MRI REPORT

Further Studies of 60 Hz Exposure Effects on Human Function

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MASTER
October 9, 1990

PREFACE

This report summarizes the work performed during the fifth quarter of project activities (July 1, 1990 to September 30, 1990) and presents plans for the next reporting period on Grant No. DE-FG01-89CE34025 (MRI Project No. RA-111-C) entitled "Further Studies of 60 Hz Exposure Effects on Human Function."

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SECTION 1

INTRODUCTION

Public concern has been expressed about possible health risks arising from exposure to the electric and magnetic fields generated by power distribution systems. This project is addressing this concern through a laboratory research program designed to evaluate the effects of brief exposure to known field conditions on multiple measures of human function. In previous research, we found that exposure had statistically significant effects on physiological measures of cardiac and brain activity, and on performance measures of reaction time and performance accuracy. Effects were seen more clearly under intermittent exposure conditions, and at certain levels of electric and magnetic field strength.

In this continuation effort, we are performing a series of exploratory studies, to be followed by a confirmatory experiment, to determine if the above physiological effects differ as a function of exposure to the electric and magnetic fields separately and combined, time of day, and rate of intermittent exposure. Further studies will explore the mechanisms underlying these effects. The information developed in this project will be of value in risk assessment activities, and in basic research aimed at identifying specific factors involved in the interaction of power line fields with the human system.

Project status is as follows. An initial exploratory study was completed on 24 healthy male volunteers. Over multiple exposure sessions, this study evaluated whether cardiac activity differed over the day as a function of intermittent exposure to electric versus magnetic fields. Magnetic field exposure produced the pattern of cardiac change observed in our previous research; electric field exposure did not. Findings from this study were discussed with the DOE Project Review Team during their site visit to MRI in March. Two additional exploratory studies have also been completed, and an extensive series of "probe" studies is now underway to further examine variations in magnetic field exposure parameters. Preliminary results from these studies were reviewed and discussed with the DOE Project Review Team during their site visit to MRI in August.

In this reporting period our goals were to: (a) continue performance of the probe studies; (b) participate in a site visit at MRI; (c) request 1991 research continuation funding; and (d) submit an abstract of project findings for presentation at the 1990 DOE Contractors Review Meeting.

SECTION 2

ACTIVITIES DURING THE PRESENT REPORTING PERIOD

PERFORMANCE OF THE PROBE STUDIES

In our earlier exploratory studies, cardiac effects were found when subjects were exposed to magnetic fields that switched on and off every 15 sec for 45 min. A number of factors are involved in this seemingly uncomplicated situation. While the total exposure period was 45 min, the period of actual exposure to the fields was 22.5 min, and the maximum period of continuous exposure was 15 sec. In addition, during this time, the fields switched on and off 180 times, and the subject was exposed to both horizontal and vertical magnetic fields each set at a selected level of field strength. Thus, a basic issue in need of resolution is to identify which factor, or combination of factors, is the primary stimulus for cardiac change. The situation is further complicated by the fact that some individuals appear to be more responsive to the effects of the fields than others.

The aim of the ongoing probe studies is to provide information to help answer the above questions. Individuals with demonstrated sensitivity to the fields in previous studies are included among the study participants. The probe studies are performed under single-blind experimental control conditions, and they involve extensive repeated testing of individuals under a variety of exposure conditions. In each exposure session, measures of the electrocardiogram, heart rate, and abdominal and thoracic respiration are recorded and monitored in real time. Cardiac data are stored in computer files for later analysis. The studies are designed to examine how cardiac activity is influenced by variations in, and combinations of, the following exposure parameters.

- Exposure duration: Intermittent fields are being presented for periods of 15, 30, 45, 90 and 135 min.
- Intermittency rate: The magnetic fields are being switched on and off at rates of once every 15, 30, 45, 60, 120, and 180 sec.
- Field strength: Magnetic field strength levels of 50, 100, 200 and 400 mG are being evaluated.
- Field orientation: Subjects are being exposed to vertical, horizontal, and rotating magnetic fields.

PARTICIPATION IN SITE VISIT

Preliminary findings from the probe studies were reviewed and discussed with the DOE Project Review Team during their site visit to MRI in August. Based on these discussions, additional exploratory work is now underway to better understand the influence of particular configurations of field orientation and intermittent exposure rate on cardiac function.

REQUEST 1991 RESEARCH CONTINUATION FUNDING

Appropriate materials were prepared and submitted to DOE requesting a one-year continuation of this research effort for the period January 1, 1991 through December 31, 1991.

ABSTRACT SUBMISSION FOR 1990 DOE CONTRACTORS REVIEW MEETING

The following abstract of project findings was submitted for presentation at the 1990 DOE Contractors review meeting.

EXPLORATIONS OF HUMAN EXPOSURE TO INTERMITTENT ELECTRIC AND MAGNETIC FIELDS. C. Graham, H.D. Cohen, M.R. Cook and M.M. Gerkovich. Midwest Research Institute, Kansas City, MO. 64110.

In a previous double-blind study involving 45 healthy young men, we found that intermittent exposure to combined 60 Hz electric (9 kV/m) and magnetic (200 mG) fields resulted in statistically significant slowing of human heart rate and alterations in brain evoked potential measures compared to sham exposure. In this presentation, we describe the additional exploratory research we have undertaken to identify the specific exposure parameters responsible for these effects.

Our first exploratory study was designed to evaluate whether physiological effects differed over the day as a function of intermittent exposure to the electric versus the magnetic fields. Twenty four healthy young men participated in the study. Over two test sessions, 12 of the men were exposed to the electric field (9 kV/m) and the sham field, and 12 were exposed to the magnetic field (200 mG) and the sham field. Exposure order was counterbalanced, and within each group, half the men were exposed in the morning and half in the afternoon. The fields were presented at the intermittent rate used in our previous study (i.e., the fields were switched on and off four times a minute for two 45-min periods separated by a 45-min sham exposure period). Heart rate was recorded continuously, and additional physiological measures were obtained before and after each 45-min exposure epoch. Exposure to the magnetic fields produced the same pattern of

cardiac changes observed in our previous research. This pattern was not found when subjects were exposed to the electric field.

Subsequent research has focused exclusively on the effects of exposure to the magnetic fields. A series of small-scale "probe" experiments is currently underway to better understand how physiological activity is influenced by variations in, and combinations of, the following parameters: (a) exposure duration (15 to 135 min); (b) intermittency rate (fields switched on and off at 15 to 180 sec); (c) field strength (50 to 400 mG); and (d) field orientation (vertical, horizontal, and rotating). A standardized testing protocol is followed in the probe studies, and the data obtained are analyzed to evaluate six specific hypotheses derived from our previous exposure research. The findings will be used to design an appropriately-controlled confirmatory experiment, and in future research to identify the specific factors involved in the interaction of power line fields with the human system.

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SECTION 3

PLANS FOR THE NEXT REPORTING PERIOD

Our plans for the next reporting period are to:

- Continue performance of the probe studies.
- Participate in the 1990 DOE Contractors Review Meeting.

SECTION 4

PERSONNEL CHANGES

No personnel changes have occurred during this reporting period.

- END -

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