BANGLADESH RURAL ELECTRIFICATION BOARD

PBS INSTRUCTION 100-22

ADEQUATE GROUNDING ON PBS DISTRIBUTION SYSTEM

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SUBJECT: ADEQUATE GROUNDING ON PBS DISTRIBUTION SYSTEM

I. PURPOSE:

To provide technical guidance for adequate grounding of PBS distribution system.

II. GENERAL:

Grounds are provided in PBS distribution systems to relieve the system of abnormal voltages and currents, to stabilize the neutral at or near earth potential, and to provide a low impedance return circuit for a maximum degree of safety to operating personnel and the public.

For safety, it shall be ensured that in both normal and abnormal situations, no undesirable voltage appear on equipment or lines for which accident may occur. To comply this all metallic items and neutral of equipment and lines are to be connected to earth.

III. SYSTEM GROUNDING:

System grounding for PBS distribution system must conform to the requirements of the Electricity Safety Code.

(1) Grounding of Sub-station:

An effective sub-station ground system consists of driven ground rods, buried

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inter-connecting grounding cables or grid, equipment ground mats, connecting cables from grounding grid to metallic parts of structures and equipment, connections to grounded systems neutral. The specification of Sub-Station grounding rod is mentioned below-

Ground rod will be Copper weld (Clad) ideal driven electrode. It will be protected against corrosion by a 3 (three) mm thick exterior of copper tube, permanently welded/bounded to a high strength steel core.

The maximum resistance to earth in a sub-station shall be less than 0.5 (zero point five) ohm. The 33/11 KV transformer neutral shall be solidly grounded by connection to the sub-station ground mat.

(2) Grounding of Distribution Line:

A driven ground rod shall be installed at each equipment location, individual service and secondary dead end. The primary neutral shall have a ground connection at least every 402 m (1320 ft.) or less, in addition to the ground connection at the individual services. More ground connections may be needed to limit the voltage rise on the system neutral. The number will depend upon the resistance-to-earth of the individual electrode, earth resistivity, and magnitude of neutral and earth return current.

(3) Grounding of 11 KV network/ secondary dead end and services.

Maximum resistance to earth in line or secondary dead end and service shall be 10 (ten) ohm but it is desirable within 3 Kilometer from sub-station less than 5(five) ohm. All equipment cover in 11 KV line or secondary or service dead end are to be grounded.

Where buried bare concentric neutral in contact with the earth is employed, the concentric neutral need not be grounded every 402 m (1320 ft.)

Table-I describes the BREB accepted grounding assemblies and gives recommendations for their use.

If grounding is stolen, it must be reinstalled immediately of occurrence. If it can not be reinstalled then power supply will be switched off in that section of line and will not be re-energized till replacement of neutral. Senior General Manager/ General Manager and AGM (O&M/E&C/P&M) must adhere to this instruction.

IV. MAGNITUDE OF GROUND RESISTANCE:

50 (fifty) Hertz system ground resistance requirements are usually met by the inherent low resistance of the multi-grounded neutral.

Resistance to earth of the individual grounding electrodes is significant, principally when considering the effects of lightning. Low resistance grounds drain to earth much of the energy in lightning surges. Much of this energy is dissipated close to the point of the lightning stroke. Where high resistance grounds exist, lightning surges may travel over many miles of line before the energy is finally dissipated.

Though low resistance grounds are always desirable, they are not essential for primary equipment protection. Failures of primary equipment protected by gaps or arresters commonly occur because of conditions other than high resistance grounds. Failures are often the result of excessive voltage produced by surge current flowing through unnecessarily long arrester leads. Because primary equipment failures are seldom due to ground resistance problems, system grounding improvement programs for the sole purpose

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of reducing primary equipment losses are seldom justified.

On the other hand, resistance to earth of individual grounding electrodes is a factor where lightning repeatedly causes damage to secondary equipment and wiring. Often this difficulty is due to failure to interconnect to the primary system neutral with grounded objects on the secondary; such as metallic water piping systems, well casing and grounding electrodes. This lack of interconnection will have far more effect in high resistivity soil areas than in low resistivity soil areas. To improve protection of secondary equipment and wiring, the first and usually only action necessary is to interconnect all secondary grounds with the primary system neutral. If this is ineffective, the resistance to earth of the existing secondary grounding electrodes should be lowered or additional grounding electrodes should be installed. If this measure is unsuccessful, a secondary surge arrester placed close to the entrance may prove helpful.

The resistance to earth of an individual grounding electrode is dependent upon its depth in the earth, contact area, chemical makeup and moisture content of the surrounding soil. The ground rods should be driven at least 2.8 M (9 ft.) into the earth and deeper into the permanent moisture level, if conditions permit. Rods in the permanent moisture level will lend to minimize the variation of ground resistance due to the seasonal fluctuation of moisture content in the soil. At locations where one ground rod does not provide sufficiently low resistance, the resistance may be lowered by installing two or more ground rods in parallel. If two or more ground rods are used, they should be at least 2 m (6 ft.) apart for optimum benefit. Spacing of less than 6 ft. will result in overlapping of the ground rod currents being dispersed into the earth and increase the resistance to earth of the parallel ground rods. Where enough space is not available and one ground rod of 8 ft long 5/8" diameter does not provide sufficient low resistance, the resistance may be lowered by doubling the diameter of the electrode. This will reduce resistance about 10%

approximately.

Another method used to lower the resistance to earth of a grounding electrode is chemical treatment. This consists of treating the soil surrounding as the grounding electrode with chemicals such as sodium nitrate, ammonium sulphate, calcium chloride, sodium chloride or any other suitable chemical. Three main disadvantages of this approach are:

1. Chemicals could promote or add to the corrosion rate of the grounding electrode.
2. Chemicals could contaminate nearby water supplies and be harmful to deeply rooted vegetation.
3. Chemicals may dissipate and periodic chemical treatment may be needed. It is, therefore, recommended that chemical treatment be considered only when multiple grounding fails to provide sufficiently low ground resistance or when existing conditions make multiple electrode grounding impractical.

V. GROUNDING SYSTEM ARRANGEMENT IN SUB-STATION

The system function is served by providing the lowest practical resistance between circuit neutral and true earth. When a sub-station bus or transmission or distribution line is faulted to ground, the flow of ground current may be between portions of a sub-station ground grid, between the ground grid and surrounding earth, along connected overhead ground wires, or along a combination of all these paths. The fault current flowing between a sub-station ground grid and the surrounding earth will result in potential gradients within and around the sub-station, which can result potential hazard to a person on or near the sub-station.

Therefore to relieve system abnormal voltage and currents, following matters are to be done carefully.

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