



SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EE605 PROTECTION AND SWITCHGEAR

III YEAR /VI SEMESTER

Unit 1- PROTECTION SCHEMES

Topic: Zone of Protection



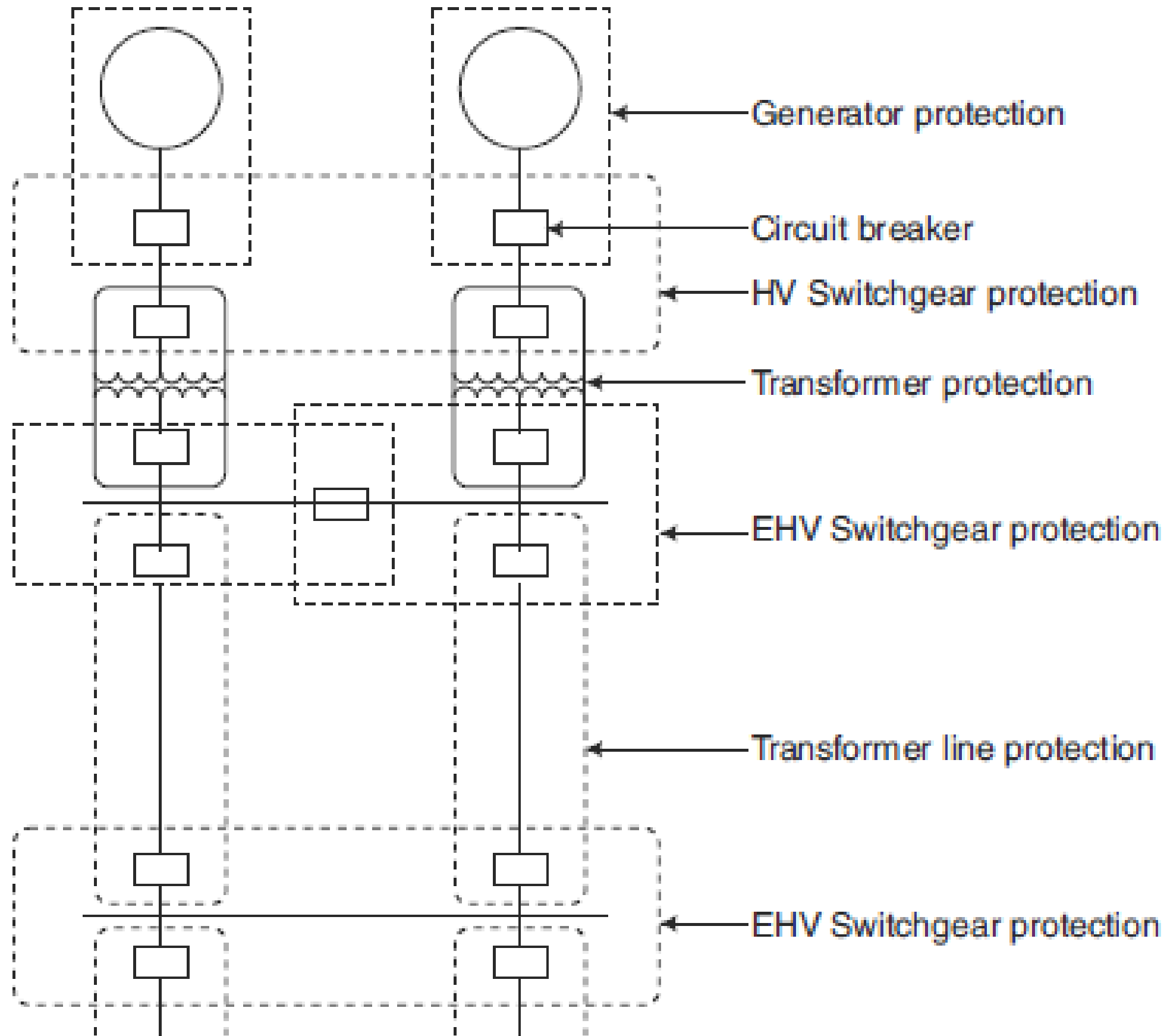
ZONES OF PROTECTION



- A power system contains generators, transformers, bus bars, transmission and distribution lines, etc.
- There is a separate protective scheme for each piece of equipment or element of the power system, such as generator protection, transformer protection, transmission line protection, bus bar protection, etc.
- Thus, a power system is divided into a number of zones for protection.
- A protective zone covers one or at the most two elements of a power system.
- The protective zones are planned in such a way that the entire power system is collectively covered by them, and thus, no part of the system is left unprotected.



