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SMART GRID

Roshan Popat Bagul [*1], **Piyush Sunil Chikne**[*2], **Yogesh Sunil Rathod**[*3],
Akshay Baburao Darade[*4], **Prof.Khute Y.R**[5]
Department of Electrical Engineering, JES's S.N.D. Polytechnic(Yeola), Nashik, Maharashtra, India[*1,2,3,4]
Department of Electrical Engineering, JES's S.N.D. Polytechnic (Yeola), Nashik, Maharashtra, India[5]

ABSTRACT: This paper presents a discussion of the future of the electric energy system, addressing the entire spectrum from power generation, through substations, to distribution and the customer, and the feedback loops along the way necessary to provide the computational intelligence necessary to make the "Smart Grid". Both at the federal and state levels, governments have recognized a need for modernizing the electric energy system and establishing such Smart Grids around the world. We are at the point of a historic paradigm shift, with the opportunity to implement new, more intelligent methods for producing, distributing, delivering and using electricity in a much more sustainable manner. Whereas the current electric system is based on a one-way flow of energy and information from the sources to the end users, the future Smart Grid will provide multiple paths for the flow of electricity, and particularly information about that flow, throughout the system. This paper introduces this Special Issue by presenting a broad definition for the Smart Grid. We discuss the necessary attributes for such a system-of-systems, review the need for change, and identify the technical challenges facing successful deployment and implementation.

KEYWORDS: Cybersecurity, Security classification, Smart grid, Certification, Advanced metering infrastructures

I. INTRODUCTION

Three dominant factors are impacting the future electric systems of the world; government policies, efficiency needs of the consumer, and the introduction of new intelligent computer and hardware technologies. In addition, environmental concerns have created governmental policies around the world, including at the federal and state levels, which are driving the entire energy system to efficiency, conservation, and renewable sources of electricity. These factors are the main drivers that are expanding the use of all sorts of new renewable energy and storage technologies on the one hand and new energy efficiency and conservation techniques on the other. Consumers are becoming more proactive and are being empowered to engage in the energy consumption decisions affecting their day-to-day lives. At the same time, they are expanding their energy needs. For example, consumer participation will ultimately include extensive use of electric vehicles (both cars and trucks), remote control of in-home appliances to promote energy conservation, ownership of distributed generation from ever more renewable energy sources, and management of electricity storage to locally match supply to demand. The availability of new technologies such as more abundant and aware SCADA sensors, secure 2-way communications, integrated data management, and intelligent, autonomous controllers has opened up opportunities that did not exist even a decade ago. The electric energy system of the future needs to address all these needs and concerns by using advanced technologies to create a smarter, more efficient and sustainable grid. During recent years, there have been numerous articles and conferences about the Smart Grid, but much confusion remains among all constituencies about just what the term entails. Although many different definitions have been proposed for the Smart Grid, in most cases the users have chosen particularly focused definitions related to their specific applications and local needs. Below, we define the Smart Grid in its broadest global terms. We begin with a description of the make up of the present conventional electric energy system, and we then identify the areas that must change in order to provide the intelligence and control necessary to convert to the safe, secure, and efficient Smart Grid of the future. Papers that follow in this Special Issue give a cross-section through this vast new enterprise, and while not meant to be all-inclusive, are meant to be illustrative of the changes coming to the Smart Grid.

II. METHODOLOGY

The objective of this document is to present a four-step methodology for the energy management of a smart microgrid based on the efficiency of dispatchable generation sources and storage systems.
The prescribed sequence of actions required to attain these desired outcomes is out-lined as follows:

Step 1. Identification of elements. First of all, it is necessary to identify all the elements necessary to carry out the energy management of a smart microgrid

Step 2. Monitoring of elements. After identifying the various components, a crucial next step involves monitoring and integrating them into a comprehensive control software. This software serves as a communication conduit, enabling the elements within the microgrid to interact with one another effectively. Through this integrated control system, commands are issued to dispatchable generation sources and distributed energy storage systems, contingent upon the consumption of the microgrid from the distribution network. It is necessary to monitor the following parameters.

Step 3. Characterise the efficiency of the elements of the microgrid. Once all the elements of the microgrid have been identified and monitored, it is necessary to characterise them in order to subsequently classify them according to their efficiency.

Step 4. Microgrid energy management. Energy management in a microgrid encompasses many aspects, and it is always difficult to single out one over another. In this methodology, the main objective is to optimise the performance of the microgrid by prioritising the commissioning of dispatchable generation sources and the charging and discharging of storage systems according to their efficiency, reducing the energy consumption of the distribution grid and eliminating power peaks.

