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THE CONTINUING MEDICAL SURVEILLANCE OF PERSONNEL EXPOSED TO EXTREMELY LOW FREQUENCY (ELF) ELECTROMAGNETIC FIELDS

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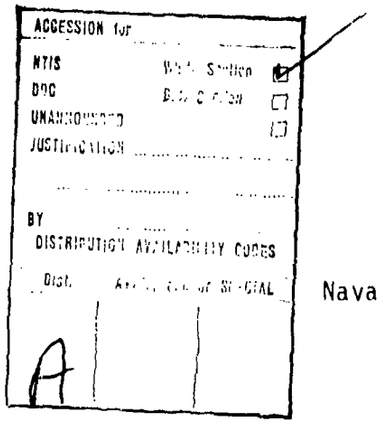

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SUMMARY PAGE

THE PROBLEM

In the occupational health survey, initiated in 1971 by Krumpe and Tockman at the Naval Medical Research Unit #4 (NMRU-4), Great Lakes, Illinois, 24 age-sex pairs of controls and personnel associated with the Extremely Low Frequency Wisconsin Test Facility were examined. The objective of the program was "to investigate the effects of extremely low frequency (ELF) electromagnetic radiation on the health of personnel working near the Test Facility in Clam Lake, Wisconsin." By 1975 only six subjects remained, including five from the original group. As each year passed and fewer personnel were available for follow up, it became readily apparent that, because of the small population, it would not be possible to detect subtle changes in the health of the exposed personnel that might be attributed to ELF electromagnetic radiation. Due to the closure of NMRU-4, the annual examinations in 1974 and 1975 were conducted at the Naval Aerospace Medical Research Laboratory (NAMRL) in Pensacola, Florida.

FINDINGS

All of the test results can logically be related to diet and personal habits, genetic predisposition, or concurrent medical disease. More extensive use of laboratory techniques, tests of carbohydrate and lipid metabolism, and analyses of endocrine function were employed in the 1974-1975 examinations. Statistics were not employed due to the small number of subjects. Since 1973 the purpose of continuing the surveillance has been to monitor the state of health of the personnel working or living near the ELF antenna system.

While there was no evidence to indicate that the ELF communication test system had any deleterious effect on the health of personnel, the nature and scope of this health surveillance program does not lend itself to certifying the safety of the system.

ACKNOWLEDGMENTS

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INTRODUCTION

Since 1971 personnel manning and operating the ELF communications test station near Clam Lake, Wisconsin, have been provided the opportunity to volunteer for participation in a medical surveillance program. Initially, the stated objective was to determine if there were any obvious trends noticeable in routine clinical evaluation that could possibly be related to ELF electromagnetic field exposure.

The objective of this report is to present the results of the continuing medical surveillance of those persons associated with the ELF communication system who have volunteered to have annual medical evaluations. The small number of subjects, some of whom had pre-existing medical problems, and the loss of paired controls make it impossible to validly determine the effect, or lack of effect, of ELF radiation on health. Therefore, this report is not a survey, but a report of the medical surveillance performed on a small group of people over periods ranging from 2 to 5 years along with statements regarding their health.

Because of the small numbers of people participating in the study, in order to protect their rights against unauthorized disclosure under Title 5 USC 301, and Executive Order 9397, all specific information, the nature of which would allow their easy identification, is not published in this report. In signing consent agreements the subjects indicated their desire to remain anonymous and refused permission to use specific case summaries and specific data assigned to them by coded means or otherwise. The author agrees, since assignment of findings by age and sex specifically identifies each person participating in the study.

HISTORY OF VOLUNTEER PARTICIPATION IN THE MEDICAL SURVEILLANCE PROGRAM

No vehicle currently exists to insure participation of volunteers in the medical surveillance program. Table I details the specifics of the subjects' participation in the medical surveillance program. By 1975 only six subjects remained, five of whom have been in the study since 1971. As the number of subjects gets smaller, the value of the program diminishes.

METHODS AND PROCEDURES

EXAMINATION PROFILE AT PENSACOLA

The extensive physical examination, including physiochemical survey and psychometric testing, was structured to cover various parameters which had been specified by other studies as being important or of interest in magnetic field studies (1-6). Emphasis was placed on objective analysis of history, physical examination, testing, and analysis of body fluids and functions, without injecting any materials or taking biopsies. Wherever possible, the

items of the examinations performed at Great Lakes were repeated in Pensacola, the only exceptions permitted were when a given technique could be supplanted by a more advanced technique yielding more information. Since the subjects were available for only one week, some redundancy was built into the examination protocol in order to avoid losing any significant parameters. Certain tests such as glucoses, triglycerides, cholesterol, and other lipids were repeated several times.

