

Protection of naval systems against electromagnetic effects due to lightning

Abstract

This study investigates possible lightning threats to naval crafts, especially those sailing in the shallow waters of tropical oceans where thunderstorms prevail throughout the year and Far-East Asian region where dangerous positive lightning is a significant characteristic in winter thunderstorms. It is empathized that sea water acts as nearly a perfect conductor thus lightning electromagnetic transients propagate over the sea with almost zero attenuation of amplitude and high frequency components intact. The ratio between the peak electric fields at 5 km from the lightning channel, after fields propagate over dry soil and over sea water is 0.75. The ratio between the peak electric field derivatives under the same conditions is 0.1. Such small ratios are observed in the magnetic fields and their time derivatives as well. Apart from the conductivity, the topological irregularities of the plane over which propagation takes place also contribute to further attenuation of fields and their time derivatives. This makes marine naval systems more vulnerable to lightning induced effects than their ground-based counterparts. The paper discusses in detail the lapses of existing naval standards in the defense of electrical and electronic systems against both direct lightning currents and induced effects of nearby lightning. Consequently we propose the development of a dedicated standard for the lightning protection of naval systems, with the inclusion of several significant recommendations specified in this paper.

Keyword: Lightning; Naval; Surge; Protection; Electromagnetic waves;