

# Distributed Generation Access and Power Flow Management

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**Abstract**—Connection of Distributed Generation brings about a need to manage operation of distribution networks in a way that is more active. In order to allow for this change, DNOs need to devise strategies of how to manage generator outputs so to facilitate connection of renewable resources and maximize use of network assets. The paper will look into different techniques that allow for this type of operation and analyze possible directions of transitions from current operation strategies used in active power flow management, towards possible new approaches.

**Index Terms**— distribution generation; DG access rights; active power flow management.

## I. INTRODUCTION

DISTRIBUTED Generation has a major role in SmartGrids and their aim to achieve sustainable and secure supply in an economic way. In Europe, SmartGrids concept was first introduced through a vision paper [1] while views on the research priorities were outlined in [2]. Finally, a draft of the third document on the strategic deployment has recently been published [3]. It has revisited some of the definitions of the SmartGrids, and identified key challenges, which include:

- Integrating intermittent generation – finding the best ways of integrating intermittent generation including residential microgeneration;
- Active demand side – enabling all consumers, with or without their own generation, to play an active role in the operation of the system;
- Developing decentralized architectures – enabling smaller scale electricity supply systems to operate harmoniously with the total system;
- Capturing the benefits of DG and storage.

It is important to recognize that in order to achieve above challenges, operation of distribution networks has to change significantly. Thus, distribution networks have to transform from passive networks into active ones that do not depend on human intervention, but operate in a manner that is more

similar to the current transmission network operation. Increase in the level of distributed generation, but also future active demand side participation, will mean that new services, operational arrangement and possibly market models and rules will have to be developed and introduced at the distribution level in order to accommodate these changes.

## II. DG ACCESS ARRANGEMENTS

Access of distributed generation is one of the key issues if the SmartGrids and low carbon networks are to be achieved. Since distribution networks were usually originally designed for transfer of power from mostly one point of injection towards customers, directions of flows were known. Connections of distributed generators changed that, and put network operators in a position which required adjustments in order to enable investments in, as well as connection of, renewable generation.

One of the issues related to the DG connections is network access and management of power flows so to maintain secure operation. This paper considers the availability of distribution network capacity considering thermal limits of the lines.

When a new DG unit wishes to be connected to the distribution network, responsible DNO needs to assess the available capacity of the network. Based on these analyses, it decides whether a generator can be added at a specified location, or not. In the case that the network is capable of accommodating this new generating unit, a firm connection may be offered. However, if a network needs reinforcement, it may become more economical to a generator to accept a non-firm access instead of paying for the network upgrade that would guarantee it a firm connection. In this case, DNOs will need to manage power flows on their networks by curtailing outputs of some generators under certain conditions. This active power flow management approach allows for a better utilization of the existing network, although economic benefits of the arrangements to particular generators depend on how DNOs implement the active power management scheme [4].

## III. POWER FLOW MANAGEMENT APPROACHES

In order to control power flows in the distribution networks with DG resources that have non-firm rights, DNOs usually apply the *Last-in-First-out* rule, which implies that the

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generator that has been last connected to the network. While this rule seem transparent for generators and easy to implement for DNOs, there are suggestions that there could be other access and power flow management arrangement which may increase networks utilization and even improve overall economic aspect of the network operation [5, 6, 7].

This paper will analyze these new access methods, as well as propose a new approach based on curtailment strategies and trading in wholesale electricity markets and transmission system operation [8]. Finally, it will investigate possible transition arrangements from the current state towards those that improve overall network and generation utilization.

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#### V. BIOGRAPHIES

**Ivana Kockar** received the B.Sc. degree from the University of Belgrade. After 4 years in industry, she obtained the M.Eng and PhD degrees in electrical engineering from McGill University, Montreal, Canada. She spent a year at University of Manchester, UK, and then joined Brunel University. Currently, she is with the Institute of Energy and Environment, University of Strathclyde, Glasgow, UK.

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