Reliability Effects of Maintenance on TNEP Considering Preventive and Corrective Repairs

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Abstract

The aim of this paper is to investigate maintenance effects on system reliability and transmission network expansion planning (TNEP) considering line loading and repairs. For this purpose, the maintenance cost is formulated taking into account transient and permanent forced outage rates, as well as durations of planned and forced outage. Also, transmission reliability is modeled considering load shedding (LS) and energy not supplied (ENS) criteria. LS index is calculated for transient forced outages and ENS criterion is computed for permanent forced outages, and planned outage rates and durations

INTRODUCTION

proposed circuit uses a linear regulator with smart control algorithm to provide temperature .The microcontroller also senses the battery charging current through R6, to provide variouscharging .In recent days, Structural Health Monitoring (SHM) technology is widely used in the field of aerospace, vehicles, ships and building structures. The metal structure health monitoring is used by high-speed dynamic strain gauge to continuously acquire the strain data in different position of the structure, so as to analyze the stress state of reliability degree it is of great significance to ensure personal and production safety. Some of the drawbacks of conventional dynamic strain measurement system are large outlines, inconvenient usage, few channels and low sampling frequency. The experimental efficiency is very less and data accuracy cannot be carried out with these dynamic strain gauges

Increasing efficiency of power plants and distribution systems; and demand for distributed power generation, especially the demand for guaranteed power supplies, also has changed the system. With the advancing Power System Deregulation, the electricity's price is getting decreeing, by another hand, the planning method and voltage stability were requested by resume. There is an idea that transmission line which already exists should be used efficiency. But it causes heavy flow transmission line to be getting worse and leads stability of voltage as well as synchronous stability to be more severe. This is the method that makes calculation of the algorithm for generation reinforcement for system planning in use of DC method more quickly. With this method, under the restricted condition as (n-1) rule, this paper estimates the margin of each power rapidly, developed the screening method of voltage stability and analyzed the results that were simulated with the IEEE30 model system

In case of this restriction, estimation of all of the transmission lines and transformers is needed and there is a problem that involves computational labors. In Addition, under the (n-1) restriction condition, we should consider about what kinds of phenomenon problems should do the calculation. As mentioned top of this section, the phenomenon of overload is one of the problems, which can be analyzed relatively simply. However, to evaluate power voltage stability and the synchronization stability of a system in the second item, (2), we will need numerous calculations even single sequence calculation

Most of system planning methods which has already suggested are based on the approach that work for minimizing cost under the restriction condition on transmission capacity with some new proposed transmission route, transmission capacity and the construction fee as a restriction condition on overload flow. However, the power transmission route that can be actually newly established is often limited. Therefore, the necessity that the procedure for optimizing target contains the route planning itself is not large. What is more important problem in a method which has already proposed is that indispensable two points as follows for planning system are not considered. (1) Restriction condition on a assumption accident of a transmission line (2) The voltage stability or the synchronization stability The (1) as mentioned-above is the basis of the system stability which is universally and it is commonly called as (n-1) restriction in sho

which relating to calculation of the generation margin under the demand rise situation. The keynote described in this paper as following.

1) Proposal of the efficiently processing under (n-1) restriction calculation that need (required) calculation labor

2) Proposal of efficient calculation method of power generation margin from specific power supply

The (n-1) evaluation method of generation margin considered from overload current:

This study uses the flow calculation of DC method, which is well known as the calculation method only with effective power flowRestriction factor of the stable power transmission includes the maintenance within proper voltage level and synchronized stability in addition to overload of the effective power as mentioned above. In the power system in real, what the latter mainly becomes the restriction factor is commonly

Therefore, in this section, we describe the method which calculates the generation margin consignment limitation power PGmax from specific generation efficiently. Where, the condition as follows is precondition for the calculation.

