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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Load Flow Analysis of 66/20 KV Substation

Charan Awad Mahavir, Dr. Sweta Shah

U.G. Student, Department of Electrical Engineering, Indus University, Ahmedabad, Gujarat, India

Department of Electrical Engineering, Indus University, Ahmedabad, Gujarat, India

**ABSTRACT:** The load flow analysis of a 66/20 kV substation would summarize the study's objectives, methods, and key findings. It would typically outline the investigation into the electrical characteristics and performance of the substation under various operating conditions. The analysis would assess parameters such as voltage levels, power flows, and losses within the substation network. Key considerations might include load distribution, system stability, and efficiency optimization. The abstract would conclude with insights gained from the analysis and potential recommendations for enhancing the substation's operation and reliability.

## I. INTRODUCTION

The introduction for a load flow analysis of a 66/20 kV substation sets the stage by providing context and outlining the significance of the study. It typically introduces the purpose of the analysis, which could include evaluating the electrical performance, stability, and efficiency of the substation. The introduction may also discuss the importance of load flow analysis in power system planning and operation, highlighting its role in ensuring reliable and optimized power delivery. Additionally, it might mention any specific challenges or objectives pertinent to the particular substation being analyzed.

## II. LOAD FLOW ANALYSIS

Load flow analysis, also known as power flow analysis, is a fundamental computational tool used in electrical engineering and power systems to study and analyze the steady-state behavior of an electrical network. The primary purpose of load flow analysis is to determine the voltage magnitude and phase angle at each bus (node) in the power system, as well as the real and reactive power flows in the branches (transmission lines and transformers), under various operating conditions.

### 2.1 LOAD FREQUENCY CONTROL

Load frequency control (LFC) is a crucial aspect of power system operation, ensuring a balance between power generation and consumption to maintain system frequency within acceptable limits. It involves regulating the power output of generators in response to changes in load demand to keep the system stable. LFC achieves this through automatic control mechanisms that adjust generation output based on real-time measurements of frequency deviations, maintaining grid stability and reliability.

#### 2.1.1 FLAT FREQUENCY CONTROL

Flat frequency control is a simplified approach to load frequency control (LFC) where generators maintain a constant power output regardless of changes in system frequency. This method aims to minimize frequency deviations by adjusting generation capacity in response to load changes, without considering frequency variations. While less responsive than traditional LFC methods, flat frequency control can be suitable for systems with relatively stable loads or where precise frequency control is not critical.

#### 2.1.2 TIE-LINE FREQUENCY CONTROL

Tie-line frequency control involves coordinating power exchange between interconnected power systems to maintain frequency stability. It employs control mechanisms to adjust power flow across tie-lines based on frequency deviations between interconnected grids. By continuously monitoring and regulating power transfer, tie-line frequency control helps balance generation and demand, ensuring consistent frequency across interconnected systems and enhancing grid reliability.



