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To Study Machine Learning Enabled Steady – State Security Predictor as Deployed For Distribution Feeder Reconfiguration

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Abstract: *The distribution network is reconfigured by modifying the topology arrangement of the network feeders. Because the voltage stability of the distribution networks can differ within a range following network reconfiguration, the calculation of steady-state voltage stability plays a significant role in real me feeder reconfiguration, Examining the state of security and estimating it for the next operational configuration is crucial for making real-me decisions. Online security evaluation needs minimal complexity and computing me. Standard methods of assessing the distribution network's steady-state voltage stability can be insufficient for online and real time environments due to their high complexity and long computing period. This study proposes a machine learning (ML) approach for classifying configuration states and adopts the decision tree technique to interpret the online applications in the feeder reconfiguration. For the classification, the single line equivalent L index voltage stability and switching configurations of the feeders are employed as training information for the ML models. A modified IEEE 14-bus and 30-bus test systems verifies the feasibility of the suggested solution. Once trained, the proposed system provides a quick and accurate classification for unknown configurations of the specific security state in 0.3 seconds.*

Keywords: Distribution Network

I. INTRODUCTION

Current distribution networks are undergoing a transformation towards the smart grid paradigm i6ncluding rapid increase in the quantity of distributed energy resources (DERs). This has prompted considerable interest from the research and vendor communities to develop innovate tools and algorithms that are adapted to smart distribution networks that provide advanced feeder reconfiguration, enable evaluating specific operational and planning objectives, and thereby can help utilities to implement operational strategies.

Owing to their rapid development, functioning close to technical limits, economic constraints and deregulation, the growing complexity of the modern power distribution network systems demands quick online security status monitoring. Distribution networks encounter various differences from a medium to high degree of load, specific network configurations for daily optimal service and maintenance purposes. In a power distribution network, the mesh style distribution network is reconfigured into a radial one for various advantages such as lower short-circuit current, low cost of operation, and easy coordination of protection, low cost of design. But at the same time, the configuration may hinder system stability, resulting in more active and reactive power losses to the network .A power network to remain stable in the actual state of time, it is crucial to screen the network status with respect to specific circuit situation and take precautionary measure each time for each reconfiguration .

Existing industry exercise studies offline to assess system voltage stability and establishing online operational plans through performance of offline data base.. The power system size is incredibly large with power grid integration, and control strategies get quite complicated. To identify system voltage stability thresholds, operating designers need to conduct further offline tests for a different combination of network topologies and functional conditions. Study of offline generate numerous data at any moment Operational designers usually assess offline raw data or semi-automatically to derive operating guidelines which consumes a lot of me. In addition, the results of the analysis rely on the skill and understanding of the individual. Since the expertise and understanding of every organizational designer is limited. The operating guidelines deriving from the decision of the individual may not be accurate or comprehensive.

Fast online voltage stability analysis also involves huge data which makes difficult for system operators.

II. LITERATURE REVIEW

Distribution is the process flow from one process to the next. Supply Chain Management includes management information systems, purchasing, customer service, resources, transportation, production schedules, demand fulfillment processes, inventory management, warehousing and marketing marketing (Nabhani, et all, 2009). Logistics Logistics service activities are divided into three parts namely: management of raw materials (material management),exchange/conversion management (convertion management), and physical distribution (Iriani, et all, 2010). Furthermore, physical distribution service includes several activities such as transportation, facility structure management inventory management, and handling of raw materials for packaging or loading (material packaging and handling) (Iriani,et all,2010)

Debbie et al " proposed a novel online monitoring method using ANN to quickly find the long term stability margin. The PMUs over the network were used as sources to obtain voltage magnitudes and phase angles. "

In this paper , an artificial neutral network (ANN) based method is developed for quickly estimating the long term voltage stability margin. The investigation presented in the paper showed that node voltage magnitudes and the phase angles are the best predictors of voltage stability margin.

Devaraj et al. "suggested an ANN approach for online stability measurement by using Radial Basis Function(RBF) systems to approximate the stability under contingency state."

In recent years, voltage instability has become a major threat for the operation of many power systems. This paper presents an arficial neutral network (ANN) – based approach for online voltage security assessment. The proposed approach uses radial basis function (RBF) networks to estimate the voltage stability level of the system under contingency state. a novel wavelet transform has been used authors to extract features of voltage analysis along with RBF. On the other hand, in the present paper,the features was derived directly from the switching status of the feeder line and used for ML training purposes. Thus, the proposed study was claimed to be less computational and time-consuming.

Chakraborty et. al. implemented a self-organizing characteristic map with a radial basis function to identify and distinguish the voltage instability of power systems.

ANN s are typically seen as a more robust and efficient method common for nonlinear regression. However, it has limitations such as longer training time and needs several training parameters.

This paper proposed a sensitivity - based methodology for voltage stability enhancement of a power output of a participating generators. An enhanced radial basis function network(RBFN) is used to confused the sensitivities of the voltage stability margin with respect to the generators outputs. The sensitivities are used in formulating the linearized voltage stability constraints in the optimization procedure.

