# Insulator Extension Arms

## Lindsey Fail-Safe Insulator Base Testing

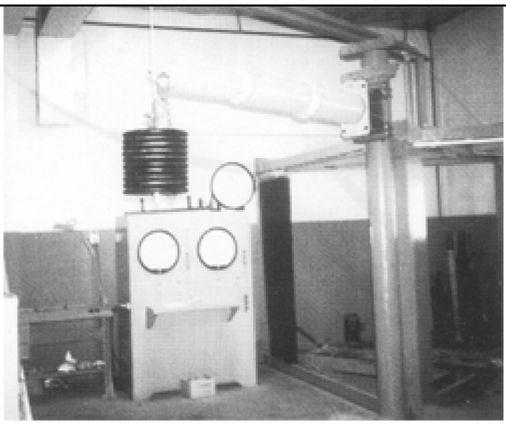

**Figure 1. Set-up of a 2000 ft./lb. Impact test on a 230 KV insulator.**

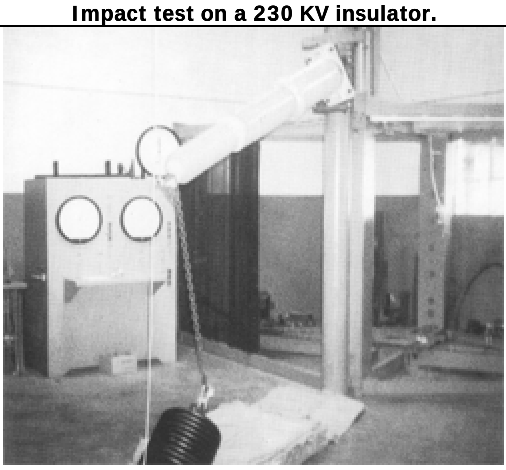

**Figure 2. Results of impact test. Note deformation of fail-safe base.**

The reliability and ultimate performance of horizontal line post insulators mounted on rigid structures is limited by the insulators ability to withstand severe loading conditions, such as a broken conductor, galloping, heavy ice loading or other highly unbalanced longitudinal loads. It is well known that when horizontal line post insulators are mounted on flexible structures, their ability to withstand severe longitudinal loading is greatly enhanced.

The Lindsey Fail-Safe Base improves the integrity of horizontal line post construction by providing a flexible support for the insulator. This flexibility lowers the dynamic stresses induced in an insulator by an impact load. In addition to this elastic flexibility, Fail-Safe Bases are designed to plastically deform at a predetermined level, thus limiting the maximum cantilever load that can be applied to the insulator. These features protect the insulator not only from longitudinal overloads but also from vertical overloading, e.g. from severe ice conditions.

Extensive static and dynamic tests have been performed on Fail-Safe Bases at our own plant (see Figures I and 2). These dynamic impact tests demonstrated that even a 230 KV insulator, when mounted on a Fail-Safe Base, would not break when subjected to four or five times the maximum impact load of a rigidly mounted insulator.

In addition to our own tests, independent full scale broken conductor tests have also been performed using these bases. In this test four lattice type towers with span lengths between 650 and 900 feet were equipped with our No. 4036 Fail-Safe Base and a 91 inch long 230 KV simulated insulator stack (see Figures 3 and 4 below).

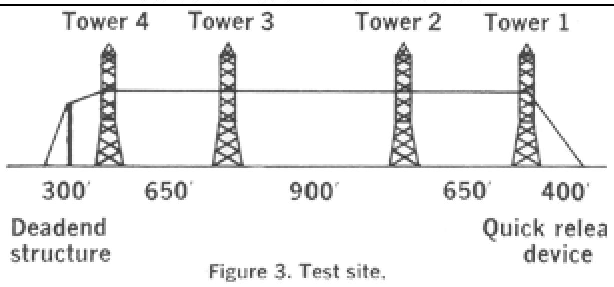


Figure 3. Test site.

