Study Comittee B2

Overhead Lines

10852_2022

Electromagnetic interference investigation of two overhead lines with a natural buried gas pipeline: Agri-Horasan Region

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Motivation

- Electromagnetic interference occurs between the transmission line and metal pipeline when they use same routes. This electromagnetic interference induces current and voltage in metal pipelines.
- Solutions to reduce the inducing voltages occurring in the pipeline in 400 kV OHLs three-phase short-circuit faults are investigated in detail.

Method/Approach

- The current distribution electromagnetic interference, grounding and soil structure analysis software (CDEGS) program is used in the calculations made in this study.
- Two different methods are used in electromagnetic interference computations. These methods are electromagnetic field theory and circuit approach.
- CDEGS's Right of Way (ROW) program makes electromagnetic interference calculations by using the circuit approach.
- OHL phase conductor and voltage, earth protection conductor, number of phase conductors , positions of phase conductors and earth protection conductor on the tower, pipeline coating thickness, and resistance, earth resistance, tower foot resistance, and cathodic protection anode are used in the simulation.

Objects of investigation

- Electromagnetic interference in a buried metal natural gas pipeline at Horasan-Agri location using the same corridor as 400 kV Erzurum III (Horasan)-Agri and 154 kV Horasan-Agri OHLs installed in Turkey is investigated.
- The variation of the current and voltage parameters induced in the metal pipeline in different tower protection conductors in the case of a three-phase fault in transmission lines.
- 400 kV OHLs earth grounding conductors used in the present study are 96 mm^2 stainless steel, 93 mm^2, and 200 mm^2 alumoweld.

Topographic Data

- Electromagnetic interference is investigated in a 42.5 km zone where the 400 kV OHL and the pipeline intersect each other 5 times with parallel routes.

Discussion

- The coating stress voltage, step voltage and, touch voltage parameters in the natural gas pipeline are calculated with CDGES when there is a 3-phase fault in the 400 kV Erzurum III (Horasan)-Agri overhead line for chosen three different types of earth protection conductors.

Type of Earth Protection Conductor	Coating Stress Voltage (V)	Step Voltage (V)	Touch Voltage (V)
96 mm^2 Stainless Steel	224.20	6.43	247.57
93 mm^2 Alumoweld	140.26 (37.4%)	4.81 (25.2%)	154.96 (37.4%)
200 mm^2 Alumoweld	68.09 (69.6%)	4.16 (35.3%)	118.21 (52.2%)

Conclusion

- 96 mm^2 steel and 93 mm^2 alumoweld conductors are in very close cross-sections, but the alumoweld protection conductor performs much better in coating stress voltage, step voltage and, touch voltage parameters.
- The voltages induced in the pipeline decrease significantly with the increase in the cross-section of alumoweld conductor.
- Since alumoweld protection conductors have higher conductivity than steel, fault current easily flows to earth conductor at high amplitude. This reduces the induced voltages on the pipeline, thus preventing the deterioration of the pipeline's coating and increasing its service life as well.

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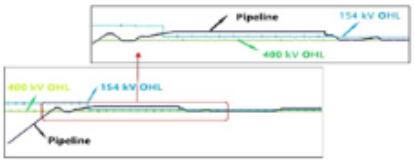
Simulation Data

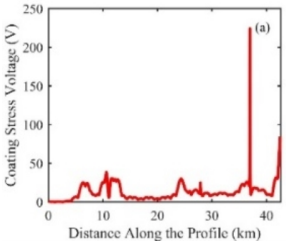
- ROWCAD simulation region and critical zone of the Horasan-Agri pipeline with 400 kV and 154 kV OHLs are shown in Figure.



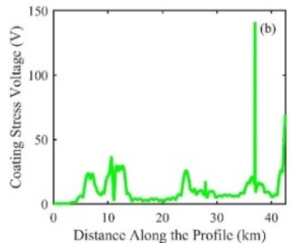
Simulation Results

A. Coating stress voltage

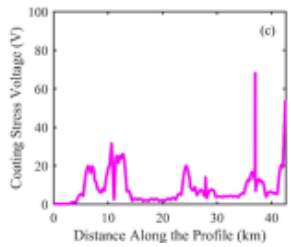
(a) 96 mm² stainless steel



(b) 93 mm² alumoweld

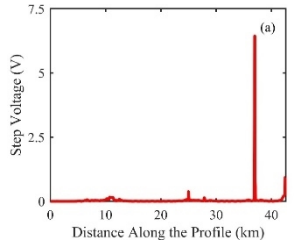


(c) 200 mm² alumoweld

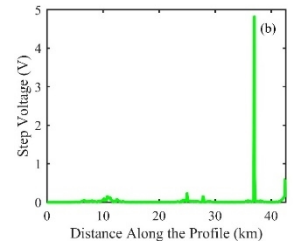


B. Step voltage

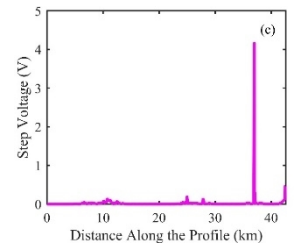
(a) 96 mm² stainless steel



(b) 93 mm² alumoweld



(c) 200 mm² alumoweld



Conclusions

- In the region where there is a significant induced voltage variation, the pipeline crosses the OHLs and approaches approximately 10 meters from the OHLs tower during this crossing (37th km).
- According to the simulation results, touch and coating stress voltage decreased significantly with earth protection conductor change.
- In practice, in similar situations, it is a suitable solution to replace the OHLs earth conductor with a better conductivity earth conductor in order to reduce the coating stress voltage and touch voltage as well.