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Casing – Carrier Electrolytic Short Rectification

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ABSTRACT

As per standard practice, the pipeline across Rail and major road/highways crossings are provided with casing pipes. The purpose of casing is to avoid any mechanical stress to pipeline due to movement of rail/vehicle. Prior to insertion of carrier inside the casing, insulator rings are provided on the carrier pipe at every one meter distance & after insertion both ends of casing is provided with casing end seals to prevent ingress of water, mud/electrolyte. For proper cathodic protection of carrier pipe inside the casing pipe, usually Zn-ribbons anode are provided at 04 & 08 O'clock position at a distance of approximately two meters over the Carrier pipe.

Two Types of Casing – Carrier shorting is possible

1. Electrolytic Coupling: This can occur due to presence of moisture / liquid in the Annular Space (space between Casing and Carrier pipe). Moisture / Liquid enters through the Vent Pipe / Drain Pipe during heavy monsoon and it is comparatively easier to handle.ie to rectify

2. Electric Carrier Shorting means that carrier pipe get shortened with casing pipe by metallic interconnecting bolts of damaged insulator and sometimes the Zn-ribbon anode got detached from one end and provide an electrical path to flow of Cathodic protection current between casing & carrier pipes. These situations resulted drainage of CP current & sometimes the PSP of the effected zone goes below the protection level.

Keywords: electrolytic, casing, carrier,

INTRODUCTION

M/s GAIL (India) Limited is a major operator of cross country natural gas/RLNG/LPG pipeline in India & having approximately 10000 Kms of natural gas pipeline and having capacity around 175 MMSCMD. M/s GAIL (India) Limited is also having around 2000 Kms of LPG pipeline having capacity around 3.8 MMTPA. Diameter of the main pipeline varies from 04” to 48”. These natural gas pipelines are utilized for transporting of Natural Gas & these pipelines are feeding Natural Gas to various Petrochemical, Fertilizer, LPG & Power Plants located along the pipeline route.

Pipelines pass through different kind of environments. Cased Crossings are generally provided where pipelines needs to cross rail and major road/ highways. The casing pipes are larger in diameter than carrier pipe to make the insertion of carrier pipe and avoid the transfer of stress on carrier pipe. Prior to insertion of carrier in to casing, casing insulator rings are provided on the carrier pipe at an interval of one meter & after insertion both ends of casing is provided with casing end seals to prevent ingress of water, mud/electrolyte in the annular space. For proper Cathodic protection of carrier pipe inside the casing pipe, usually Zn-ribbons anode are provided at 04 & 08 O’clock position at interval of approximately two meters.

Casing insulators electrically insulate pipelines from casings to prevent carrier-casing shorting. Insulators also provide support to the pipeline and protect pipe coatings during insertion. For the proper Cathodic protection of carrier pipe inside the casing pipe, ribbon anodes usually zinc ribbon anodes is provided. Zinc ribbon anodes are welded to the carrier pipe at of 4 & 8 O’ clock position at an interval of approximately 02 meter. Zinc ribbon anodes provide a very simple, cost effective, maintenance free method of corrosion control for buried or immersed metals such as iron, steel etc.

Pipeline coatings can be damaged when coated carrier pipe is being pushed inside the Casing pipe without taking proper care and the longer the casing, the greater the probability of damage. Water sometimes enters the casing through defective end seals and through Vent and drain pipes at the crossing locations which are vulnerable for getting submerged due to heavy water flow

This paper is a case study about rectification of electrolytic casing and carrier shorting in larger diameter pipeline.

EXPERIMENTAL PROCEDURE

Types of Shorted Casings

A short is generally characterised as being either a metallic short or an electrolytic short.
Figure 1 illustrates a Typical Schematic of normal healthy Cased Crossing. Here the Cathodic protection current is picked up on the carrier pipe outside the region of the casing, but is not picked by the casing because of the electrical isolation being provided by the insulators. Figure 2a illustrates metallic short. In this, the carrier pipe is in metallic contact with the casing. This can happen due to Zinc anodes getting detached from the carrier pipe and providing the electrical continuity or metallic ring supports of insulators provides the contact with casing pipe.

