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Sudden Pressure Relay

Technical Guide

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1 Scope

This leaflet contains general procedures to be followed from the time the transformers and their accessories are received, until they are put into operation. These instructions do not purport to cover all possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment. If you require additional information regarding this particular installation and the operation or maintenance of your equipment, contact the local representative of ABB Inc.

2 General Description

The ABB Sudden Pressure Relay is a device designed to respond to the sudden increase in gas pressure in a power transformer which would be caused by an internal arc. The Relay consists of three main parts: a pressure sensing bellows, a micro switch and a pressure equalizing orifice, all enclosed in a sealed case and mounted on the outside of the transformer at the gas space.

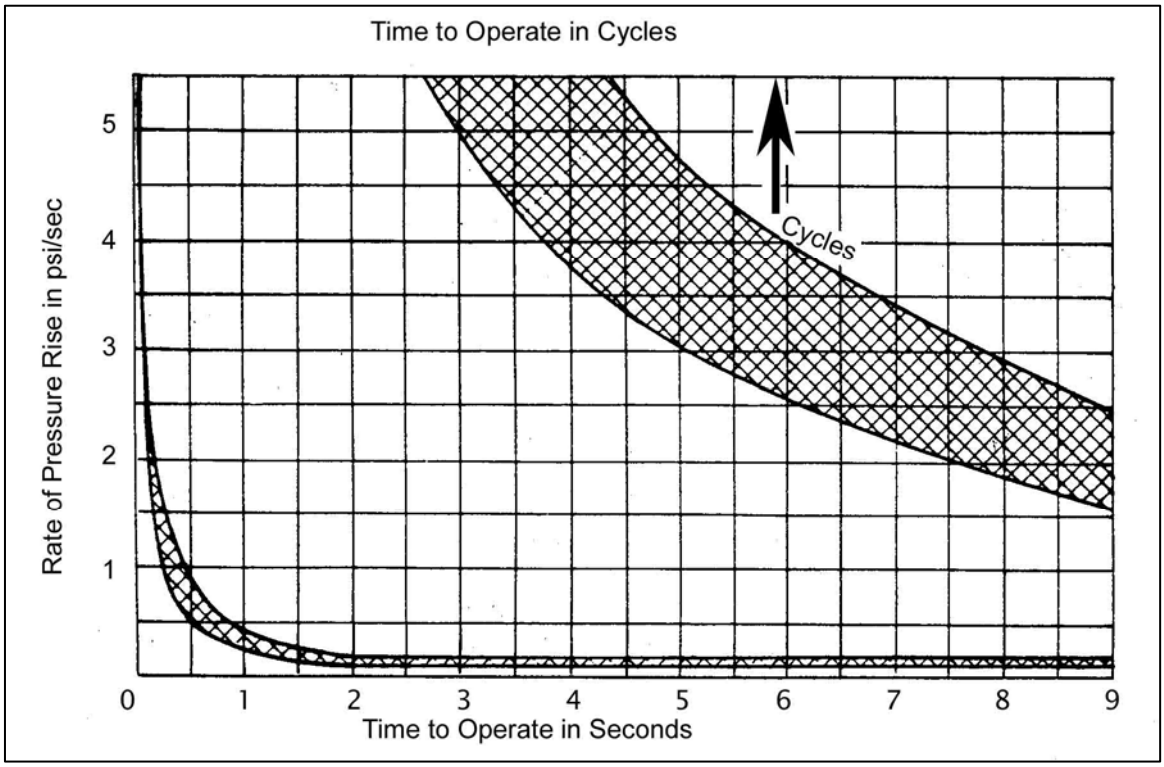

Figure 1: Operating Characteristic for Sudden Pressure Relay

Note that the Sudden Pressure Relay can only be applied to transformers with a gas space.

When an arcing internal fault in the transformer produces an abnormal rise in gas pressure, the bellows will expand, operate the Sudden Pressure Relay micro switch and signal the occurrence of the fault. The equalizing orifice is a non-corrosive plug with a very small hole, which will equalize the pressures between the Relay and the transformer gas space during

the slow pressure variations associated with transformer load changes. It will throttle an abnormal increase in transformer pressure, however, and cause a signal. Figure 1 shows the operating characteristics of the Sudden Pressure Relay. Seal-in Relay

In a typical application, a Seal-in relay with reset pushbutton and associated circuitry is mounted on a panel in the transformer control cabinet; it is a fast acting, high impedance relay with alarm contacts. The Seal-in relay is energized by the Sudden Pressure Relay micro switch; its purpose is to close alarm and/or trip circuits and seal itself closed until manually reset by the reset pushbutton. ABB does not manufacture the Seal-in relay panel. ABB can furnish a Seal-in relay panel which is manufactured by others. A typical circuit for a Seal-in relay is shown in Figure 2. NOTE: There are many variations of this circuit. Always check the transformer Wiring Diagram.

