

Lightning Strike and Thunder and its Effect on Television Signal Transmission

Nweke F. U.

Industrial Physics Department, Ebonyi State University, Abakaliki

Abstract: *The lightning strike and thunder and its effect on television signal transmission in Nigerian Television, NTA Abakaliki Nigeria was analyzed. From the analyses, it was observed that lightning and thunder strike affects television transmissions. This is paramount at the beginning and end of the raining seasons of every year. The result showed that the lightning strike and thunder effect causes image fading lost of signal, breaking of images and sometimes causes the station to be out of broadcast. National Communication Commission, NCC should ensure that all television stations in Nigeria be digitalized and powerful/modern lightning arrester and surge protection device be installed to avert the effects of lightning strike and thunder on their stations to keep transmitter “ON” during transmission.*

Keyword: *Television, Transmission, Transmitter, Lightning strike, Thunder strike, Lightning arrester and Broadcast*

I. Introduction

Lightning is a harsh weather phenomenon which occurs mostly during seasons. Its effect cannot be neglected in telecommunication and radio signal transmission, especially breaking networks. It is essentially a very high transient that can cause destruction if it occurs directly on conducting systems such as transmitter, antenna, computer, radio and television sets etc [Encyclopedia Britannica].

Lightning is an atmospheric electrostatic discharge (or spark) accompanied by thunder which typically occur during thunderstorms, and sometimes during volcanic eruption. [Encyclopedia Britannica]. Lightning strike is an electric discharge on a massive scale between the atmosphere and the earth bound object. The mostly originates on the ground and terminates in the thunder cloud, called ground to cloud lightning. Also upwards propagating lightning is initiated from a fall ground object and reaches into the clouds.

Lightning occurs with both positive and negative polarity. An average bolt of negative lightning carries an electric current of 30 kA, and transfers 15 C of electric charge and 50 MJ of energy. Large bolt of lightning can carry up to 120 kA of electric current and 350 C of electric charge. [Martin, 1986].

Average bolt of positive lightning current and electric current of about 300 kA is about 10 times that of negative lightning. [Rakov and Uman, 2003]. Lightning rapidly heats the air in its immediate vicinity to about 20,000⁰C which is about three times the temperature of the surface of the sun. The sudden heating effect and the expression of the heated air giving rise to a supersonic shock wave in the surrounding clear air. This shock wave once it decays to acoustic wave is heard as thunder [Encyclopedia Britannica].

Lightning strike damages electronics devices like telephone, modems, computers etc as it produces over current which can get to these devices through phone jack, Ethernet cable, or electricity outlets. Also the lightning strike can generate electromagnetic pulse, especially during positive lightning strike. Lightning current have very fast rise time of order of 40kA per microseconds. The conductor of such current can exhibit marked skin effect causing most of the current to flow through the outer surface of the conductor . Also lightning interferes with AM radio signals more than FM signals [Joni et al., 2007]

Thunder

Thunder is the sound caused by lightning [Rakov and Uman, 2007). However, depending on the nature of the lightning, thunder can range from sharp, loud crack to long, low rumble. Then the sudden increase in pressure and temperature produces rapid expansion of the air surrounding and within a bolt of lightning. This expansion of air in turn causes a sonic shock wave, which is the same to sonic boom, which produces the sound of thunder that is referred to as clap, crack, or peal of thunder [Encyclopedia Britannica, Granean, 1989]

Lightning effect on Transmitter

Damaging power surges or transient occurs when lightning strikes transmitter, metallic plant equipments. Lightning damage to transmitter depends on the access route of its strike. A direct hit generally destroys a transmitter while a nearby strike can induce damaging current in piping or wiring. On the process, piping will usually damage the sensor module and may damage the electronic components of the transmitter [Technical data sheet, 2002].