ZONES OF PROTECTION





- Adjacent protective zones must overlap each other, failing which a fault on the boundary of the zones may not lie in any of the zones (this may be due to errors in the measurement of actuating quantities, etc.), and hence no circuit breaker would trip.
- Thus, the overlapping between the adjacent zones is unavoidable.
- If a fault occurs in the overlapping zone in a properly protected scheme, more circuit breakers than the minimum necessary to isolate the faulty element of the system would trip.
- A relatively low extent of overlap reduces the probability of faults in this region and consequently, tripping of too many breakers does not occur frequently.



PRIMARY AND BACK-UP PROTECTION



- Power system is divided into various zones for its protection.
- There is a suitable protective scheme for each zone.
- If a fault occurs in a particular zone, it is the duty of the primary relays of that zone to isolate the faulty element.
- The primary relay is the first line of defense. If due to any reason, the primary relay fails to operate, there is a back-up protective scheme to clear the fault as a second line of defence.



Percentage failure rate of various equipment

Name of Equipment	% of Total Failures
➤ Relays	44
➤ Circuit breaker interrupters	14
➤ AC wiring	12
➤ Breaker trip mechanisms	8
➤ Current transformers	7
➤ DC wiring	5
➤ VT	3
➤ Breaker auxiliary switches	3
➤ Breaker trip coils	3
➤ DC supply	1



- The reliability of protective scheme should at least be 95%.
- With proper design, installation and maintenance of the relays, circuit breakers, trip mechanisms, ac and dc wiring, etc. a very high degree of reliability can be achieved.
- The back-up relays are made independent of those factors which might cause primary relays to fail.
- A back-up relay operates after a time delay to give the primary relay sufficient time to operate.
- When a back-up relay operates, a larger part of the power system is disconnected from the power source, but this is unavoidable.
- As far as possible, a back-up relay should be placed at a different station.



- Sometimes, a local back-up is also used. It should be located in such a way that it does not employ components (VT, CT, measuring unit, etc.) common with the primary relays which are to be backed up.

- There are three types of back-up relays:
 - (i) Remote back-up
 - (ii) Relay back-up
 - (iii) Breaker back-up



Remote Back-up

- When back-up relays are located at a neighbouring station, they back-up the entire primary protective scheme which includes the relay, circuit breaker, VT, CT and other elements, in case of a failure of the primary protective scheme.
- It is the cheapest and the simplest form of back-up protection and is a widely used back-up protection for transmission lines.
- It is most desirable because of the fact that it will not fail due to the factors causing the failure of the primary protection.



Relay Back-up



- This is a kind of a local back-up in which an additional relay is provided for back-up protection.
- It trips the same circuit breaker if the primary relay fails and this operation takes place without delay.
- Though such a back-up is costly, it can be recommended where a remote back-up is not possible.
- For back-up relays, principles of operation that are different from those of the primary protection as desirable.
- They should be supplied from separate current and potential transformers.



Breaker Back-up



- This is also a kind of a local back-up. This type of a back-up is necessary for a bus bar system where a number of circuit breakers are connected to it.
- When a protective relay operates in response to a fault but the circuit breaker fails to trip, the fault is treated as a bus bar fault.
 - In such a situation, it becomes necessary that all other circuit breakers on that bus bar should trip.
 - After a time-delay, the main relay closes the contact of a back-up relay which trips all other circuit breakers on the bus if the proper breaker does not trip within a specified time after its trip coil is energised.



Assessment



1. What is the purpose of back up protection?

- a) To increases the speed
- b) To increases the reach
- c) To leave no blind spot
- d) To guard against failure of primary.





References



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3. Badriram, Vishwakarma B.H, “Power System Protection and Switchgear”, New Age International Pvt Ltd Publishers, 2nd Edition 2017.

Thank You