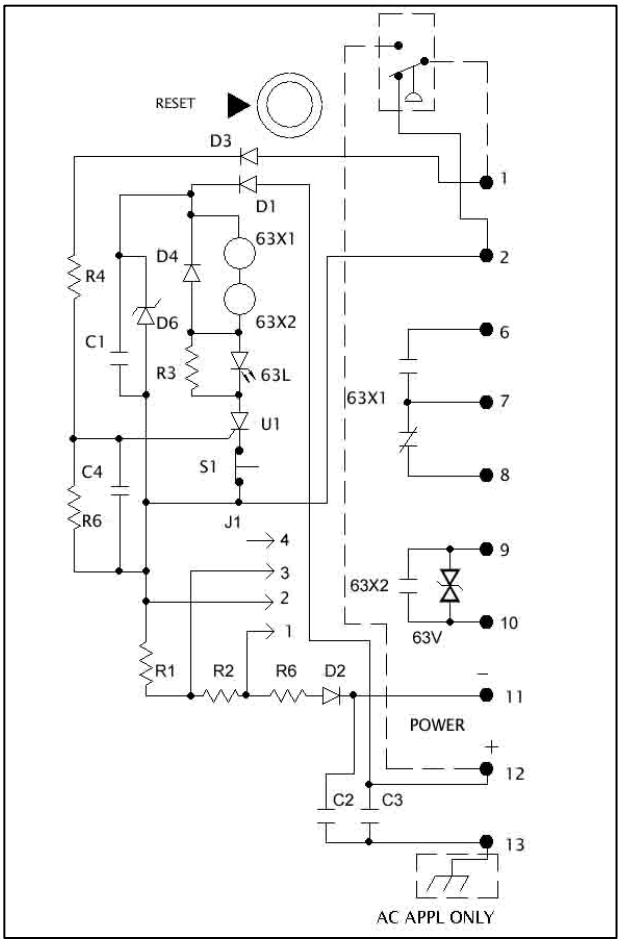

Figure 2:Typical Seal-in Relay Circuit

For those customers who wish to design a seal-in relay circuit, Table 1 gives the current ratings of the typical Seal-in relay contacts. A high impedance relay should always be used between the Sudden Pressure Relay micro switch and the low impedance tripping switch to prevent false trips due to electrical flashover of the Sudden Pressure Relay micro switch contact.

The typical Seal-in relay circuit (Figure 2) includes a Voltrap across trip contacts 9 - 10 of the Seal-in relay. The Voltrap acts like a non-linear resistance which will discharge induced voltages before they become high enough to flashover the trip contacts. Most users shield the long alarm and trip leads between transformer and station house. Where shielding may be inadequate, the Voltrap provides backup protection. The Voltrap must be disconnected if trip circuit voltage is higher than 270 volts.

The Seal-in relay circuit also incorporates a shunt path around the Seal-in relay, through the normally-closed side of the Sudden Pressure Relay micro switch. This guards against closing of the Seal-in relay due to electrical flashover in the Sudden Pressure Relay micro switch. The resistor R1 is used to limit follow current, in the event of a flashover in the

Sudden Pressure Relay micro switch, to a value which the Sudden Pressure Relay micro switch contacts can readily interrupt. One normally-closed contact of the Seal-in relay is used to hold the shunt circuit open when the Seal-in relay is energized.

Table 1: Seal-in Relay Circuit Characteristics

Seal-in Relay				Seal-in Relay Contact Ratings				
Coil Voltage	Style No	Coil Current mA		Make amperes	Carry anperes	Break amperes		Open Contact Voltage
		In-rush	Cont			Resistance	Inductive[1]	
120 AC	7112C75H01	65	34	20	10	10	5.00	120 AC
240 AC	7112C75H01	44	23	20	10	5	2.50	240 AC
24 DC	7112C75H01	-	107	20	10	5	3.00	24 DC
48 DC	7112C75H01	-	58	20	10	2	1.00	48 DC
125 DC	7112C75H01	-	35	20	10	0.5	0.25	125 DC
250 DC	8220C55H57	-	35	20	10	0.1	0.05	250 DC

[1]Where: (L in henrys) / (R in ohms) ≤ 0.026

3 Installation

The Sudden Pressure Relay is mounted above the maximum oil level in the gas space when applied on transformers. The Sudden Pressure Relay can be satisfactorily mounted on the transformer cover particularly when applied to transformers in the field.

