Kommt es auf einer Freileitung zu einem Kurzschluss, entsteht häufig ein Störlichtbogen, der nicht von selbst verlischt. Der Strom steigt und der Relaisschutz erzeugt das Abschaltungssignal.

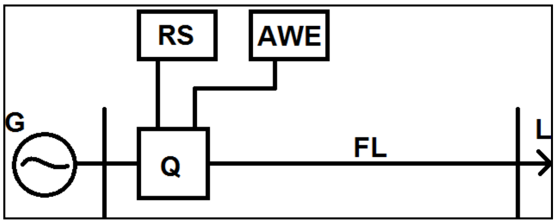

Abb. 1. Schema der Arbeitsweise eines AWE,. wo: G – Generator, Q – Leistungsschalter, RS – Relaisschutz,.
AWE – automatische Wiedereinschaltung, FL – Freileitung, L – Last.

Da durch den Lichtbogen die Fehlerursache häufig beseitigt wird (z.B. ein Ast, der auf die Leitung gefallen ist, verbrennt; ein Blitzeinschlag), führt man eine automatische Wiedereinschaltung durch.

AWE schaltet den Leistungsschalter nach kurzer Zeit ("Pausenzeit") wieder automatisch zu: bei einpoligen Fehlern nach etwa 0,5 bis 3 Sekunden, bei dreipoligen Fehlern nach 0,2 bis 0,5 Sekunden.

Besteht nach dem Wiedereinschalten der Fehler nicht mehr, spricht man von einer erfolgreichen AWE (AWE mit Erfolg).

Besteht der Fehler immer noch, spricht man von einer erfolglosen AWE (AWE ohne Erfolg). In diesem Fall schaltet der Relaisschutz den Leistungsschalter aus und dieser bleibt ausgeschaltet.

Zurzeit existieren folgende Typen der AWE:

- drei- und und einpolige AWE;
- automatische Eintakt- und Zweitaktwiedereinschaltung.

Die dreipolige AWE ist einfacher in der Nutzung, als einpolige AWE.

Deshalb werden die dreipolige AWE an elektrischen Freileitungen mit Spannungsebene bis 500 kV eingesetzt. Und die einpolige AWE von 500 kV.

Breite Anwendung hat die automatische Eintaktwiedereinschaltung bekommen.

Automatische Zweitaktwiedereinschaltung wird nur auf Verlangen der Verbraucher hin eingesetzt.

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Harvesting lightning energy

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What do we know about lightning? We know that lightning – a powerful electric discharge. Also we know that lightning has enormous power voltage and current. And some people wonder: Is it possible to catch lightning and transport to energy grids? Talking about this has been going on for a long time, but it is possible that someday we will see such stations.

Describing this process, it is necessary to start with question «How is lightning formed?».

Lightning formed when water and ice move around inside the cloud; forced up by warm air currents, down by gravity, and compressed in the cloud. The particles in the cloud become charged. It’s not clear how it happens, but charges separate in the cloud. Positive charges move up, and negatives move down.

Once a significant charge separation has built up, the positive and negative charges seek to get each other an neutralise. ‘Streamers’ come up from the ground to form a pathway. Once a pathway is completed a spark forms, neutralizing the charge.

As the negative charge races down, the air surrounding it heats up. The spark is very hot at almost 20,000 degrees Celsius, and it fast heats the air to create a shock wave.

Considering light travels very fast – about 300 million metres per second, and that sound only travels at 300 metres per second; light is a million times faster than the sound produced. To find out how far away the storm is, you can count how long you hear the sound after the lightning. For every 4 seconds between the flash and the rumble, the thunderstorm is 1 mile away.

Let us now proceed to consider data NASA.

By using data from the NASA Tropical Rainfall Measuring Mission (TRMM) satellite, a study published in the August 2006 issue of the Bulletin of the American Meteorological Society identified the regions on Earth that experience the most intense thunderstorms.

The researchers examined global thunderstorm data supplied by TRMM from 1998-2004. To determine an individual storm's intensity, they specifically examined the height of radar echoes, radiation temperature, and lightning flash rate, each measured by separate TRMM instruments.

