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# Assessment of the Transmission System Capacity to Connect New Generation

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**In the regulated business environment in which many transmission system operators supply their services, the connection of new generation involves ever more complex analysis. The process to identify a suitable connection location and to determine the installed capacity of the new generator usually goes through several stages. Each of the stages should be tackled through activities that provide a balanced approach. This paper describes a method for the transmission system capacity assessment for connecting the new generation that can be used at the early stages to identify suitable connection locations. The method is built around several design criteria for generation connection as laid out in industry standards. The paper presents the method and discusses the fine tuning options suitable for use on existing transmission systems. System study results obtained on the England and Wales transmission system are presented to illustrate the method of implementation.**

## I. Introduction

THE transmission, generation and distribution networks are operated according to increasingly complex business and technical frameworks. This raises difficult challenges for the operators, developers and other stakeholders concerning the connection of new generation.

The transmission and distribution systems throughout the world are now operated at ever tighter safety margins and the pressure to accept more generation, predominantly from renewable sources, is escalating [1]. This happens at a time when transmission capacity reinforcements face increasingly difficult consenting issues and planning becomes more challenging because of tighter operating margins.

The developers of renewable generation, particularly from wind, compete with conventional generation operators seeking to identify suitable connection points to the transmission and/or distribution networks. Although the regulatory environment postulates free access to connect to the transmission networks, the identification of a suitable connection point is critical. Transmission capacity limitations may reduce the ability of a generator to export its full potential output [2]. Due to the significant and continuous increase in the wind generation capacity the development of the networks to which these will connect can lag the rate at which new generation capacity is installed. The task of planning and developing a network in such a context is particularly challenging when diverse wind farm developers are seeking to advance projects rapidly.

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The identification process has to consider the fact that the transmission and distribution systems do not have infinite capacity to allow connections from new generators. Usually the transmission system capacity is limited due to a number of different factors including the transmission line thermal limits in normal operation or perturbed states, the transient stability constraints and the need to maintain system voltage stability. In the early stages of identifying the suitable connection sites insufficient information is available about the type of plant to be connected. Therefore the analysis considering the impact upon the system transient and/or voltage stability cannot be readily carried out.

Simplified yet robust analysis methods of the capacity limitations due to the circuit thermal limits under normal and contingency scenarios are required to identify suitable connection substations.

A number of methods were presented in the literature concerning similar aspects including the assessment of the transmission system loadability [3], the calculation of the available capacity transfer within transmission systems [4], [5], [6] or the determination of the cross-border transmission capacity [7] for the European transmission operators.

The system loadability quantification is used for assessing the system transmission capacity with respect to the system voltage stability. An energy method-based measure that expresses the degree to which various regions of a system can serve additional load in terms of a percent loading estimate is presented in [3]. The method has limited scope for application in the selection of suitable connection points due to its focus on the voltage stability issues.

The available capacity transfer [4], [5], [6] is a measure of the transfer capability remaining in the physical transmission network for future commercial activity over and above already committed uses. It is extensively utilized for operational planning but its features render it less practical for the connection point selection.

The procedures adopted by the European transmission system operators (ETSO) for determining the net transfer capacity (NTC) and transmission reliability margin (TRM) are discussed in [6]. The NTC determination is subject to security rules being fulfilled while the base case exchanges are gradually modified through a correlated increase or decrease of power generation within adjacent TSO networks. Its operational planning orientation renders it less suitable for identifying new connection opportunities.

A method that measures the transmission system security and determines the generation locations that are beneficial to the grid was described in [8]. The locations for renewable generation that benefit the grid security are determined using the weighted Transmission Loading Relief sensitivities. However the method focuses on different aspects of connecting the new generation such as the improvement of the transmission system capacity.

Simple probabilistic planning methods that assess the economic risks of a more efficient utilization of the existing capacities are discussed in [9]. These methods focus on how to maximize the use of the existing assets but are not suitable for indicating potential connection points.

