BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

SECTION G73.231.9
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Long Lines Department
Dist.Class. 208

PRESSURE TESTING

MAINTAINING SF_6 FILLED CABLES

UNDER PRESSURE

CONTENTS

1. GENERAL

1.01 This is a new Practice prepared to cover the maintenance of cables charged with Sulphur Hexaflouride (SF_6) gas.

1.02 SF_6 is a very costly gas. It is much heavier than nitrogen or air. The gas is colorless, non-explosive and will not cause injury to people under normal conditions. However in the presence of a flame it breaks down and produces a highly irritating gas which is poisonous. It is important,

therefore, that the precautions outlined in this and other Practices be carefully followed, that leaks be located and cleared promptly and that gas loss be kept to a minimum.

1.04 Other Practices covering SF_6 filled cables, which have been standardized for Long Lines use are:-

G10.212.6 - Testing Manhole Atmosphere
G10.213.1 - Gas Warning Signs
G73.205.6 - Engineering Data Covering Basis for Altitude Corrections
G73.306.1 - Initial Charging with SF_6
G73.056.2 - SF_6 Cylinders, Their Volumes and General Precautions
G85.142.2 and Addendum - B Gas Regulator

2. METHOD OF OPERATION

2.01 SF_6 filled cables will be maintained under the periodic charge system.

2.02 In general the entire length of SF_6 filled cable adjacent to both sides of a power feed point location will be maintained as one gas section (see exceptions in G73.205.6). The desired pressure at the lowest valve in a gas section is 24 psia (gauge reads to 25 psia) when the cable is fully charged.

2.03 All pressure measurements will be made with absolute pressure measuring instruments. For normal charging and gradient work use a W & T FA160191 absolute pressure gauge. For special, more sensitive leak location work, where leaks must be pin-pointed for dig-up and repairs, etc., use W & T FA185031 absolute pressure manometer, under technical supervision (refer to G73.205.6). Absolute pressure measurements are not affected by atmospheric pressure. Instrument readings are in pounds per square inch absolute, abbreviated to "psia".

2.04 Normally pressure measurements made on nitrogen filled cables with a pressure testing manometer are not corrected for changes in elevation because the error per 100 ft. change is only 0.03 psi. On the SF_6 filled cables all pressure readings used for gradient work must be corrected because the error per 100 ft. difference in elevation ranges from 0.25 to 0.47 psia, depending on the cable pressure and temperature. Thus on a leak-free, fully stabilized cable, valves at a low elevation will have a much higher pressure reading than those at a higher elevation and gradient plots for leak location work would be worthless without correction of measured pressures for differences in elevation.

2.05 G73.205.6 provides more detailed information and reasons for the procedures called for in this Practice.

3. TAGGING VALVES AND MANHOLES

3.01 All pressure reading points, charge points and contactor locations shall be equipped with a tag showing their elevation above the low valve in the gas section and the approximate gauge reading of pressure which should exist at that location when the cable is free of leaks and is fully charged and stabilized at a nominal temperature of 60°F. These tags should read as follows:-

186'
23.2

Use octagonal lead tags, stamped as above, attaching them close to the valve on cable in conduit and at L stations. Use strap tags at valves on markers on buried cable, attached around the top of the riser pipe near the valve. This elevation and pressure data will be furnished to the field forces.

3.02 Install gas warning signs as called for in G10.213.1.

4. ROUTINE CABLE CHARGING

4.01 Cable charging shall be done at all L and main stations in the gas section when the average pressure reaches 1 psia above contactor operating pressures. At main repeater stations, where the handling of cylinders to upper floor locations is difficult, a charge point may be established in a convenient manhole close to the station.

4.02 Attach the standard 2 stage regulator, through an adaptor, to the SF_6 cylinder (see G73.056.2). Attach an absolute gauge to the low pressure side of the regulator. Set regulator static to the pressure indicated on the tag, witnout regard to temperature (Caution: - To avoid loss of the costly gas, all regulators should be checked for proper operation and creepage, as covered in standard instructions, before each charging). When pressures reach the tagged pressures at representative valves in the section, remove the cylinders and wait two weeks for complete stabilization before taking any gradient readings.

5. CONTACTOR ADJUSTMENT AND DELAY TIME

5.01 Contactors shall be adjusted to a pressure 3.0 psia below the tagged pressure at the contactor location. When a check of contactor operating pressure indicates they fall within +0.5 psia of this pressure, no adjustment is necessary. If outside the limits adjust to desired pressure.

5.02 When a contactor requires adjustment, temperature correction is necessary so that any later checks or adjustments will be on the same basis. Temperature corrections can be determined using a B pressure testing rule which has been modified for absolute pressures as outlined in G73.205.6.

5.03 The operation of a contactor will generally be a warning of a cable leak and the loss of expensive SF_6 gas. It is important, therefore, that contactor operation be investigated as promptly as practicable to keep gas loss to a minimum. From the standpoint of protection to service, the maximum delay interval for investigating an operated contactor should be:-

Location of Contactor Relative to Plug	Permissible Delay Period
First	0 Hours
Second	6 "
Third	24 "
Fourth	40 "
All Others	70 "

6. CORRECTING PRESSURE READINGS

6.01 Pressure readings taken for a gradient or for direct comparisons of any kind must be corrected for elevation. Charts will be furnished to field forces which provide the correction to be applied at each valve, based on the read pressure and the cable temperature. In gas sections with less than 100 ft. difference in elevation no temperature measurements are necessary and only one column of correction figures is furnished for each valve. For elevation differences greater than 100 ft., two or more columns are furnished to cover the temperature ranges. Sample charts are attached to G73.205.6.

6.02 To use the charts, assume that a gauge reading at a valve with a tagged elevation of 273 ft. (Manhole 123) is 20.26 psia and measured cable temperature is 58°F. From the chart, the measured pressure of 20.26 psia falls between 20.20 and 20.29; refer to the pressure corrections on this line. 58°F. falls between 48-65°F. and the correction in the column is shown as 0.99 psia. Add the correction to the read pressure (0.99 + 20.26) to get 21.25 psia, the corrected pressure. The same procedure is followed for all other valve readings, after which the corrected pressures can be plotted for a gradient, which is analyzed in the usual manner.

7. PRECAUTIONS AND NOTIFICATIONS

7.01 Do not use an acetylene torch or open flame on or near a cable from which SF_6 gas is escaping. Observe all the precautions in G10.212.6.

7.02 Oxygen deficiency tests and report of results of tests must be made where work is to be done which may release SF_6 gas into adjacent manholes on the main conduit run or into lateral runs. Follow instructions in G10.212.6.

8. SPECIAL CONDITIONS

8.01 Because of the special nature of the problems of maintaining cables containing SF_6 gas, refer any conditions not specifically covered by this Practice and the Practices mentioned in Part 1 to your supervisor for consideration at technical levels.