to communicate the output estimated by one service to other related services, the standardization methodologies have been proposed for effective monitoring of interconnected power systems.

Data exchange is very important in electrical power system applications. A data exchange model has been proposed and developed which is more reliable, error-free and adaptable to different types of softwares used in different power system clients. This thesis uses XML as the data exchange base for power system data because of its easy integration with the Web and Intranet/Internet applications which makes XML one of the best choice for data exchange in on-line power system analysis.
The need for Web-based computing in power system analysis has been discussed which is based on Internet protocol, distributed processing and Java programming for the analysis of large scale interconnected power systems. The discussion was carried in view of the new open energy market demands and the low cost, high availability and expandability, interoperability and computational speed-up that can be achieved by using Web-based computing, as this technology permits sharing of data and computing resources across the whole system.

Grid computing provides high computing power, sharing of resources across the network among many computers and access to remote and distributed data. This thesis highlights the advantages and huge potentials of grid computing applications in power engineering. The proposed grid computing model provides more open access and more efficient and effective computing services to meet the increasing needs of the power industry. The developed power system applications on the grid computing can provide real-time information for the whole system. The exchange of computing power is inherent to grid environment and hence quicker and fault tolerant models for power system operations have been designed and implemented.

A trigger is a statement that the system executes automatically as a side effect of a modification to the database. Trigger is useful mechanism for alerting power system automatically when certain conditions are met. In the trigger model, the contingency selection has been incorporated in two stages. In the first stage, load flow server will compute load flow solution and the
abnormal voltages and line loading will be checked. In the second stage, the contingency server will find contingency ranking.

The proposed Service-Oriented Architecture (SOA) models for on-line power system analysis provide the solutions at every specific period of time automatically. They are designed in such a way that a server node that can provide the power system service obtains the power system data from different power system clients and responds with power system solutions to the respective power system clients. They use the built-in security mechanism. Hence the distributed on-line power system analysis through an applet definitely secures the safety of the server as well as the power system data transfer.

The core power system operations are being carried out in distributed environment. The round trip time is measured for the different power system networks that invoke the services. The round trip time has been measured for each request and response for various power system client applications. Even though Web services suffer from poor performance compared to other distributed computing approaches such as RMI and CORBA, Web service provides a cross-platform, cross-language data model that facilitates developing heterogeneous distributed applications for solving multi-area power system problems.