The method presented in this paper is formulated based on the statutory requirements for generation connection laid out in [11]. These requirements use the security of supply concepts and usually include criteria for the normal operation and for the operation under abnormal conditions. The potential locations and the available capacity for connecting new generation will be determined on the basis that the new generation will not cause violations of the statutory limits defined by the security of supply criteria. The method is intended to be a simple, yet practical tool that may be applied at the early stages of the process for identifying candidate substations where new generation may be connected. The fine tuning required for the implementation of the method to an existing system will be discussed.

A selection of results obtained by implementing this method for the analysis of the National Grid transmission system [10] in England and Wales will be presented. The method was applied assuming an operational scenario corresponding to the 2013/14 timeframe and the discussion of selected results is included.

## II. Method Outline

### *A. General considerations*

The assessment of the transmission capacity for connecting new generation was carried out within the context of typical design procedures laid out in [11] for the connection of generation to the GB transmission network. The generation connection capacity requirements recommend a set of pre-fault and post-fault criteria that should be met by the design for a generator connection. These indicate the constraints that should be analyzed when considering the suitability of a generator connection at the candidate substations.

The pre-fault criteria ([11], art.2.9) stipulate that the transmission capacity for connecting a generator shall be planned such that prior to any fault there shall not be any equipment loadings exceeding their ratings, any voltages outside the planning voltage limits and any system instability.

The post-fault criteria ([11], art.2.10 and art.2.12) include a complex set of single and multiple contingencies for which the transmission capacity for the generator connection should be planned so that there shall be no overloading of any primary transmission equipment, insufficient voltage performance margins or system instability.

To analyze the available transmission system capacity for connecting new generators, two sets of contingencies from the post-fault criteria are considered relevant and reasonably indicative of the system available capacity. These are:

- single or (N-1) contingencies simulating the unplanned outage of a transmission circuit or transformer. This is a planning situation likely to occur during the winter season and a winter loading scenario of the system was therefore considered;
- double or (N-2) contingencies simulating the unplanned outage of a transmission circuit with the prior planned outage of another transmission circuit. This is a planning situation likely to occur during the summer season and a summer loading scenario of the system was therefore considered.

The interconnected transmission system will be impacted by the addition of new generation and will experience a variation in the power flows. The variation is expected to be significant in the vicinity of the connection point, but other areas of the system will also be affected. This is caused by the re-scheduling of the existing generation to include the new generator in the line-up that will supply the system demand.

### *B. Capacity Assessment*

New generation will be simulated at substations within the existing system. An assessment will then be carried out to check whether this addition will cause, assuming representative operational scenarios, lack of conformity with the retained pre-fault and post-fault design criteria. The analysis will not consider simultaneous connection of new generation at different locations in the system. This does not represent a limitation for the applicability of this method provided any simultaneous connections will be located in different geographical areas of the transmission system. If simultaneous connections are desired within the same area of the transmissions system the method should be used with caution.

The general procedure to determine suitable locations for connecting the new generation in a transmission system and the maximum amount of generation that can be safely connected is presented below:

1) Select a candidate substation.
2) Assume the step increase of new generation connected at the selected candidate substation.
3) Review the generation schedule such as the new generator is included in the line-up while assuming a winter loading scenario.
4) Set-up and solve the base case load flow. If this is a return from step 5) go directly to step 6). Otherwise go to step 5).
5) Check for limit violations. If no limit violations occur then go to step 6). Otherwise reduce the new generation and return to step 3).
6) Simulate all single contingencies in the system and check whether limit violations occur. If there is no limit violation go to step 7). Otherwise reduce the new generation, record this new generation value and go to step 8).
7) Apply a step increase on the new generation and

return to step 3).

8) Review the generation schedule such as the new generator is included in the line-up while assuming a summer loading scenario.

9) Set-up and solve the base case load flow. If this is a return from step 10) go directly to step 11). Otherwise go to step 10).

10) Check for limit violations. If no limit violations are observed then go to step 11). Otherwise reduce the new generation and return to step 8).

11) Simulate all double contingencies in the system and check whether limit violations occur. If there is no limit violation, go to step 12). Otherwise reduce the new generation and return to step 8).

12) The recorded new generation value is the maximum acceptable capacity that can be connected at the selected candidate substation.

