Observation of Icing on the Stand at Studnice

***Abstract*—In this paper observation and measurement of icing on the stand at Studnice is described.**

I. Nomenclature

Ice measurement, Conductor, Altitude gradient, Design of overhead lines.

II. Introduction

EGU Brno has been involved in solving the problems of icing on overhead lines since its establishment. It carries out observation and measuring of icing at test site Studnice. The test site is located about 60 km northwest from Brno at 800 m above see level in the Czech-Moravian Highland. The test site was built in the late 70's and has been in operation since 1980. There are 2 spans (cca 250 m each).

Fig. 1. Middle tower at test site Studnice

Various measurements are performed here:

- Ice measurement on conductors and measuring rods of various diameters
- The measurements on samples of stranded isolated conductors
- Observation of icing with respect to altitude gradient
- Continuous measurements
- Testing sensors, new equipment etc.

III. Ice Measurement on Conductors and Measuring Rods of Various Diameters

The measurement of ice deposits on the samples of conductors started in 1995 at the test site Studnice. The test samples and the measuring rod were installed at the height of 10 m above earth. The diameter of the test samples ranged from 30 mm to 90 mm.

The weight of ice on conductors with the increasing diameter revealed not to increase proportionally as is assumed in the Czech standard [3] (as well as in standards of other countries). In areas with a smaller icing the growth of the ice deposit increases slightly or remains on the same value while in areas with icing above 18 kg (as measured on the measuring rod) it even moderately decreases with the increasing conductor diameter.

On diagrams in pictures 2 and 3 updated weight of ice deposit on conductors of various diameters for category 8 kg and 12 kg is shown. The measured values of icing magnitudes (red line) do not correspond to those calculated from the relation given in the Czech standard (black line).

This is a very important assessment for the practice of designing overhead lines in icing areas as these structures may be dimensioned for a lower ice load than till now. We suppose the respective parts of the standards will allow the designers to lower the mechanical loading of the structures and thus to reduce their weight and the investment cost.

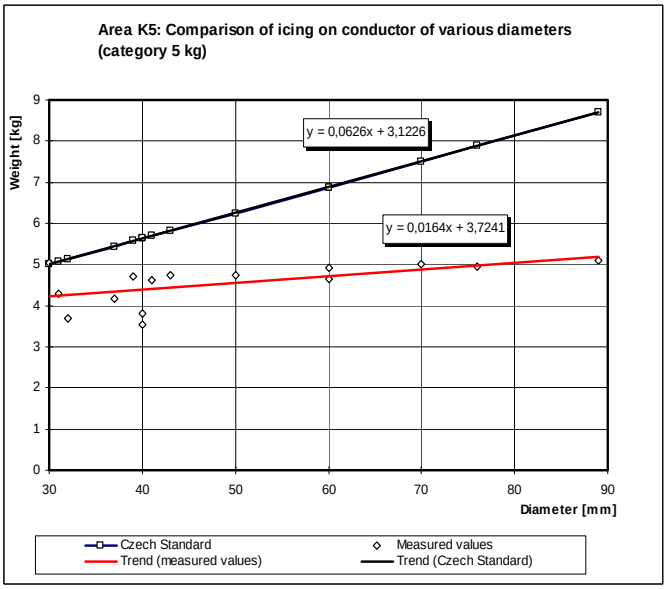

Fig. 2. Weight of ice deposit on conductors of various diameters for category 8 kg

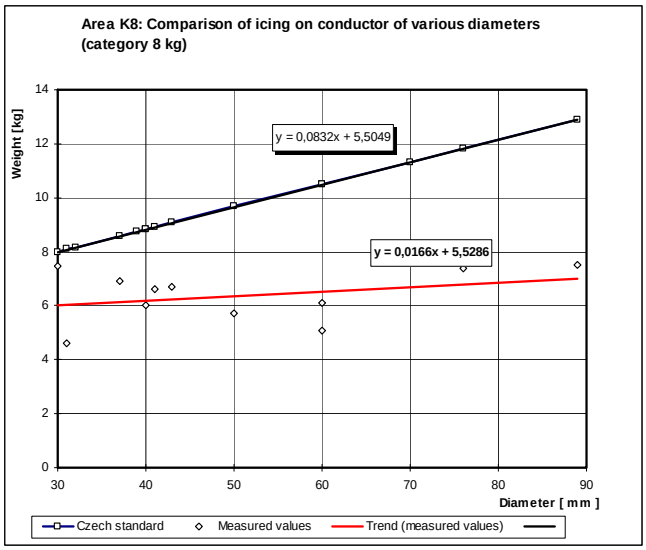

Fig. 3. Weight of ice deposit on conductors of various diameters for category 8 kg

Platform with samples of conductors of various diameters at height 10 m above ground is shown on figure 4.

Fig. 4. Samples of conductor with various diameters

Knowledge acquired from these measurements will be implemented in new Czech standards for designing overhead lines (ČSN EN 50 341-3-19 and ČSN EN 50 423-3-19).

IV. Observation of Icing with Respect to Altitude Gradient

We started evaluating icing gradient in winter season 2002-2003. Measuring rods, free rotated and oriented horizontally, with diameter of 30 mm and length of 1 m have been used. Rods are situated at the platforms at the height of 5, 10, 20, 30, 40 and 50 m above the ground. Data measured each winter season are appended to the database. Altitude gradient is then updated every year.

