A DISPATCH STRATEGY FOR REMOTE INDEPENDENT POWER PRODUCERS CONNECTED TO RADIAL FEEDERS

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Degree of Master of Science in Electrical Installations

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date: 24/07/2025

(B.A.C. Sachintha)

The above candidate has carried out research for the Masters of Science under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of the supervisor: Dr. W.D. Prasad

Signature of the supervisor: Date: 24/07/2025

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ABSTRACT

This thesis presents a cost-optimized dispatch strategy for distributed generators (DGs) in radial distribution feeders using the open-source power system analysis toolbox, PyPSA. The study addresses the operational condition where the cumulative DG generation exceeds local load demand, leading to power export toward the grid substation. A control methodology is proposed to allocate DG dispatch levels such that the sum of the dynamic generation cost and associated line loss cost remains below the marginal cost defined by the utility.

The dynamic generation cost is evaluated for each DG based on its tariff rate and the cost of power losses incurred during transmission to the grid. A four-stage algorithm is developed to identify the optimal output of each DG while ensuring compliance with predefined operational limits. The algorithm iteratively reduces the output of high-cost DGs and finalizes dispatch levels based on economic feasibility and system constraints.

The methodology is implemented and validated using PyPSA, with comparative analysis against ETAP simulations to verify model accuracy. The results demonstrate that the proposed approach effectively minimizes operational costs by prioritizing lower-cost DGs and managing surplus capacity without compromising system reliability. This work contributes a practical framework for utility-oriented DG dispatch planning and offers insights for integrating dynamic cost control mechanisms into Power Purchase Agreements (PPAs).

Keywords: Distributed Generation, DG Dispatch Scheduling, PyPSA, Loss Optimization

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LIST OF ABBREVIATIONS

Abbreviation	**Description**
DG	Distributed Generation
MGC	Marginal Generation Cost
DGC	Dynamic Generation Cost
HV	High Voltage
MV	Medium Voltage
LV	Low Voltage
PPA	Power Purchase Agreement
IPP	Independent Power Producer
PyPSA	Python for Power System Analysis
kW	Kilo Watt
MW	Mega Watt
PCC	Point of Common Coupling
AVR	Automatic Voltage Regulator