III. SLD OF 66/20 KV SUBSTATION

3.1 SUBSTATION (66/20 KV)

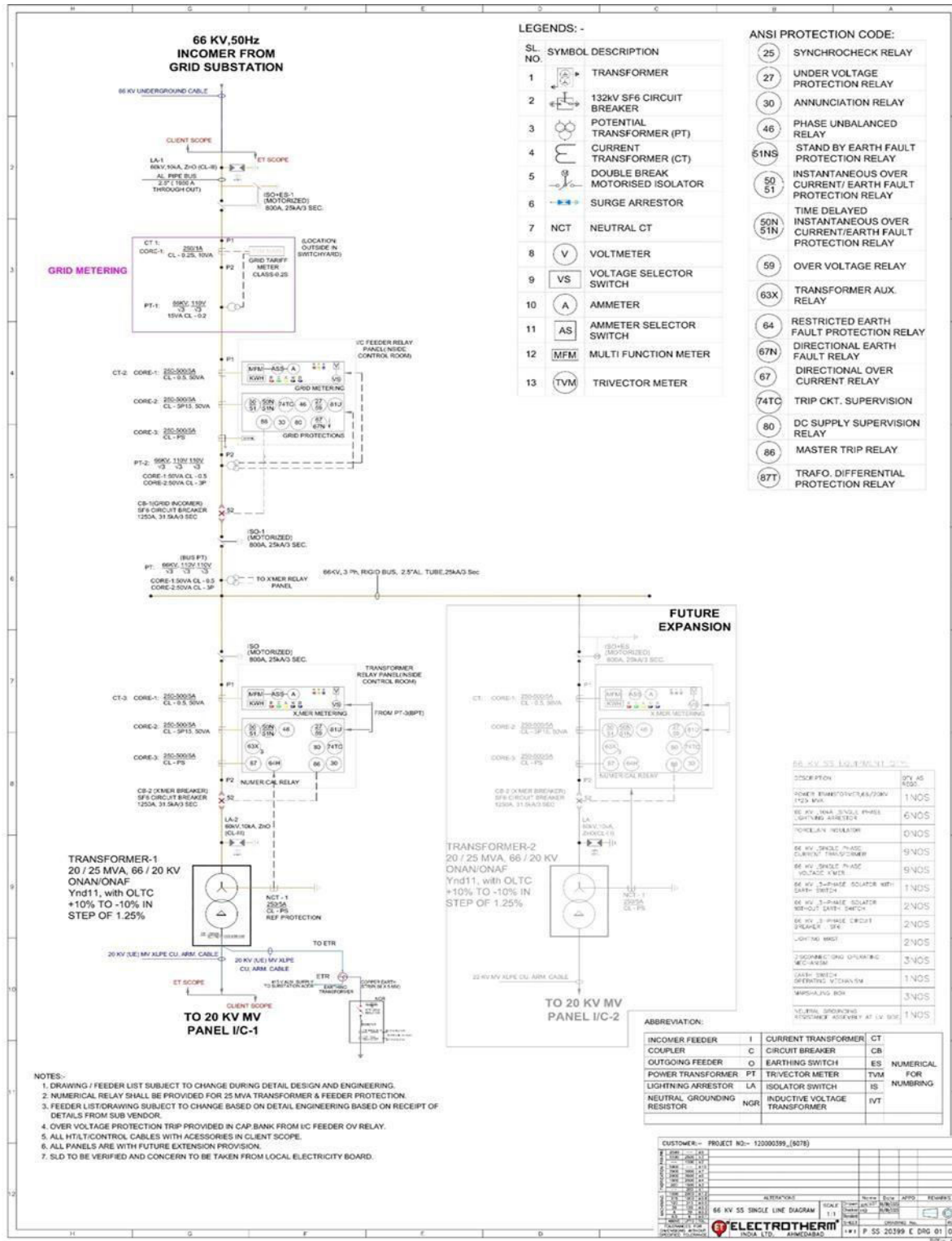


FIGURE 3.1



3.2 MV SLD @ 20 KV

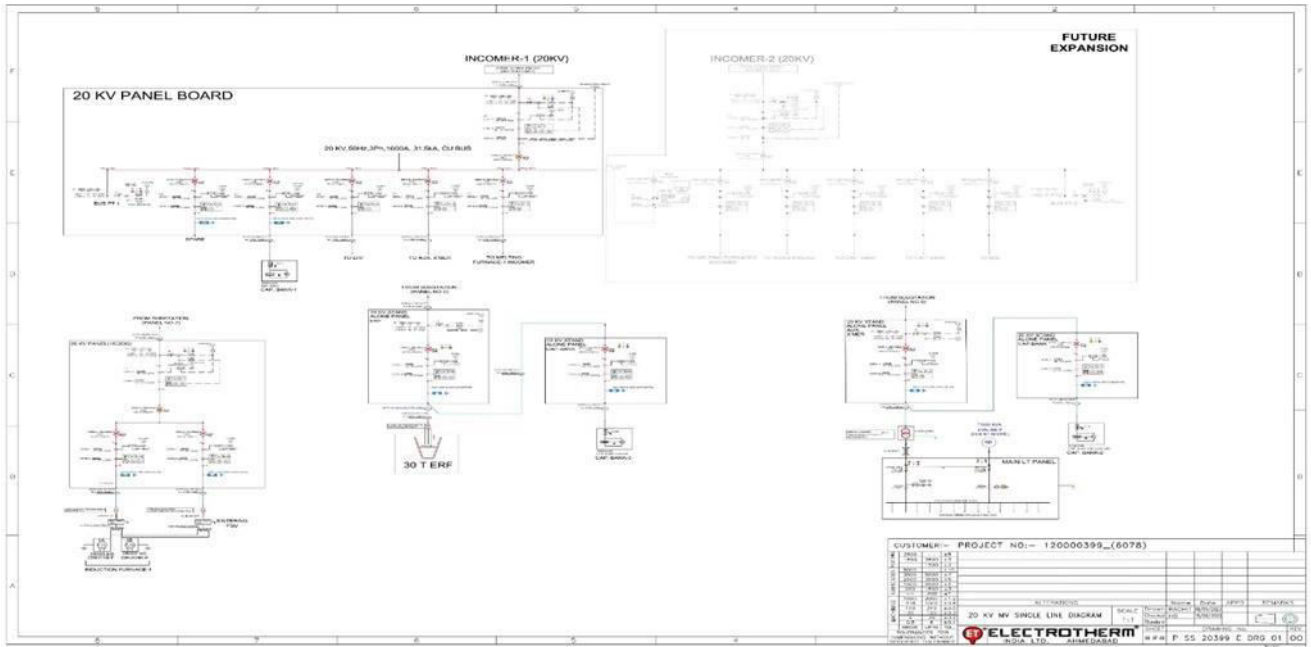


FIGURE 3.2

3.3 LV SLD @ 450 V

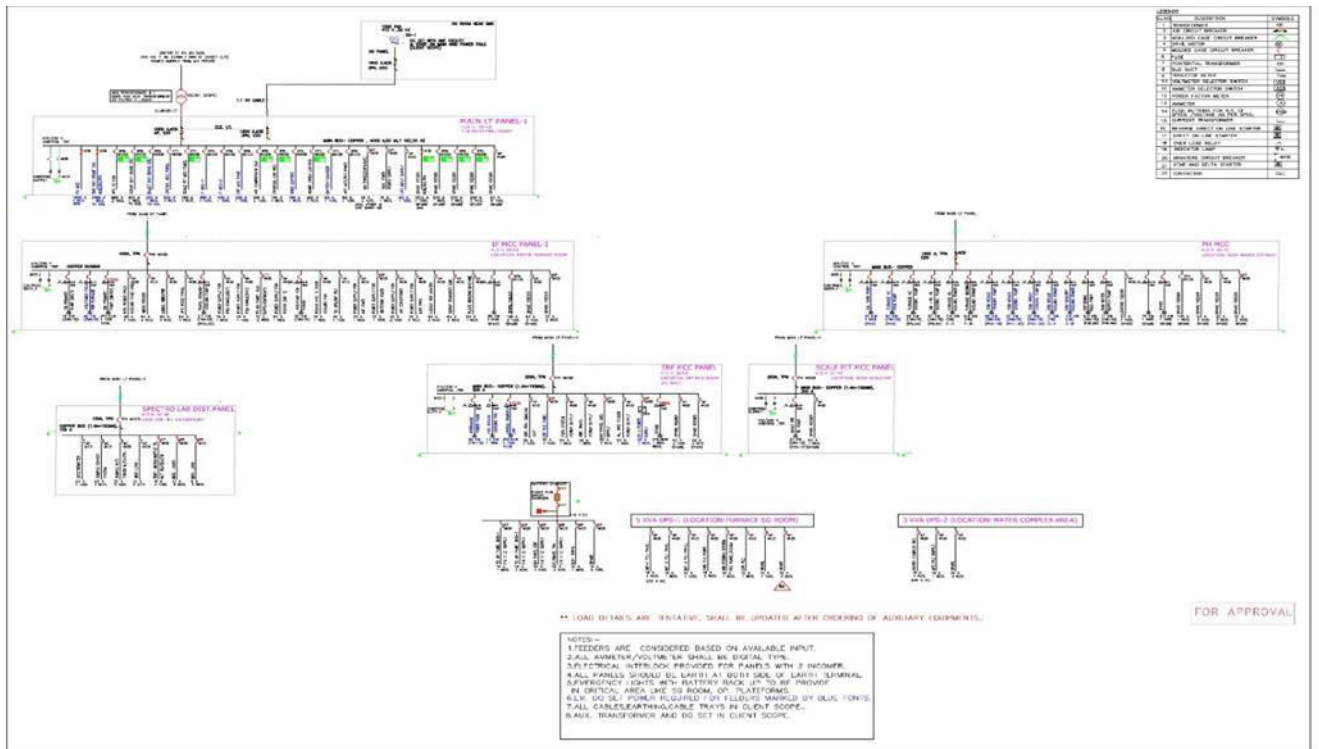


FIGURE 3.3



IV. SIMULATION & RESULTS OF LOAD FLOW ANALYSIS