**Figure 4. Tower No. 1 before test.**


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3/0 copper conductor was tensioned to 4300 lbs. After the line was cut, the first two bases plastically collapsed without damaging the insulators or dropping the conductor (see Figures 5 and 6). The third base sustained almost no damage (see Figure 7), i.e. the shock waves were almost completely damped out by the third tower due to the ability of the Fail-Safe Bases to plastically deform and absorb much of the strain energy released by a broken conductor (see Figure 8). The insulator stack in this test consisted of two station post insulators (rated at 2800 lbs.) and one pipe section with strain gages attached. The maximum dynamic cantilever loads recorded from these strain gages were 1605 lbs. at the first tower and 1620 lbs. at the second tower. These dynamic loads are well below the initial conductor tension and only slightly above the 1270 lb. static longitudinal fail-safe load of the No. 4036 Base-.

In addition to tests such as this, our own research with Fail-Safe Bases is still continuing. We are presently developing a computer model to study the static and dynamic effects of a broken conductor on horizontal post insulators mounted to structures of varying elastic-plastic flexibility. The purpose of this continued research is to insure that our Fail-Safe Bases will perform their job of adding integrity and reliability to horizontal line post construction.

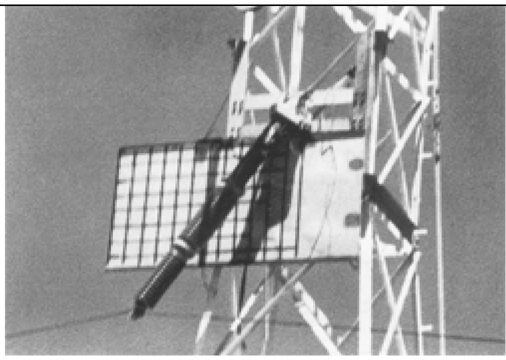

**Figure 6. Tower No. 2 after test.**

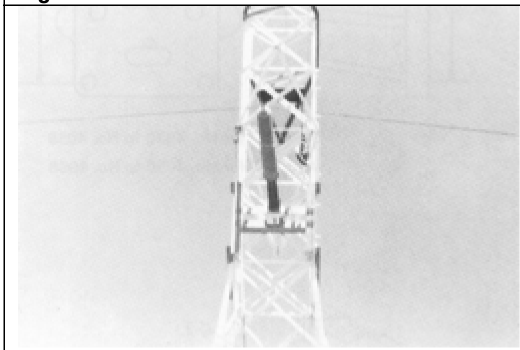

**Figure 7. Tower No. 3 after test.**

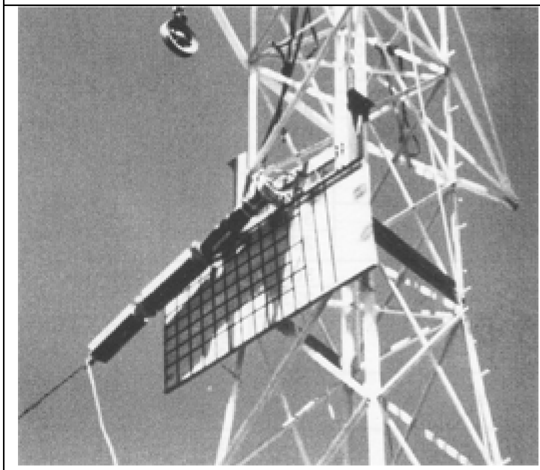

**Figure 5. Tower No. 1 after test.**

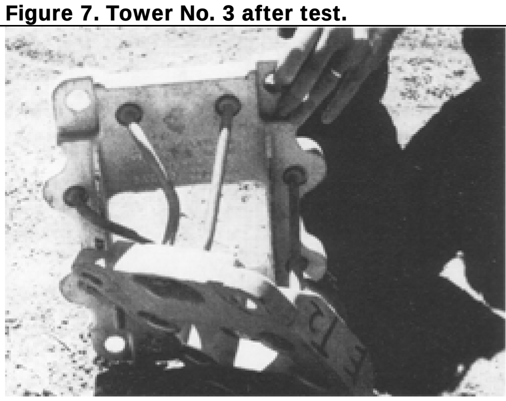

**Figure 8. Close-up of deformed base after test.**


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