Amroune M et al. suggested method in which the voltage magnitudes of the phasor measuring unit (PMU) buses was used as input data for Support Vector Regression (SVR) and the Dragon fly optimization methodology used in determining parameters for SVR.

Eventually, the lowest voltage stability index (VSI) values is taken as the output vector. Amroune M et al. show the application of SVR and adaptive neuro-fuzzy Interface system(AN FIS) models that are amalgamated with synchronized phasor measurements for on line voltage stability assessment. The name black-box is mainly used to identify all those ML models that are very difficult to understand and to be interpreted by practical experts. A neural network is a black box in the way that even if it can approximate any function. Learning its structure would not provide any information about the structure function. Neural networks create their questions and rules. The lack of transparency with how the rules are enforced is a matter of concern. Moreover, the internal data extraction mechanism cannot be disclosed so that it is problematic for the operators to get useful information about voltage stability

III. PROPOSED WORK

Apply Machine learning for network reconfiguration.

In the purposed work,the 'Decision-Tree-Classifier' was used to identify the voltage stability status of the unidentified network structure. However,the voltage stability index and the losses of the particular structure could not be the

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predicted. We, therefore, used 'Decision-Tree-Regressor' to find the values of the voltage stability Index,Active and Reactive Losses.

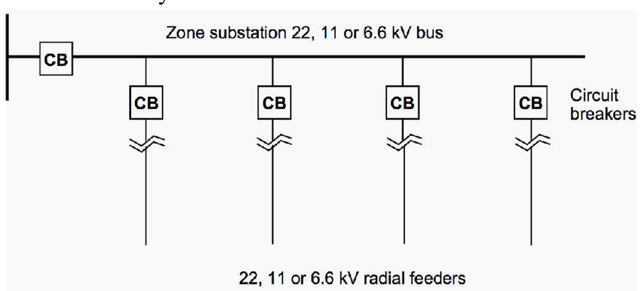
Decision Tree: Classification and Regression Trees(CART) is classically referred to as Decision Trees.The DT. Algorithm represents a binary tree in which each node resembles an attribute,and a leaf node resembles a class label. DT begins with the root node. Interior nodes link the root node with the leaf nodes. There is a class label in each node. Classification rules are indicated from the root to leaf nodes. The binary tree is created by splitting the input space. We test the different split points using the cost function. Finally, the lowest cost function is chosen as the best split.

Distribution Feeder

Radial Feeder

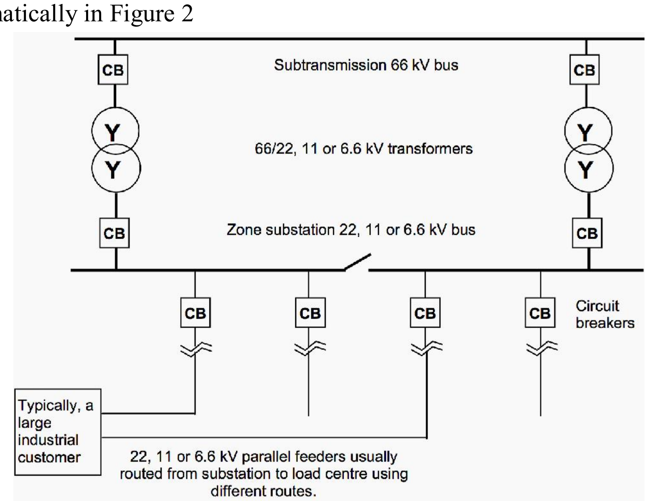
Many distribution systems operate using a radial feeder system. A typical radial feeder system is shown schematically in figure 1. Radial feeders are the simplest and least expensive, both to construct and for their protection system.

"A fault would result in the loss of supply to a number of customers until the fault is located and cleared. The next level of reliability is given by a' parallel feeder' system.



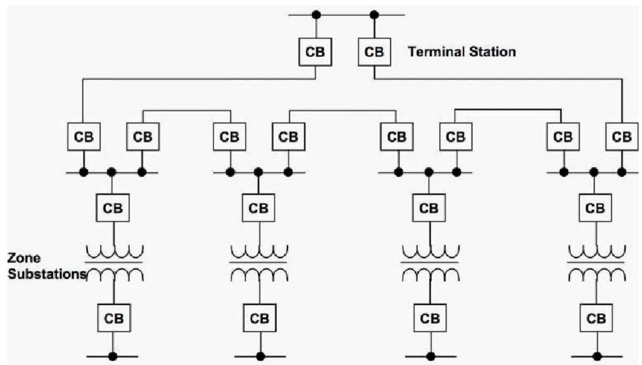
Parallel Feeder

A Greater level of reliability at A higher cost is achieved with a parallel feeder. A typical parallel feeder system is shown schematically schematically in Figure 2



