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ESTABLISHING THE CONDITION OF THE CORROSION PROTECTION OF STEEL LATICE OVERHEAD LINE TOWERS IN BELGRADE AREA

D. Jašović,[*] S. Stupar
Research Institute "Kirilo Savić", Belgrade

V. Tomašević
Power Distribution Company - Belgrade, Belgrade

ABSTRACT

During the exploitation the steel-lattice constructions of overhead line towers are subjected to various corrosion conditions.
If the steel protection is insufficient or inadequate, there is a possibility of more rapid degradation.
Degradation of the protection automatically means the exposure of steel construction to the direct influence of corrosion agents. Long time effect of these influences leads to the decrease of steel construction cross section thickness that can endanger the safety of towers, and by that also the transmission of electric energy.
Considering that the restoration of corrosion protection has not been carried out in last 10-15 years, it is necessary to establish the real condition of the existing steel tower constructions of overhead lines.
This paper presents the results of establishing the corrosion protection condition of steel tower construction of overhead lines on Belgrade territory.

1 INTRODUCTION

Corrosion protection of steel-lattice towers of overhead lines is influencing, in great extent, the lasting of the construction, in which way enabling the stabile and reliable transmission of electrical energy.
However, the carried out corrosion protection doesn't last forever. By the time, no matter of the protection quality, the deterioration and degradation of the protection occurs. Deterioration of the existing corrosion protection can endanger the steel construction itself because it is than exposed to direct influence of corrosion agents.

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[*] Dušanka Jašović, Research Institute "Kirilo Savić", Beograd, Ul. Vojvode Stepe 51.

In order to prevent this phenomenon the prompt rehabilitation of the existing corrosion protection is necessary.
The rehabilitation of the corrosion protection automatically presumes the previous establishing of the condition of corrosion protection.

2 CORROSION PROTECTION OF STEEL CONSTRUCTIONS

2.1 Metal Coating Protection

For the corrosion protection of steel constructions the most frequently used is the METAL ZINC COATING.
Deposition of the metal zinc coating is carried out using:
- hot zinc treatment (immersion of steel construction in molten zinc)
- metallization treatment (deposition of molten zinc onto steel construction by spraying with special equipment).

In order to obtain the long-time corrosion protection in normal atmospheric conditions the thickness of zinc should be at least 120 μm .

The shortage of hot zinc treatment is the insufficient stability in aggressive environment, even with the coating thickness of 120 μm .

Metallization treatment shortage is manifested in highly porous coating. Therefore in the metallization treatment the coating thickness should be up to 120 μm .

2.2 Protection by Spreading Means

The most widely used method of the protection of steel constructions is the spread protection.
Apart from high quality spreads, the other condition needed for the efficient corrosion protection is an irreproachable of the surface. The means used for the protection of steel constructions so far were as follows:

- spreads based on drying oils having the shortages as slow drying and low resistance to chemical influences;
- the protection of steel constructions used for the a time were means based on alkali resins that are resistant to atmospheric influences, but have the low resistance to chemical influences:
- spreads based on epoxy resins have high resistance to chemical influences. Instability against sun light is the shortage of these spreads if used as final spreads, because they manifest the tendency to pulverize (“chalking”):
- for the protection of steel constructions great use have the means based on copolymer vinyl chloride, chlorine-caoutchouc, acrylate or the combination of these. The listed spreading means have high stability and therefore are used in chemically aggressive and moist environments.

2.3 Combined Protection

Several years lasting experiences concerning corrosion protection have shown that, after several years of exploitation period, steel construction protected with metal coating was captured by corrosion. Protection with systems of spreads, as the simplest way of protection have even shorter life period, which depend on the system selected, the type and the degree of the effect of aggressive environment.
The depositing of the metal coating – zinc, and afterwards of appropriate system of spreads considerably prolongs the life period of the steel construction corrosion protection, so this type of "DU-PLEX" - system protection is recommended. The total durability of "DUPLEX" system protection is longer than the sum of individual durability of zinc coating protection and protection with appropriate spreading means.

3 ESTABLISHING THE CONDITION OF CORROSION PROTECTION OF STEEL LATTICE OVERHEAD LINE TOWERS IN BELGRADE AREA

In order to obtain the data about the condition of the existing corrosion protection, the recording of the protection condition on overhead line steel constructions was carried out.
The recording of the condition encompassed the following overhead lines on the territory of Belgrade:
NKV 308A Beograd IV - Smederevski put,
NV 197 A Beograd V - FOB
NKV 307B Beograd IV - Beograd XI
NKV 315A Beograd I - Karaburma
The representatives of the Power Utility Company carried out the selection of sample overhead line towers. The parameters influencing the selection of towers were as follows:

- the age of the construction, i.e. the protection
- site
- operation conditions
- notices of the representatives of the Power Utility Company

The establishing of the existing condition of the overhead line steel-lattice towers comprised:

- Visual examination of steel construction

By visual examination the occurrence of various colorings on zinc coating as well as the changes on organic spreads were established. Besides that the occurrence of the corrosion can be detected by visual examination

- Measurement of the protection thickness.

