Nuclear EMP Characteristics or (What is EMP)

High altitude EMP (HEMP) is produced by a nuclear detonation at an altitude near or, more likely above 50 km; therefore it is not accompanied by other nuclear weapon effects such as heat and shock waves. The gamma radiation from the burst interacts with the atmosphere at a height of 20 to 40 km. High energy Compton recoil electrons are created in a huge “pancake- shaped" zone. The area of which is limited only by the height of the burst and the curvature of the earth. The Compton electrons are accelerated by the earth's magnetic field which results in a transverse Compton current. This transverse Compton current performs as a phased magnetic dipole array and is the primary source of the EMP fields. HEMP can cover a large portion of the continental United States due to the large area of the source current. ***Source:*** *Zaininger IEEE Trans on Pwr App & Sys, Vol PAS-104, June 1985*

The transient EMP fields are characterized by a high power density with a fast rise time, on the order of 10 ns. This fast rise time results in a wide excitation bandwidth with significant energy distributed over a broad range of the electromagnetic spectrum. The bulk of the EMP energy lies within the radio frequency spectrum. ranging from a few hertz to a few hundred megahertz.

A strong EMP may also be produced by a low altitude nuclear detonation. The intense source region EMP fields from these low altitude detonations exist only near the blast region, which may have a radius of only a few kilometers. SREMP fields attenuate quickly with distance and are normally accompanied by shock waves. However, the large surge induced into the power lines will propagate over long distances away from the blast and affect structurally undamaged portions of the electric grid.

A third type of EMP is MHD-EMP. an electromagnetic pulse with very low amplitude, which results from geomagnetic perturbations caused by a high altitude detonation. The electric field magnitude is on the order of 10 V/km. With a duration of several tens or hundreds of seconds MHD-EMP can interact with very long transmission lines to induce currents that produce harmonics and phase imbalances which can potentially damage major power system components, especially those with magnetic elements. This pulse is of very low frequency and may appear to the equipment as a direct current bias.