Rain Attenuation

Heavy lightning mostly results during the beginning and the end of rain. Rain along the transmission path is the major effect for satellite communication at frequencies above 10 GHz. Rain attenuations is the weakening of the satellite signal as it passes through rain drops. Rain drops absorb and scatter radio wave energy; which degrades the reliability and performance of the communication link. Rain effects are dependent on frequency, rain rate, drop size distribution and drop shapes which are determined by the type of rain [Adami et al., 2002]

This paper x-rayed the lightning and thunder effect on television signal transmission and its possible way it can be reduced.

Data Collection

Lightning logged data were collected from Nigerian Television Authority, NTA Abakaliki Nigeria from 2013 and 2014 at the beginning and ending of the raining seasons,

II. Results

The results of the effect of lightning on the transmitter of the television and the station are shown in Table 1 and Table 2.

Table: Lightning strike logged data from NTA, Abakaliki Nigeria for 2013

Date	Time	Status of the transmitter	Effect on the transmitter
10/02/2013	4.30 pm	Switched off	Nil
27/02/2013	10.20 am	On	Transmitter damaged
01/03/2013	1.25 pm	Switched off	Nil
16/03/2013	8.45 am	Switched off	Nil
30/03/2013	9.20 pm	On	Fading of images
04/04/2013	4.00 pm	Switched off	Nil
20/04/2014	2.35 pm	On	Mismatch or breaking of images
26/04/2013	9.22 am	Switched off	Nil
22/09/2013	9.20 pm	On	Breaking of images
30/09/2013	5.15 pm	Switched off	Nil
03/10/2013	5.00 pm	Switched off	Nil
19/10/2013	10.20 pm	On	Transmitter damaged
23/10/2013	8.22 am	Switched off	Nil
25/10/2013	1.50 pm	On	Fading/breaking of images

Table 2: Lightning strike logged data from NTA, Abakaliki Nigeria for 2014

Date	Time	Status of the transmitter	Effect on the transmitter
14/02/2014	6.30 pm	On	Breaking of images
22/02/2014	12.20 am	Switched off	Nil
25/02/2014	9.00 pm	On	Transmitter damaged
28/02/2014	7.28 am	Switched off	Nil
08/03/2014	11.15 pm	Switched off	Nil
11/03/2014	8.40 pm	On	Fading/breaking of images
15/03/2014	3.35 pm	Switched off	Nil
05/04/2014	10.25 am	Switched off	Nil
07/04/2014	8.00 am	On	Fading of images
08/04/2014	4.52 pm	Switched off	Nil
19/04/2014	12.00 am	On	Transmitter damaged
03/09/2014	10.00 am	Switched off	Nil
05/09/2014	3.00 pm	Switched off	Nil
10/09/2014	9.45 pm	On	Fading/breaking of images
12/09/2014	12.00 pm	Switched off	Nil
25/10/2014	5.00 pm	Switched off	Nil
31/10/2014	10.20 pm	Switched off	Nil

III. Discussion

From Table 1 and Table 2, it was observed that heavy lightning and thunder strike comes at the beginning and the end of the raining season which is towards the beginning and end of the year respectively in Nigeria. This disturbs the transmission which results to fading and breaking of images, cracking noise and in most cases switching off the transmitter of the television station. Hence, program (i.e. news, information, messages etc) transmitted by the station to the people is highly affected and sometimes vital and urgent information it cannot be broadcasted. Television stations should be digitalized to reduce the problems of fading and breaking

Moreover, in some cases the transmitter was badly damaged by the strike because it was on. The following parts were affected; exciter, power unit, modulator and encoder. This type of incidence usually keeps the station off air for some weeks before it is put in place, hence activities of the station were paralyzed. Lightning is a natural occurrence that must take place; effort should be taken to install a powerful/modern lightning arrester and surge protection device to prevent the effect on the transmission even when the station is on air.

IV. Conclusion

The effect of lightning on television transmission was analyzed. From the analysis, it was discovered that lightning is a problem to television transmission and this is mostly observed during the raining season. National Communication Commission NCC should ensure that proper lightning arresters are installed on television stations and most importantly enforce digitalization of television stations in Nigeria.

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