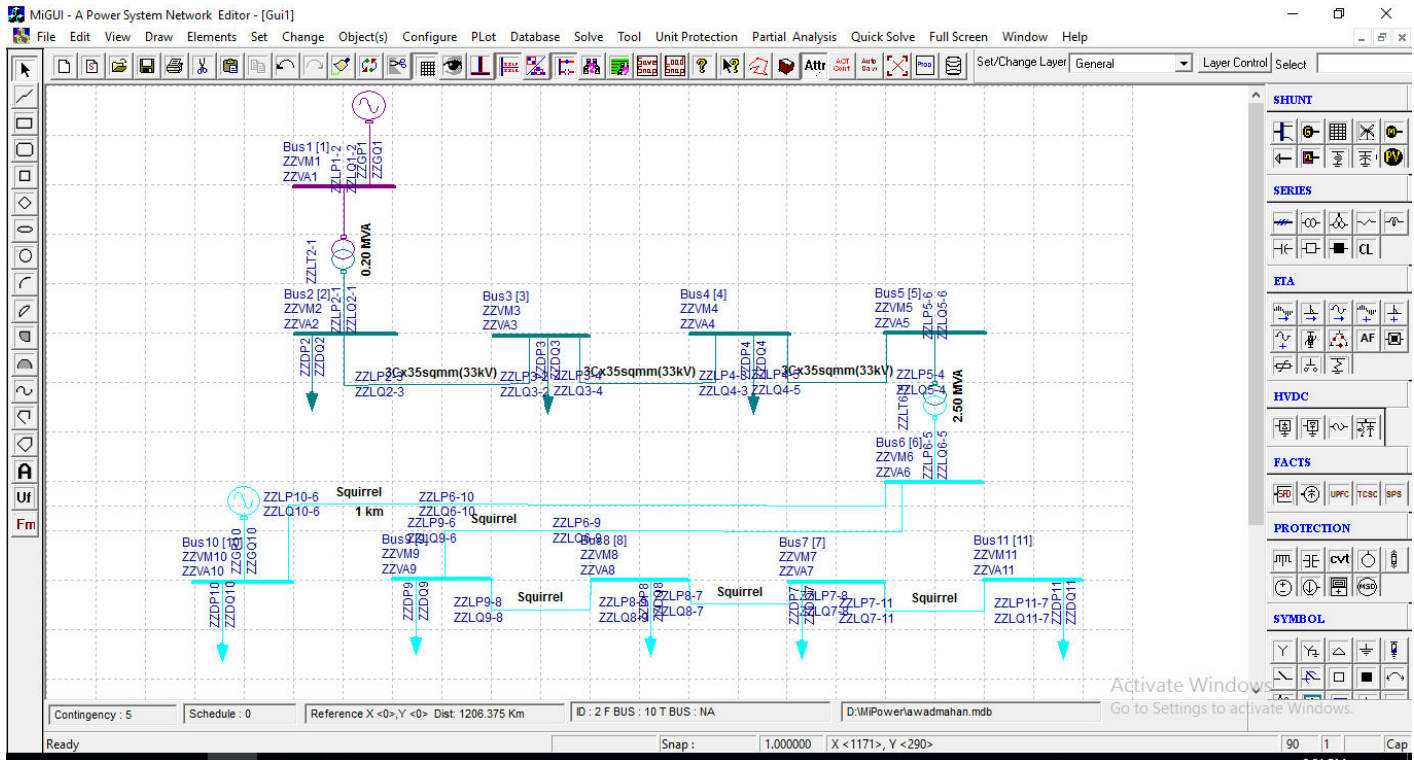


FIGURE 4.1

4.1 LINE FLOWS AND LINE LOSSES

SLNO	CS	FROM	FROM NAME	TO	TO NAME	FORWARD MW	FORWARD MVar	LOSS MW	LOSS MVar	% LOADING
3	1	2	Bus2	3	Bus3	0.000	0.000	0.0000	0.0000	0.2
4	1	3	Bus3	4	Bus4	0.000	0.000	0.0000	0.0000	0.0
5	1	4	Bus4	5	Bus5	0.000	0.000	0.0000	0.0000	0.0
6	1	10	Bus10	6	Bus6	0.101	0.031	0.1010	0.0308	5.7
7	1	9	Bus9	6	Bus6	0.000	0.000	0.0000	0.0000	0.0
8	1	9	Bus9	8	Bus8	0.000	0.000	0.0000	0.0000	0.0
9	1	8	Bus8	7	Bus7	0.000	0.000	0.0000	0.0000	0.0
10	1	7	Bus7	11	Bus11	0.000	0.000	0.0000	0.0000	0.0