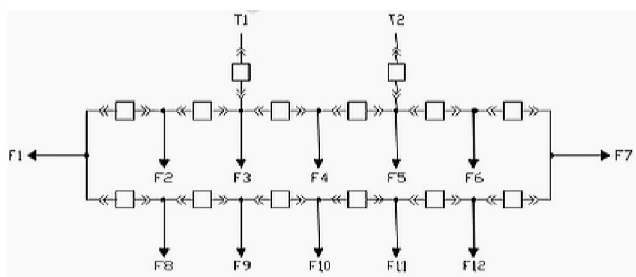
Ring Main

A similar level of system reliability to that of the parallel arrangement can be achieved by using ring main feeders. This usually results from the growth of load supplied by a parallel feeder where the cabling has been installed along different routes. These are most common in urban and industrial industrial environments.



Meshed System

In transmission and sub-transmission systems, usually parallel, ring or interconnected (mesh) systems systems are used. This ensures ensures that alternative alternative supply can be made to customers in the event of failure of a transmission line or element.



Distribution Test Feeder

A distribution network consists of power infrastructures that deliver electricity from the transmission/sub-transmission circuits to the final customers as shown in Figure 1. A wide variety of metrics metrics could be defined to exhaustively exhaustively characterize characterize a distribution distribution network network. Nevertheless, Nevertheless, there are some key descriptive components that can provide a simplified overview of it. In this review, we have described existing distribution test feeders using the metrics presented by respective authors or modelcreators in their publications, in order to be consistent with the original purposes for which these test feeders were created.

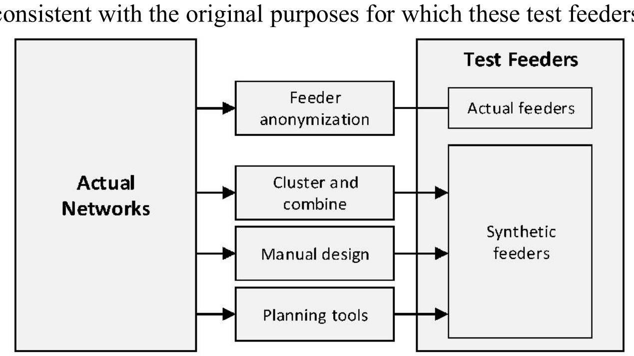


Fig.2 Test Feeder Building Procedure

IEEE Feeder

In 1991,the first set of four small test feeder was published [6] by the IEEE PES. Ten years later,a new test feeder was published [7] and was added to the previous set in order to provide a model of a three-phase transformer connection. In 2009, the roadmap for the IEEE PES Test feeder was published by the IEEE team[8].In this paper,the direction and the requirements of the upcoming test feeders were presented, highlighting seven topics to take into account. Neutral-toearth voltage(NEV), short circuit benchmarks,distributed generation(DG) protection, large distribution system models,inverter-based DG models, comprehensive test feeders were published,a NEV test case [medium-sized feeder to scale –up algorithms[10] and another with a wide variety of equipment[11].In 2014, a new meshed low voltage test system was published [12].The previous IEEE test feeders are presented chronologically. More information about these feeders is presented in table 1. A recent publication [13], review the actual collection of test feeders and propose specific analytic challenges for futuredevelopments.

IV. CONCLUSION

Based on the needs of utilities and the scientific community under the new paradigm of smart distribution grids and DER integration, this paper has presented a comprehensive review of the USBased USBased on the needs of utilities utilities and the scientific scientific community community under the new paradigm paradigm of smart distribution grids and DER integration, this paper has presented a comprehensive review of the US distribution test feeders published over the last three decades. The project presented a succinct analysis of all the feeders, classified them based on their origin and intended uses or applications,systematically delineated all of the limitations, and identified future research needs in this field related to test feeder generation.

REFFERENCES

[1]. Bacher, R. Power System Models, Objectives and Constraints in Optimal Power Flow Calculations. In Optimization in Planning and Operation of Electric Power Systems; Physica: Heidelberg, Germany, 2021;pp. 217–263.

[2]. Pérez-Arriaga, J.I.; Batlle, C.; Gómez, T.; Chaves, J.P.; Rodilla, P.; Herrero, I.; Dueñas, P.; Ramírez, C.R.V.; Bharatkumar, A.; Burger, S.; et al. Utility of the Future: An MIT Energy Initiative Response to an Industry in Transition; Massachusetts Institute of Technology: Cambridge, MA, USA, 2021.

[3]. Palmintier, B.; Giraldez, J.; Gruchalla, K.; Gotseff, P.; Nagarajan, A.; Harris, T.; Bugbee, B.; Baggu, M.; Gantz, J.;

[4]. Boardman, E. Feeder Voltage Regulation with High Penetration PV Using Advanced Inverters and a Distribution Management System: A Duke Energy Case Study; NREL Technical Report NREL/TP-5D00-65551;National Renewable Energy Laboratory : Golden,CO,USA,2021