BUILDING ELECTRICAL SYSTEMS

GROUND FAULT PROTECTION

1. GENERAL

1.01 This section covers the protection of building ac electrical systems against ground faults.

1.02 This section replaces Section 760-400-165 in its entirety. This section concentrates on protection methods that are most applicable to typical telephone company buildings.

2. GROUND FAULTS—THEIR NATURE AND PROTECTIVE MEASURES

2.01 Faults to ground pose a unique problem in electrical distribution systems. They are the most frequent kind of faults. This is because the conductors are in almost continuous contact with the grounded metallic raceway system. Any defect in the insulation that will permit the conductor to touch the metal conduit will cause a fault to ground.

2.02 If the raceway is properly grounded, as described in Section 760-400-510*, the impedance of the ground fault path will be low and there is a good chance that the circuit breaker will operate promptly, thus clearing the ground fault immediately. The first line of defense against ground faults is proper grounding.

2.03 Another step to help reduce risk is to set the adjustable instantaneous trip units on all circuit breakers to the lowest value possible without causing nuisance tripping. These are usually set at the maximum value at the factory and often left that way when installed. In most applications, the maximum trip setting, which is usually ten times the ampere rating of the breaker, is not required and a lower setting would provide much greater safety. Instantaneous trip settings should be no higher than required to avoid nuisance tripping under normal conditions.

2.04 Where fuses are used they should be sized as closely as practical to the actual load.

2.05 Even with a well designed grounding system and proper settings of overcurrent devices, there is still a possibility that the ground fault current will be too small to operate the overcurrent device promptly, or maybe not at all. The reason for this is that the fault is very often not a solid connection between the conductor and ground, but an arc. The arc adds considerable resistance to the ground path, thus keeping the current too low to operate the circuit breaker promptly. At the same time, the arc which is much like that of an arc welder, can do a tremendous amount of damage, melting and vaporizing wire and bus bars and literally destroying the electrical system in a few minutes.

2.06 From the preceding, it is obvious there is a need for supplementary ground fault protection (GFP). The most commonly used system today is the core balance type current transformer (ground sensor), which encircles all phase conductors and the neutral to detect ground faults. If a ground fault occurs, some of the current returns via the equipment ground causing an unbalance in the transformer. The current transformer develops an output voltage that operates a relay that in turn operates a circuit breaker shunt-trip device. (See Fig. 1.) The current transformer can be placed on the main only, in which case any ground fault will trip the main breaker. Selectivity can be achieved by placing separate current transformers on as many individual feeders as desired. The choice is mainly a question of cost versus service continuity. (See Fig. 2.)

2.07 As ground faults in any individual building are very infrequent and a short interruption of ac power in most telephone buildings would not be a catastrophe, GFP on the main disconnect switch for the service switchboard(s) is all that is required in most buildings.

2.08 Ground fault protection equipment is readily available off the shelf and is usually field adjustable for current and time delay. The current setting should be no higher than 200 amperes and operation should be in less than 0.5 second, including circuit breaker interrupting time.

2.09 Individual GFP should be considered for large motors or transformers, where there is a possibility of sustained low current ground faults. This

* Check Divisional Index 760 for availability.

can cause magnetic iron burning which can entail expensive and time consuming repairs. In these individual load applications ground-fault relays with settings of 5 amperes and a time delay of less than 0.1 second should be used.

3. RECOMMENDATIONS

3.01 Ground fault protection, as described in paragraph 2.06, shall be provided for ***all new*** solidly grounded wye electrical services of more than 150 volts to ground.

3.02 In addition, GFP should be provided for existing services of the same type where the overcurrent devices are over 400 amperes unless the cost is prohibitive.

3.03 Provide individual GFP for motors larger than 200 horsepower.

3.04 Control power connections for the GFP system should be taken phase-to-phase, never phase-to-neutral, to ensure sufficient voltage across the trip coil under depressed line conditions created by the fault.

