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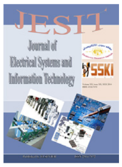

GA-based multi-objective optimization for distributed generations planning with DLMs in distribution power systems

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Abstract

In the present scenario of all over world, the planning of distributed generations (DGs) in distribution power systems are very important issues from power system performances viewpoints. The broad categories of different types of DGs on the basis of their power delivering characteristics are considered T_1, T_2, T_3 and T_4 with different load models (DLMs) for the analysis in this paper. This paper presents the impact assessment of optimally placed different types of DGs (such as T_1, T_2, T_3 and T_4) with DLMs by employing genetic algorithm (GA) in the distribution power systems (DPSs) form total minimum real power loss of the system viewpoint. Different DPS performance parameters such as minimization of real power loss, minimization of reactive power loss, improvement of voltage profile, reduction of the short circuit current or MVA line capacity and reduction of the environmental green house gases like carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxide (NO_x) and particulate matters in emergency *e.g.* under fault, sudden change in field excitation of alternators or load increase in the distribution power system are considered. The contribution of the present work is to investigate the comparisons of different DGs with DLMs by excercizing GA in the distribution systems form minimum total real power loss of the system viewpoint. The effectiveness of the proposed methodology is tested on IEEE-37 bus distribution test system. The different types of DGs (such as T_1, T_2, T_3 and T_4) with DLMs have shown different behaviours for power system performance indices such as *PLI*, *QLI*, *VDI*, *SCCI* and *EIRI* viewpoints. The sequence of overall power system performance indices such as *PLI*, *QLI*, *VDI*, *SCCI* and *EIRI* are as follows: $T_2 > T_1 > T_4 > T_3$. This paper presents that the overall performance of T_2 type DG is better as compared to T_1, T_3 and T_4 types DGs in the distribution system form minimum real power loss of the system viewpoint.

Keywords: DG planning; Different load models; Distributed generations; Genetic algorithm; Distribution power system performance indices

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Nomenclature

Abbreviation

BWL	Buses without load
COM	Commercial load model
CON	Constant load model
DERs	Distributed energy resources
DGs	Distributed generations
DGP	Distributed generation planning
DLMs	Different load models
DNO	Distribution network operator
EIRI	Environment impact reduction index
GA	Genetic algorithm
GHG	Green house gases
INS	Industrial load model
LLM	Low load model
MLM	Medium load model
ODGP	Optimal distributed generation planning
OPF	Optimal power flow
PF	Power factor
PLI	Real power loss index
PLM	Peak load model
RP	Reactive power loss
RLP	Real power loss
QLI	Reactive power index
REF	Reference load model
RES	Residential load model
SCCI	Short circuit current index
SDM	Summer day load model
SNM	Summer night load model
VDI	Voltage deviation index
VP	Voltage profile
WDM	Winter day load model
WNM	Winter night load model
WDG	With distributed generation
WODG	Without distributed generation

Symbols

LOC_{DG}	Location of distributed generation
P_{DG}, Q_{DG}	Real and reactive power delivered by distributed generation, respectively, p.u.
$P_{L\,\min}$, $Q_{L\,\min}$	Minimum real and reactive power losses, respectively, p.u.
P_{intake}, $Q_{\text{int ake}}$	Real and reactive power intake of main substation, respectively, p.u.
PF_{DG}	Power factor of distributed generation
$S_{\text{int ake}}$	Total MVA intake of main substation, p.u.
S_{system}	Total MVA of system, p.u.
T_1, T_2, T_3 and T_4	Different types of distributed generation
$V_{\max}$, $V_{\min}$	Maximum and minimum value of bus voltage, respectively, p.u.
alpha, *βeta*	Real and reactive power exponent values, respectively

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