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CASE STUDY ON PIPELINE UNDER-PROTECTION ALONG WITH MITIGATION METHODS

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ABSTRACT

Mahanagar Gas Ltd is a City Gas Distribution Company engaged in the distribution of Natural Gas in and around Mumbai. We presently have around 400 Kms of steel pipeline. All our steel pipelines are coated with 3 Layer Poly Ethylene coating. As a supplementary protection against corrosion, we have also installed Cathodic Protection system over the entire network.
Since Mumbai is a congested city with a lot of underground utilities, our assets are prone to damage due to third party excavations in the vicinity of our pipeline. Coating damages on the pipeline and cable cuts in CP assets can subsequently lead to a failure of the CP system and cause under-protection of the Steel pipeline. If these issues are not resolved on priority it may lead to major hazards.
This paper deals with an issue of under-protection at two of our locations – Mantralaya and Andheri:
The under-protection at Mantralaya was due to the addition of many spur lines from the main pipeline over a period of time, coating defects on the pipeline and due to the high corrosive nature of the surrounding soil.
The under-protection at Andheri was due to coating defects on the pipeline which was difficult to repair as the pipeline is under a concretized road.
This paper also includes the various measures and mitigation methods that were employed at site to resolve these under-protection issues.

Keywords: Cathodic Protection; Under-protection;

INTRODUCTION

Mahanagar Gas Ltd is a city gas distribution company, supplying gas in constantly evolving cities like Mumbai and adjoining areas. In such regions damages to pipeline coatings and construction near or on pipeline is frequent. If care is not taken during construction stage, it may lead to under-protection of pipelines. We shall be discussing two issues faced by Mahanagar Gas in last year at Andheri (Metro) Region and Mantralaya Area.

Issue at Ghatkopar-Andheri Metro Line

History

Mumbai Metro is a rapid transit system serving the city of Mumbai, Maharashtra. The system is designed to reduce traffic congestion in the city, and supplement the overcrowded Mumbai Suburban Railway (colloquially called local trains) network. Construction of Metro started on Feb 2008 and was completed on June 2014. The stretch of metro is constructed over 12" header line of Gas Pipeline of about 4km.

Problem

We have faced under-protection in this 4km of section due to coating damages and Bonding Cable Cuts.

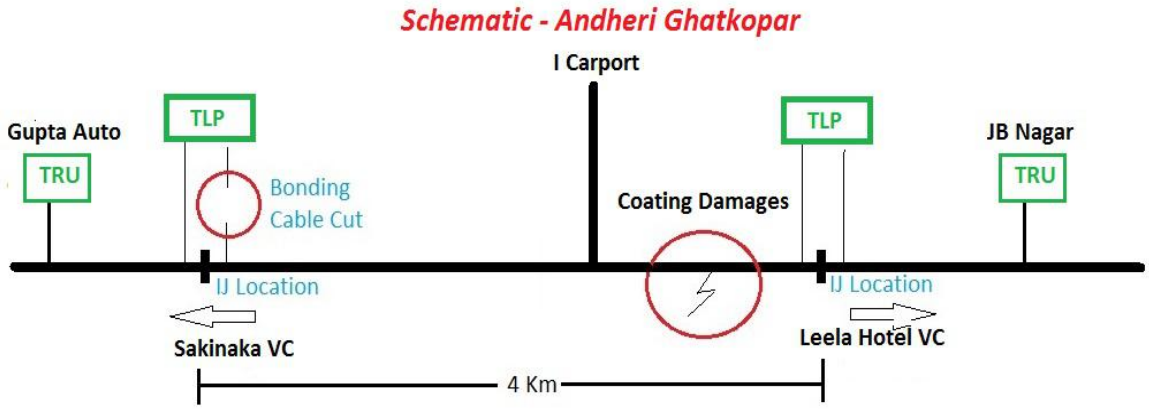

Figure 1: Schematic Diagram of Ghatkopar- Andheri Line

Previously the said section was getting protection from Gupta TRU but due to cable cut at IJ location at Sakinaka VC the under protection was observed on pipeline. Then we have bonded the same stretch at Leela VC with JB TRU but again due to coating damage the CP current were getting drain at some locations due to which again the line was not getting adequate protection. The matter was further investigated. It was seen that the anode bed of JB Nagar TRU had failed and the resistance had gone upto 18 ohms. Rectification of coating damages and cable cut was not possible due to concretization of road.