3.05 Be sure that grounding conforms to the National Electrical Code and Bell System Practices.

3.06 Overcurrent device settings should be as low as possible.

3.07 The ground fault relay should also shut down the standby generator.

4. REFERENCES

4.01 The following will provide additional information relevant to Ground Fault Protection.

The Impact of Arcing Ground Faults on Low Voltage Power System Design—General Electric Co., GET 609-B, Dec. 1970

Soares, Eustace C. *Grounding Electrical Distribution Systems for Safety*—International Association of Electrical Inspectors—1982 Edition

Ground Break Systems—General Electric Co. GET-2964

Ground Fault Protection Application Guide—I.T.E. Bulletin 18.1-4A

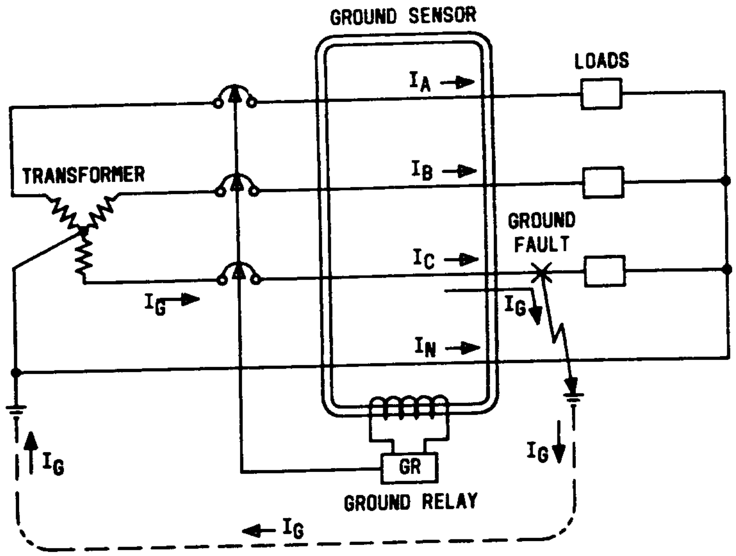
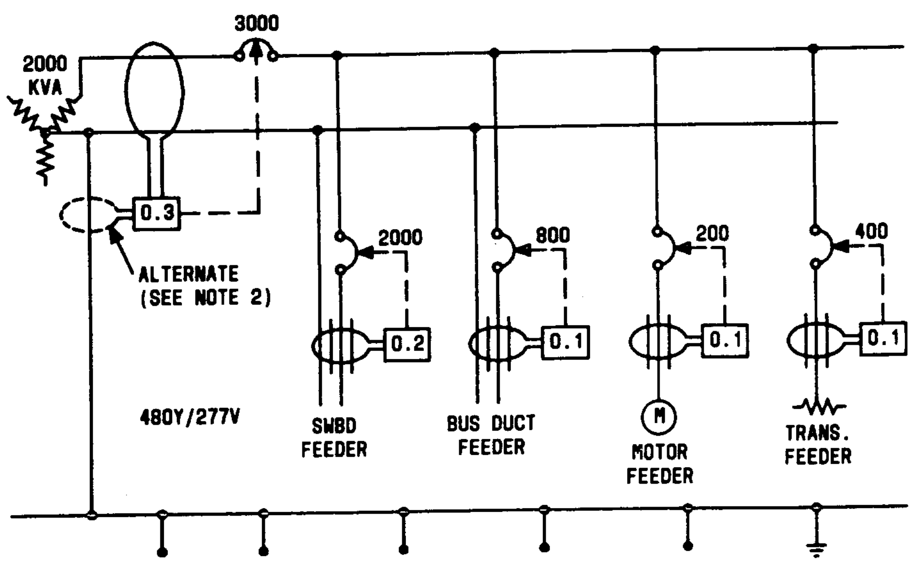


Fig. 1—Core Balance Scheme Principle of Operation



NOTES:

1. The numbers on the Ground Fault relays, (0.3, 0.2, 0.1) are typical time settings in seconds for a selective system.
2. Alternate location of sensor for main breaker is more economical.

Fig. 2—Ground Fault Protection on Typical 3 Phase 4 Wire Electric Service