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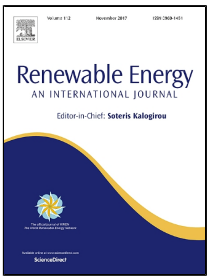

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Generation Scheduling in Non-Interconnected Islands with High RES Penetration

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Abstract

In this paper, the generation scheduling problem for autonomous island systems with significant penetration of non-dispatchable Renewable Energy Source (RES) generation is investigated, proposing a unit commitment-economic dispatch (UC-ED) model which is fully compatible with the provisions of the regulatory framework currently applicable to the Greek non-interconnected island (NII) systems. Two UC-ED model variants are presented and comparatively assessed, in order to illustrate the impact of various system parameters (technical characteristics of the thermal units, reserve requirements, etc.) on the expected operating profile of the NII system. A detailed UC-ED model is first proposed, which takes into account the reserve requirements at different time scales (primary, secondary and tertiary reserves) and respective capabilities of generating units. An alternative, simplified UC-ED model is also presented, formulated on the basis of aggregate spinning reserves, to cater for uncertainties in the actual reserve capabilities of existing thermal units. The developed UC-ED models are applied to an existing NII system to evaluate their performance and results obtained on an annual basis.

Keywords: Island systems, autonomous power systems, unit commitment, generation scheduling, high RES integration, wind penetration.

Nomenclature

Abbreviations

CF	Capacity Factor
DS	Dispatch Scheduling
ECC	Energy Control Center
ED	Economic Dispatch
ENS	Energy Not Served
HFO	Heavy Fuel Oil (mazut)
LFO	Light Fuel Oil (diesel)
LPS	Local Power Station
MILP	Mixed Integer Linear Programming
ML	Minimum Load
NII	Non-interconnected island
NII-O	NII System Operator
O&M	Operation & Maintenance
PV	Photovoltaic station
RDAS	Rolling Day Ahead Scheduling
RTD	Real Time Dispatch

$P_{W,t}$	Dispatched wind production in period t
$P_{W\max,t}^{ML}$	Wind power absorption limit due to minimum loading constraint for dispatch period t
$P_{W\max,t}^{D}$	Dynamic limitation of wind power for dispatch period t
$P_{W\max,t}$	Overall wind power absorption limit for dispatch period t
$P_{W,t}^{sp-tot}$	Total wind power set-point for dispatch period t
$P_{w,t}^{sp}$	Set-point dispatched to WF w in dispatch period t
$X_{W,t}$	Total wind power curtailments in dispatch period t
$r_{u,t,r}^{up/dn}$	Type r reserve (up or down) provided by unit u in dispatch period t
$rr_{t,r}^{up/dn}$	Type r reserve requirements (up or down) in dispatch period t
$r_{u,t}^{spin-up/dn}$	Spinning reserve (up or down) provided by unit u in dispatch period t
$rr_{t}^{spin-up/dn}$	Spinning reserve requirements (up or down) in dispatch period t

Parameters

C_u^{ML}	Production cost of unit u at ML
C_r	Remuneration for providing reserve type r
C_u^{SD}	Shut down cost of unit u
$C_{u,s}^{SU}$	Startup cost of unit u according to startup type s