On arrival Monday afternoon, the subjects were greeted and briefed by a member of the staff and shown to their quarters. They were asked to abstain from using alcoholic beverages during the week, and were given several forms and questionnaires to fill out for medical history, physical examination, and informed consent documents allowing the performance of their examinations. The first three days they were asked to fast from 2000 hours (8 p.m.) the night before testing and not take any medication without the staff's knowledge. The day after arrival, blood was drawn at 0730 for serum lipid profile, carbohydrate screening, and blood alcohol determinations. Eye examinations, audiology, radiography, and other required consultations were performed on a flexible scheduling basis. The format outlined in Table II was closely followed. This is particularly true in the case of blood drawing. History review and physical examinations were performed on Tuesday and Wednesday afternoons. EEG with hyperventilation and photic stimulation was done Wednesday morning after the major blood drawing, but before breakfast. Three or five-hour glucose tolerance tests were run on Tuesdays or Thursdays; pulmonary function and resting/treadmill EKG's were performed on Tuesdays, Wednesdays or Thursdays. Psychometric testing was performed as other studies were completed and sufficient time became available. Table III itemizes the clinical data collected during the 1974 and 1975 examinations.

After collecting all of the information, the subjects were debriefed and information prepared for their private physicians. One of the features used to solicit the subjects' cooperation was to make the records completely available to their private physicians on request. This and their own spirit of cooperation seemed to be the most dominant reasons for continued participation of the six subjects remaining in the study as of 1975.

DATA ANALYSIS OF PENSACOLA EXAMINATIONS

Because of the small number of subjects, it was decided to treat the information collected in a conventional clinical format. The detailed medical history the subject compiled was reviewed by the physician with each one before his/her physical examinations. All positive past or current complaints were discussed in depth; present history, past medical history, and review of systems were recorded. The raw records and objectively acquired data were stored for codification and analysis that may be required at a later date.

Positive physical findings were noted on an SF88 physical examination form. As subspecialty material arrived, it was noted and attached to the SF88 record. Completed records consisted of a detailed summary, physical examination, laboratory sheet, electrocardiographic records, pulmonary function records, psychometric profiles, vectorcardiograms, ophthalmology reports, and EEG reports. The last page of the summary contained a listing of all

verified medical diagnoses, and included their present clinical status (in remission, completed, active, inactive, acute, chronic, etc.). These were then related to the findings listed for 1973 and for 1971, and 1972. Progression of continuing medical disorders was carefully noted, and if necessary, specific recommendations were made to the subjects for follow up by their private physicians. All objective data were then collected and put on a master flow chart for following the year-to-year progress of the subjects from 1971 to 1975.

EXAMINATION PROFILE AT GREAT LAKES

Krumpe and Tockman (7,8) described in considerable detail (8) the profile design used to evaluate the original 48 volunteer subjects in 1971, and the remaining subjects in 1972. All objective data have been received by the principal investigator, as well as history questionnaires and psychometric information. In 1973 the data were collected in the same manner as described previously.

For sake of continuity, after completing the 1974/1975 examinations, all of the available 1971-1973 information was converted into a standard clinical format. Insofar as possible the five subjects remaining from the original survey were traced to 1971 and their data examined. In this manner the subjects' medical progress, laboratory data, and other information can be compared and followed for the 5-year surveillance period.

RESULTS

Of the seven individuals remaining in the surveillance program in 1973, there was little change in their general health status from 1971. Some changes in laboratory results occurred, which could be related to changes in laboratory methodology. A protocol shift was made in carbohydrate parameters (7). The standard 100-gram glucose meal given for the glucose tolerance test (GTT) was replaced by an amount equal to 40 grams per square meter of the subject's body surface. This caused some changes in the GTT numbers, but did not alter any subject's handling of the glucose load. No significant new clinical disorders surfaced in 1973. Some problems noted in earlier examinations were observed to be progressing; for example, three subjects who were overweight in 1972 had continued to gain weight in 1973. In 1974/1975, four of the six subjects examined had elevated GTT; three of these had elevated GTT since 1971, and one was added to the group as time progressed (Tables IV and V).