13) If all candidate substations were investigated terminate. Otherwise select next candidate substation and return to step 2).

The base case designates the pre-fault conditions for the transmission system with all circuits available interconnected according to the normal operational arrangements. Checking for limit violations includes the identification of transmission circuits overloading and of the voltage levels outside the statutory requirements.

Those candidate substations for which the scheme fails to assign any new generation value will be rejected. The work load incurred by this method can be reduced by investigating only relevant sets of contingencies. The reduction may be formulated on the basis that the contingencies affecting circuits located remotely from the connection sites usually have negligible impact on power flows and the voltage profiles next to the connection site.

### C. *Method fine-tuning*

The method described so far assumes an existing system that is free from any built-up capacity restrictions caused by conditions such as lack of timely reinforcement. The transmission systems are operated in a business regulated environment and their operators are constantly under pressure to deliver the expected level of service within controlled budgets. These pressures may cause an objective lag on the system reinforcements that in time build up into capacity limitations under contingency scenarios.

The capacity assessment method described here is based on criteria that explore the capacity limitations identified by specific contingencies. A risk exists that the application of this method will pick up capacity limitations that are not directly caused by the addition of a generator in the transmission system. In order to avoid such risks that may deliver biased results concerning the amount of new generation that may be connected at certain locations, a fine-tuning of the method is required.

Two options for the fine-tuning of the proposed method were identified. Both rely on recording in the first phase all the instances when limit violations may be experienced due to selected contingencies on the transmission system whilst assuming no new generator is connected. These are indicative of the underlying capacity constraints that are independent of the new generator connection.

The first fine-tuning option is to replace the checking for limit violations with a comparison. The list of limit violations caused by simulating selected contingencies when the power output from the new generator is included in the generation line-up will be compared with the recorded list of underlying limit violations. The comparison is carried out for identifying those changes in the limit violations that exceed a set threshold. For practical purposes an indicative +5 % threshold is considered suitable. When this threshold is exceeded the power output from the new generator is considered unacceptable and the search process for new generator installed capacity at that particular location is stopped.

The second fine-tuning option also uses a comparison that replaces the checking for limit violation phase. The comparison searches for the first limit violation caused by the simulated contingencies when the new generator is connected which was not recorded in the list of underlying limit violations. Upon detection of a new limit violation the power output from the new generator causing it is considered unacceptable. The search process for a new generator installed capacity at that particular location is then stopped.

The comparison processes described above may be applied for any type of contingency and they replace the corresponding limit violation checking.

## III. Study Case

### A. *General outline*

The method is applied to the National Grid Plc transmission system in England and Wales. An operational scenario corresponding to year 2013/14, developed according to the Seven Year Statement [10], was defined for the updated transmission system. The transmission system model includes all 400 kV, 275 kV and 132 kV buses, circuits and transformers that are owned and operated by National Grid.

A mechanism for the generation scheduling is implemented such as to simulate the effects of typical generator availability, long-term market positions and anticipated effective capacity. This involves a) ranking the relevant generating units in order of their relative likelihood of operation at the peak load demand of the system; b) identifying which plant is most likely to be contributing towards meeting the peak demand; and c) applying a straight scaling technique to refine the generation schedule of the last tier of generators supplying the system load demand.

The GB transmission system is split into 17 study zones which includes Scotland where zones 1 to 6 are located. An

