Industrial EMP Solutions
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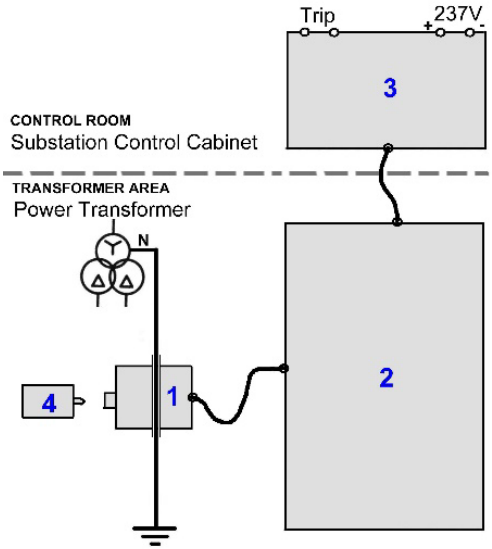
HEMP(E3)

Protection System of High-Power Transformer

* For civilian critical infrastructure protection
* The E3 HEMP sensor is mounted on the neutral conductor (ground bus) without breaking it and without turning off the transformer
* The system is protected against overload from short-circuit currents flowing through the neutral of the transformer
* All internal electronic components protected against E1 HEMP
* Suitable for all types and classes of transformers with grounded neutral
* High reliability of protection is combined with negligible cost of the system relative to the cost of the transformer

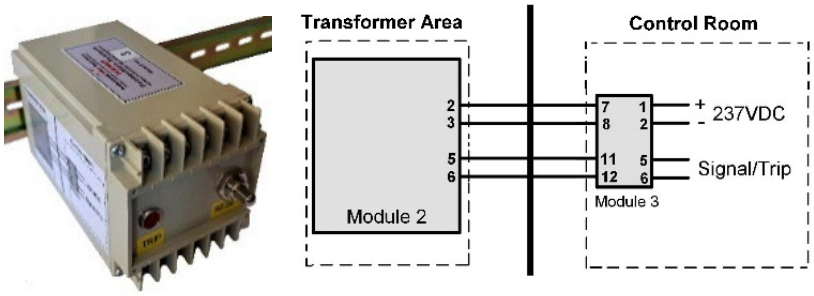
One of the components of the HEMP is a component called “E3”. It is a quasi-DC current reaching several tens to several hundred Amperes flowing ground system and leads to saturation of the transformer core, a sharp decrease in its impedance and unacceptable overheating. In addition, there are a bulk of harmonics in the network, generated by such transformer with saturated core. These harmonics disrupt the operation of relay protection, affect capacitor banks and other critical equipment.

The Transformer Protection System (TPS) consists of 4 separate modules:
No. 1 – E3 sensor placed in a protective shell,
No. 2 – HEMP protected electronic relay,
No. 3 – auxiliary substation module,
No. 4 – tester-simulator E3.
This protection system must be installed on all type transformers with a grounded neutral.



TPS flowchart

When a dangerous DC component (about 20A) of the current (E3 component of the HEMP) appears in the neutral circuit of the transformer, the electronic module (No.2) with a slight delay (2-3 sec), which excludes false trip, gives a command to turn off the transformer. After 2-3 minutes, the flow of current in the neutral circuit from the component E3 stops and the transformer can be returned automatically to normal operation by standard substation auto-reclosing system. The entire system returns to its original standby state when the "Reset" button is pressed on the auxiliary substation module (No. 3).



Substation Module (No. 3)

Electronic Module (No. 2)

The sensor (module No.1) and electronic unit (module No. 2) are protected from radiated electromagnetic interference by an aluminum enclosure and using shielded external connecting cables. These modules are protected against conducted electromagnetic interference by special HEMP filter; transient voltage suppressors and using HEMP-resistant components. The most critical elements in the electronic module are duplicated.

TPS Specification (for disconnected internal transient voltage suppressors:

Nominal sensor input current, A DC	25	Magnetic field immunity, A/m, 50 Hz	30
Over-range without damage, A	>8000	Response time (max.), s	3
Power voltage for modules:		Trip current accuracy, A DC	± 5
- No. 2, VDC ± 10%	240	Dimensions, mm:	
- No. 3, VDC ± 10%	240	-sensor (No.1)	180x180x150
- No. 4, VAC ± 10%	230	-electronic module (No.2)	180x180x70
Withstand overvoltage:		-auxiliary substation module (No.3)	115x65x65
- input sensor window, VDC	2200	-tester-simulator (No.4)	175x150x75
- power to output contacts, VDC	1000	Weight, kg:	
Total power consumption standby, W	3	-sensor (No.1)	1.8
Total power consumption max., W	5	-electronic module (No.2)	1.2
Max. switching voltage, V DC/AC	250	-auxiliary substation module (No.3)	0.2
Max. switching current, A DC/AC	5	-tester-simulator (No.4)	1.3
Breaking capacity (for DC1, 250V), A	0.25	Operating temperature, °C (%/°C)	-20+50 (0.5)

This protection system should be used not only for transformers with direct neutral grounding, but also for neutral grounding through a Petersen coil, since the Petersen coil cannot limit the direct current flowing through it.

The system is protected against overload from short-circuit currents flowing through the neutral of the transformer.

In order to be sure of the serviceability of the HEMP protection system of the power transformer, it is necessary to systematically (once a year or once every two years) check it. A simple procedure is provided to check the health of the

system using a simple tester, which can be purchased separately or as a bundle with the system.

Tester-Simulator E3 (No. 4)

This test consists of applying a DC current to the sensor of less than 20 A (the system should not trip) and a current of more than 20A (the system should be triggered).

Usually, in control cabinets on large transformers there is always a standard outlet with a standard auxiliary AC voltage. Such standard AC mains can be used to power the simulator-tester.

Tester-Simulator Specification

Nominal output current, ADC		Max. current consumption, A	
-in NON-Trip mode	18-20	-at 230VAC	1.5
-in Trip mode	22-25	-at 115VAC	3
The max. time spent in the ON-state with an output current, s	10	Short circuit protection	Yes
		Weight, kg	1.3
Amperemeter accuracy, %	3	Dimensions, mm	175x150x75
Main power, VAC	220/115	Operating temperature, ˚C	-20+50

Long-term operation of the system in real conditions on a 160/24 kV high power transformer has confirmed its high reliability. During this time, multiple periodic simulations of the E3 component were carried out using the mentioned tester, during which the correct operation of the system was recorded.