

DISCUSSION ON "TIME-LIMIT RELAYS," AND "DUPLICATION OF ELECTRICAL APPARATUS TO SECURE RELIABILITY OF SERVICE," AT PITTSBURG, JUNE 5, 1905.

H. R. STUART: Mr. Chellis is mistaken about one or two things. There are two time-limit devices that are independent of the load; that is, they are not inverse time limits and will operate in the time they are set for, no matter whether the overload is 100% or 500%. One device operates as follows: on one end an arm works a dash-pot, and the weight of the core holds that arm down; and on the other end imagine a weight which will not quite balance the armature core, but will slowly move the dash-pot and arm when the core is removed. A short circuit raises the armature core, allowing the arm to move slowly. When it has made its full travel, it will make contact, closing a tripping circuit. The other design has a clockwork mechanism that has the same time no matter what the overload is.

No two installations of relays are alike, for different conditions require different applications of the same relays. The relay described by Mr. Chellis is in some respects similar to a wattmeter in that it has series and shunt coils. One might infer that it is not so good as a straight overload relay, which is simply a kind of solenoid movement that closes a contact, and is kept from closing that contact by means of an opposing or retarding force, such as a dash-pot or bellows. I do not know how many different applications have been made of these relays. Various types of these relays are on the market, each one good for its particular purpose.

P. M. LINCOLN: The first law of the operating man is to keep the power on his circuit. It is only when he is convinced that the addition of a relay is going to prevent more trouble than it is likely to cause that he decides to insert it. The tendency is to abandon the finer developments of relays, the feeling being that they cause more interruptions to the circuits than they prevent. The relay acting wrong on one occasion and throwing off the load, will do more toward prejudicing the operating man against it than a good many years' experience when it goes all right.

H. R. STUART: I think the time-limit relay is all right in its place. Even if it did not work satisfactorily 90% of the time, it would still be satisfactory. In motor work above 100 h.p. at high voltage, a fuse is a bit dangerous; it simply keeps the circuit breakers from opening when the motor starts; when the current drops to normal the time limit goes back and everything is all right. If something goes wrong for more than the time limit, the breakers come out and protect the apparatus. A good deal of damage might be done in 10 seconds, but this is better than not having any protection at all. The tendency in generating stations is to fasten in the generator breakers, making them non-automatic; then the automatic

breakers on the far end of the feeder circuits will open to protect them and the time limit on the station end of the feeder circuits will protect the station. But it is a question whether it is best to put them in on the generators or not.

CHAS. F. SCOTT: Perhaps Mr. Buck's paper will lend itself to a mathematical solution—a solution involving a coefficient of reliability for the different parts of the plant. For example, take all the generators in the country; they will have accidents, say once a year; the switchboard cables and powerhouse cables may have an accident once in five years; transformers once a month or once in 20 years, as you choose. Then take the cost of duplicating these different elements and make calculations for definite limits. Say a generator is liable to have an accident once a year, and some other element, a transformer or time-limit relay, once a year; it is evident that one could be duplicated at very small cost, the other at considerable cost. Therefore, although both have the same liability to accident, you could increase the reliability of the system at much less cost by duplication at one place rather than at another.

A case came to my attention two years ago: the transmission voltage proposed was 30 000, with two circuits run on one line of poles. The distance was only 15 or 20 miles. I suggested that possibly the voltage was rather high, that it would be better to have two pole lines. I asked what the total cost of transmission was, including poles and wires, in percentage of the whole plant. I have forgotten the figure; it was something like 2 or 2.5%. I suggested that this most vital part of the system would be much safer by reducing the voltage and putting in duplicate pole lines at an increase of only 1 or 2% of the total cost of the plant; and that was done.

A plant about 25 miles long, at 20 000 volts, running through a rocky, mountainous country, had a single-pole line and gave remarkable service. I think it is running still with simply one line of poles; I know some time ago it had the record of running several years with practically no interruption due to the line.

While visiting some Western transmission lines I found that the operating engineers were not very solicitous about generators or switchboards or line. They were more concerned with the choking effect of leaves in the flume. The flume line was constantly patrolled, and there were automatic means of readily opening the flume at different points to let the water out. In short, the reverse-current relays were applied to the hydraulic transmission rather than to the electric.

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