*u*REG

UNIVERSAL PROTECTION RELAY
& BAY CONTROLLER

Voltage restraint overcurrent protection uREG 51V-R
(ANSI 51V - R) – version 01

1. Functional description.

Voltage restraint overcurrent protection is typically used as an alternative to impedance relays on small to medium size synchronous generators to provide back-up to the differential protection.

When a short circuit fault occurs in generator the fault current is very high for a few milliseconds after a fault. This heavy current causes the generator voltage to drop fast so current will decay. Therefore, a high current setting of regular overcurrent relay may not operate in the event of a short-circuit.

To solve this problem, voltage dependent overcurrent relay biases the overcurrent setting with the measured voltage.

At normal voltage, the overcurrent relay operates if the current exceeds the set point (usually 1.5 – 2 times full load current). However, if a voltage drop appears, the over current setting also progressive decreases according to the biasing. Thus, at lower voltages, the current required to operate relay is very low.

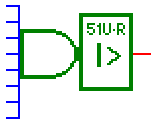
There are two kinds of voltage dependent overcurrent relays :

(1) voltage controlled overcurrent, designated 51V-C, and

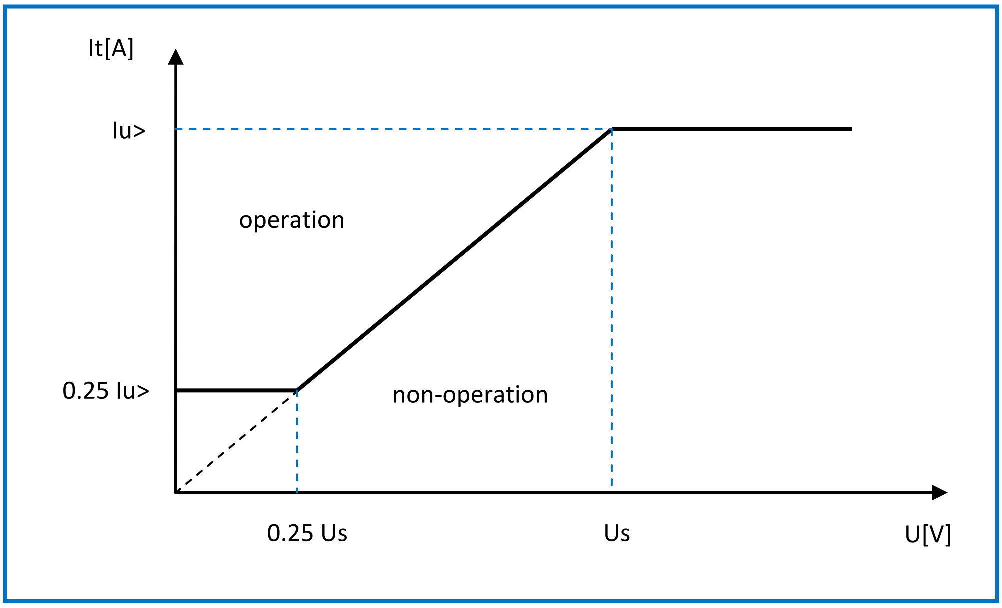
(2) voltage restraint overcurrent, designated 51V-R.

In LogCZIP system, the functionality of 51V-C can simply be obtained connecting regular overcurrent I> functor and its supervising undervoltage U< in a series. The I> - with a pickup of 50-80% of full load - is inactive unless the voltage drops below set point - 40-70 % of nominal value. There is now obstacles to extend the scheme to multi-stage protection by replicating the pair I> and U< as many times as required.

For voltage restraint overcurrent protection LogCZIP provides dedicated functor 51V-R.



The logic element provides improved sensitivity of overcurrent relaying by making the set overcurrent operating value proportional to the applied input voltage. The overcurrent operating characteristic changes linearly with the input voltage within specified voltage range of 0.25*Us up to Us from 0.25*Iu> up to Iu> , where Us and Iu> are initial settings. Below 0.25*Us down to 0 V triggering current settles on 0.25*Iu> and above Us current fixes on Iu>, featuring as a regular high overcurrent stage (see fig. 1).



It – tripping level of overcurrent Iu> [A]

Fig.1

The logic element comes as an integrated three-phase protection. Currents and voltages are single phase rms values and are independent of other phases. Phase current recovery value is calculated dynamically according to phase voltage and common hysteresis setting kpIu>.

2. Settings.

Settings of the **51V-R** functor include:

- **Sel I** selected hardware configuration of current measuring paths:
  - **0: [1] → CT-0 module (Ir 5A, measuring range 0 - 192 A);**
  - **1: [2] → VT-7 module (Ir 1A, measuring range 0 - 10 A);**
  - **2: [3] → VT-6 or VT-7 module (Ir 1A, measuring range 0 - 10 A).**
- **Iu>[A]** max tripping current,
- **Us [V]** restraint interphase voltage setting corresponding to high current inflexion point Iu> (internally recalculated to single phase voltage value):
  - VT-0, VT-2, VT-3, VT-6 modules (Ur 100V, measuring range 0 - 130V);

- VT-1, VT-4, VT-7 modules (Ur 400V, measuring range 0 - 500V);

➢ **kpIu>** common current resetting ratio (0.910 – 0.985).

3. Accompanying functions

The logic element **51V-R** can be operated together with auxiliary logic elements. This is especially the case of necessary tripping delays.

In simple cases an operating time can be picked out as definite time delay. The first choice there could be a functor ‘Delay 04’ or ‘Delay 05’.

In most cases however the inverse time delay is preferred ie. where delay time is a function of the applied input voltage within the specified voltage range. This means that the operating time is shortened by a reduction in voltage as well as an increase in current. This function is supported by a functor ‘Delay14_Utilt’ (pattern 272). The delay element should be appended in series to output path of 51V-R. The settings of ‘Delay14_Utilt’ establish co-ordinates of two inflexion points and in this way define slope of the time characteristic. The voltage co-ordinates (expressed as interphases values) of inflexion points should possibly be chosen a little bit wider than Us and 0.25*Us of ‘51V-R’ in order not to restrict the operability of 51V-R.