Response of the 750/760 Relay to Changing Fault Current

GE Publication No. GET-8388

DESCRIPTION

The response of the 750/760 Feeder Management Relay, in terms of operating time, to the changing fault current depends on the amount of energy stored in the relay for tripping.

EXAMPLE 1

If a TOC condition exists for a period of time and then the current increases to a level still below the IOC settings, the relay will trip at a time that is recalculated taking into account the previous energy capacity used. The 750/760 determines when to trip on TOC based on an accumulator that increases from 0 to 100%, with 100% being a trip condition (similar to TC on a motor relay). As the relay times out on the curve, the energy accumulator increases. However, if the fault current increases during this time, the rate in which the energy capacity accumulates will also increase, thereby reducing the trip time.

Consider a relay programmed for TOC with an IAC extremely inverse curve and multiplier setting of 1. The IAC extremely inverse curve will be derived from the following formula:

$$T = 0.0040 + \frac{0.6379}{\left(\frac{I}{I_{pickup}} - 0.62\right)} + \frac{1.7872}{\left(\frac{I}{I_{pickup}} - 0.62\right)^2} + \frac{0.2461}{\left(\frac{I}{I_{pickup}} - 0.62\right)^3} \quad \textbf{(EQ 1)}$$

where: T = Operate Time (sec.), I = Input Current, I_{pickup} = Pickup Current Setting

Assume the relay sees a 1.5 × CT fault current for approximately 2 seconds which then increases to 8 × CT. According to the Table 1 on the following page, the relay will trip in 3.398 seconds at 1.5 × CT. Since this current level occurs for 2 seconds, the energy used accumulator will be around 60%. For the 8 × CT current level, the table indicates that the relay should now trip in 0.124 seconds. But since the energy used accumulator is already at 60%, the relay will now trip 60% faster since the energy accumulator will reach 100% much faster. The trip time will be:

$$t = 2\text{ s} + 0.6(0.124\text{ s}) = 2.0744\text{ s} \quad \textbf{(EQ 2)}$$

TABLE 1. IAC CURVE TRIP TIMES FOR EXTREMELY INVERSE CURVE

MULTIPLIER	CURRENT (I / I_{pickup})									
	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
IAC EXTREMELY INVERSE										
0.5	1.699	0.749	0.303	0.178	0.123	0.093	0.074	0.062	0.053	0.046
1.0	3.398	1.498	0.606	0.356	0.246	0.186	0.149	0.124	0.106	0.093
2.0	6.796	2.997	1.212	0.711	0.491	0.372	0.298	0.248	0.212	0.185
4.0	13.591	5.993	2.423	1.422	0.983	0.744	0.595	0.495	0.424	0.370
6.0	20.387	8.990	3.635	2.133	1.474	1.115	0.893	0.743	0.636	0.556
8.0	27.183	11.987	4.846	2.844	1.966	1.487	1.191	0.991	0.848	0.741
10.0	33.979	14.983	6.058	3.555	2.457	1.859	1.488	1.239	1.060	0.926

EXAMPLE 2

If a TOC condition exists for a period of time and then the current increases to a level exceeding the IOC settings, then a trip will occur on whatever element (TOC or IOC) times out first.

Consider a 750/760 relay programmed for TOC with an IAC extremely inverse curve, a multiplier setting of 1, and the IOC element set to pick up at 15 × CT with an instantaneous time delay. Assume the relay sees a fault current of 2 × CT for 0.5 seconds which then increases to 16 × CT. Since 16 × CT exceeds the IOC pickup setting, the relay will trip immediately after 2.0 seconds on the IOC element.