- NUMBER OF LINES LOADED BEYOND 125% : 0
- NUMBER OF LINES LOADED BETWEEN 100% AND 125% : 0
- NUMBER OF LINES LOADED BETWEEN 75% AND 100% : 0
- NUMBER OF LINES LOADED BETWEEN 50% AND 75% : 0
- NUMBER OF LINES LOADED BETWEEN 25% AND 50% : 0
- NUMBER OF LINES LOADED BETWEEN 1% AND 25% : 1
- NUMBER OF LINES LOADED BETWEEN 0% AND 1% : 7



**4.2 TRANSFORMER FLOWS AND TRANSFORMER LOSSES**

Description	Zone # 1
MW generation	82.0000
MVAr generation	3.4261
MW load	0.0066
MVAr load	0.0047
MVAr compensation	0.0000
MW loss	0.2706
MVAr loss	3.4221

Sl.No	CS	FROM NODE	FROM NAME	TO NODE	TO NAME	FORWARD MW	FORWARD MVA <sub>r</sub>	LOSS MW	LOSS MVA <sub>r</sub>	LOADING %
1	1	1	BUS1	2	BUS2	6.660	2.527	2.345	9.382	34.2
2	1	4	BUS4	5	BUS5	-3.645	0.037	5.342	21.37	51.7

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

**4.3 RESULTS OF FLAT FREQUENCY CONTROL**

Description	Zone # 1
MW generation	102.0000
MVAr generation	3.3913
MW load	0.0080
MVAr load	0.0054
MW loss	0.1696
MVAr loss	3.3913



**4.4 RESULTS OF TIE-LINE FREQUENCY CONTROL**

ISLAND	FREQUENCY	SLACK-BUS	CONVERGED
1	40.52204	1	0

ISLAND	FREQUENCY	SLACK-BUS	CONVERGED
1	31.28999	1	0

**V. CONCLUSION**

load flow analysis of a 66/20 kV substation summarizes the key findings and insights derived from the study. It typically highlights the performance of the substation under various operating conditions, including voltage levels, power flows, and system losses. The conclusion may discuss any observed limitations or challenges encountered during the analysis and suggest potential strategies for addressing them. Additionally, it might offer recommendations for improving the substation's efficiency, stability, or overall operation based on the analysis results. Overall, the conclusion provides a concise overview of the study's outcomes and implications for the substation's performance and future planning.

**REFERENCES**

1. A.E. Guile and W.D. Paterson, „Electrical power systems, Vol. 2“, (Pergamon Press, 2nd edition, 1977).
2. W.D. Stevenson Jr., „Elements of power system analysis“, (McGraw-Hill, 4 th edition, 1982).
3. W. F. Tinney, C. E. Hart, "Power Flow Solution by Newton's Method, " IEEE Transactions on Power Apparatus and systems , Vol. PAS-86, pp. 1449-1460, November 1967.
4. D.I.Sun, B.Ashley, B.Brewer, A.Hughes and W.F.Tinney, “Optimal Power Flow by Newton Approach”, IEEE Transactions on Power Apparatus and systems, vol.103, No.10, 1984, pp2864- 2880.
5. Dharamjit\*, D.K.Tanti,” Load Flow Analysis on IEEE 30 bus System”, 1. international Journal of Scientific and Research Publications, Volume 2, Issue 11, November 2012
6. Y. Wang, R.R. Mohler, R. pee and W. Mittelstadt, Variablestructure FACTS controllers for power system transient stability, IEEE Trans. Power Syst., 7 (1) (1992) 307 313
7. Load flows, Chapter 18, Bus classification, Comparison of solution methods, N-R method–Electrical Power system by C.L.WA HWA.
8. Modern Power System Analysis, I. J. Nagrath& D. P. Kothari, TMH



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