ULTRARAPID DEVICE FOR AUTOMATIC RELEASE OF THE SPARE – DUAAR

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INTRODUCTION

The paper aims at presenting a device for automatic release of a spare destined for the consumers affected by voltage sags lasting longer than 8 milliseconds which benefit from two or several different sources of electrical energy. The DUAAR device provides consumers with permanent alimentation out of the source of energy displaying the best parameters, achieving the switch from one source to another in maximum 4 milliseconds.

GENERAL CONSIDERATIONS

The negative impact of the voltage sags upon the quality of the electrical energy provided to the consumers is extremely important and depends on the type of these voltage sags as well as on the curves of acceptability of different classes of equipments consuming electrical energy. The voltage sag can be defined as a sudden reduction of energy, below a certain value, followed by a coming back to normal values after a relatively short period of time. The level of this perturbation which negatively affects the consumers relies upon the percentage of voltage as well as upon duration.

The effects of these voltage falls/sags upon a certain class of equipments are quantified through the curves of acceptability which represent the graph of a function of delimitating the functioning conditions of the equipment when the level of tension varies in time.

Figure 1 depicts the curves of acceptability.

From the analysis of the three curves one can draw the conclusion that the maximum duration accepted for a total voltage sag, during which the tension might go down to zero, ranges from 8.33 ms (The CBEMA curve) to 20 ms (The ITIC and SEMI curves). It is obvious that for voltage falls when tension does not disappear completely, the accepted duration will be longer.

Nowadays the security of the consumers’ supply with electrical energy is achieved by means of the classic devices of automatic release of a spare (AAR), alimented by two independent sources of energy. These classic AAR devices impose certain conditions of functioning and switching the energy consumption from one source to another is achieved by two tetra polar contactors in motion. The scheme of the classic AAR is...
characterised by an AAR break to which the time of action belonging to the elements recording the minimal tension is added as well as the time of action pertaining to the two contactors of power. The functioning of the device is allowed only if the normal source of supply has previously been disconnected, at the moment of the disappearance of tension on it and if the tension on the additional path has the minimum functioning value accepted.

Consequently the fastest classic AAR device will produce at its exit a voltage sags of at least 500 milliseconds with negative effects upon consumers, representing the loss of the data being processed on computers at that particular moment, the interruption of fluorescent illumination, the damaging of the functioning of elevators or sensitive industrial processes. The ultra rapid device of automatic release of the spare - DUAAR comes to complete the range of equipment designed for securing the alimentation with electrical energy.

THE DESCRIPTION OF THE DEVICE

The ultra rapid device for automatic release of the spare can be used by the consumers affected by voltage sags longer than 4 milliseconds which make use of several different sources of alimentation with electrical energy meant to rapidly provide the consumer with energy by switching this one to the source of energy displaying the best parameters. The DUAAR device is alimented by two phasic sources of energy of low tension and is able to produce electrical energy at its exit as long as at least one of the sources has the voltage value established within the acceptable range. DUAAR is a static device, made up of electronic components of force and command, in a mono phase or three phase version, comprising a bloc of decision, command and alimentation (DCAB), two static contactors (SC), a relay of supervising the phases (RSF), a protection relay against surcharges and short circuits (P) and a current transformer (CT).

The usage of DUAAR, in comparison to that of the classic device of automatic release of the spare, displays the following advantages:
- allows the ultra rapid re-alimentation of the consumers (in maximum 4 milliseconds), the consumer’s switch from one source to another is performed without interrupting the tension and every time the quality parameters of voltage during the alimentation go beyond the admissible range of values.
- the substantial limitations of thermic and electrodynamic solicitations to short-circuit currents generated by flaws of insulation in the sections preceding DUAAR, due to ultra rapid protections
- insures the dynamic balance of the two nets of alimentation due to the fact that the DUAAR device permanently chooses the source with the highest tension, on the condition that this should be situated within the accepted range of values
- eliminates the multitude of conditions which has to be ensured for the functioning of the classic device of automatic release of the spare
- minimum supra tensions while switching from one source to another
- does not produce noises or vibrations
- switching from one source to another is not perceived by sensitive consumers
- enhanced utility due to static switching
- assures the consumer’s protection against supra tensions and limits the destructive effects for the consumers in cases of short-circuits

In case both sources of electrical energy are valid, switching the consumption to the source with better parameters takes place without affecting the sinusoid of the tension with the consumer; the frequency of switching from one source to another, however high it might be, is not noticeable for even the most sensitive consumers: computers, fluorescent illumination and special technological processes.