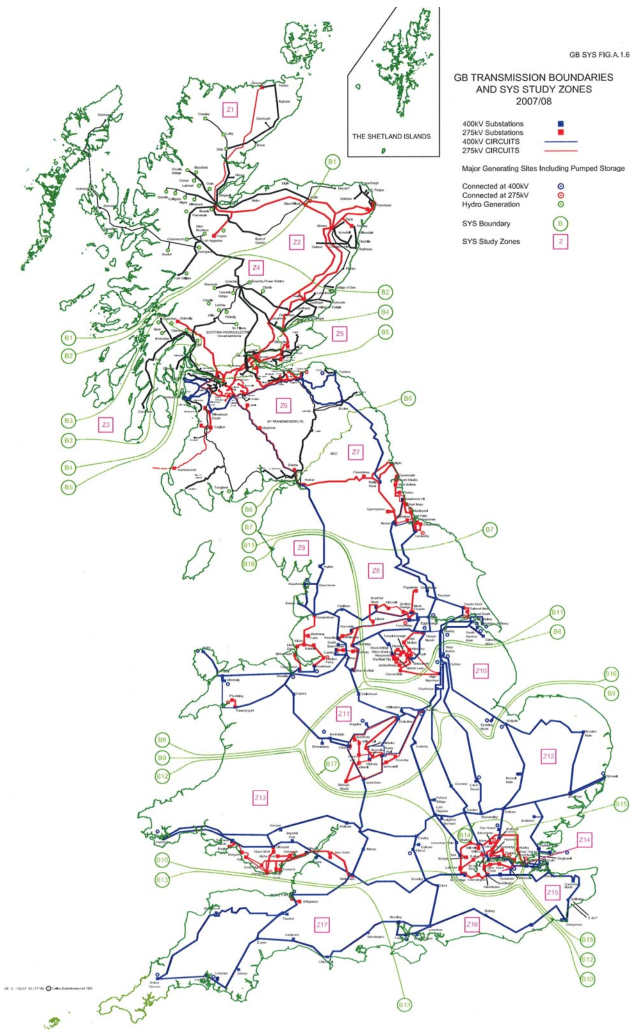


Fig.1. GB transmission system boundaries and system study zones [10].

overview of the system configuration and the zones is presented in Fig.1. The transmission system model did not include the Scottish part and the power exchanges between the sections of the system were simulated at the separation substations.

The step change for the new generator installed capacity search process is 250 MW.

*B. Single contingency criterion analysis*

The candidate substations were selected in most of the system zones. The analysis simulated selected contingencies depending on the substation where the new generator may be connected.

Two options for the fine tuning of the transmission capacity assessment method were described above. Selective results from the single contingency criterion analysis were used to demonstrate the features of the two fine tuning options.

*1) Fine-tuning by monitoring the limitation violations progressive change*

In order to demonstrate the practicality of this fine tuning option, the method applied to a candidate substation in system study zone 8 is presented. The list of underlying limit violations observed for this zone when no new generator is connected in the transmission system comprises of 40 instances when the power flow exceeded the circuit rating during the simulated single contingencies. There was no situation when insufficient voltage performance was caused by the single contingencies. The 40 individual limit violations were caused by only 27 single contingencies from the 491 that were simulated for zone 8.

A series of incremental power outputs of the new generator were simulated and the limit violations caused by the same selection of single contingencies were recorded. In order to illustrate the fine tuning option (that may replace the checking for the limit violations proposed in the assessment method), a set of 10 underlying limit violations were selected. Table I indicates the effect of the gradual increase of new generator power output upon the magnitude of the observed limit violations. The first two columns present the circuit designations for the simulated contingency and for the corresponding circuit that becomes overloaded. Columns three and four show the pre-outage and post-outage MVA power flows on the affected circuits and the loading in percent of the circuit rating assuming that no new generator is connected. The last five columns indicate the variation of the limit violation magnitude for each circuit with the gradual increase of the new generator power output.

The graphical variation of the limit violations with the change of the power output shown in Fig.2 demonstrates conflicting trends for the selected circuits. Most notably the last three circuits suffer a reduction of the magnitude of limit violation while the first five show an increase. Additionally the pace of the trend varies from circuit to circuit. These features indicate that this fine tuning of the search process is fairly