Table IV shows the age progression of the total study group over the entire surveillance period. For this group the fluctuations in mean age occurred as persons left or entered the study, as documented in Table I. For comparison the same data are presented in Table V for the five subjects present in the study since 1971.

Table VI contains the mean serum triglyceride levels of the five subjects participating in the study in all five years. These data are hard to compare since methodology is different in 1971, 1972/1973, and 1974-1975. (The normal range listed for 1972/1973 at NRMC Great Lakes Laboratory is 20 mg/100 ml.) The standard deviations are very wide because of the small population size and the variability in triglyceride levels between individuals.

Certain other laboratory parameters were definitely out of normal range for specific subjects: hyperuricemia in one subject known to have gout, depressed thyroid function studies in one subject with a past history of treated hypothyroidism, and abnormal liver function studies in a subject with clinical evidence of liver enlargement. Other findings include a clinically evident lens opacity in a subject with past history of eye trauma; high frequency hearing loss in one or both ears of three subjects, all of whom have a history of exposure to high impulse noise (gunfire), and occupational (jet engine) high intensity noise exposure; and benign prostatic enlargement in one subject.

Except for one subject, all electrocardiograms taken at rest were normal. The abnormality in the one subject had been noted in previous examination, however. Electroencephalograms were all entirely normal, as were routine X-rays (see Table III). PAP smears have continued to be Class I for the female participants from 1971 to 1975.

Psychological testing and personal interview substantiate the previous findings noted by Krumpe and Tockman (7), with virtually no changes apparent.

DISCUSSION

Greater emphasis on lipid metabolism in the 1974 report (7) would have been desirable, but these parameters did not become of specific interest until 1973 (3). There is difficulty in interpreting the results of serum triglycerides as indicated in Tables IV, V, and VI, because of the use of different laboratory techniques (7). Isolated single sample laboratory results often return "abnormal" for spurious reasons, and require repeating for verification. Because of the short period of time the subjects were available at Great Lakes, this was not always possible. In 1974/1975 this redundanc was deliberately put into the examination protocol, and served to clarify which subject has abnormalities in lipid metabolism.

Table VII lists the tests performed in the early examinations and deleted or replaced in 1974/1975. These tests, when performed at Pensacola, were done on the basis of clinical indication and not as a routine part of the medical surveillance.

Certain tests were added during 1974/1975 examinations because they dealt specifically with lipid metabolism or were indicated by patient history or physical findings. Table VIII lists these additions to the protocol. One feature of the Pensacola examinations was that the same physician performed all of the physical examinations, conducted the interviews,

collected and collated the data, as well as maintained the records and wrote the patient summaries. This ensured that all portions of the examinations were the same in 1974 and 1975.

CONCLUSIONS

As noted in the original report (8), the health status of the volunteers participating in this health surveillance program is stable. Four of the six remaining subjects have a significant health problem that requires medical attention. This may be important in determining what disposes an individual to volunteer for participation in a medical surveillance program.

There is no evidence that exposure to the ELF electromagnetic fields of the Wisconsin Test Facility bears any causal relationship to the abnormal findings seen in the surveyed population. There is nothing noted that cannot be appropriately explained by known causes of these abnormalities. Elevated GTT results are not uncommon and are often found in association with lipid abnormalities. Obesity, hypertension, and heart disease are also observed in association with elevated GTT. With so few subjects, many of whom had pre-existing medical problems, it is impossible to determine what effect ELF electromagnetic fields might have on the general health of people. It is therefore recommended that the Navy-sponsored surveillance of the health of WTF personnel be discontinued.

REFERENCES

1. Llaurado, J. G., Sances, A., Jr., and Battocletti, J. A. (Eds.), Biologic and Clinical Effects of Low Frequency Magnetic and Electric Fields. Springfield, Illinois: Charles C. Thomas, 1974.

2. Kouwenhoven, W. B., Longworthy, O. R., Singewald, M. L., and Knickerbocker, G. G., Medical evaluation of men working in alternating electric fields. IEEE Trans Power Apparatus Systems, PAS-86:506-511, 1967.

3. Beischer, D. E., Grissett, J. D., and Mitchell, R. E., Exposure of man to magnetic fields alternating at extremely low frequency. NAMRL-1180. Pensacola, Florida, 32512: Naval Aerospace Medical Research Laboratory, July, 1973.

4. Gibson, R. F., and Moroney, W. F., The effect of extremely low frequency magnetic fields on human performance: A preliminary study. NAMRL-1195. Pensacola, Florida, 32512: Naval Aerospace Medical Research Laboratory, August, 1974.

