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Heuristic Approach to Service Restoration

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Abstract

The proposed algorithm consists of two parts. One is to set up a decision tree to represent the various switching operations available. Another is to identify the most effective the set of switches using proposed search technique and a feeder load balance index. Test results on the KEPCO's 108 bus distribution system show that the performance is efficient and robust

I. INTRODUCTION

Electric distribution networks maintain radial structure with normally closed sectionalizing switches along a feeder and normally open interfeeder tie switches for proper protection coordination. For every tie switch closed, another sectionalizing switch is opened. Under feeder faulted conditions, switches are used for fault isolation and service restoration.

In this paper, the authors present a heuristic service restoration algorithm considering load balancing based on an effective exhaustive search method.

II. DESCRIPTION OF DEVELOPED FEEDER LOAD BALANCE INDEX

$$FL_i = FNC_i \times \frac{\sum_{t \in K} SL_i}{\sum_{t \in U} TAC_i}$$

$$LI_i = FL_i - SL_i$$

$$LI_{sum} = |LI_1| + |LI_2| + |LI_3| + \ldots\ldots + |LI_i|$$

FLi : Projected load of feeder i (MVA)
LIsum Feeder load balance index
SLi Actual load in feeder i (MVA)
TACi : Nominal capacities in transformer i (MVA)
FNCi : Nominal capacities in feeder i (MVA)
USet of transformer
K : Set of feeder

During service restoration, the object in distributing feeder loadings with respect to their nominal capacities in the proportional manner is to minimize feeder load balance index.

Ⅲ. CONSTRUCTING THE SUB TREE

Under the constraint of the radial structure in the

load transfer process, closing a normally open tie switch should follow the opening of a complementary normally closed sectionalizing switch. Therefore, if n tie switches are closed, then n sectionalizing switches has to be opened.

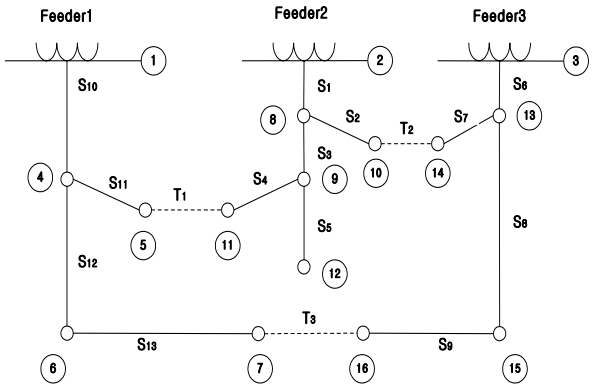

Fig 1. Three-feeder example system

If feeder section S1 experiencing an fault, then the amount of load on isolated feeder section must be transferred to feeder 1 and/or 3 without creating an overload on either of these feeders. To transfer load at node 11 from feeder 2 to feeder 1, the notation (T1, S4) is used to denote the operation of closing switch T1 and opening switch S4,

Ⅳ. TEST RESULT

The distribution network for KEPCO 108 bus system is used to demonstrate the validity and effectiveness of the proposed algorithm. The network consisting of two feeders with 108 busbars and 14tie switches as shown in figure 2. The total load are 72.27[MW], 32,78[MVAR] . Table 1 shows initial feeder loadings

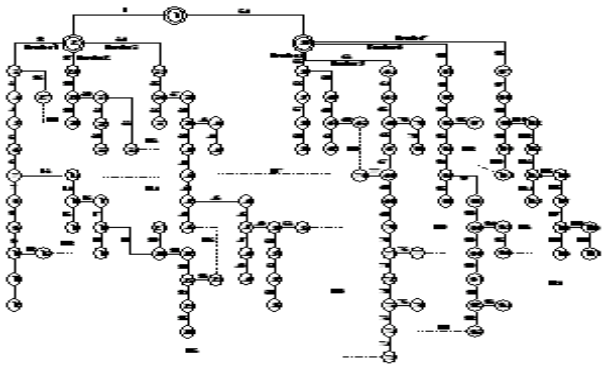

Fig. 2. Initial configuration of 108 bus system

Table 1. Feeder loadings before service restoration when T 120 is closed to energize isolated section

Feeder loadings [MVA]						
Feeder 1	Feede 2	Feeder 3	Feeder 4	Feeder 5	Feeder 6	Feeder 7
14.47	5.17	13.04	8.38	26.06	0	13.80

Table 2.Feeder loadings after service restoration when T 120 is closed to energize isolated section

Feeder loadings [MVA]						
Feeder 1	Feeder 2	Feeder 3	Feeder 4	Feeder 5	Feeder 6	Feeder 7
13.17	11.29	13.04	11.70	17.91	0	13.80

Ⅴ. CONCLUSION

In this paper, a new heuristic algorithm and feeder load balance index was presented for service restoration considering feeder load balance in distribution networks. The proposed search algorithm adopts the concept of sub-tree proposed by reference J. S. Wu Et.al 1991, and utilizes cyclic best-first search and feeder load balance index developed by the authors. Cyclic best-first search is using best-first search thatgets a solution much faster even if it lies deep down in the tree. And, by using revered sub tree, it compensates best-first search for not obtaining the best solution every time.

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