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Rural Electricity Stress Assessment for a Feeder in Maharashtra State

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Abstract: Rural electrification is often considered to be the spine of the rural economy of a country. Rural electrification is seen to improve farm productivity and enhance overall improvement in health and education through better employment opportunities since rural areas traditionally depend on agriculture-related income generation activities. Our study realizes the need of rural electrification and focuses on the assessment of rural electricity stress. It would help us to tackle the stress on electricity consumers in villages through the analysis of certain parameters.

Keywords: Rural Electrification, Rural Economy, Rural Electricity Stress, Electricity Consumers.

I. INTRODUCTION

Rural electrification has numerous objectives, out of which primary concerns are: first, to improve the economic status of the rural population by increasing the productivity of human and animal labour and secondly, to promote rural welfare by providing an environment equal in comfort and convenience to that enjoyed in urban areas. Thus electrification is an important factor in preventing the drift of the rural population to urban population. While rural electrification is an important input for rural development, the fact remains that it is a financial burden on the electricity boards and needs to be heavily subsidized. In general, the rural consumer is not well conversant with the use of electricity and electrical devices. They should be educated in the conservation of energy measures, such as the use of efficient devices and of alternative energy resources such as solar energy, biogas plant, wind power etc. In rural areas, long scattered lines and heavy peaks with predominant agriculture loads lead to the usual problem of bad voltage regulation, lower power factor, heavy distribution losses and total harmonic distortion in voltage as well as current waveforms on the receiving consumer end.

II. SYSTEM CONNECTIONS AND EQUIPMENT

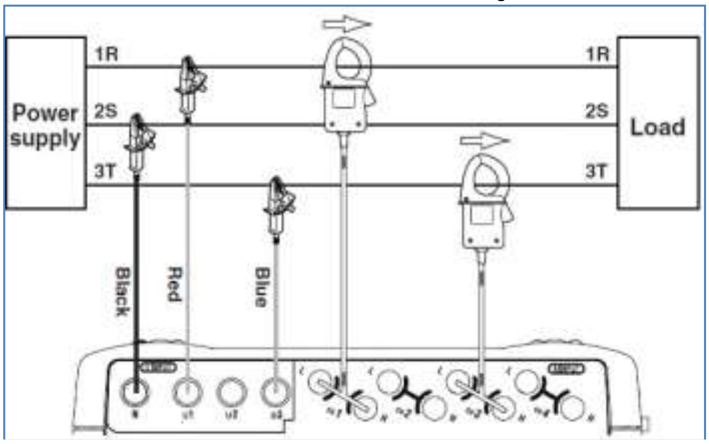

Fig. 1 Connection diagram

Here in Fig. 1 R, S, T are the three phases also represented as R, Y, B, respectively.

The power analyser or power meter used to analyse the system used was CW 240 Yokogawa and has four slots for voltage and four slots (2 X 2 slots) for current measuring clamp on meters. The conventional order of connection of probes is followed where voltage probes are attached to the leftmost slots and current clamp on meters are connected to the right-most slots. The probes and meters can be connected in any order but conventionally connected in R, Y, B, N phase both for voltage and current measurement respectively. However, they may be attached to the user's requirement if condition and need arise.

The voltage probes are connected to the supply side each being connected to a separate phase or bus bar.

The current measuring clamp on meter is connected onto the load side with each being connected to a separate phase with their direction pointing towards the load end.

Fig. 2 Live connection to a 22KV/440V panel

Here in Fig. 2 a panel of rating 22KV/440V is shown which comprises of three bus bar plates each representing R, Y, B, N phase respectively. The voltage probes were each connected to a separate bus bar plate and the current measuring clamp on meters was each connected to a separate phase R, Y, B, N respectively.

The readings were noted for an interval of time and the graphs corresponding to both voltage and current readings were prepared and analysed.

