XVII International Conference on
Electromagnetic Disturbances EMD'2007
September 19 - 21, 2007, Bialystok, Poland

FLAGSTAFF AS AN AIR-TERMINATION ROD MEASUREMENTS RESULTS

Jarosław WIATER
jaroslawwiater@we.pb.edu.pl
Electrical Department, Białystok Technical University, Poland

Summary: Main purpose of this paper is to present flagstaff as the lighting air-termination rod. Examples of damages caused by surge current are presented. High current surge generator was used for testing purposes. Photography-based discussion about flagstaff mounting, typical errors is presented.

Keywords: flagstaff, lightning, air-termination rod.

1. Introduction

High flagstaff is frequently placed on the open area where high lightning hazard occurs. It also frequently acts as an air-termination rod. During a direct lightning strike current flows by the metallic and non-metallic parts to the ground. It may happen that listed below phenomenon appears all at once:

- metal thermal erosion in the places where lighting current flow-in,
- metal makes red-hot along the lightning current circuit,
- electrodynamical current circuit deformation,
- mechanical damages caused by lightning sound-wave,
- sparking on the connection points.

High temperature and sparking can cause fire of flammable substances placed nearby. Sparking and flagstaff interconnection resistance growth can be dangerous for human being. Electric and magnetic fields generated by lightning can cause electric and electronic devices damage. In this paper high surge current influence on the flagstaff by will be taken into consideration. Used surge current shapes were different than IEC 62305-1 [3] standard recommends. The tests were provided to observe high current damages however, not to verify IEC 62305-1 [3] requirement.

2. High current measurements

Flagstaff was made from aluminium. For the test purposes high current surge generator was used. High current surge generator was supply from 10kV high voltage AC source. It can generate different surge types according requirements. Additional element such as R_1 and L can change front time and time to half of the value. During the tests 3 surge types were used: 8/20μs, 8/75μs, 8/10μs. Maximal current value received from generator was up to 55kA.

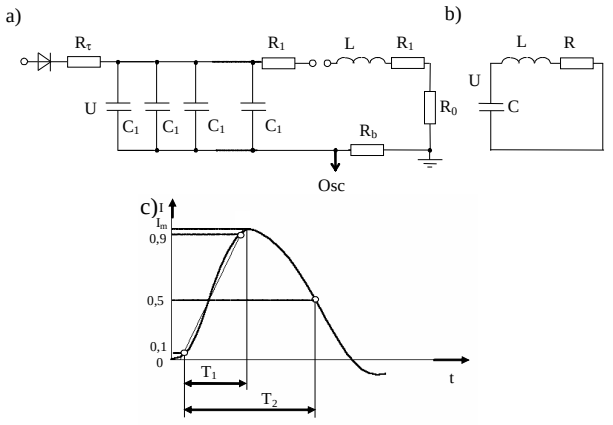

Fig. 1. Surge generator used for tests: a) electric circuit, b) electric circuit for calculation purposes, c) surge current shape

Fig. 2. Surge generator in the high voltage laboratory

During the tests flagstaff was connected to surge generator main electric circuit. Current flows in to the flagstaff top by the copper tape. At the bottom flagstaff was grounded. The flagstaff surface was coated by the

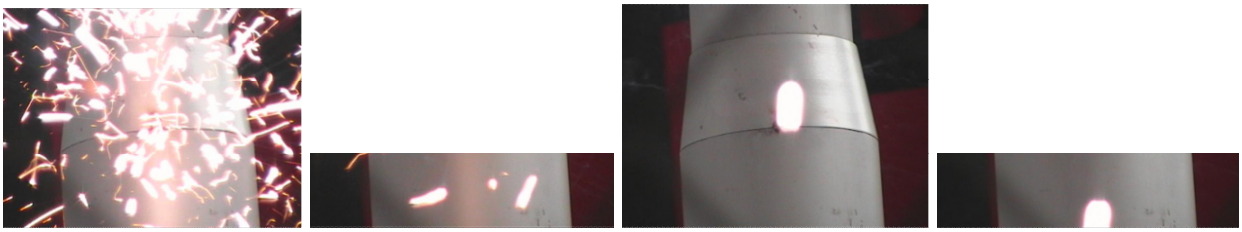

Fig. 3. 8/10µs 40kA surge current result on the flagstaff interconnection point between sections – sequence photos

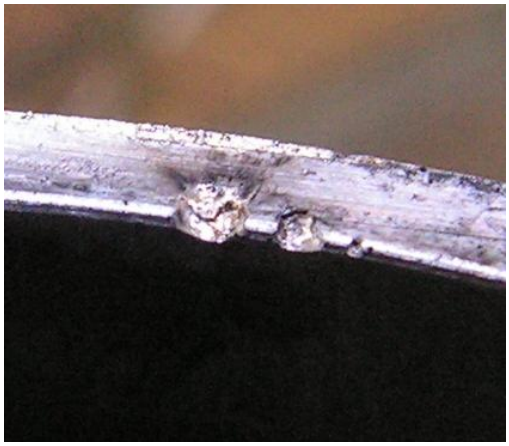

Fig. 4. 8/20µs 1kA surge current result on the flagstaff interconnection point between sections