(1) Fundamental calculation sequence

The general calculation method of voltage stability is as follows and setting the generation g we want to evaluate to the standard node makes the calculation efficient. Step 1: We do calculate Amount of power generation of the generation g Step 2: Flow calculation in case of opening one line for all branches. Step 3: Back to Step1 if we can obtain the flow solution of all cases, because it means (n-1) voltage stability. Finish calculating if there are any cases that the diversity occurs in this calculation, because is means (n-1) voltage instability. Table.1 shows the conceptual diagram of the procedure as mentioned above and is an example of (n-1) flow calculation for seven branches, L1 to L7. The ○ sign indicates the voltage stability, which means that we obtain the solution, and the × sign indicates the voltage instability. In this example, the solution is obtained for four times ΔPg increase, 11 cases of calculation is needed.Yet, it is difficult to set theΔP , the width of increment, reasonably

(2) Development of efficient evaluation method

In this section, we suggest a calculation method to reduce the calculation labor to around one-ten. The concept of this method is shown at right side of the Table.1. In this method, we estimate the output Pz of generator g which is the voltage stability limitation in standard flow section and calculate (n-1) flow in this flow condition. As a consequence, if the × case is occurred at more than one time, the voltage limitation is less than Pz . Therefore, with this Pz decreasing, we do (n-1) flow calculation repeatedly. At this time, the Pw where all of (n-1) calculations becomes stability is the generation margin we want. This method can make the whole flow calculation time fewer compared with general method. In Table.1, when the generation output is Pw , five branches are evaluated as stability. Then accident calculation from there on is not needed because voltage stability is the supply and demand condition that is relaxed, so the relevant branch can be ignored. Incidentally, in this case, the solution Pw is obtained by calculating flow at 11 cases. The difficult point for this method is to assume output Pz of generator g rationally. In this paper, we suggest the equation as follows in use of the stability index

We describe the checking result of (n-1) voltage stability margin for IEEE30 model system shown at Figure.1. Here, it is required that the system at 6.9(pu) for total demand is (n-1) voltage stability. Total demand was assumed to be increased in proportion to the load of each load. Moreover, the thing which a generator correspondence to demand increment is set to the generator of Node10 located at the right end of the system. Table.4 which is an example that (n-1) voltage stability with demand increment of 1.0 interval is evaluated shows the result which is conducted by general method. In a general method, the total demand which is solved at the one previous calculation is the solution when the divergence is occurred during 32 times' calculation with the total demand increased 1.0(pu) a calculation like 6.9+1.0=7.9. We got the solution of this example as 16.18(pu), the generation margin from generator10 for the demand increment is evaluated as 9.28(pu), 16.18-6.9. The number of cases of flow calculation required by getting this solution is 297 steps, 33×9.

1.83 times of 6.9 p.u. 1.35 times of 12.67 p.u.

Multiples of 6.9	1				1.83 times			2.37 times	2.38 times		2.49 times
Σ load (p.u.)	6.9	7.9	·····	11.9	12.627	12.9	·····	16.35	16.422	16.9	17.181
L1	O	O	·····	O	O	O	·····	O	O		O
L2	O	O	·····	O	O	O	·····	O	O		O
L3	O	O	·····	O	O	O	·····	O	O		O
L4	O	O	·····	O	O	O	·····	O	O		O
L5	O	O	·····	O	O	O	·····	O	O	×	×
L6	O	O	·····	O	O	O	·····	O	O		O
L27	O	O	·····	O	O	O	·····	O	O		O
L28	O	O	·····	O	O	O	·····	O	×	×	×
L29	O	O	·····	O	O	O	·····	O	O		O
L32	O	O	·····	O	O	O	·····	O	O		O

In the present condition of total demand, a stability margin assumption value was 12.63(pu), which is shown at Table. Then, as a result of the (n-1) voltage calculation with this demand condition, all transmission lines are stable.4. So, we calculated Equation again with 12.63(pu) and the result is 17.18(pu), which means the two branches are voltage instable. From this result, we understand that this solution is less than 16.68(pu). So, we set the interval of a decrease in demand to 0.5(pu) and continue to calculate in only two branches. As a result, all is stability at 16.18(pu) on the eighth flow calculation. Amount of case of flow calculation that is required for solving is 71 times. To sum up, the improvement for solving with the method we proposed is 0.24, 71/297, which is four times efficient than general method.

Conclusion

In this paper, we suggested the effective method of generation reinforced calculation method for planning system in use of DC method. Practical (n-1) restriction includes the voltage restriction and the stability restriction in addition to the effective power one, which is mentioned in this paper. Therefore, we will consider the (n-1) effective calculation method based on the energy function method and the voltage stability index. However, by calculating generation of all generators and comparing with these, we can make quantitative evaluation in the weak area, huge margin area and so on in the power system.

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