



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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Contingency Analysis of 66/20 KV Substation

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ABSTRACT: The contingency analysis of 66/20 kv substation involves a comprehensive study of power flow, voltage stability, and system reliability within this particular power network. Typically, it includes the assessment of different parameters such as line losses, voltage profiles, power generation, and transmission constraints. It may also involve the examination of different scenarios, including contingencies, to understand the system's behavior under various operating conditions and potential failures. This analysis often utilizes various computational methods, such as load flow analysis, contingency analysis, and optimization techniques to ensure the system's efficient and stable operation. The abstract of such an analysis would summarize the methodologies employed, the key findings, and the implications for the 66/20 KV substation system's performance and reliability.

I. INTRODUCTION

Performance analysis in power systems is a crucial process that involves the evaluation and assessment of various operational parameters to ensure the reliable, stable, and efficient supply of electricity. Power systems are complex networks of generators, transformers, transmission lines, distribution networks, and loads. Analyzing their performance is essential for maintaining the quality of electrical supply, optimizing energy usage, and preventing system failures.

II. CONTINGENCY ANALYSIS

Contingency analysis is a critical aspect of power system performance analysis that focuses on evaluating the impact of various contingencies, such as line outages or equipment failures, on the stability and reliability of the power system. In the context of the 66/20 KV substation SLD, which is a widely used test system in power system research, contingency analysis helps assess the system's behavior under different fault conditions.

2.1 LINE OUTAGE

Line outage contingency analysis is a specific type of contingency analysis commonly used in electrical power systems. It focuses on evaluating the potential impact of the outage of a transmission line, also known as a line outage, on the stability and reliability of the power grid.

Definition: Line outage contingency analysis is the process of assessing the consequences of the failure or outage of a transmission line within an electrical power system. This analysis aims to identify potential issues such as overloads, voltage instability, and cascading failures that could result from the loss of the line.

2.2 GENERATOR OUTAGE

Generator outage contingency analysis is a vital component of power system planning and operation, specifically focusing on assessing the impact of the unexpected failure or outage of a generator on the stability and reliability of the electrical grid.

Definition: Generator outage contingency analysis involves evaluating the consequences of the sudden loss of a generator within an electrical power system. This analysis aims to understand how such an event affects the system's stability, voltage profile, and overall reliability.



III. SLD OF 66/20 KV SUBSTATION

3.1.SUBSTATION (66/20 KV)

