ISSN 2350-1049

International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)
Vol. 4, Issue 3, pp: (1-4), Month: July - September 2017, Available at: www.paperpublications.org

USE OF REACTOR AT POWER STATIONS IN MITIGATING THE EFFECTS OF SHORT CIRCUIT FAULTS IN POWER EQUIPMENTS

[1]John E. Ananti, [2]Paul A. Abang

[1]Department of Electrical Electronics Engineering, Federal Polytechnic Oko Anambra State Nigeria
[2]Department of Electrical Electronics Engineering, Federal Polytechnic Oko Anambra State Nigeria

Abstract: **A reactor is a coil which has large number of turns and whose ohmic resistance value is much greater. They are used in electrical Power systems to limit the short circuit currents which can cause damage to the equipments of the power system. The additional reactance added in series with the system for protection, are called reactors. A current limiting reactor is a type of reactor which limits the heavy flow of current through other sections of the system. In this way, we don't have to shut down the whole system; we can just isolate the faulty section. The objective of this paper is to show how the reactor is used to reduce or if possible completely remove the any effect of short circuits currents that may lead to the damage of power system equipments. Results obtained by installing a reactance in series with the system equipment shows that the short circuit current is drastically reduced thereby eliminating any contingency fault in the power station that may affect even the consumers of electricity.**

Keywords: **Air-core reactors, current limiting reactors, iron core Reactors, phase voltage, Reactor, short circuit.**

1. INTRODUCTION

Reactors are also used to protect the circuit breakers of different ratings. They are used to limit the short circuit currents according to the capacity of circuit breakers. Therefore while doing changes in the system, we don't have to replace the circuit breakers, instead we can add reactors and utilize the same circuit breaker, due to which, time and money, both can be saved. The main motive of using current limiting reactors is to reduce short-circuit currents so that circuit breakers with lower short circuit breaking capacity can be used. They can also be used to protect other system components from high current levels and to limit the inrush current when starting a large motor(Agbo S.A et al,2015).

A line reactor is an inductor wired between a power source and a load. In addition to the current limiting function, the device serves to filter out spikes of current (Dann and Rudd, 1915) and may also reduce injection of harmonic currents into the power supply. The most common type is designed for three-phase electric power, in which three isolated inductors are each wired in series with one of the three line phases (Simpson, James, 2012). Line reactors are generally installed in motor driven equipment to limit starting current, and may be used to protect Variable-frequency drives and motors.

ISSN 2350-1049

International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)
Vol. 4, Issue 3, pp: (1-4), Month: July - September 2017, Available at: www.paperpublications.org

2. MATERIAL USED FOR CONSTRUCTION

It is desirable that the reactor does not go into magnetic saturation during a short-circuit, so generally an air-core coil is used. At low and medium voltages, air-insulated coils are practical; for high transmission voltages, the coils may be immersed in transformer oil. Installation of air-core coils requires consideration of the magnetic field produced by the coils, which may induce current in large nearby metal objects. This may result in objectionable temperature rise and waste of energy (Alden, Vern,1923).

METHOD OF OPERATION OF CURRENT LIMITING REACTORS:

Refer to fig 1 below for the principle of operation of a reactor

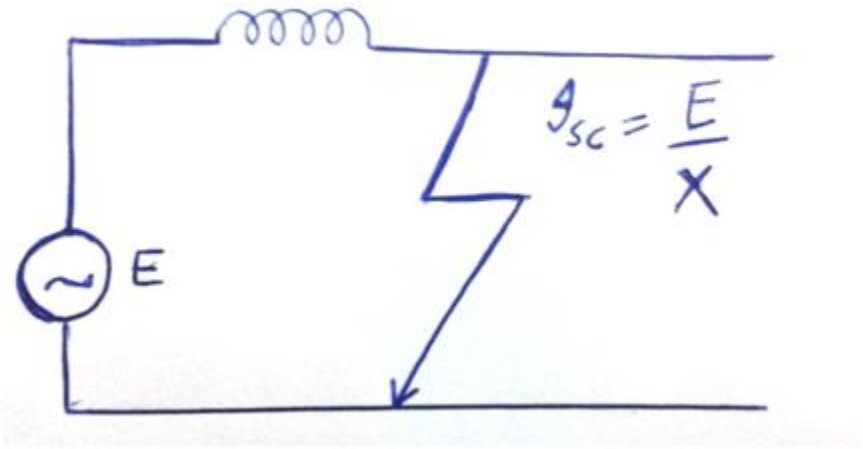

Fig. 1

If the reactance of a circuit during fault is X, and E voltages are given, then the short circuit current can be calculated as: $\mathbf{I_{sc} = E/X}$

i.e, the reactance is inversely proportional to the current. If X increases, Isc decreases and vice versa. Short circuit currents depend on the generating capacity, fault point voltage and the reactance of the circuit. The figure illustrates the use of a current limiting reactor:

The rating of reactors is given in KVA and the formula for percentage reactance is:

%X= KV drop/ KV (phase voltage)

3. RESULTS AND DISCUSSION

It is shown from the above that the series connection of reactance to the protective device controls any impending contingent fault in the system where connected. If the short circuit current is intended to be reduced, the reactance has to be increased.

