

DTRA Operation Independent Spark Overview: SREMP Test on an Operational Transmission-Distribution Power Substation and Components at HERMES III

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Operation Independent Spark was a successful collaboration and unique test of elements of the power grid. Participating organizations included DTRA, UK MoD Dstl, NRL, SNL, ARA, SARA, L-3 and Engility. The test was conducted in two phases: a component phase and an assembly phase. The component phase tested power grid and supporting elements. Test items included line insulators, surge arrestors, digital protective relays, computers, network routers and switches, mobile and satellite phones, and a trunked radio system. The assembly phase tested a simulated substation. Test items included two transformers, gas circuit breaker, substation battery charger, and digital protective relays. The test environment was the combined EMP and radiation pulses from HERMES III gamma simulator. The assembly phase also included a simultaneous pulse current injection.

The test sought to understand source-region EMP (SREMP) effects on a modern electrical power grid. For the component phase of the testing, the test examined potential arcing or damage to power grid elements. It characterized the time-dependent impedance of line insulators and surge arresters as a function of voltage and dose rate. The test also recorded response of operational protective relays, looking for upset, latching, or damage effects. The assembly phase looked at whether an operational substation would possibly arc or damage. Response of the simulated substation was examined as a function of dose rate as well as a synchronized 5,000 A current injected one of the transformers to simulate, as best as possible, a combined SREMP environment.

Main test results noted that no significant radiation effects on the operational power substation or its components were observed. This robust response was unexpected and significantly alters understanding of SREMP effects on the power grid. No arcing occurred during the test despite the realistic voltages and radiation levels. The unhardened COTS and radio equipment tested was not as robust to radiation as the operational power grid substation and power grid components.