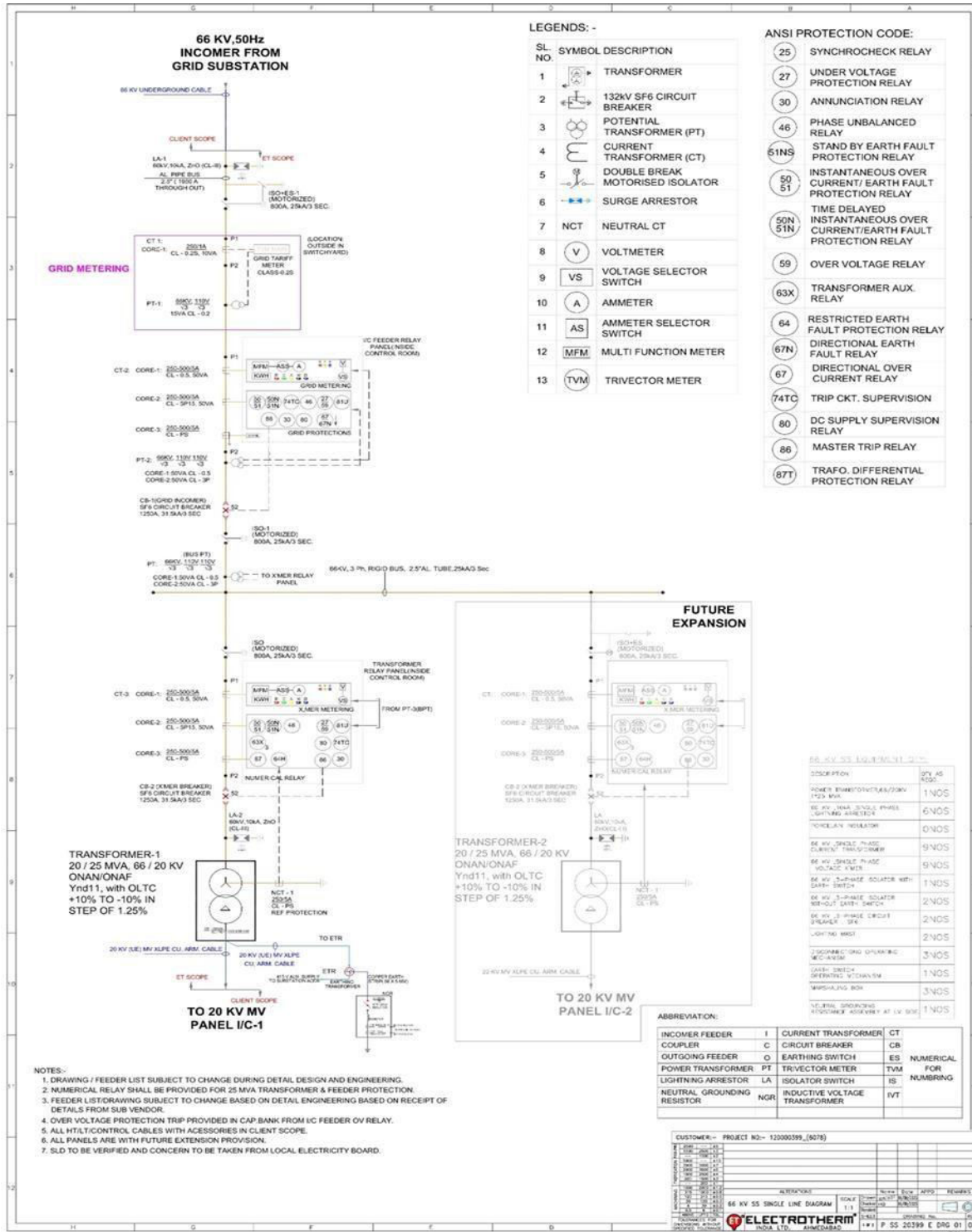


FIGURE3.1



3.2MV SLD @ 20 KV

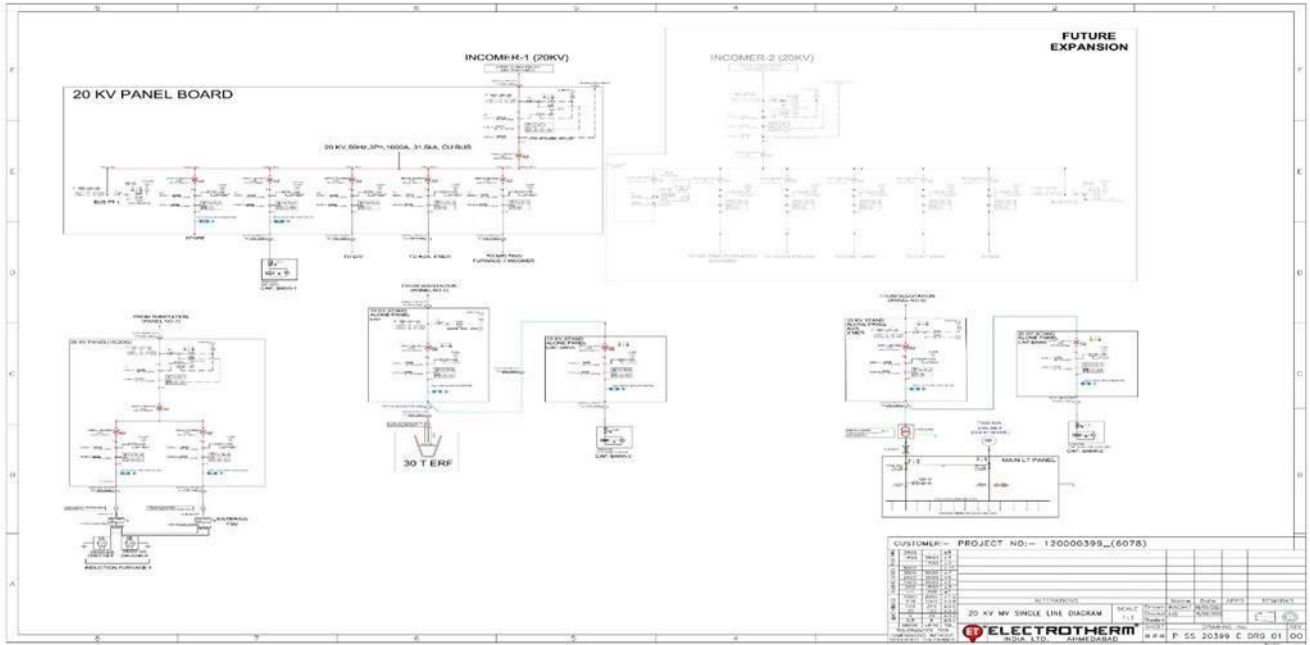


FIGURE 3.2

3.3 LV SLD @ 450 V

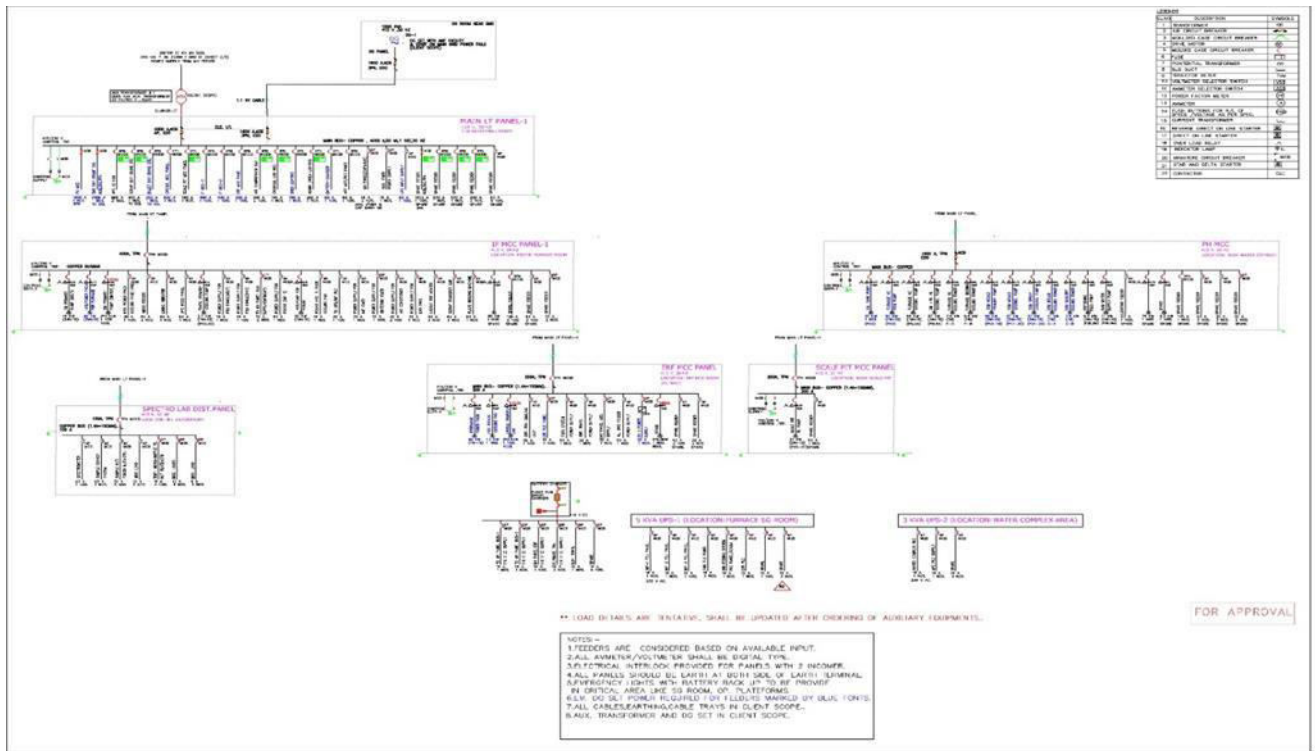


FIGURE 3.3