TABLE I LIMIT VIOLATIONS CHANGES WITH THE VARIATION OF POWER OUTPUT FROM THE NEW GENERATOR

| Outaged circuit | Overloaded circuit | Pre-outage [MVA (%)] | Post-outage [MVA (%)] | Post-outage [% of rating] | | | | |
|---|---|---|---|---|---|---|---|---|
| From-to | From-to | | underlying inadequacy | 500 MW | 750 MW | 1000 MW | 1500 MW | 2000 MW |
| 815-4270 | 4270-5785 | 1872 (86.3) | 2316 (107.4) | 108.7 | 109.4 | 110.2 | 111.6 | 113.1 |
| 4975-7885 | 755-4655 | 642 (75.8) | 851 (101.8) | 102.9 | 103.5 | 104.0 | 105.1 | 106.2 |
| 5095-5350 | 5005-5050 | 1493 (72.8) | 2056 (101.1) | 102.7 | 103.5 | 104.4 | 106.0 | 107.7 |
| 5460-8965 | 5605-5635 | 886 (84.0) | 1117 (106.8) | 105.9 | 105.4 | 105.0 | 104.1 | 103.2 |
| 5835-5915 | 5905-5920 | 1032 (72.7) | 1581 (116.7) | 117.9 | 118.6 | 119.3 | 120.6 | 122.0 |
| 5840-5920 | 5835-5915 | 1003 (72.9) | 1716 (126.4) | 127.8 | 128.5 | 129.3 | 130.8 | 132.3 |
| 5390-5545 | 5570-5605 | 807 (76.5) | 1223 (118.5) | 117.6 | 117.2 | 116.7 | 115.8 | 115.0 |
| 5390-5545 | 5605-5635 | 886 (84.0) | 1300 (126.8) | 125.1 | 124.7 | 124.2 | 123.3 | 122.4 |
| 5630-5670 | 5615-5635 | 815 (76.8) | 1213 (117.2) | 116.3 | 115.9 | 115.6 | 114.8 | 114.0 |
| 5655-5735 | 5605-5635 | 886 (84.0) | 1149 (110.1) | 109.1 | 108.7 | 108.3 | 107.4 | 106.5 |

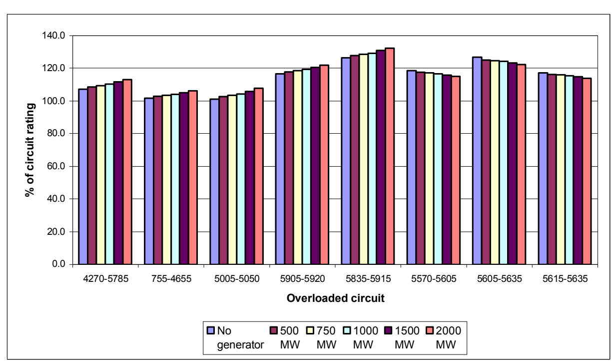


Fig.2. Variation trends of selected limit violations with the amount of power output from the new generator

difficult to achieve. Many limit violations require monitoring and the decision will eventually be taken based on the hierarchic selection of the limit violation change and the selected change threshold.

In the case of bus 5100 assuming a 5 % threshold for the limit violation change, the result is that a generator with installed capacity up to 1500 MW may be connected.

*2) Fine-tuning by monitoring new limit violations*

The results obtained when assuming that a new generator would be connected at bus 5100 were processed according to the alternative fine-tuning option. The limit violations caused by the selected single contingencies were recorded for every incremental power output from the new generator. Each set was then compared with the set of underlying limit violations and any new limit violation identified.

In Table II the full list of all new limit violations caused by the simulation of the same set of single contingencies is presented. For each power output the new limit violations are indicated by the overloaded circuit identifier, the pre-outage and post-outage MVA power flow and the corresponding percentage loading based on the circuit rating.

The monitoring of new limit violations delivers a more objective decision making. For bus 5100 this fine-tuning option indicates that a new generator of up to 750 MW installed capacity may be connected while meeting the requirements of the single contingency criterion for generation connection.

The results from the first phase of the transmission capacity assessment method obtained through implementing the new limit violations monitoring are indicated in Table III. These are only partial results that do not include those substations at which new generators with installed capacities up to 3000 MW did not cause any limit violations when single contingencies were simulated. The indicative generator sizes shown in third column are actually the power outputs that cause the cutout in the limit violation checking.

## C. *Double contingency criterion analysis*

For the system zones where candidate substations for connecting new generation were evaluated the number of relevant double contingencies used in the analysis is indicated in Table IV. The underlying limit violations observed are caused typically by different double contingencies but the number of circuits that are actually affected is substantially smaller. The number of different circuits affected is indicated in the last column of Table IV. From the latter set only a small selection comprise the vast majority, in excess of 95 %, of the limit violations that were recorded. The numbers in the parentheses indicate how many individual circuits are affected by the majority of limit violations.