There are some other uses of reactors which include but not limited to these:

1. For arc suppression.
2. To filter out harmonics.
3. In series with low reactance auto transformers.
4. In series with low reactance induction regulators.
5. To protect from high voltage waves, surges and lightning.
6. To control starting currents of motors.

ISSN 2350-1049

International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)
Vol. 4, Issue 3, pp: (1-4), Month: July - September 2017, Available at: www.paperpublications.org

TYPES OF REACTORS:

On the basis of construction, the reactors are of two types:

1. Dry type or Air core or Open type or Unshielded type reactors.
2. Oil immersed or magnetically shielded or iron core reactors.

1. Air core reactors:

The reactors in which no iron core or steel core is used are called air core reactors. These reactors are only used up to 33kv.

These reactors are larger in size. Concrete slabs are arranged in the form of a circle and stranded copper coil conductors are embedded in it. These slabs provide good mechanical strength during short circuit currents.

Post insulators made of porcelain support these reactors. These are also called cast concrete type reactors. Insulated conductors are used for winding. To provide insulation between turns, glass or porcelain material is used.

Advantages:

These are simple, have constant current and reactance and have greater mechanical strength.

Disadvantages:

Not suitable for outdoor services, take much space due to their large size, difficult to provide cooling and can only be used up to 33kv.

2. Iron core reactors:

The reactors consisting of iron core are called iron core reactors. A coil is placed inside a standard transformer tank and oil is filled for cooling and insulation purposes. Shielding is provided to prevent losses. And to prevent stray magnetic fields, the core is laminated. Shields are made in the form of short circuited rings and are earthed through end plates. The mmf produced in the rings, due to short-circuit current, keeps the flux inside the shield.

These reactors are also called oil immersed type reactors and can be used for any voltage level.

Advantages:

These reactors provide greater protection against short-circuit currents, have high thermal capacity, suitable for both indoor and outdoor services and can be operated at any voltage level.

Disadvantages:

They are costly, complex and difficult to repair.

4. CONCLUSION

Reactors are very good but have its challenges as well for instance like in the generator reactor, the fault on a feeder disconnects the supply of other feeders also. After removing the faulty feeder, the generator has to be synchronized again. During normal operation, full load current passes through the reactor which causes continuous power loss.

REFERENCES

[1] Agbo S.A, Ahmed Y.A, Yayaha B, The use of heat balance method in the thermal power calibration of Nigeria Research Reactor-1 (NIIR-1) Prog. Nucl. Energy, 85 (2015), pp. 344-351

[2] Alden, Vern(1923), US 1467771, "Current Limiting Reactance Coil", issued September 11, 1923, assigned to Westinghouse Electric and Manufacturing Company.

[3] Ahmed Y.A., Balogun G.I., Jonah S.A, Funtua I.I The behavior of reactor power and flux resulting from changes in core-coolant temperature for a miniature neutron source reactor Ann. Nucl. Energy, 35 (2008), pp. 2417-2419.

[4] Burite, Joseph(2006). "Nigeria Is in Talks With Rosatom for Nuclear Power Plants". Bloomberg.com. Retrieved 15/05/2017

[5] Dann, Walter Melville; Rudd, H. H. (June 17–18, 1915). The Use of Current-Limiting Reactors. Meeting of the Society of Mechanical, Electrical, and Steam Engineers. Boody House, Toledo, Ohio. Retrieved 15/05/2017.

[6] "Emerging Nuclear Energy Countries".(2017) World Nuclear Association. Retrieved 2017-05-15.

[7] "Current Limiting Reactors: Technical Overview and Measurement Procedures" (PDF). NWL. Retrieved 04/05/2017.

[8] Simpson, James(2012). "The how and why of current-limiting reactors". Highbeam Business. EC&M Electrical Construction & Maintenance. Retrieved 17/03/2017.

[9] "Current Limiting Reactors: Technical Overview and Measurement Procedures" (PDF). NWL. Retrieved 15/05/2017

[10] "Quality Power". Retrieved 17 September 2012. "Electrical Transmission and Distribution Reference Book", Westinghouse Electr Corporation, Pittsburgh PA , 1950 pp. 133-135

[11] http://www.myronzucker.com/linereactorpg1.html What is a Line Reactor?

[12] http://www.cosphi.com/line-load-reactor-applications.html Line reactor configurations

[13] http://ecmweb.com/mag/electric_line_reactors_vfds/https://en.wikipedia.org/wiki/Current_limiting_reactor