Design of methodology for measuring current load capacity of ACSR conductor

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***Abstract*— Power system is formed by a machine for generation, transformation, transmission and distribution of an electric energy. Based on current developments, there is a need for real-time maximum current load solutions. This can be addressed by the CIGRE 207 standard, the equations of which have been determined empirically. However, from the point of view of the reliability of the results, the verification and possible confirmation or refutation of the equations is in place. This scientific hypothesis was a prerequisite for the creation of this work and of the research to determine the current carrying capacity of external lines based on ambient conditions and this change. This paper describe design methodology for measuring current load of conductor. In this paper is described a method for construction and measuring current load in laboratory.**

***Keywords*— Ampacity of power lines, maximum permissible current value, ACSR conductor, ambient temperature.**

I. Introduction

Extensive development of renewable sources requires expansion of transmission capacity of power lines. Despite the fact that power lines are an integral part of the system but their expansion is in seclusion interests.

For these reasons, it is necessary to seek other means of safeguarding the power transmission system. One possibility is using operational methods which we monitor the temperature of the electrical wire and ambient influences. These indicate the actual permissible current.

To determine the allowable current of the conductor is necessary to determine all factors influencing temperature of the conductor. Subsequent calculation can be determined at any given time under the conditions of maximum load capacity.

II. Power line ampacity system

Conductor ampacity is defined as the maximum permissible load current, which can transmit the conductor without compromising its function. This distortion is mainly caused by exceeding the maximum permissible temperature [1].

The ampacity depends on the electrical and mechanical properties of the conductor material, thermal insulation properties (the cables), ability to dissipate within the conductor generated and received from nearby heat, ambient weather conditions[1].

It is therefore apparent that the ampacity is mainly influenced by the thermal condition of the conductors, because it determines the elongation conductors and therefore sag of power line over the terrain. In determining the maximum transmission capacity we use a method that is based from thermal equilibrium between the conductors and the environment[2].

At steady state (1) can be expressed as equality heat gain = heat loss[2][6].

$$P_\mathrm{J} + P_\mathrm{M} + P_\mathrm{S} + P_\mathrm{i} = P_\mathrm{C} + P_\mathrm{r} + P_\mathrm{W} \tag{1}$$

Where:

P_J is heat losses in the conductor (W)

P_M is magnetic heating of magnetic field variations AC (W)

P_S is solar radiation (W)

P_i is heating from the corona (W)

P_C is cooling by heat convection (W)

P_r is radiant cooling (W)

P_W is cooling from water evaporation (W) [3] [7]

III. Design of an experimental kit to verify the mathematical model for the determination of external transmission line ampacity

The basic hypothesis for this work is the verification of the proposed mathematical model, which was determined on the basis of empirical equations to determine the current carrying capacity of drivers based on the influence of ambient conditions according to the CIGRE standard.

The main element for exploration will be the driver that will run the I-th current value. This current, due to Joula's losses, causes the driver to heat up while neglecting ambient conditions. On the basis of theoretical knowledge, when the influence of ambient conditions on the temperature of the conductor is influenced, the ambient temperature, which also enters the temperature contribution due to Joule's losses, and the intensity of the solar radiation influence. On the other hand, when the driver cools down, the temperature drop due to forced air flow and the temperature drop due to natural convection are affected.

Another essential element for the measuring assembly is a transformer, which allows continuous current regulation up to the current I-value along with the current flow measurement. The measurement will also include thermal probes for measuring conductor temperature on the surface.

On the basis of the theoretical analysis for the measuring assembly, a measuring opinion was compiled. The block diagram of the measurement assembly is shown in the following figure.

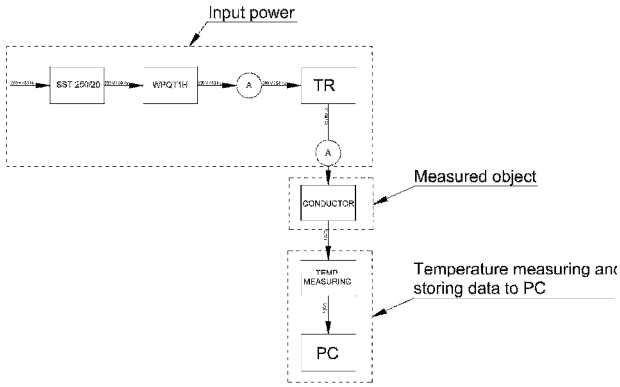

Fig. 1 Block diagram of equipment for determining ampacity

There is a three-phase power supply SST 250/20 with input voltage regulation 0 - 250V and current regulation with range 0 - 20A at the input of the measuring system. The SST250 / 20 power supply is a high current transformer. At the output of the large current transformer, the current is regulated in the range of 0 - 1000A label. WPQT1H is connected in the wiring between the SST250 / 20 drive and the large current transformer. The device primarily serves as a test device for electromechanical protection. In the measuring system, its protective functions are used to prevent damage to the large current transformer.

