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Power & Voltage Profile Detection for Water Treatment Plant Electric Network by Performing Load Flow Analysis Using ETAP Software

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Abstract
We all know today that power is the most important requirement for the development of a country. In order to meet out requirements, power production must be at an adequate level and electricity must be delivered to the consumer good quality. The power grid studied at the water treatment plant operates at lower voltages due to bus overload. The main objective of this project is to perform load flow analysis in a typical water treatment plant electrical network using the Electrical Transient Analyzer Program (ETAP) software and provide solutions to overcome low voltage loads.
Keywords: Load Flow Analysis, ETAP Software, Power Grid.

Introduction

Industrial power networks are usually designed so that all loads/equipment connected to the network operate efficiently (i.e., maintain correct voltage and power profiles across loads). The power grid studied at the water treatment plant operates at lower voltages due to bus overload. The power and voltage profile of the system changes according to the changing values of the loads connected to the transmission line. This voltage profile should be improved as much as possible for the system to be efficient. A water treatment plant is an area where sewage is treated on a large scale and clean water is taken from the treatment plant. This water treatment plant can be electrically treated as an industrial load.

The reasons for getting low voltages:
1. Due to ageing effect of the equipment.
2. Due to power distribution lines.

Required Power System Data

S. No	Required information
1	Power system network
2	Transformer details
3	Cables details
4	Load details
5	Grid voltage

Software Information

ETAP is a full spectrum analytical engineering software developed by operation Technology Inc. (OTI). The software specializing in the analysis, simulation, monitoring, control, optimization, and automation of electrical power systems. ETAP software offers the most comprehensive and integrated suite of power system enterprise solution that spans from modelling to operation. The ETAP Software provides a good interface for performing rigorous analysis on electrical power systems such as load flow analysis, short circuit analysis, relay coordination, transformer sizing etc.

Source	Short Circuit Level (KA)	X/R ratio
SC Current	25	15

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Transformer Name	Voltage Levels	Impedance (%)
TR-31	11/6.6	5
T1	6.6/0.415	4

S. No	Cable ID	Length (m)
1	Cable from EB to TR-31	30
2	Cable from TR-31 to 6.6kV switchgear	50
3	Motor-1 cable	70
4	Motor-2 cable	70
5	Motor-3 cable	70
6	Cable to TF2	60
7	Cable from TF2 to 4.15kV switchgear	60

S. No	Parameter	Ratings	Unit
1	Rating	225	KW
2	Voltage	6.6	KV
3	Power Factor	0.9	-
4	Efficiency	93	%
5	Rated Current	25	A
6	Locked Rotor Current	600%	X/R
7	Starting Time (80%)	4	sec
8	Locked Rotor withstand Time	17	Sec
9	No. of cold starts	-	3
10	No. of hot starts	-	2

S. No	LV loads	Lumped load
1	Battery charger-1	5 KVA
2	Battery charger-2	3 KVA
3	Lighting Panel	4 KVA
4	Indoor Panel	5 KVA
5	Hoist	4 KVA
6	Instat Panel	6 KVA
7	MoV	4 KVA

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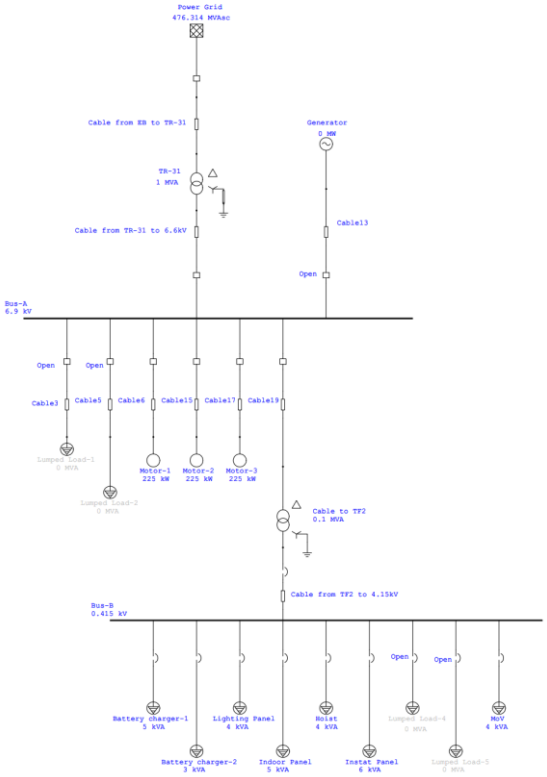

