Hot Dip Galvanized Case Study No. 15
Pentrich Sub-station, Mkondeni, Pietermaritzburg

The Application

Eskom has for many years applied hot dip galvanizing as the primary corrosion control system used to protect their steel structures including power stations, pylon for transmission lines and substation steelwork which are exposed to many different and variety of environmental conditions throughout South Africa. The Pentrich substation is clearly one such example. The sub-station was built around 1967 and exposed to the atmosphere environment of Mkondeni, Pietermaritzburg.

As a result of the sub-station showing signs of "rust staining" and discolouration, maintenance paint was been considered. A suitable painting contractor was requested to provide a quotation for refurbishment of the carbon steel structures. A cost estimate of R1.2 million to prepare and paint over the residual hot dip galvanized coating made staff at Eskom to under-take an in depth review of sub-station. The Association was requested to evaluate the condition of the existing hot dip galvanized steel, which used as the bases of the case study.

A 132/88kV termination pylon at the Pentrich sub-station of the Georgedale to Pentrich transmission line

General view of the Pentrich sub-station

Environmental Conditions

There are three important criteria to be considered when conducting an inspection of hot dip galvanized coatings. The first two issues relate to the zinc coating thickness and continuity, i.e. no uncoated areas. The third and as important is the environmental condition in which to hot dip galvanized (zinc) steel is exposed.

In terms of the environmental conditions reference to the ISO 9223 specification – Corrosion of Metals and Alloys – Corrosivity of Atmospheres – Classification is used , as a guide when determining an approximate service life of an installation.
The Pentrich sub-station estimated corrosivity category is believed to meet the criteria of a C2 or at worst that of a C3 environment.

For a guide to the ISO 9223:2012 specification, refer to the Association Information Sheet No.8 "**Corrosion of Zinc – Corrosivity of Atmospheres".**
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The Site

Pentrich Substation lattice steel structures were examined in order to establish the condition of the hot dip galvanized coating after 40 years of service life.

Examination of the hot dip galvanized steel indicated that no maintenance would be required and the "rust staining" was found to be that of surface contamination

Findings

The hot dip galvanized coating thickness on several components within the sub-station was cleaned of contaminants and various zinc coating thicknesses measured with a calibrated electromagnetic "Elcometer" gauge. Coating thickness readings were tabulated in tabulated format.

In terms of the SANS 121 (ISO 1461:2009) specification requirements, steel thickness equal and greater than 6mm the minimum local coating thickness shall be 70µm and the important mean of 85µm.

Steel equal and greater than 3mm but less than 6mm shall have a local coating thickness of 55µm with a mean of 70µm.

NB. Zinc coating thicknesses and conformance to specification; using no less than 5 readings per component; mean coating measurements are applied as the acceptance criteria.

All the structural steel components inspected were found to be well within the requirements of the SANS 121 (ISO 1461:2009) specification.

Hot dip galvanized coating thickness recorded at the Pentrich Sub-station

132/88kV Terminal Tower	No. of readings	Max	Mean	Min
90 x 90 x 8mm angles	9	114	**95**	83
30 x 30 x 3mm angles	11	161	**134**	114
M12 Hex nuts	10	141	**78**	55
M12 Hex bolts	12	132	**97**	65

132/88kV Isolator Supports	No. of readings	Max	Mean	Min
50 x 50 x 6mm angles	22	61	**88**	61
50 x 75 x 6mm channels	18	89	**123**	89
70x 70 x12mm angles	14	145	**155**	145
M12 Hex nuts	4	59	**73**	59

Conclusion

A significant benefit of using a metallic zinc coating, irrespective of how it is applied, is that it is possible to estimate the service life of components. This is calculated by measuring the mean hot dip galvanized coating thickness and comparing that with the corrosion rates given in the ISO 9223:2012 specification.
(Reference Association information sheet No. 8).

Fundamentally, the service life of a zinc coating is proportional to its thickness; i.e. the thicker the coating the longer the service life.

It is for this reason that the thinner zinc electroplated coatings found on holding down nuts, in spite of the original corrosion control provided by the paint, is far less durable than that of the superior thicker hot dip galvanized coating on the structural steel components described in this case study.

The uncoated holding down bolts and zinc electroplated nuts, should be suitably cleaned and comprehensively over coated with an approved paint system. An approved coating system consists of zinc rich epoxy paint such as “Galvpatch” also known as “Zincfix” can be used in this repair procedure.

Residual hot dip galvanized coating on the structural steel, comprising the sub-station, after 40 years of exposure to the atmosphere of Mkondeni, Pietermaritzburg, is in a sound condition and will not require any refurbishment for another 40 years.