For the double contingency criterion analysis phase of the capacity assessment process, the monitoring of the new limit violations was the fine tuning option employed in lieu of the checking for the limit violation process control. The process continued with the recorded generator sizes of the single contingency criterion analysis phase and 250 MW decrease steps were applied until a satisfactory check on the convergence was achieved.

In order to demonstrate how the method was implemented the results for substations located in system study zones 7 to 10 of Fig.1 are included in Table V. The search process demonstrated that for the lowest acceptable generator size, i.e. 250 MW, the check for limit violations was still positive and therefore no new generation can be connected at the selected substations. The positive check meant that when a new generator of 250 MW was connected at the selected substation the simulated double contingencies will still produce new limit violations. This is unacceptable according to the proposed method. The last four columns in Table V indicate for the selected substations the number of new limit violations still observed on the affected circuits that were caused by the double contingencies over and above the recorded number of underlying inadequacies.

TABLE II NEW LIMIT VIOLATIONS MONITORING WITH THE VARIATION OF POWER OUTPUT FROM THE NEW GENERATOR

| Generator [MW] | nr. crt. | Overloaded circuit | | | Outaged circuit |
|---|---|---|---|---|---|
| | | From-to | Pre-outage [MVA (%)] | Post-outage [MVA (%)] | From-to |
| 500 | - | - | - | - | - |
| 750 | 1 | 5005-5050 | 1529 (74.6) | 2048 (100.5) | 5010-5100 |
| 1000 | 1 | 5355-16380 | 1561 (83.8) | 1878 (101.3) | 3165-3170 |
| | 2 | 5005-5050 | 1542 (75.2) | 2101 (103.2) | 5010-5100 |
| 1500 | 1 | 5355-16380 | 1618 (87.1) | 1942 (105.0) | 3165-3170 |
| | 2 | 5355-16380 | 1618 (87.1) | 1897 (102.7) | 3205-16300 |
| | 3 | 5005-5050 | 1567 (76.4) | 2208 (108.6) | 5010-5100 |
| 2000 | 1 | 3135-16380 | 1546 (83.3) | 1871 (101.8) | 3165-3170 |
| | 2 | 5355-16380 | 1673 (90.4) | 2005 (108.8) | 3165-3170 |
| | 3 | 5355-16380 | 1673 (90.4) | 1960 (106.5) | 3205-16300 |
| | 4 | 5005-5050 | 1592 (77.8) | 2315 (114.1) | 5010-5100 |
| | 5 | 5100-5350 | 1415 (51.7) | 2797 (103.6) | 5010-5100 |

TABLE III SUMMARY OF SINGLE CONTINGENCY CRITERION ANALYSIS

| Bus | System zone | Generator [MW] | Overloaded circuit, [MVA (% of rating)] | | | Outaged circuit |
|---|---|---|---|---|---|---|
| | | | From-to | Pre-outage | Post-outage | From-to |
| 5575 | 7 | 750 | 5005-5050 | 1596 (78.1) | 2061 (101.1) | 5010-5100 |
| | | | | | | |
| 5100 | 8 | 750 | 5005-5050 | 1529 (74.6) | 2048 (100.5) | 5010-5100 |
| 5155 | 8 | 1000 | 5355-16380 | 1612 (86.5) | 1936 (104.4) | 3165-3170 |
| 5220 | 8 | 1000 | 5355-16380 | 1580 (84.9) | 1911 (103.8) | 3165-3170 |
| 5350 | 8 | 1000 | 5355-16380 | 1569 (84.3) | 1936 (104.4) | 3165-3170 |
| | | | | | | |
| 3890 | 9 | 1000 | 3890-16095 | 1173 (61.5) | 2025 (102.8) | 4050-16090 |
| 4360 | 9 | 500 | 5570-5605 | 815 (81.9) | 1050 (100.5) | 5460-8695 |
| 4155 | 9 | 250 | 5570-5605 | 812 (81.6) | 1046 (100.1) | 5460-8695 |
| 5785 | 9 | 250 | 5570-5605 | 813 (81.7) | 1048 (100.2) | 5460-8695 |
| | | | | | | |
| 16300 | 10 | 1000 | 5355-16380 | 1444 (81.1) | 1903 (102.2) | 2975-3205 |
| | | | | | | |
| 6295 | 15 | 2750 | 6255-6300 ckt 1 | 1071 (64.2) | 1963 (101.4) | 6255-6300 ckt 2 |
| | | | | | | |
| 2165 | 17 | 2750 | 2165-2375 | 1094 (42.6) | 2805 (100.9) | 2165-2170 |
| 2345 | 17 | 1650 | 2345-2375 | 537 (41.5) | 1419 (101.0) | 2345-16010 |
| 2385 | 17 | 1500 | 2365-2385 | 665 (51.9) | 1392 (100.1) | 2360-2385 |