The domain of usage for the DUAAR device is extremely wide. It can be produced in mono phase or three phase versions, with powers up to 350 KW. Under these circumstances DUAAR can be used for domestic appliances as well as for the assistance of the consumption of certain technological processes or extremely important and sensitive public manifestations. DUAAR eliminates the break necessary to the classic devices in the process of switching from one source to another. This attribute offers really important advantages for beneficiaries by avoiding the economical and psychological consequences of even short interruptions of the energy supply.

The protection of DUAAR in case of short-circuit in the section preceding it, triggers the interruption of the energy supply in a period of 10 ms; this period is short enough to ensure the proper protection against the thermic and electrodynamic effects both of the DUAAR device and of the circuits preceding or following it. In case of surcharge, DUAAR protects itself by permanently monitoring the temperature of its own elements placed in the current path. After reaching the critical level of temperature for the elements of commutation in function, DUAAR organises the charge commutation to the other source of energy on condition that the parameters of this source of energy should be within the accepted values. DUAAR can emit warning signals for the surcharge system in due time allowing the human consumers to operate in the direction of reducing the charge of the assisted circuits. If the critical situation is prolonged when reaching the critical level of temperature of the DUAAR elements placed on both current paths, the device orders the selective disconnection on levels of priority of certain portions of the assisted consumption.

Providing DUAAR with devices of self-protection against atmospheric surcharges implicitly ensures the protection of the assisted consumption for these systems which might be dangerous for electrical installations and receivers.

THE FUNCTIONING OF THE DEVICE

The bloc scheme of mono phase DUAAR – according to Figure 2 it is made up of:
- two static mono phase contactors CS-1, CS-2
- decision, command and alimentation bloc DCAB
- two relays of supervising the phases RSF1, RSF2
- relay of protection against surcharges and short-circuits P
The two static contactors CS function in opposition and play the part of ensuring the alimentation of consumers with electrical energy out of one of the two sources of energy commanded by the electronic decision, command and alimentation bloc DCAB. The decision, command and alimentation bloc DCAB permanently analyses and compares the values of tension of the two-phase sources, between them or with another reference value (normal tension). The decision criterion of the DCAB bloc is manually selected by the human operator so that the consumer should be at any time alimented either by the source with the highest tension or by the source with the closest tension to the normal value.

Irrespective of the chosen functioning system, the time of commuting from one source to another is extremely short. In the worst case, when the tension placed on the current path would completely disappear, the voltage sag, at the exit of the ultra rapid device of automatic release of the spare, will last only for 4 ms, period which will not be noticed by the consumers.

The two relays of surveying the phases RSF play the part of inhibiting the action command of the corresponding static contactor, when the tension of a source goes beyond the admissible range, between a maximum and a minimum value – values which are established for each relay.

The protection relay P commands the temporised or instantaneous blocking of two, four or six static contactors at the moment when the current transformer on a phase, two or all the three phases detects a surcharge or short-circuit in the section preceding the device of automatic release of the spare.

\[ \text{RESULTS} \]

The equipment was tested in the laboratory. The graph in Figure 3 made after the complete disappearance of tension on the functioning path, confirms the enunciated characteristics.

![Oscillographic image of tension when main source failed](image)

\[ \text{REFERENCES} \]


situated within the range of established admissible values, the consumers are permanently alimented either out of the phase with the highest tension or out of the ones which are closest to the normal value, by manually selecting one of these systems. According to the values of these tensions it is possible that the receivers of electrical energy be at the same time alimented by one or by two sources (two phases of a source and one phase of the other source).

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