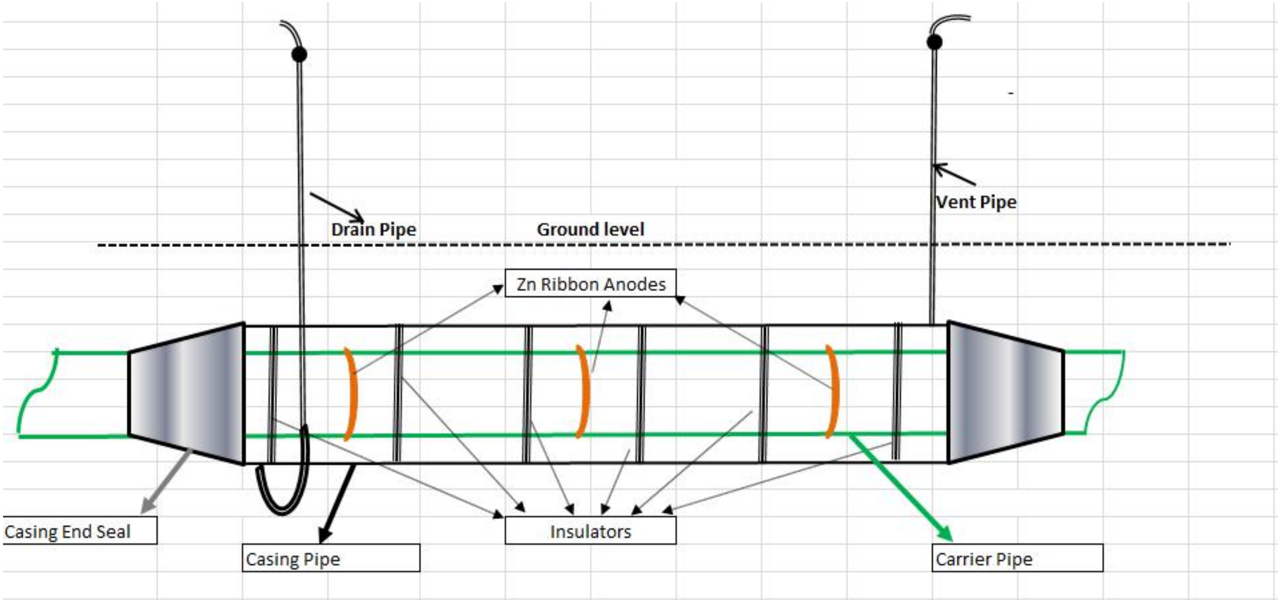

Figure 1: Schematic Diagram of Cased Crossing

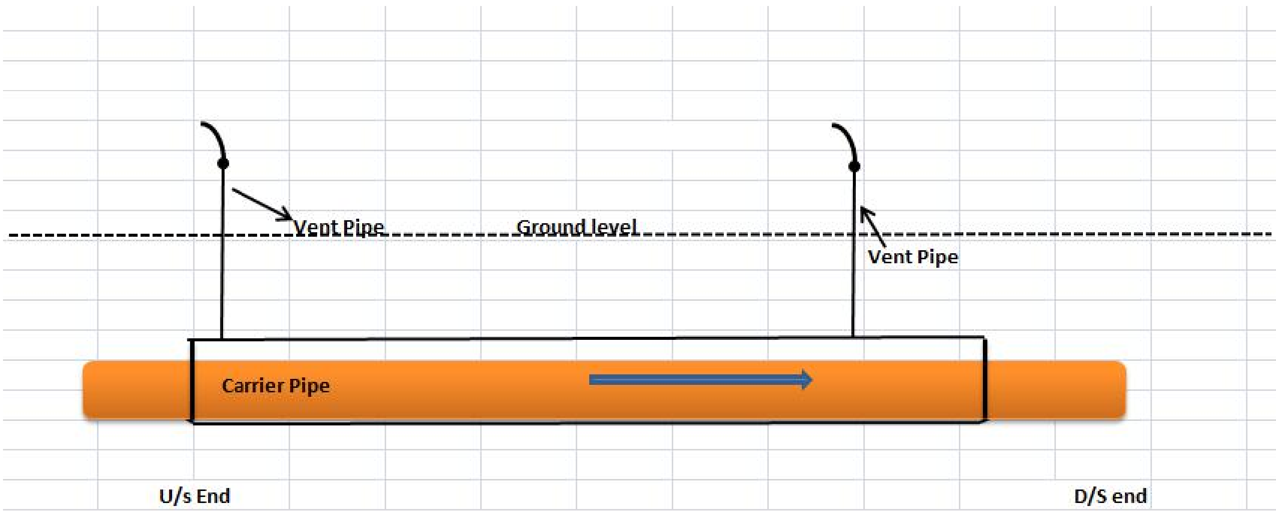

Figure 2 a. Metallic Short

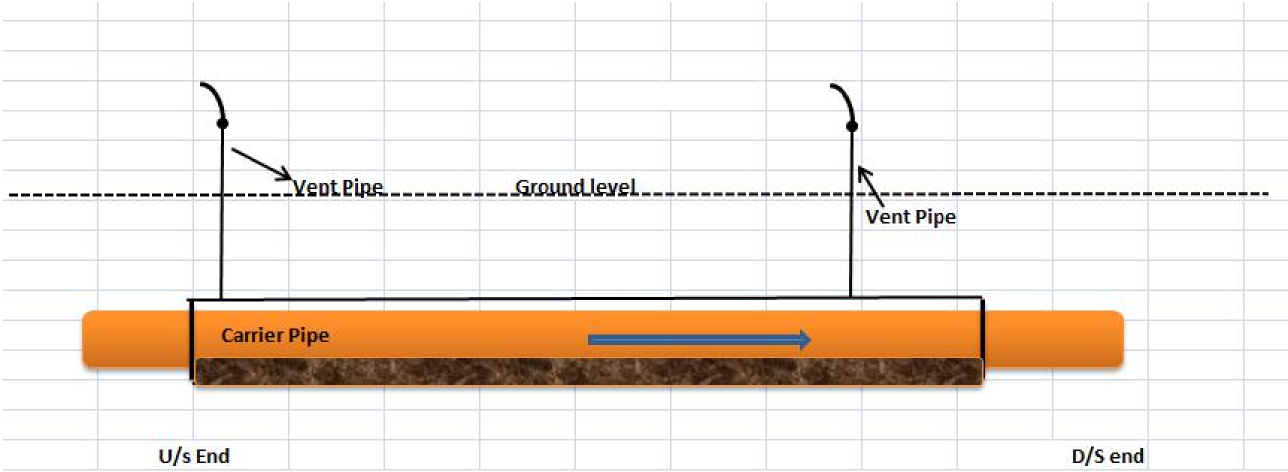

Figure 2 b. Electrolytic Short

Figure 2b illustrates an electrolytic short. This can occur due to the presence of moisture / liquid in the Annular Space (space between Casing and Carrier pipe) which provides the ionic conducting path between the casing and the carrier pipe.

During the pipe to soil potential (PSP) monitoring, it was observed that the Casing PSP and the carrier PSP was same at one of the Cased Road Crossing location. The status of the Casing and Carrier short at that location is as described below.

1. No Continuity was observed between the Casing and the Carrier Pipe.
2. Resistance Value between the Casing and the Carrier Pipe was measured in the range of 1.68 Mega Ohm to 1.80 Mega Ohm with Multi meter.
3. Output Current of CPPSM unit observed in the range 0.2 to 0.4 ampere.
4. Bulb was not glowing while connected between the casing and the carrier pipe with 9 volt battery

The above facts are suggesting that the shorting at this Location is of electrolytic type. The initial CPPSM and PSP data as measured is as detailed in **Table 1**.

Table 1: Initial CPPSM and PSP Data

CPPSM UNIT Parameters before Venting & Dewatering			Filed DATA	
Description	Value		Casing Pipe PSP	- 1.19 V
Input Voltage	27.0 V		Carrier Pipe PSP	- 1.37 V
Input Current	0.6 Amp		ΔV (1.37 - 1.19)	180 mV
Output Voltage	2.8 V			
Output Current	0.2 Amp			
External ref PSP	- 1.17 V			
Internal Ref PSP	-1.15 V			

Internal Resistance Test as per NACE Standard RP0200-2014 using Earth Tester with four pin test method has also been carried out at this location

As mentioned in the NACE standard RP0200-2014, A four-pin soil resistivity meter may replace the battery, voltmeter, and ammeter shown in Figure B2 so that the resistance may be read directly. If a four-pin soil resistivity meter is used, the locations of the test leads are the same as those shown in **Figure 3**. C1 is connected to T3, P1 to T1, P2 to T2, and C2 to T4.