IV. SIMULATION & RESULTS OF LINE OUTAGE

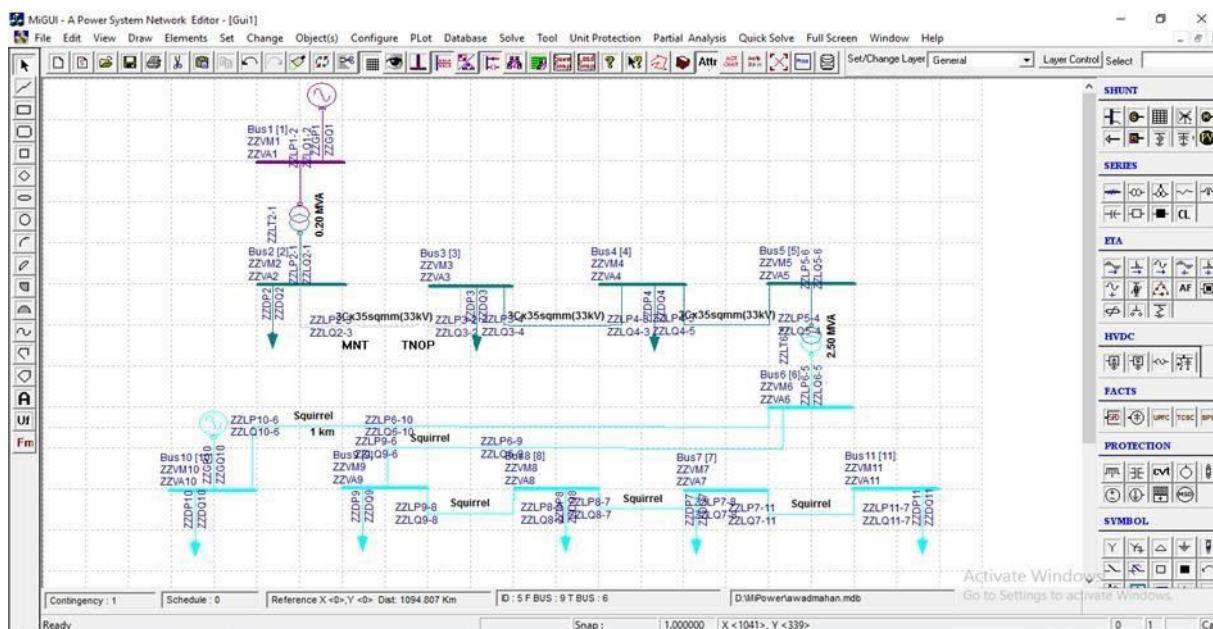


FIGURE 4.1

4.1 LINE FLOWS AND LINE LOSSES (2-3 AND 6-9 LINE OPEN)

SLNO	CS	FROM	FROM NAME	TO	TO NAME	FORWARD MW
3	1	2	Bus2	3	Bus3	LINE IS OPEN
4	1	3	Bus3	4	Bus4	0.000
5	1	4	Bus4	5	Bus5	0.000
6	1	10	Bus10	6	Bus6	0.101
7	1	9	Bus9	6	Bus6	LINE IS OPEN
8	1	9	Bus9	8	Bus8	0.000
9	1	8	Bus8	7	Bus7	0.000
10	1	7	Bus7	11	Bus11	0.000