Mitigation

Identification of faults was necessary to apply mitigation methods. We carried out CIPL as well as DCVG survey to identify exact location of coating damages and identification of cables cuts but due to low soil resistivity and concretization, all nearest metallic structures were getting charged and identification of exact location was not possible. Also, excavation of doubtful stretch was not possible as CC road was newly constructed.
After carrying out all the surveys, we decided to carry out Current Drain survey to find out the requirement of CP current to protect the 4kM of Section such that a new TRU can be installed to meet the requirement.
Installation of TRU was not feasible on main line as it was under CC road and Bore well for Anode bed was also not possible on road due to permission issues. We decided to install a new TRU on the 800mtrs spur line at Intel carport. The spur line is of 3" diameter.
During Current Drain survey the current requirement came out to 2A for 4km of under-protected section which is quite high than the normal MGL pipeline requirements due to coating damages.

Current Requirement Calculations:

Surface Area= Length of Pipe x Diameter of Pipe x π
= (2800 x π x 0.304) + (1300 x 0.0762 x π) …(12inch – 0.304m & 3inch- 0.762m)
= 2985 m2
Current Requirement= Surface Area x Current Density x Safety Factor
= 2985 x 0.9 x 1.3 …(Current Density- 0.9 A/m)
= 1.2 A

To meet this requirement as well to supplement the JB Nagar TRU we installed 50V/50A TRU on spur-line for CNG Station I Carport which was the only feasible location and was meeting the requirement of Protection Criteria.
As the protection criteria says -0.850(CSE) at end location we have maintained TRU potential of -1.5(CSE) at drain point. After this we have achieved protection till the end points of Section.

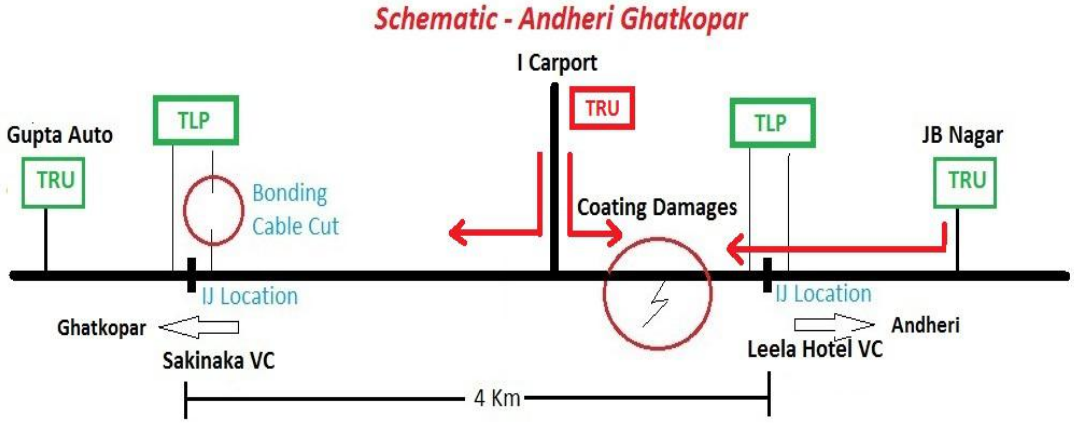

Figure 2: Schematic Diagram of Ghatkopar- Andheri Line with Solution

Issue At Mantralaya Section

History

This section of 14kms has 4 nos. of sectionalizing insulating joints (IJs). The TRU for this section was initially designed for up to Mantralaya DRS 33; and was installed at new Modern auto in the year 2005-2006. After the TR was commissioned, over a period of time, spur lines for Royal auto (Bhendi bazaar) was laid and mainline was extended beyond Mantralaya DRS up to Oberoi Trident hotel.

Problem

From the year 2012, we started observing under-protection issues from Mantralaya to Oberoi Trident. (4kms). We then installed temporary anodes at 4 locations (total number of 36 Mg anodes – 2.1 Kg each for 4kms). This improved the PSP for a few months after which again the values went down. Anode measurements were seen to be healthy. However the required current was not being dissipated.
The matter was investigated further. We initially carried out DCVG survey on the entire pipeline. 17 nos. of minor coating defects and 6 nos. of medium coating defects were recorded in the survey. These defects were in close proximity to each other and were spread out in a distance of 300mtrs.
The under protection on 3.8km of line was not only due to addition of spur lines on main line but also due to lots of minor coating damages on line and contact with foreign water pipeline.
Mostly minor faults does not contribute much to under-protection of pipeline but all 17 minor faults were on a stretch of 300mtrs contributed well in under-protection of section. All these damages were due third party excavations and during backfilling by third party after completion of work. Out of 17, 8 nos of coating damages observe due to hammering of Crowbar during third party excavation and remaining 9 were due to falling of stones/rocks during backfilling over line.