5. Beischer, D. E., Human tolerance to magnetic fields. Astronautics, 7, 1962.

6. Kaufman, G. E., and Michaelson, S. M., Critical review of the biological effects of electric and magnetic fields (Chapter 3). In: Llaurado, J. G., Sances, A., Jr., and Battocletti, J. A. (Eds.), Biologic and Clinical Effects of Low Frequency Magnetic and Electric Fields. Springfield, Illinois: Charles C. Thomas, 1974. Pp 49-61.

7. Krumpe, P. E., and Tockman, M. S., Evaluation of the health of personnel working near Project Sanguine Beta Test Facility from 1971 to 1972. In: Llaurado, J. G., Sances, A., Jr., and Battocletti, J. A. (Eds.), Biologic and Clinical Effects of Low Frequency Magnetic and Electric Fields. Springfield, Illinois: Charles C. Thomas, 1974. Pp 98-122.

8. Krumpe, P. E., and Tockman, M. S., Evaluation of health of personnel working near Project Sanguine Beta Test Facility from 1971 to 1972. Technical Report. Great Lakes, Illinois: Naval Medical Research Unit No. 4, December, 1972.

9. Classification of hyperlipidemia and hyperlipoproteinemias. Bulletin of the World Health Organization, 43:891, 1970. Cited in Circulation, 45:501-508, 1972.

Table I

History of Volunteer Subject Participation in the Medical Surveillance Program

YEAR	TOTAL NUMBER SUBJECTS	NEW SUBJECTS	SUBJECTS LOST TO STUDY	COMMENT
1971	24 Exposed (3 Female) 24 Control (3 Female)	-	-	NMRU-4 assigned task of the medical surveillance. RCA is contractor for ELF project.
1972	12 Exposed (2 Female) 21 Control	0 0	12 Exposed 3 Control	Nine original age-sex pairs were available for study; all were male. These are the only ones reported on by Krumpe and Tockman (1).
1973	8 Exposed (2 Female) 0 Controls	1 Exposed	5 Exposed 21 Control	Of four new employees only one consented to participate in the study. NMRU-4 closed.
1974	7 Exposed (2 Female) 0 Controls	1 Exposed	2 Exposed	NAMRL, Pensacola, FL, assigned surveillance responsibility of the subjects. Sylvania awarded contract for ELF Project.
1975	6 Exposed (2 Female) 0 Controls	0	1 Exposed	Of the original 24 exposed subjects 5 persons (3 male and 2 female) are left. The additional male subject entered the surveillance group in 1974.

Table II

Medical Examination Schedule 1974/1975
(Conducted February and March)

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
0730		Blood Drawn	Blood Drawn	Blood Drawn	Used for blood drawing if necessary
0800		EKG Treadmill Vectorcardio-graphy Pulmonary functions	EEG	Glucose Tolerance and Insulin Response Tests	
0900					
1000			Eye Clinic		Debriefing
1100					
1130			Audiology	X-rays	DEPARTURE
1300		Physical Examinations	Psychological Testing	Consultation and/or Psychological Testing	
1400					
1500					
1600	ARRIVAL				
1630	Briefing			F R E E	
1800	SUPPER	SUPPER	SUPPER	T I M E	
1930					
2400	Water Only	Water Only	Water Only		
	NPO	NPO	NPO		

Table III

Factors Analyzed in the Medical Examinations of 1974/1975

CLINICAL STUDY	DETERMINATION	COMMENT (See Notes at End of Table)
Subject Medical History	Subjective Complaint	Personal History Forms (1)
Physical Examination	Objective Findings	Performed by Author
Clinical Services		See Note (2)
Cardiology	Routine 12 Lead EKG	Supervised by CAPT Kevin Stanton, MC, USN
	Treadmill EKG	Omitted in 2 cases for Reasons of Clinical Contraindication
	Vectorcardiography	
Pulmonary Service	Pulmonary Function Studies	Supervised by CDR David L. Stoop, MC, USN
ENT	Examination	Performed by Author
	Audiometrics	Audiology Lab, NAMRL
Eye Examination	AFVT Screening Manifest and Objective Tonometry Slit Lamp Examinations Funduscopic Exam Color Vision (Isihara Plates)	Clinical Referral: Performed by CAPT Fred S. Evans, MC, USN, Ophthalmologist
Neurology	Working & Resting Electroencephalography (Photic & hyperventilation stimulation also performed)	Supervised by LCDR M. J. Luzecky, MC, USNR, Staff Neurologist