4.2 TRANSFORMER LOADING

NUMBER OF TRANSFORMERS LOADED BEYOND 125% : 1
 NUMBER OF TRANSFORMERS LOADED BETWEEN 100% AND 125% : 0
 NUMBER OF TRANSFORMERS LOADED BETWEEN 75% AND 100% : 0
 NUMBER OF TRANSFORMERS LOADED BETWEEN 50% AND 75% : 0
 NUMBER OF TRANSFORMERS LOADED BETWEEN 25% AND 50% : 0
 NUMBER OF TRANSFORMERS LOADED BETWEEN 1% AND 25% : 1
 NUMBER OF TRANSFORMERS LOADED BETWEEN 0% AND 1% : 0

V. SIMULATION & RESULTS OF GENERATOR OUTAGE

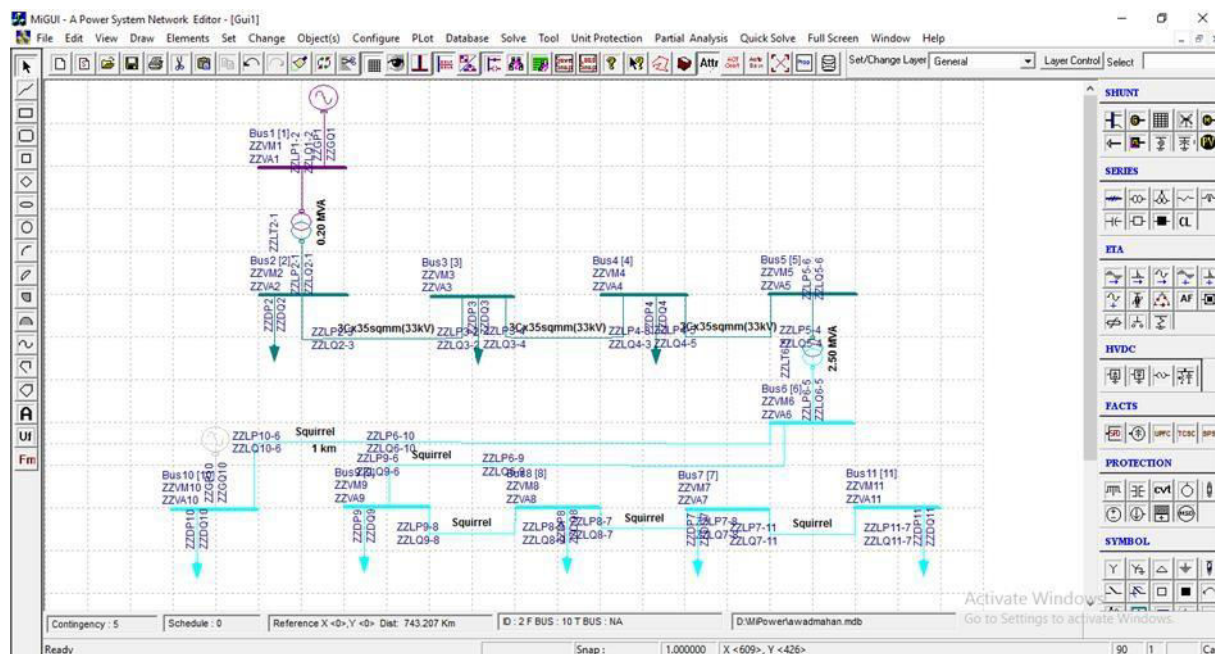


FIGURE 5.1

5.1 OUTPUT DATA

PARAMETER	VALUE
TOTAL SPECIFIED MW GENERATION	55.00000
TOTAL MINIMUM MVAR LIMIT OF GENERATOR	0.00000
TOTAL MAXIMUM MVAR LIMIT OF GENERATOR	41.25000
TOTAL SPECIFIED MW LOAD	69.29051
TOTAL SPECIFIED MVAR LOAD	54.96568
TOTAL SPECIFIED MVAR COMPENSATION	0.00000
TOTAL (INCLUDING OUT OF SERVICE UNITS)	