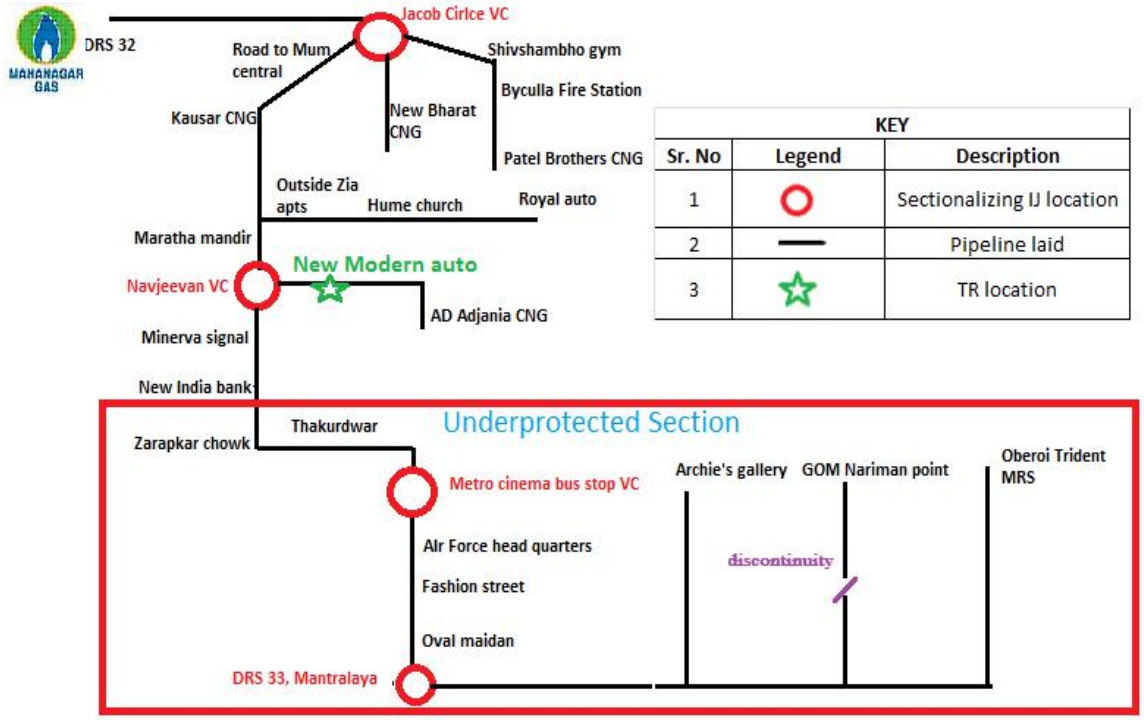

Figure 3: Schematic Diagram of Mantralaya Section

Mitigation

The consumption rate of Mg Anode was also very high at this stretch due to coastal salt enriched soil. As protection level was not achieved, we have carried out CIPL and DCVG survey for the area, in which all 23 coating defects were identified.
After rectification of coatings at 17 minor locations we have observed that the line PSP is increasing at starting location near Thakurdwar which was previously under-protected. After rectification of 17 minor defect locations 700mtrs section bought under protection out of 3.8km.
Further, when we started rectification of remaining 6 locations, it has been observed that MGL pipeline is in contact with water pipeline flange. Due to deterioration of additional insulation sheet and pipeline factory coating at Flange location the flange came in contact with MGL pipeline. The CP current of MGL pipeline was getting drained in BMC Water pipeline, due to which the MGL pipeline was not getting adequate CP current. The bolts of Flanges were penetrating the coating with a high force which resulted in coating damage over a period of time. The insulation sheet was installed at the time of pipeline laying but after around 3 years the coating along with insulation sheet got damaged and resulted in direct shorting of MGL pipeline with Water pipeline.

Figure 4: Shorting of MGL Gas Line and Water Line

To mitigate this we have inserted an insulator having life more than neoprene/ rubber sheets viz., Clock-spring. Pipeline cold wrap coating was not possible at such congested location due to inadequate space for rolling of coating rolls. To mitigate this contact we have inserted a clock-spring in between flange and pipe after application one coat of zinc based primer.