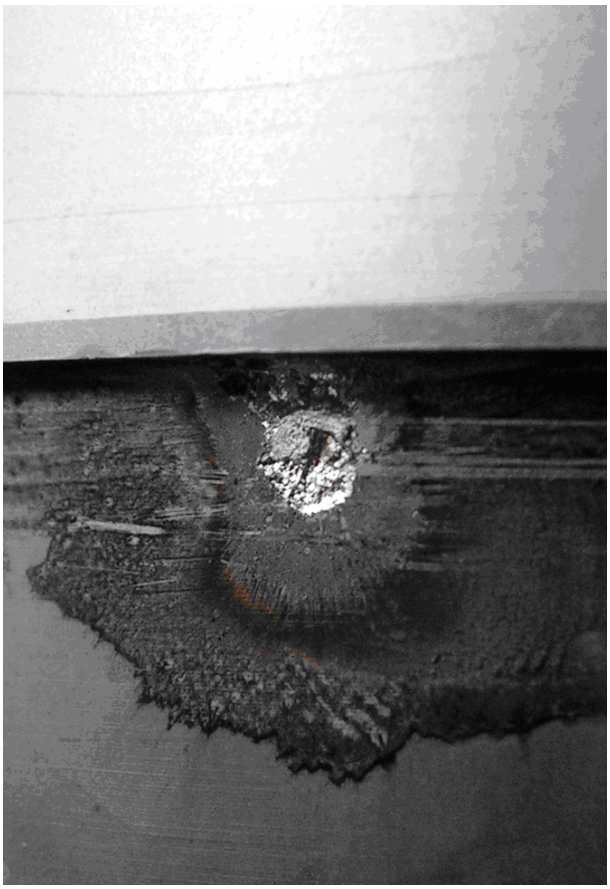

Fig. 5. 8/10µs 26kA surge current result on the flagstaff interconnection point between sections

Fig. 6. 8/10µs 55kA surge current result on the flagstaff interconnection point between sections

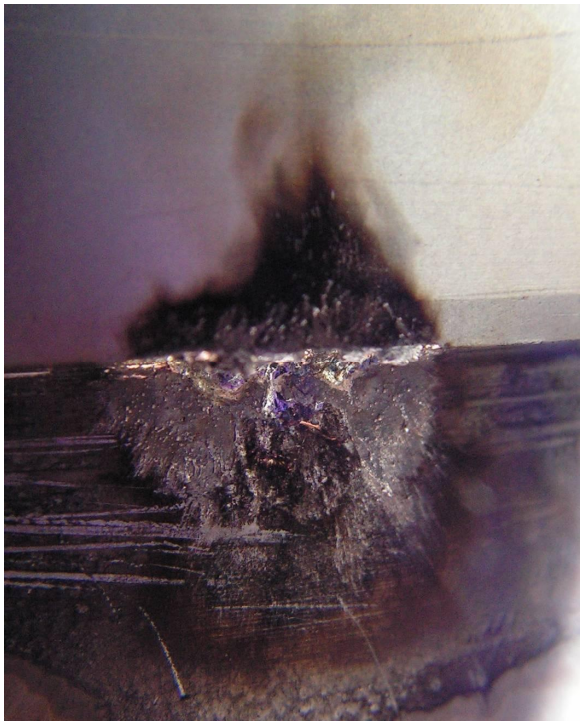

Fig. 7. 8/10µs 55kA surge current result on the flagstaff interconnection point between sections

Fig. 8. 8/10µs 55kA surge current result on the flagstaff interconnection point between section and ground

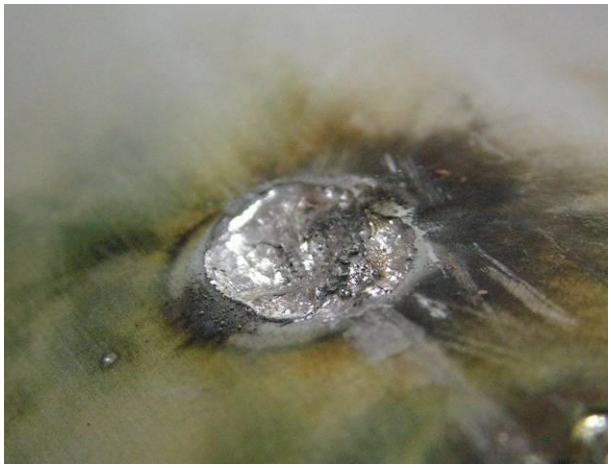

Fig. 9. 8/10µs 40kA surge current result on the flagstaff interconnection point between sections

anticorrosive course. All tests were performed to investigate connection point's quality. Connection points split 3 parts of the flagstaff into higher one. They look fine at the first sight.

3. Conclusions

High current surge flowing by the flagstaff caused severe problems:

- sparking effect appears on the flagstaff interconnection
- sparking effect can cause a fire if the flagstaff is nearby the flammable objects
- high surge current provide a inside and outside anticorrosive coat degradation

It is necessary to carry into effect some improvements:

- made a solid interconnection between the flagstaff sections
- add wire inside flagstaff to force surge current to flow inside, not by the outside flagstaff surface
- to improve human being safety flagstaff should be well grounded by the solid connection (step and touch voltage reduction). Restore shouldn't be used – fig.8.

Nowadays lighting protection standard [3] provide test for surge currents with high peak value and long duration time so the scale of damage will be greater.

4. References

1. IEC 62305-1: 01-2006, Protection against lightning – Part 1: General principles.
2. Flisowski Z.: „Trendy rozwojowe ochrony odgromowej budowli. Część I. Wyładowania piorunowe jako źródło zagrożenia". PWN Warszawa 1986.
3. IEC 62305-1:2006-02; Protection against lightning. Part 1: General principles.