PARAMETER	VALUE
TOTAL SPECIFIED MW GENERATION	82.00000
TOTAL MINIMUM MVAR LIMIT OF GENERATOR	0.00000
TOTAL MAXIMUM MVAR LIMIT OF GENERATOR	61.50000
TOTAL SPECIFIED MW LOAD	69.29051
TOTAL SPECIFIED MVAR LOAD	54.96568
TOTAL SPECIFIED MVAR COMPENSATION	0.00000



5.2 SUMMARY OF RESULTS

PARAMETER	VALUE
TOTAL REAL POWER GENERATION (CONVENTIONAL)	102.000 MW
TOTAL REAL POWER INJECTION (-VE LOAD)	0.000 MW
TOTAL REACTIVE POWER GENERATION (CONVENTIONAL)	3.391 MVar
GENERATION POWER FACTOR	0.999
TOTAL REAL POWER GENERATION (WIND)	0.000 MW
TOTAL REACTIVE POWER GENERATION (WIND)	0.000 MVar
TOTAL REAL POWER GENERATION (SOLAR)	0.000 MW
TOTAL REACTIVE POWER GENERATION (SOLAR)	0.000 MVar
TOTAL SHUNT REACTOR INJECTION	0.000 MW
TOTAL SHUNT REACTOR INJECTION	0.000 MVar
TOTAL SHUNT CAPACITOR INJECTION	0.000 MW
TOTAL SHUNT CAPACITOR INJECTION	0.000 MVar
TOTAL TCSC REACTIVE DRAWL	0.000 MVar
TOTAL SPS REACTIVE DRAWL	0.000 MVar
TOTAL UPFC INJECTION	0.000 MVar
TOTAL SHUNT FACTS INJECTION	0.000 MVar
TOTAL SHUNT FACTS DRAWAL	0.000 MVar
TOTAL REAL POWER LOAD	0.008 MW
TOTAL REAL POWER DRAWAL (-VE GEN.)	0.000 MW
TOTAL REACTIVE POWER LOAD	0.005 MVar
LOAD POWER FACTOR	0.826
TOTAL COMPENSATION AT LOADS	0.000 MVar
TOTAL HVDC REACTIVE POWER	0.000 MVar
PERCENTAGE REAL LOSS (AC+DC)	0.166%
TOTAL REACTIVE POWER LOSS	3.391291 MVar

VI. CONCLUSION

Contingency analysis is a vital aspect of ensuring the reliability and stability of power systems, especially in substations like the 66/20 kV substation. In analyzing contingencies, we evaluate the impact of potential failures or disturbances on the system's operation. For this specific substation, the analysis focuses on scenarios where certain components, such as transformers, circuit breakers, or lines, may fail or be removed from service.

The conclusions drawn from the contingency analysis of this substation provide critical insights into its resilience against various potential disruptions. By simulating and assessing multiple contingency scenarios, we can identify vulnerabilities and prioritize measures to enhance the substation's robustness. Key findings may include identifying critical contingencies that could lead to system instability, overloading of equipment, or voltage violations.

Additionally, the analysis may highlight the effectiveness of existing protection schemes and the need for improvements or upgrades. Recommendations stemming from these conclusions could involve enhancing redundancy in critical components, optimizing relay settings, or implementing better coordination between protection devices. Furthermore, the analysis may inform maintenance schedules and investment decisions to ensure the continued reliability and performance of the substation.

In summary, the contingency analysis of the 66/20 kV substation serves as a proactive approach to safeguarding power system reliability. Its conclusions provide valuable guidance for enhancing the substation's resilience, mitigating risks, and maintaining uninterrupted electricity supply to consumers.



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