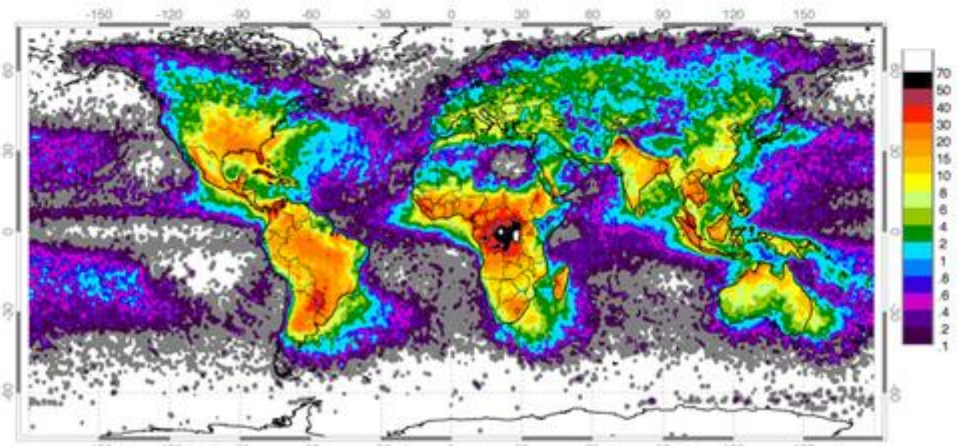

Image (left): This map reveals the uneven distribution of worldwide lightning with color variations indicating the average annual number of lightning flashes per square kilometer. Produced by NASA Marshall Space Flight Center's Lightning Imaging Sensor Science Team, the map includes data taken over an 11-year period from NASA's Optical Transient Detector and TRMM's Lightning Imaging Sensor. The yellow and red colors indicate higher concentrations of lightning. Credit: NASA/MSFC.

Let's imagine if a harnessing method were derived, the primary drawback of lightning power is its inconsistency. Storms might come regularly into some regions, but would enough lightning potential fall within the range of the device to make it worth while? See NOVA's special on Lightning (1989), to see how difficult it is to draw down lightning even in the most prone areas, using rockets attached.

"One of the things that has chilled my excitement about harnessing the tremendous power in lightning is to realize that some of the same electrostatic and possibly even cosmic forces that drive lightning might also be at work in some of the other free energy technologies such as overunity electromagnetic generators -- but in a much more constant and reliable manner." -- Sterling D. Allan, Aug. 5, 2010.

"Each year lightning destroys more property and causes more injuries than hurricanes, floods and tornadoes combined? It can cause structural damage to buildings, destroy electronics and damage electrical and communication systems....the cost of this damage can be astounding!".

Voltage: A typical lightning bolt bridges a potential difference (voltage) of several hundred million volts.

A typical lightning bolt may transfer 1020 electrons in a fraction of a second, developing a peak current of up to 1000 kiloamperes.

Current: Most measurements have been in the range 5,000 to 20,000 amps. Currents over 200,000 amps have been reported.

Assuming that you are lucky and get a lightning bolt to hit your conductor, there would be major difficulties in storing the energy and then converting it to alternating current so it can run your appliances. In addition, any solution to these problems would need to be able to withstand the enormous surges in energy generated by each strike.

Finally, much of the lightning bolt's energy goes into heating the surrounding air to temperatures greater than the surface of the Sun. So even if you managed to overcome the problems of collecting, storing and converting the energy from the lightning to make it useful, you would still only be harnessing a small proportion of the lightning bolt's power.

Moving on to our next point – The experimental setup.

ROANOKE, VA -- October 11, 2006 -- Alternate Energy Holdings (PINKSHEETS: AEHI), announced the successful development of a model prototype to demonstrate the 'capturing' capabilities of AEHI's marketable lightning farm technology.