When vacuum filling a transformer on which a Sudden Pressure Relay is mounted, care must be taken that the Sudden Pressure Relay is not filled with oil. Also pull vacuum and break vacuum at 1/4 psi/second maximum to avoid any possibility of straining the bellows. If the transformer is shipped with a blind flange mounted in place of the Sudden Pressure Relay, the transformer should be filled with oil before the Sudden Pressure Relay is mounted. If the Sudden Pressure Relay should accidentally be filled with oil, it should be replaced.

4 Operation

The Sudden Pressure Relay will accomplish the following: (See Figure 1)

1. It will operate on a sudden increase of gas pressure regardless of the operating pressure on the transformer.
2. A pressure rise of 5.5 psi per second will operate the Sudden Pressure Relay in three to four cycles on a 60 Hertz circuit. At high rates of rise: 30 to 40 psi per second, it will operate in a half cycle.
3. It will not operate on changes in pressure due to normal transformer operation.

4. It will detect abnormal disturbances which are sufficient to operate the conventional pressure relief device.

5. Mounting of the Sudden Pressure Relay is rigid and well braced to prevent false operation due to the vibrations which accompany through short circuits.

6. The typical Seal-in relay circuit (See Figure 2) protects against flashover of the Sudden Pressure Relay micro switch or Seal-in relay contacts due to severe electrical disturbances. When an operation occurs, the Seal-in relay will keep the alarm and trip circuits closed until the manual reset switch is opened. It is necessary to open this switch for a fraction of a second only to interrupt the circuit and release the Seal-in relay. Opening and closing the reset switch will restore the alarm and trip circuits to their original condition, ready for detection of further sudden pressure rises in the transformer.

IMPORTANT: SOLENOIDS, RELAYS AND MOTORS ARE INDUCTIVE LOADS. WHEN AN INDUCTIVE CIRCUIT IS OPENED, A VOLTAGE IS INDUCED WHICH TENDS TO MAINTAIN CURRENT FLOW. THE RESULTANT ARCING CAUSES SEVERE CONTACT DUTY AND MAY RESULT IN FAILURE OF THE CONTACTS TO INTERRUPT CURRENT. LIMIT SEAL-IN RELAY LOADS TO THE VALUES IN TABLE 1.

5 Maintenance

The operation of the Sudden Pressure Relay should be checked when it is installed and every six months or each year afterwards. There is a definite relationship between the transformer gas pressure and the time required to equalize the pressures between the transformer and the Sudden Pressure Relay. This relationship is shown graphically in Figure 3 and is the basis for checking the operation of the Sudden Pressure Relay. The following test may be made on the Sudden Pressure Relay while the transformer is in service, providing the transformer is operating at a positive tank pressure in excess of 3/4 psig.