The measurements of the thickness were carried out by electromagnetic method (elkometer Qua Nix7500).

- Establishing of the adhesion degree of the existing protection.

Establishing of the adhesion degree of the existing protection was carried out according to the methods given in current standards.

- Recording

Recordings were carried out with digital camera FUJI 2600Z with the quality resolution of 1600 x 1200 dpi.
The results of the condition recording are given in tables (Tables 1, 2, 3 and 4) and in photos (Figures 1-8).

TABLE 1 - Results of site recordings on 35 kV overhead line Beograd IV - Smederevski put

Tower site (No.)	1458	1453
Visual examination	Construction differently colored. Apart from gray color of final spread the oxide-red and orange coloring was detected. The occurrence of spread separation as well as the corrosion <1% was detected on lower parts of the construction.	Visual condition as on tower 1458
Protection thickness (μm)	250-350	220-340
Adherence of the spread, coating (degree)	"2", "3" and "4"	" "1", "2" and "3"
Notice	Corrosion protection done with organic spreads. The last protection was done in 1990.	

Figure 1

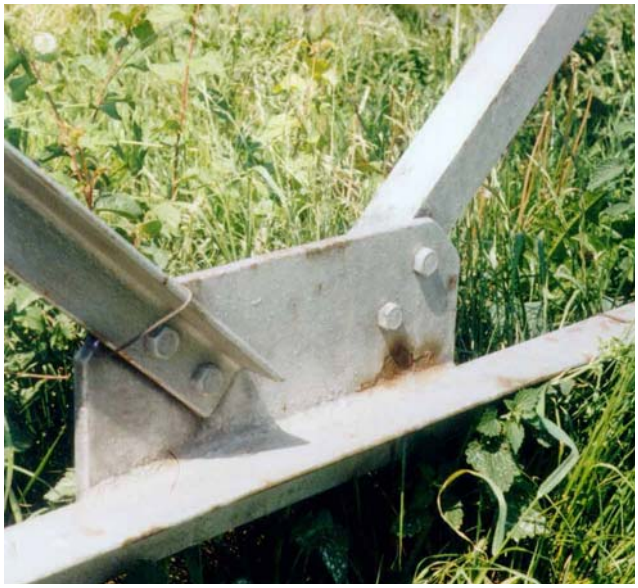

Figure 2

TABLE 2 - Results of site recordings on 35 kV overhead line, Beograd V - FOB

Tower site (No.)	7	6	6A
Visual examination	On the surface of the construction apart from the gray color of the final spread oxide red color of previous spreads was also noticed. Corrosion < 1% was noticed on lower parts of the construction.	Visual condition as on tower 7	On the construction apart from the gray color of zinc coating red-brown coloring was noticed. Corrosion was not observed.
Protection thickness (μm)	60-110	70-110	80-110
Adherence of the spread, coating (degree)	"0", "1" and "3"	" "0", "1" and "3"	" "0" and "1"
Notice	Corrosion protection done with organic spreads. The last protection was done in 1989.		Protection done in hot zinc coating

Figure 3

Figure 4

TABLE 3 - Results of site recordings on 35 kV overhead line, Beograd IV - Beograd XI

Tower site (No.)	1397	1398
Visual examination	Construction is of gray color. On some parts the oxide red color of previous spreads was noticed. Corrosion was registered on lower parts of the construction, nodes, tower body and main bracing.	Construction is of gray color and some parts are oxide red colored. Corrosion was registered on lower parts of the construction. On main bracing the occurrence of separation (creasing of spread).
Protection thickness (μm)	- on bracing 40 - 70 - on waist bracing 120-150	50-100
Adherence of the spread, coating (degree)	"0" and "1"	from "0" to "5"
Notice	Corrosion protection done with organic spreads. The last protection was done in 1988.	

Figure 5

Figure 6

TABLE 4 - Results of site recordings on 35 kV overhead line, Beograd IV - Beograd XI

Tower site (No.)	1619	1621
Visual examination	Grey color of final spread was noticed and on some places oxide red colors of previous spread. Corrosion was detected on lower part.	Visual condition as on tower 1619
Protection thickness (μm)	160-250	230-280
Adherence of the spread, coating (degree)	"0" and "1"	"0" and "1"
Notice	Corrosion protection done with organic spreads. The last protection was done in 1988.	