On the secondary side of the large current transformer, the examined AlFe rope is connected together with temperature probes for temperature measurement. Based on the driver's temperature, the maximum permissible driver temperature can be determined.

A flowchart measurement procedure is shown in Fig. 2. After initializing the ampacity measurement, the temperature and humidity measurement in the room and the driver temperature are started simultaneously. Subsequently, the I-th nominal current value is set by the voltage source depending on the purpose of the measurement. To terminate the measurement, the condition of the driver's temperature is set, ie. has no upward or downward tendency.

IV. Conclusion

This article described method to real time measuring and determining the current capacity for ACSR conductor in laboratory. If we can accurately determine the ambient conditions in real time, we can determine the current capacity under these terms and adapt operation of power system or power lines.

Acknowledgment

This work was supported by the Scientific Grant Agency of the Ministry of Education of Slovak Republic and the Slovak Academy of Sciences by the projects VEGA No. 1/0372/18.

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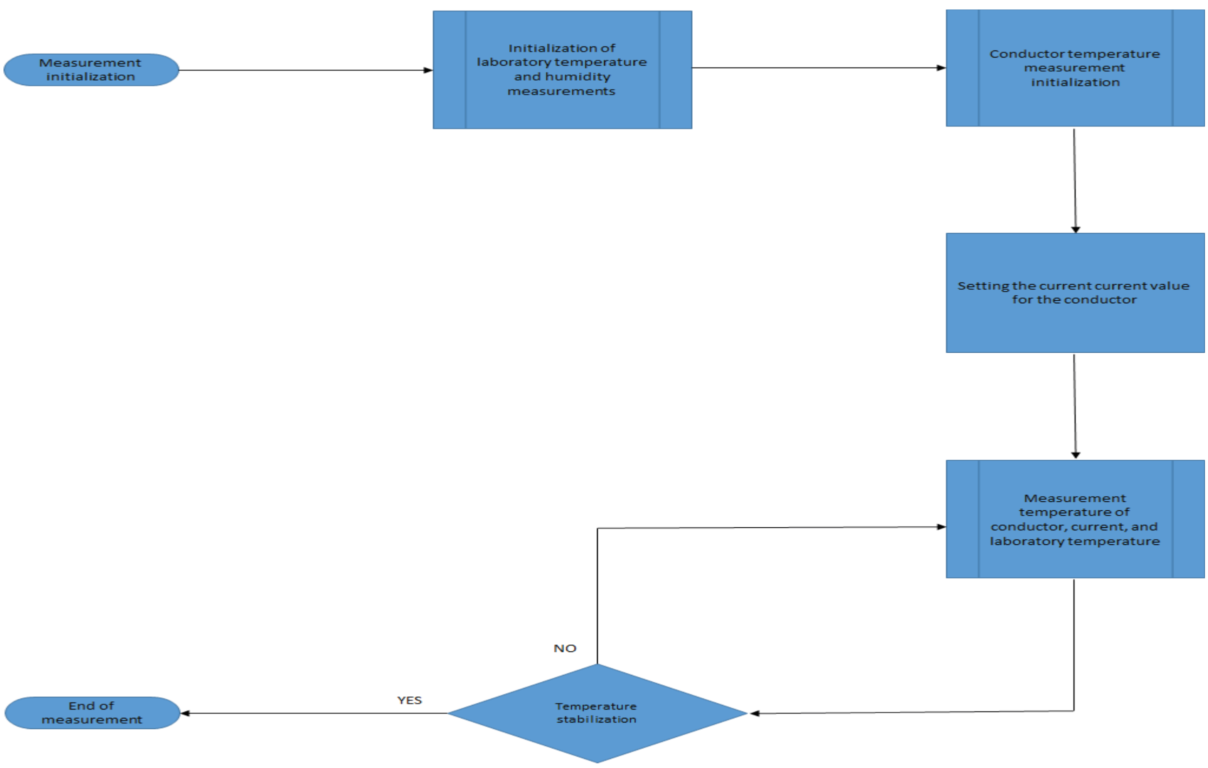

Fig. 2 Flowchart for power ampacity research