TABLE IV NUMBER OF DOUBLE CONTINGENCIES SELECTED FOR EACH SYSTEM STUDY ZONE

| SYS study zone | (N-2) contingencies | Underlying inadequacies | Individual circuits |
|---|---|---|---|
| 7 | 9,045 | 309 | 10 (3) |
| 8 | 12,246 | 365 | 10 (3) |
| 9 | 12,720 | 518 | 12 (5) |
| 10 | 9045 | 147 | 4 (2) |

TABLE V EVIDENCE OF MONITORING THE NEW LIMIT VIOLATIONS FOR DOUBLE CONTINGENCIES ANALYSIS

| System zone | Overloaded circuit | No. of underlying inadequacies | No. of new limit violations | | | |
|---|---|---|---|---|---|---|
| | | Substation | 5575 | | | |
| 7 | 5835-5915 | 139 | 34 | | | |
| | 5905-5920 | 107 | 33 | | | |
| | 5905-5915 | 46 | 93 | | | |
| | | Substation | 5220 | 5350 | 5155 | 5100 |
| 8 | 5835-5915 | 162 | 3 | 3 | 3 | 4 |
| | 5905-5920 | 128 | 18 | 21 | 18 | 22 |
| | 5905-5915 | 58 | 78 | 83 | 75 | 86 |
| | | Substation | 3890 | 4360 | 5785 | |
| 9 | 3425-3440 | 153 | 5 | 7 | 10 | |
| | 5835-5915 | 164 | - | - | - | |
| | 5905-5920 | 119 | - | - | - | |
| | 3235-3330 | 16 | 131 | 131 | 108 | |
| | 5905-5915 | 48 | - | - | - | |
| | | Substation | 16300 | | | |
| 10 | 3425-3440 | 123 | 4 | | | |
| | 3235-3330 | 19 | 5 | | | |

## IV. DISCUSSION AND CONCLUSIONS

The method proposed in this paper for assessing the transmission system capacity for connection of new generation is based on typical connection requirements set out in standards. The method was formulated as a simple yet robust approach to the capacity assessment problem that may be used in the early stages in the process of identifying suitable locations for the connection of new generators.

The selected design criteria for generation connection as laid out in a standard for the security of supply form the core of the method that involves an iterative search. The search goes through an analysis of the capacity limitations identified by the simulation of single contingencies assuming that new generators are connected in turn at selected candidate substations. After identification of a maximum power output that may be delivered the process continues with a search through the capacity limitations that are revealed by the simulation of double contingencies when the new generators are connected. A full algorithm for the proposed method is described and then implemented in a complex case study.

The fine tuning options identified for implementing the proposed method in a real, existing transmission system, were described. The implementation features of each fine tuning option were analyzed in the case study. The use of monitoring the new limit violations caused by the simulated contingencies over and above the number of underlying inadequacies observed when no new generation is connected is the preferred option.

The search process used in this method has additional benefits by providing a good indication of the problematic areas within the transmission system. The circuits affected by power flows that exceed their ratings under single or double contingency scenarios provide early indications of areas where reinforcement actions should be considered for unlocking transmission system capacity. However the confirmation of the success of these reinforcement actions cannot be obtained without further detailed analysis both of the technical and economic aspects.

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