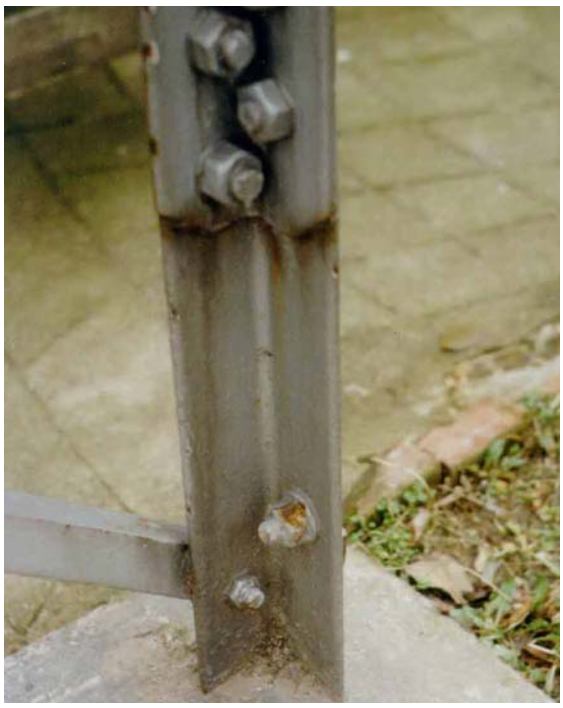

Figure 7

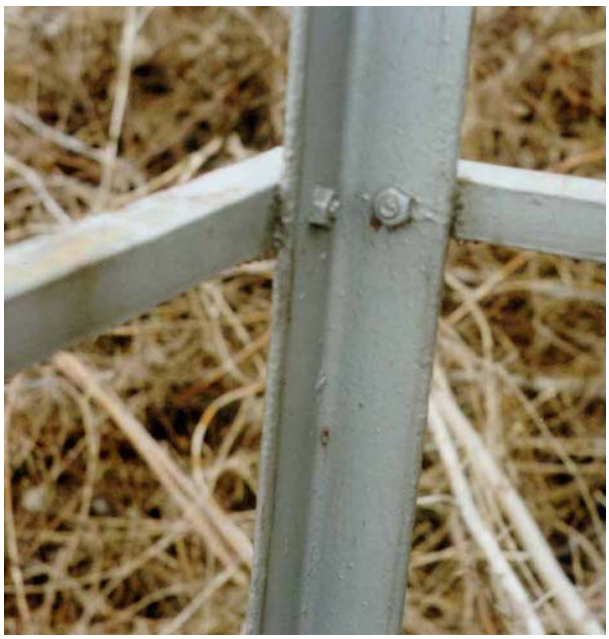

Figure 8

4 CONCLUSION

The recording of the existing condition of corrosion protection of overhead line steel – lattice towers on Belgrade territory was conducted on 4 (four) overhead lines:

35kV Beograd IV-Smederevski put
110kV Beograd V-FOB
35kV Beograd IV-Beograd XI
35kV Beograd I-Karaburma
Based on the results of the condition recorded the following can be concluded:

- The existing corrosion protection was done in zinc coating or spreading means.
- The last rehabilitation of the protection, according to the data available, was done 10 to 15 years ago.
- The condition of the existing corrosion protection is remarkably different.

On some overhead lines, namely towers, the sufficient thickness of the protection was observed, but with occurrence of partial vanishing of final spread. Mainly on lower parts of towers observed the occurrence of separation - creasing of spread was registered. On these parts the occurrence of corrosion < 1% of the surface was noticed. Corrosion is of the local character and of the surface type (Tables 1 and 4, Figures 1, 2, 7 and 8).
On overhead lines Beograd V - FOB
Beograd IV - Beograd XI (Tables 2 and 3, Figures 3, 4, 5 and 6) the measured thickness of corrosion protection, zinc coating as well as protection spreads were insufficient. On these towers the occurrence of final spread vanishing was noticed as well.

Degradation of spread in form of separation (creasing) as well as the partial corrosion of surface type was registered mainly on lower parts of the construction up to the height of 1,5 m.

- Because of great variety, the listed results of the recorded condition can be considered only as preliminary.
- In order to get the real picture of the condition of corrosion protection it is necessary to conduct more detailed and wider recording of the condition, so that the adequate and on time rehabilitation of the corrosion protection can be done.

5 BIBLIOGRAPHY

1. Mladenović S, Petrović M, Rakovski T, 1975, “Korozija i zaštita materijala" (*Corrosion and protection of materials, book in Serbian*), "Rad", Beograd.
2. Šuman A, 1981, “Metalografija" (*Metalogrphy, book in Serbian*), “Tehnološko-metalurški fakultet", Beograd
3. Stupar S, 1995, “Zaštita od korozije elemenata spojne opreme dalekovoda postupkom toplog cinkovanja" (*Corrosion protection of the overhead line accessories by hot zinc treatment, 22th Syposium JUKO CIGRE, paper in Serbian*), 22 savetovanje JUKO-CIGRE, R22-01, Vrnjačka banja.
4. Stupar S, Jašović D, Tomašević V, 1999, “Procena stepena oštećenja antikorozione zaštite čeličnih konstrukcija" (Esimation of the degree of corrosion protection damage of steel constructions, *24th Syposium JUKO CIGRE, paper in Serbian*), 24 savetovanje JUKO CIGRE, R22-09, Vrnjačka Banja.
5. JUS ISO Standardi, 1998, 12944/1 - 12944/8.