Figure 5: Insertion of Clockspring between Shorting of MGL Gas Line and Water Line

After carrying out application of Clock-spring, we have managed to obtain protection till Metro VC. Protection of whole section was not possible as the strength of anode bed degraded over a period of time as it was supplying current to BMC non-coated pipeline. Also, The cables used for the deep well anode bed were XLPE / PVC which is not resistant to chemical attack. Also due to road development, the anode bed was buried and hence there was no path for accumulated gas to escape. This may have damaged the cables over a period of time. In the present anode bed at new modern auto, only 3 anodes were seen to be conducting, out of 15 anodes that were installed.
For the remaining section to bought under protection level we need to install a separate TRU but due to discontinuity of pipelines at many places it was not possible. Hence we decided to install cable jumper between pipeline to make them electrical continue and TRU installation can be made possible.

Figure 6: Schematic Diagram of Mantralaya Section

Hence we carry out current drain survey with the drain point at GoM Nariman point which is the mid-point of section considering future expansions of MGL Pipeline. After carrying out current drain survey, the requirement of section comes out to 3Amp for a section of 6km.

Current Requirement Calculations:

Surface Area = Length of Pipe x Diameter of Pipe x π

= (3328 x π x 0.1016) + (1990 x π x 0.1524)…(4inch – 0.1016m & 6inch- 0.1524m)
= 2014 m2

Current Requirement = Surface Area x Current Density x Safety Factor
= 2014 x 0.9 x 1.3 …(Current Density- 0.9 A/m)
= 2.4 A

The requirement was still high but it was due to the coastal region.
Installation of new TRU is carried out along with Cable jumper installation at discontinuity near GoM Nariman point and it is thus protecting whole section now and capable to take new spur/main line.

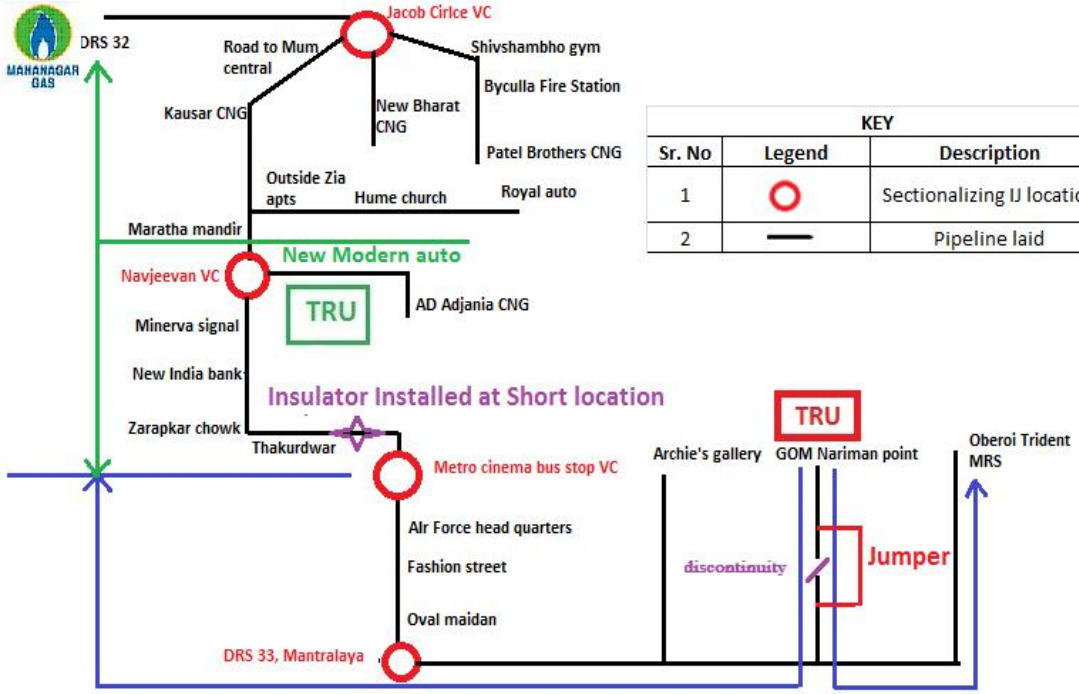

Figure 7: Jumper installation for Electrical Continuity at GoM Narimanpoint

LEARNINGS

1. Close observation on Excavation site.
2. Maintaining records of exposed pipelines, Thickness and Coating rectifications.
3. CIPL/ DCVG Survey Frequency reduced to 3yrs.
4. None of the Coating defects to be left unattended.
5. All precautions against shorting need to be taken in construction stage only.
6. Monitoring and maintenance of the CP system should be done as per the scheduled frequency to maintain the CP system effectively.

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REFERENCES

1. NACE 1 & II Course Manual
2. NACE RP 0177-2014
3. MGL CP philosophy
4. OISD Standard 188
5. Corrosion Survey Data of MGL Pipelines