

TRANSFORMER PROTECTION SUDDEN PRESSURE RELAYS

WSCC RELAY WORK GROUP
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Sudden pressure relays provide an excellent example of the classical protection dilemma of dependability versus security. For although dependable for internal transformer faults, sudden pressure relays have only limited security against tripping for external events. Attempting to balance the competing trade offs of security and dependability has given rise to a variety of application philosophies. This paper identifies some application considerations and describes some of the approaches used by protection engineers through out the WSCC.

I. INTRODUCTION

Sudden pressure relays are a specialized protection device to detect transformer or reactor problems. The sudden pressure relay detects sudden changes in transformer oil or gas pressure due to internal faults. The sudden pressure relay has an inverse time characteristic. It operates faster for severe faults. The sudden pressure relay may be used in conjunction with other types of power transformer or shunt reactor protective devices.

There are three types of sudden pressure relays. The Buchholz type relay is used only on transformers with conservator tanks. The Buchholz relay is mounted on the oil line between the main transformer tank and the conservator tank. The other two types of sudden pressure relays can be used with any type of transformer. They measure changes in gas or oil pressure. A relay placed above the transformer oil measures a change in gas pressure. The relay placed below the oil measures a change in oil pressure. All of these relays are designed with equalizing pressure with the intent to prevent false operations for through faults.

The sudden pressure relay detects some types of faults which other relays such as differentials and overcurrents typically cannot detect. The sudden pressure relay can detect internal faults, such as turn to turn faults. Differential or overcurrent relays are required to detect external faults such as bushing faults, trouble outside the transformer tank, or internal faults involving ground.

II. DISCUSSION

Transformer tank mounted sudden pressure relays have had a failure prone history. They have misoperated numerous times because of vibration for through faults, earth quakes, trains and various other non transformer fault related events. The Buchholz relay is immune to such misoperations.

Design improvements made to sudden pressure relays have reduced their tendency to misoperate for through faults or other vibration producing phenomenon. The changes have improved the security of the sudden pressure relays but have not totally eliminated the security problem. Some versions of relays also have two or more sensitivity settings. Decreased sensitivity makes the relay more immune to external events.

It is quite important to connect the sudden pressure relay properly to the auxiliary tripping device. Most sudden pressure relays utilize form C contacts. The normally closed contact shorts out the auxiliary tripping coil, while the normally open contact energizes the trip coil. This design reduces the chance of false tripping for contact bounce.

III. OPTIONS

Utilities have conscientiously elected to utilize sudden pressure relays in many different ways. The following

examples are found within the WSCC.

Some utilities choose not to use sudden pressure relays. This prevents misoperations. Faults which a sudden pressure relay are likely to detect may become more severe. The utility who chooses not to use sudden pressure relays may be risking more severe equipment damage. Various protection engineers question if a sudden pressure relay does minimize equipment damage.

Some utilities use sudden pressure relays for alarm indication only. The transformer may be inspected following a sudden pressure alarm. Other utilities elect to operate in the alarm mode normally, only enabling tripping when other transformer protective relays are out of service.

Some utilities enable tripping only on selected transformers. These may be large EHV transformers or large unit connected transformers.

Current operated fault detectors are sometimes used to supervise the sudden pressure relay. The fault detector disables sudden pressure tripping for high magnitude internal and external faults which can be detected by other protective devices. When the fault detector is not picked up, sudden pressure tripping is enabled.

Utilities in high seismic zones have disabled the sudden pressure relays for several days following an earthquake. This prevents possible misoperations from aftershocks. Sudden pressure relays in high seismic areas should be equipped with mechanical contacts as opposed to mercury wetted contacts. The mercury in mercury wetted contacts tends to move during earthquakes creating false trips.

Older sudden pressure relays such as the General Electric Type J are being phased out. This relay is particularly prone to misoperation on vibration. We recommend a short time delay be used with a Type J relay if tripping is enabled. This may be accomplished with a suitably connected auxiliary relay. It has also been reported that plugged orifices in the Type J may cause a misoperation.

Some utilities have also experienced problems with the Qualitrol sudden pressure relay. Metal defects in the housing have allowed the relay to draw moisture and subsequently misoperate.

The Buchholz relays on conservator equipped transformers do not appear prone to misoperations on through faults. Utility experience has shown the security of the Buchholz is much higher than other types of pressure relays. Contact surge protection is recommended for the Buchholz relay.

There is also some concern regarding liability. If a sudden pressure relay is disabled and a transformer or reactor faults, there may be some problems with warranty repairs.

IV. MAINTENANCE

Maintenance of transformers equipped with sudden pressure relays must be done with care. Taking transformer oil samples does involve some risk of a false sudden pressure relay operation if proper procedures are not followed.

Periodic testing of the sudden pressure relay is recommended. The test procedures should follow manufacture's recommended procedures. This insures the security of the entire trip circuit.

V. CONCLUSIONS

The sudden pressure relay is a useful device for protecting transformers and reactors. The sudden pressure relay has unique capabilities to detect faults not normally seen by other protective devices. Other protective

devices may detect a sudden pressure type fault, but only after it evolves into a more severe fault.

Buchholz relays have the highest security rating of the available sudden pressure detection devices. A utility has little or no risk of false operation when tripping is enabled.

Newer style sudden pressure relays are more immune to misoperations although not 100% secure.

If a utility chooses to use sudden pressure relays for tripping, the Relay Work Group recommends the newer style relays such as the Qualitrol be employed for non-conservator type transformers. Buchholz relays are recommended for conservator type transformers. Sudden pressure relays should not have mercury wetted contacts.

Regardless of the care taken in selecting and installing a sudden pressure relay, there remains some risk of the sudden pressure relay to false trip. Utilities must accept the risk of an occasional false trip against the consequences of serious transformer damage when the relay is not used.