Figure (1) Typical Power Network for simulation using ETAP

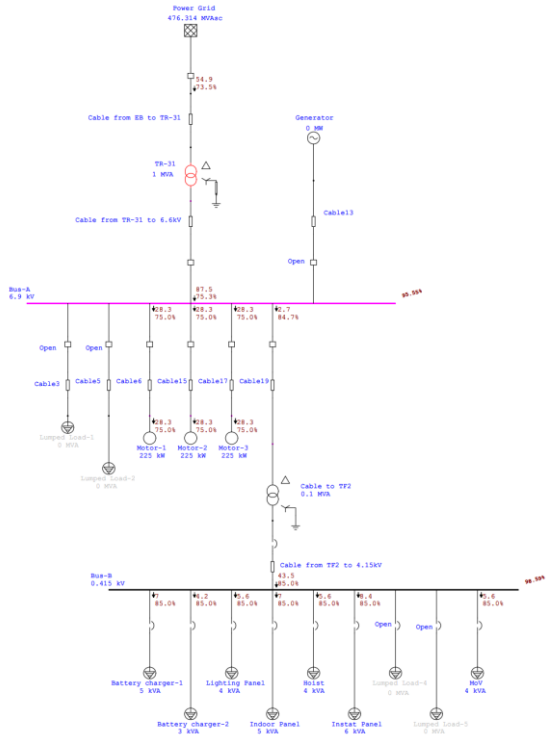

Figure (2) Simulation Results

Observations

After carrying out load flow analysis using ETAP, an alert summary report is generated which tells us which part of the system needs immediate attention and it can be clearly seen from the figure-2 that the Bus is operating at an under voltage.

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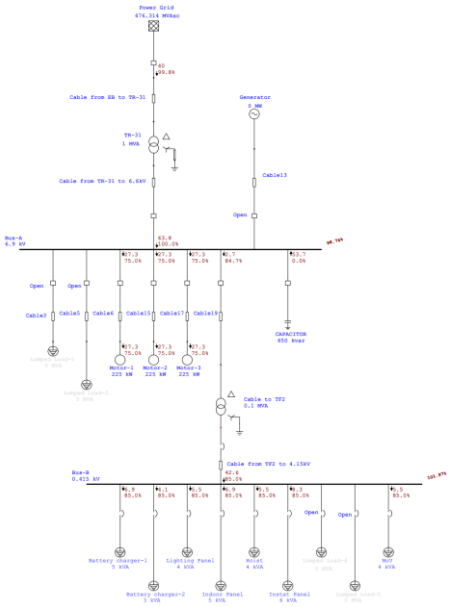

Figure (3) Simulation Results after adding capacitor to the power system

We can observe that from the figure (2) a bus colour has changed to pink, which indicates that the voltage is being lowered and bus voltage value is about 95.55%. Also, we observe the colour change in the first transformer which indicates that there is some mistake in the power system. To solve this issue, we will be adding the capacitor banks at the bus. After adding the capacitor, we can observe that the voltage levels are being maintained as required and the bus voltage is about 98.76%

Conclusion

Load Flow study using ETAP software is carried out with an approach to overcome the problem of an under voltage. Load Flow Studies using ETAP Load-flow studies are often used to identify the need for additional generation, capacitive, or inductive VAR support, or the placement of capacitors and/or reactors to maintain system voltages within specified limits.

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