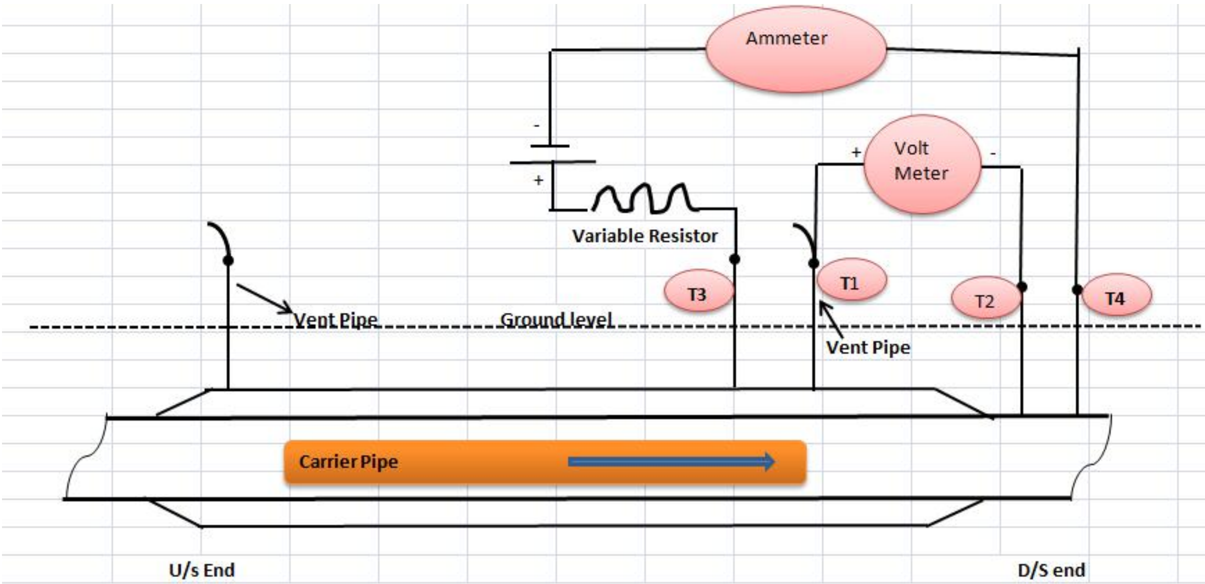

Figure 3: Internal Resistance Test

T2 and T4 are carrier pipe cable terminal and T1 and T3 casing Pipe cable terminal. In earth tester C1 and C2 Current terminal and P1 and P2 are Potential terminal

T3 of Casing Pipe is connected to C1 terminal of Earth Tester
T1 of Casing Pipe is connected to P1 terminal of Earth Tester
T2 of Carrier Pipe is connected to P2 terminal of Earth Tester
T4 of Carrier Pipe is connected to C2 terminal of Earth tester

The Internal Resistance value Obtained as 2.68 Ohm. Since the Internal Resistance as measured is greater than 0.01 Ohm, there is no metal to metal short is indicated.

Vent Pipe at the downstream side was cut up to 0.5 meter above ground. Dry Compressed air was blown at a pressure of 1.5 to 2 Kg/cm2 through the vent Pipe for drying the annular space. Compressed air was blown continuously for about half an hour and observed no air was coming out of the drain Pipe.

Then the drain Pipe at the upstream side was also cut up to 0.5 meter above ground. Then using a DIP tape, the presence of water was checked and found the presence of water traces of almost 1.5 meter length on the DIP tap

Then using the dewatering pump the water present inside the annular space was pumped out from the drain side, again started blowing compressed air at a pressure of 1.5 to 2 Kg/cm^2 continuously for 2 to 3 hours and observed full air is getting vented through the drain pipe with the same pressure applied.

Finally additional pipe of length (say 2 meter) is welded to Vent Pipe to increase its height, as it is in such a Vulnerable Location where Water entry is possible during heavy monsoon season.

RESULTS

After Rectification of Electrolytic Shorting the PSP Values of the Casing and the Carrier pipe was measured and it is as given in Table 2 below.

Table 2: Final Results as measured after rectification

CPPSM UNIT Parameters after Venting & Dewatering			Filed DATA	
			Casing Pipe PSP	- 0.57 V
Description	Value		Carrier Pipe PSP	- 1.36 V
Input Voltage	27.0 V		ΔV (1.37 - 0.57)	790 mV
Input Current	0.6 Amp			
Output Voltage	2.8 V			
Output Current	0.2 Amp			
External ref PSP	- 1.17 V			
Internal Ref PSP	-1.15 V			

The field test measurements made as detailed above shows the Electrolytic Shorting between the Casing and the Carrier pipe is rectified

CONCLUSION

Carrier-casing shorting makes it very difficult to maintain the pipe to soil potential of pipeline at the crossing and near to the crossing within acceptable limits because it can absorb as much CP current as several kilometres of cathodically protected pipeline. Less negative, than - 0.850V, potentials of pipeline make it under polarization which may result into beginning of corrosion activity. The drainage of CP current makes the pipeline vulnerable to corrosion & could result failure of the pipeline.

For new construction, the cased crossings should be avoided whenever structural analyses indicate they are not needed and codes/regulations permit uncased crossings. Where the use of casings cannot be avoided, care must be exercised in selecting the proper material, sound design for casing spacers, end seals and its length should be kept as small as possible. Sufficient increase in the height of Vent and drain pipes to be provided. All possible care must be given during the installation of casing insulators, zinc ribbon anodes, end seals and utmost care shall be given at the time of insertion of carrier pipe.

ACKNOWLEDGMENTS

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REFERENCES

NACE Standard RP0200-2014- Standard Recommended Practice Steel-Cased Pipeline Practices.