III. RESULT AND DISCUSSION

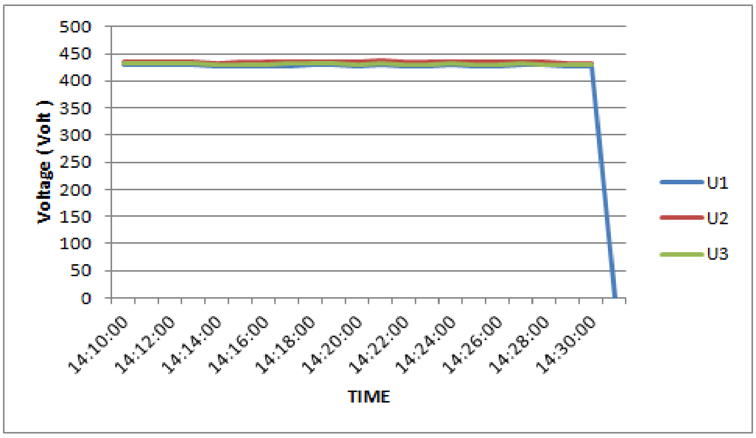

Fig. 3 Three phase voltage Vs Time interval

In fig 3, the graph of three phase voltage (per phase) Vs time interval is shown. Here, U1, U2, and U3 are the voltages across each phase respectively, also known as the voltage across R, Y and B phase respectively.

For the phase to phase voltage readings 423, 429, 432

Average voltage = (423+429+432) / 3

Average voltage = 428 V

Maximum Deviation from average voltage = 429 - 423

= 6 V

Voltage imbalance (unbalance) = 6 / 429

= 0.0139 or 1.39%

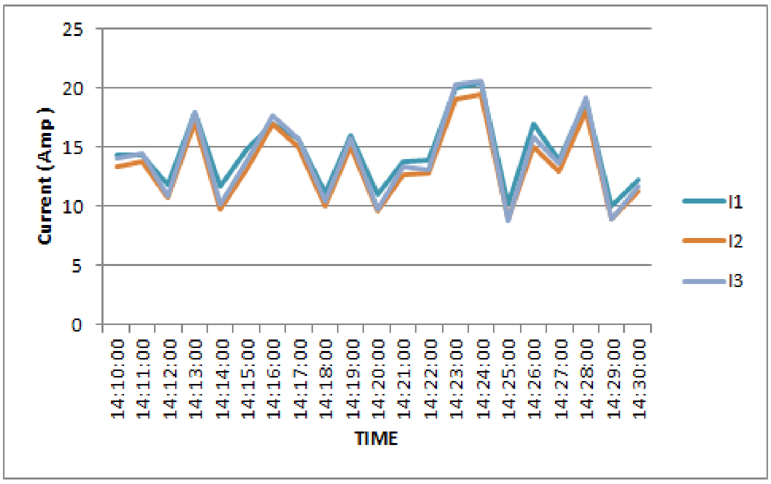

Fig. 4 Three phase current (per phase) Vs Time interval

In fig 4, the graph of three-phase current (per phase) Vs time interval is shown. Here, I1, I2, I3 is the current across each phase respectively, also known as current across R, Y and B phase respectively.

The nature of the waveform of current indicates the presence of harmonics or harmonic distortion in the electrical system.

CONCLUSIONS

The permissible value for voltage imbalance is 0.5% - 2.5% according to the ANSI C84.1 standard. However, greater values of voltage imbalance may cause overheating and eventually malfunctioning of system components. The use of mitigation devices such as voltage regulators is used to tackle voltage imbalance. Thus the system values mentioned above are considered to be normal.

The presence of current harmonics indicates the presence of nonlinear loads. Harmonic currents load the power sources such as transformer and alternator and also contribute towards copper losses in the system. One way to reduce or cancel harmonics is to use shunt type harmonic filter due to its dual nature of removing harmonics and correcting power factor. The other way is to connect the harmonics causing load as close to the source as possible in a separate feeder.

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