By collecting power from the ground area surrounding a lightning strike and converting it into usable electricity to be sold through existing power grids, AEHI is able to harness the natural energy delivered in a bolt of lightning. Lightning harvesting is a clean energy solution that will not only eliminate numerous environmental hazards associated with the energy industry it will also significantly reduce the costliness of power production. When amortized over 4-7 years, a lightning farm will be able to produce and sell electricity for as low as $0.005 per kilowatt hour, thus significantly undercutting the current production costs of its competing energy sources.

In the summer of 2007, an alternative energy company called Alternate Energy Holdings, Inc. (AEHI) tested a method for capturing the energy in lightning bolts. The design for the system had been purchased from an Illinois inventor named Steve LeRoy, who had reportedly been able to power a 60-watt light bulb for 20 minutes using the energy captured from a small flash of artificial lightning. The method involved a tower, a means of shunting off a large portion of the incoming energy, and a capacitor to store the rest. According to Donald Gillispie, CEO of AEHI, they "couldn't make it work," although "given enough time and money, you could probably scale this thing up... it's not black magic; it's truly math and science, and it could happen."[6].

A relatively easy method is the direct harvesting of atmospheric charge before it turns into lightning. At a small scale, it was done a few times with the most known example being Benjamin Franklin's experiment with his kite. However, to collect reasonable amounts of energy very large constructions are required, and it is relatively hard to utilize the resulting extremely high voltage with reasonable efficiency.

According to Martin A. Uman, co-director of the Lightning Research Laboratory at the University of Florida and a leading authority on lightning, a single lightning strike, while fast and bright, contains very little energy, and dozens of lightning towers like those used in the system tested by AEHI would be needed to operate five 100-watt light bulbs for the course of a year. When interviewed by *The New York Times*, he stated that the energy in a thunderstorm is comparable to that of an atomic bomb, but trying to harvest the energy of lightning from the ground is "hopeless".

In consequence, it can be concluded that the probability of obtaining energy from lightning is extremely small. But technology does not stand still, and perhaps in the future, such stations still appear.

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The influence of geomagnetic storms on transformers

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The aim of the article is to describe the influence of geomagnetic storms on transformers and connection with the magnetic field of the earth.

A geomagnetic storm is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and cloud of magnetic field which interacts with the Earth's magnetic field.

Geomagnetic storm could be one of the biggest natural disasters. It will disrupt telephone communications, television, radio, and Internet.

On September 1-2, 1859, there was the largest recorded geomagnetic storm. From August 28 until September 2, 1859, numerous sunspots and solar flares were observed on the Sun, the largest flare occurred on September, 1. It is called a Solar storm of 1859 or the Carrington Event.

It can be assumed that a massive coronal mass ejection, associated with the flare, was launched from the Sun and reached the Earth within eighteen hours – a trip that normally takes three to four days. A prominence is a large, bright, gaseous feature extending outward from the Sun's surface, often in a loop shape. This is coronal mass ejection. Coronal mass ejections release huge quantity of matter and electromagnetic radiation into space above the sun's surface, either near the corona, or farther into the planet system, or beyond. More severe proton events can be associated with geomagnetic storms that can cause widespread disruption to electrical grids. Power grids are only sensitive to changes in the Earth's magnetic field.

The increase in the solar wind pressure initially compresses the magnetosphere and the solar wind's magnetic field interacts with the Earth’s magnetic field and transfers an increased energy into the magnetosphere. Both interactions cause an increase in movement of plasma through the magnetosphere and an increase in electric current in the magnetosphere and ionosphere. Electric field weakens and starts to fall charged particles. Bulk charging occurs when energetic particles, primarily electrons, penetrate power grids and deposit their charge. Transformers connected to long, overhead power transmission lines, induced currents in the solar storm cause saturation of the core, and it begins to melt due to magnetic perturbations.

Modern power grids are working to maximum efficiency, which means that the system is not amortized, there are no additional transformers that do not have additional lines. Transformers will be destroyed and we cannot do anything but to create new ones. Today, large areas of the planet plunged into darkness for 10 years or more.

The solution of this problem is to build power grids to have more transformers. There is still an expensive option, transformers immersed in water.