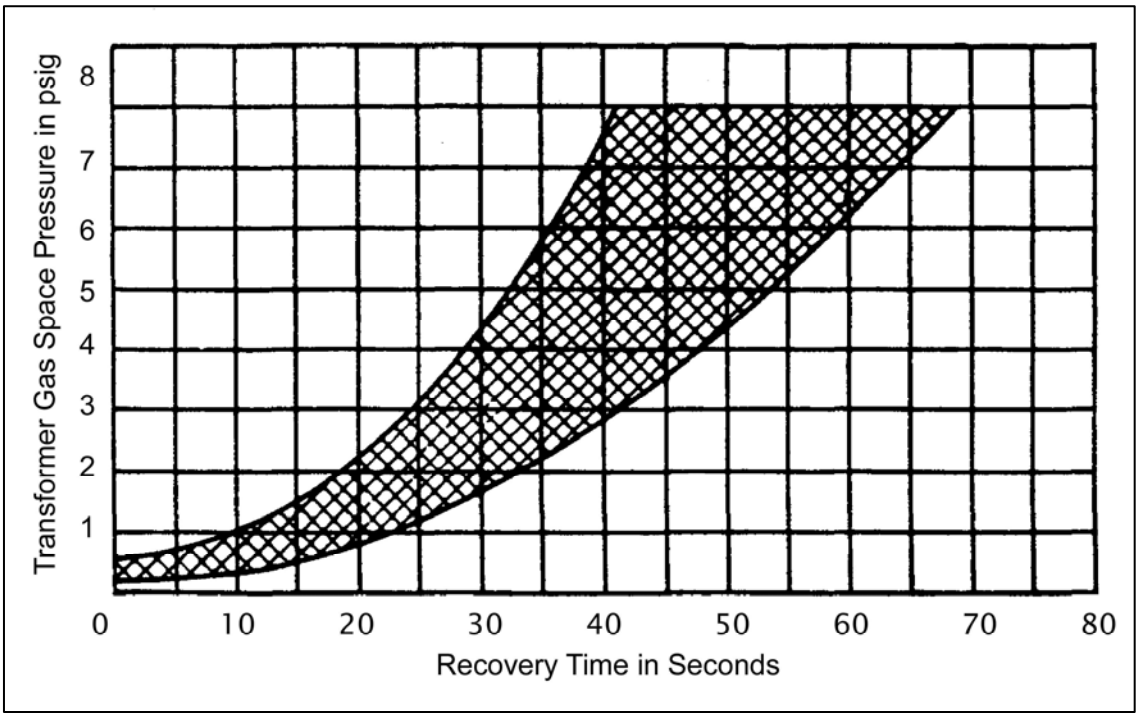

Figure 3: Recovery Time vs Pressure Curve

6 Field Test Procedure

1. Disconnect the Sudden Pressure Relay supply voltage.
2. Record the transformer operating pressure. (Note: The pressure must be greater than 3/4 psi for the following tests.)
3. Connect a circuit tester across terminal 1 and 2 on terminal strip.
4. Remove the test plug from the Sudden Pressure Relay case. The Sudden Pressure Relay micro switch will operate and the circuit tester will indicate a close contact.
5. Close the test plug and record the time in seconds required for these same contacts to open.
6. Using the recovery time recorded in (5) and the pressure recorded in (2) as coordinates on Figure 3, Time and Pressure Curve, check to see that the point is within the allowed operating area. Wide deviation of this field test point from the allowed area of the curve should be referred to your ABB representative.
7. Disconnect any external trip or alarm circuit.
8. Check the reset switch to be sure it is closed.
9. Reconnect the Sudden Pressure Relay supply voltage.
10. Connect the circuit tester across terminals 7 & 8.

11. Remove the test plug. The relay will operate and the circuit tester will indicate an open circuit.
12. Replace the plug and allow sufficient time (see 5 above) for the Sudden Pressure Relay to equalize.
13. Operate the reset switch and note that the circuit of 7 & 8 re-closes.
14. This check should be made on each of the alarm and trip circuits.
15. Following the correct operation of the Relay, reconnect the trip or alarm circuits.

It will be necessary to remove the Sudden Pressure Relay only if a fault is found when testing the Sudden Pressure Relay micro switch and bellows (steps 1 to 6). If this is required the gas space in the transformer tank must be brought to atmospheric pressure. The Sudden Pressure Relay can then be removed and replaced by a new Relay.

If a fault is found in the Seal-in relay panel, the entire panel should be removed and replaced.

7 Factory Test

The factory tests made on the Sudden Pressure Relay are more conclusive than those necessary for field testing to insure that the Sudden Pressure Relay is in operating condition and properly calibrated.

The following tests are made on all Sudden Pressure Relays at the factory:

1. A 1500 volt, 60 hertz insulation test to ground is applied to the electrical circuit of the Sudden Pressure Relay and the panel for one minute.

2. An operating test is made to determine the make and break pressure of the Sudden Pressure Relay micro switch. (a) The maximum make pressure, at which point the normally-open contacts of the Sudden Pressure Relay micro switch close, is 0.44 psi or 12 inches of water (b) The minimum break pressure, at which point the normally-open contacts of the Sudden Pressure Relay micro switch re-open, is 0.20 psi or 5.5 inches of water.

3. An orifice test is made in the same manner as outlined under Field Test Procedure. The above tests check the operating characteristics of the Sudden Pressure Relay without actually making a rate-of-rise pressure test.

4. One 20 psi pressure test is made to insure that the relay case is pressure tight. During this test, it is necessary to apply pressure to both the tank side and the relay case so as not to damage the bellows.

5. The Seal-in relay must operate at 80% of rated voltage within 12 milliseconds. The maximum pressure applied to the bellows in the completed Sudden Pressure Relay should be limited to 8 psi.

8 Procedure Following a Sudden Pressure Relay Operation

After an operation of the Sudden Pressure Relay which tripped a circuit breaker and de-energized the transformer, the transformer and the Sudden Pressure Relay panel must be checked before the transformer is re-energized to prevent possible extensive damage to the coils and insulation.

As a minimum, the following checks should be made before re-energizing the transformer:

1. Make the Field Tests of the Sudden Pressure Relay and its panel as described in Section 6. This will determine whether the Sudden Pressure Relay is in proper operating condition.

2. Verify by suitable tests and observations that the transformer is undamaged and suitable for re-energization. If in doubt, contact the transformer manufacturer.

3. The relay operation may have been caused by extraneous electrical or mechanical disturbances. These should be documented from the substation operating log.

4. If all the inspections and tests are satisfactory the transformer can be re-energized and returned to service. Please contact the transformer manufacturer for any additional instructions concerning maintenance and inspection procedures.

9 Replacement

In the event it becomes necessary to replace the Sudden Pressure Relay or its Panel, give the style number of the Relay along with the stock order and serial number of the transformer. Address all correspondence to the nearest ABB representative

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