NEUTRAL ISOLATION AS A MEANS OF MITIGATING ELECTROMAGNETIC FIELDS

(IIT Research Institute, April 7, 1993)

BACKGROUND

Recent developments regarding electromagnetic fields (EMF)—for example, the outcome of two Swedish studies and the unprecedented media coverage of EMF—indicate that the controversy over possible health effects is neither heading toward rapid resolution nor toward a situation without consequences for the power industry. Interest in and expectations from EMF engineering research and mitigation development remain high. Many studies have already focused on commanding subjects such as transmission lines, and deal with familiar schemes such as line compaction, underground burial of transmission lines, phase wire configurations, or more refined techniques such as the use of shielding wires. In comparison, little substantive progress has been made in mitigation on the household side of the problem, even though recent exposure assessment studies indicate that a considerable portion of the exposure to magnetic fields comes from net currents (ground currents). A research portfolio on EMF mitigation should include all reasonable approaches. We feel that neutral isolation represents a feasible approach to the management of ELF electromagnetic fields.

Part of the magnetic field exposure in a household may be due to net currents flowing on grounding wires and interconnected facilities, such as plumbing, telephone, and cable television (estimated at one third by Donnelly and Agnew, Ontario Hydro). EPRI's own survey study so far provides some support for this assessment (Zaffanella). One little-used technique that has been demonstrated to be useful in limiting the conductivity of these paths is neutral isolation at a service transformer. This technique is in compliance with the National Electrical Safety Code and has the potential to be an effective EMF mitigation tool whether used alone or in conjunction with other means. Although it is a controversial procedure with many unanswered questions with regard to safety, effectiveness, cost, and interutility coordination, neutral isolation may be a distinctive solution for the multigrounded-neutral power distribution system prevalent in the United States. The American power industry should investigate the potential value of neutral isolation for EMF mitigation.

OBJECTIVE

Evaluate service transformer neutral isolation potentials for EMF mitigation, study related safety questions, develop the know-how and engineering tools needed to utilize neutral isolation effectively and inexpensively for EMF mitigation, and publicize and disseminate information on neutral isolation both within the power industry and outside it, where interutility cooperation is essential.

APPROACH

A comprehensive and methodical program divided into three progressive phases:

- **Consolidate Data:** survey utilities and look at past uses of neutral isolation, review existing studies to establish extent of EMF problem caused by net currents, and assess EMF mitigation potential of neutral isolation.
- **Develop Engineering Tools:** develop hardware and installation specifications, investigate safety, verify effectiveness in an urban setting, and optimize application design.
- **Transfer Technology:** advance coordination with other utilities, develop source material, and disseminate information within the power industry.

STATEMENT OF WORK

PHASE 1. CONSOLIDATE DATA

Task 1. Historical Review of the Use of Neutral Isolation. Identify existing and past uses of neutral isolation among EPRI members, such as for dairy farm "stray voltage" mitigation, and among other entities, such as for the U.S. Navy ELF radio transmitter interference mitigation. Examine the issues and controversies accompanying these applications and extrapolate this knowledge to evaluate neutral isolation as a means of EMF mitigation.

Task 2. Characterization of Net Current as a Source of EMF. Review existing survey studies such as Zaffanella's and modeling studies such as Maurer's information on net current. Determine the part that net current plays in the EMF problem. This information will help in measuring the contribution of neutral isolation to the overall resolution of the EMF problem and help determine the value of this technique.

Task 3. Field Validation of Neutral Isolation for EMF Mitigation. Determine the validity of this approach at EPRI's HVTRC in Lenox, Massachusetts and through other experiments with EPRI's member utilities. Assess the effectiveness of this procedure and appraise its potential for mitigating EMF caused by net currents. The findings could be used to fine-tune the research work in the next two phases.

PHASE 2. DEVELOP ENGINEERING TOOLS

Task 4. Development of Design Specifications for EMF Neutral Isolator. Review commercially available neutral isolators and develop design specifications and installation requirements optimized for the EMF problem. Identify or develop isolation techniques and technologies for telephone, cable television, and water utilities to make neutral isolation effective, as well as other possible schemes and approaches that would improve the efficacy of neutral isolation.

Task 5. Neutral Isolation and Service Transformer Safety. Resolve the safety concerns associated with neutral isolation clearly and convincingly. Emphasize data based on staged tests and statistical time-regional studies. Outline effective remedies and strategies to improve safety.

Task 6. Neutral Isolation Effectiveness in an Urban Environment. Grounding by other utilities tends to bypass neutral isolation and become intricate in congested environments. Study the effectiveness of neutral isolation in an urban environment where the density and number of other utilities are highest. Base the analysis on a case study involving a small town.

PHASE 3. TRANSFER TECHNOLOGY

Task 7. Interutility Workshop. Organize a number of interutility workshops involving telephone, cable television, water, gas, and any other utilities to educate/coordinate them in neutral isolation concept. Cooperation and support from these other utilities is needed to make neutral isolation work. The workshops would thus provide the basis for a better understanding and closer cooperation.

Task 8. Source Material. Prepare a sourcebook on neutral isolation to be used by power utility engineers as a reference manual and as a source of information for planning, designing, costing, implementing, and dealing with neutral isolation as an EMF mitigation measure. Computer applications, ranging from expert systems to computational packages, would also be considered.