III. MODELING AND ANALYSIS

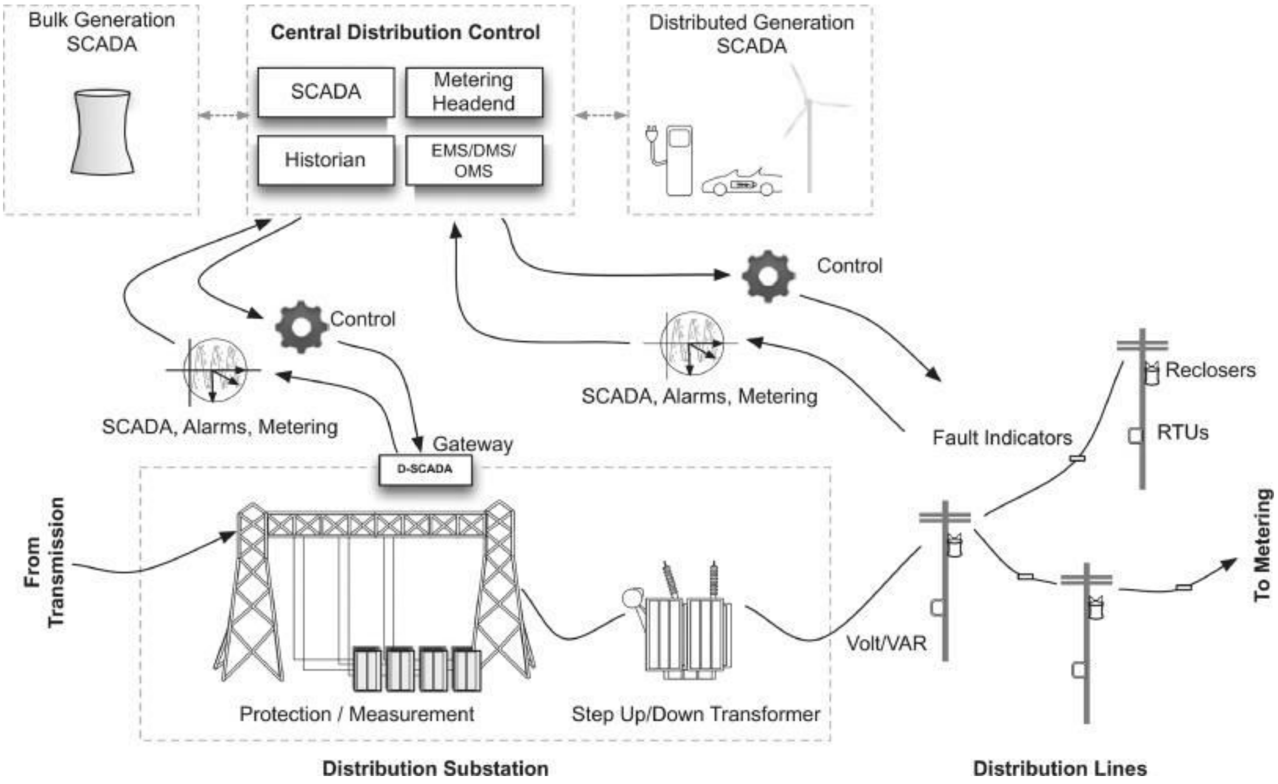

Figure 1: View of project

IV. RESULTS AND DISCUSSION

The electric grid is considered an ultra-large-scale (ULS) system,1 much like natural ecosystems and cities, in that it is faced with a) inherently conflicting and diverse requirements; b) decentralized data, development, and control; c) continuous evolution and deployment; d) heterogeneous, inconsistent, and changing elements; and e) normal failures. This complexity is becoming more pronounced as consumers shift from being users of the grid to becoming elements of it, along with technology providers offering grid services utilities traditionally supply. ULS systems are not typically designed through top-down engineering, yet they function in a highly complex and organized manner, given competing needs and objectives by the elements that function within it. The challenges we face are both technological and institutional in nature; we need to advance and effectively integrate our technological solutions, as well as help decision makers with methods and tools so they can craft grid modernization strategies that deploy these solutions over time in practical ways to meet future demands. This will require instituting the appropriate technology, processes, and design considerations to maintain a stable, coherent, and manageable grid system as it evolves, and to do so in a way that addresses the increased levels of complexity and uncertainty presented by continual technological advancement, policy shifts, and changing customer expectations. In the end, such strategies need to consider reliability, efficiency, security, resilience, and affordability as outcomes.

V. CONCLUSION

This paper has dealt with the evolution of Smart Power Grid System. It is still in it nascent stage. The whole power community is busy now in understanding and developing smart power grid system which is no longer a theme of future. This introductory paper is a small but a very vital step towards achieving the ultimate goal of making a “National Grid” a reality.

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