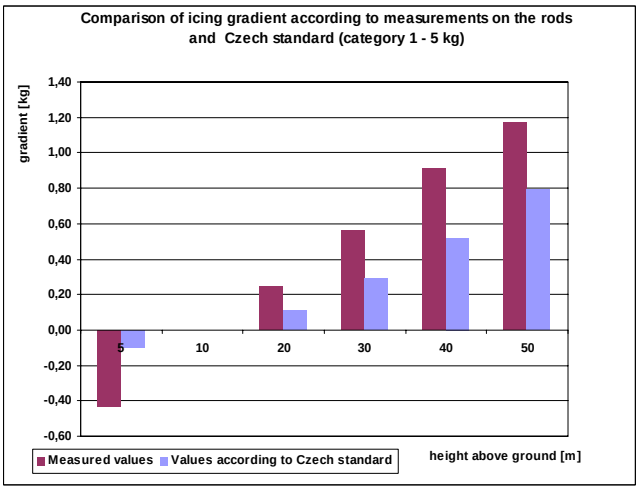

Fig. 5. Comparison of icing gradient according to measurements on the rods and Czech standard (category 1 - 5 kg)

On figure 5 comparison of icing gradient with respect to altitude, which is calculated from values measured on the rods and according to the Czech standard, is shown. It follows from the diagram that method used in standard is too conservative. On the other hand it should be underline that database is not yet as extensive as needed. Results presented should be taken as informative.

V. Time Serie

EGU Brno has operated a test site at Studnice continuously since 1940. The annual maxima of loads of this unique time series on the rack for the period 1940/41 – 2004/05 are presented in figure 6.

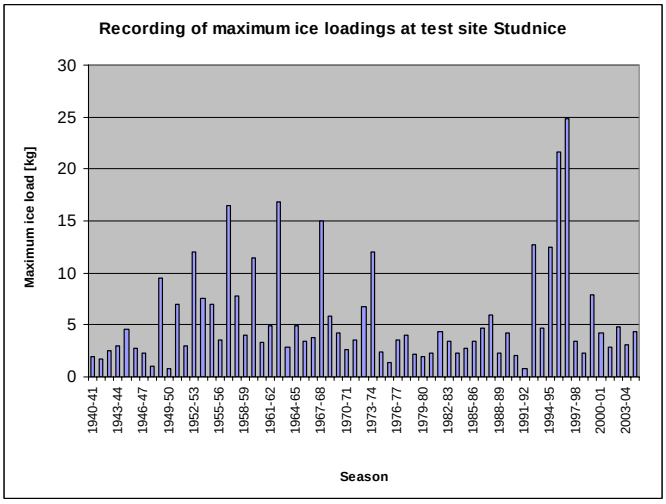

Fig. 6. Maximum ice loadings recorded at test site Studnice

VI. Testing of Equipment

The test site Studnice is used for testing various equipment. The first prototype of Meteo device was tested here. Distribution company JME (E.ON at present) located one Meteo, which is part of its automated icing monitoring

network, at the test site.

We have tested sensors for new meteorological monitoring station (PMS) which is based on the concept of Meteo device and also PMS itself.

VII. Continuous measurements

At the test site Studnice on-line measurements are also performed. Location of individual instrument on the tower is presented in the table 1.

TABLE I
Location of measurement devices at Studnice

Measuring device	Measurement height (m)	Output	Since
Icing - vertical rods (length of 0.5 m)	5, 10, 20, 30, 40, 50	Digital	1997
Icing - horizontal rods (length of 1 m)	10, 30	Digital	1997
Temperature	5, 10, 20, 30, 40, 50	Digital	1997
Humidity	10	Digital	2006

For on-line measurement of ice accumulation we use different instruments with horizontally and vertically oriented rods (with diameter of 30 mm and the length of 0.5 and 1 m) – see fig. 7 and 8. Temperature and humidity are also measured at different heights.

The measured data are obtained every minute, evaluated, and archived into the database on the computer.

Fig. 7. Icing on vertical, freely rotating rod with sensor, at test site Studnice

Fig. 8. Icing on horizontal, freely rotating rod with sensor, at test site Studnice

VIII. Future of test site studnice

Future of the test site Studnice is very much unclear at the moment. Because the permission to run the test site has expired, we have asked local authority to prolong it. The test site was built up in the nature protected area which is the main obstacle to get the permission. At present negotiations with local authority are under way.

IX. Conclusion

The test side Studnice plays a key role in our research of icing and its influence on overhead lines. Different measurements and testing of new sensor and technologies have been carried out here.

Results from the research of icing are used for a subsequent statistical evaluation of icing when designing overhead lines.

We do hope that running of the test site will be prolonged and will be able to present results acquired at the test site Studnice at next workshops.

X. References

Technical Reports:

[1]

Papers from Conference Proceedings (Published):

[2] P. Lehký, J. Šabata, Z. Zálešák, "Automated for icing monitoring system" in *Proc*. 2002 IWAIS

Standards:

[3] *CSN-Standard 33 3301 "Construction of overhead lines with nominal voltage up to 52kV", Ceský normalizacni institut, Prague, Czech Republic, 1997.*