Table III, Continued

CLINICAL STUDY	DETERMINATION	COMMENT (See Notes at End of Table)
Psychology: Psychometric Tests	Minnesota Multiphasic Personality Inventory (MMPI) Personality Research Forum Personality Tests (PRF) Wechsler Adult Intelligence Scale (WAIS) Psychiatric Interview Questionnaire	Evaluated and interpreted by LCDR John Jones, MSC, USNR, Staff Clinical Psychologist
Radiographic Studies	Chest X-ray (PA & Lateral)	Specific studies were ordered as history or physical findings dictated (Cardiac series with Barium swallow, Cholecystogram, etc.).
Serum Biochemistry	SMAC Analysis Calcium Inorganic Phosphorous Glucose BUN Uric Acid Cholesterol Total Protein Albumin Bilirubin (Total) Alkaline Phosphatase LDH SGOT Sodium Potassium Chloride CO_2 Creatinine Serum Iron Triglycerides Glucose Tolerance Test Insulin Response Curve	See Note (2) Glucose oxidase reaction See Notes (3) & (4), Hycel Method See Notes (3) & (4), Hycel Method 100 Grams Dextol, See Notes (3) & (4)

Table III, Continued

CLINICAL STUDY	DETERMINATION	COMMENT (See Notes at End of Table)
Serum Biochemistry (Continued)	Lipid Profile	
	Cholesterol	See Note (4)
	Triglycerides	See Note (4)
	Total Lipids	
	Phospholipids	
	Free Fatty Acids	
	Lipoproteins Electrophoresis	See Notes (3) and (4)
	Serum Protein Electrophoresis	
	Endocrine Profile	
	TSH	
	GH	Abbot CABS, ^{125}HGH
	Testosterone	
	Protein Bound Iodine	
	T_3 Uptake	Malinckrodt T_3 ^{131}I kit
	T_4 Isotope	Malinckrodt "Resomat" Diagnostic Kit
	Free Thyroxin	
	ST-3	
	Plasma Cortisol	Acid Fluorescence Method
	Serum Insulins	RIA procedure - Schwartz Mann Diagnostic Reagents
	Blood Toxicology	
	Blood Alcohol	
	RBC Cholinesterase	
	Plasma Cholinesterase	
	Blood Lead	
	Other Analyses	
	Amylase	
	Lipase	
	Creatine Phosphokinase	
	Direct Bilirubins	
Serology	VDRL	See Note (5)
	ASO Titer	See Note (5)
	Latex Fixation	See Note (5)

Table III, Continued

CLINICAL STUDY	DETERMINATIONS	COMMENT (See Notes at End of Table)
Hematology	Hemoglobin Hematocrit White Blood Cell Count Red Blood Cell Count Red Blood Cell Indices Differential Counts Platelet Count Erythrocyte Sedimentation Rate Prothrombin Time	See Note (5) Quick Method
Urine Analysis	Routine Microscopic Occult Blood	See Note (5)
Other Tests	Papanicolau Cervical Smears Guiac Spot Test of Stool	See Note (5)

Notes:

(1) The NAMI Personal History Forms are basically analogous to the Cornell Medical Index, but coded differently for local computerization and stress organic illness.

(2) Unless otherwise indicated, all laboratory procedures were performed by Regional Medical Laboratories of Pensacola, Florida, under the direction of CDR T. E. Wheeler, MSC, USN(Ret.).

(3) Tests performed by the Regional Medical Laboratories using autoanalyzer techniques or modification of Hycel fluorometric determinations.

(4) Test performed by Mr. Don Personette, NAMRL, Laboratory Technician under Dr. Houk's supervision. All tests were "bench" methodology performed on split samples from those sent to Regional Medical Laboratories. Parameters duplicated and rerun involved: serum glucose by a modified glucose oxidase method; serum triglycerides and cholesterol by a modified technique using Oxford Laboratory reagents and control sera.

(5) Tests performed at NAMRL, Pensacola, Florida, or NRMC Hospital Laboratories, Pensacola, Florida.

Table IV

Listing of Medical Problems Experienced by ELF Exposed Personnel Participating in the Medical Surveillance Program in 1973, 1974, or 1975

	1973	1974	1975
Total Number of Subjects in Group	8	7	6
Mean ±1 S.D. Age of Total Study Group	40.4(±11.3)	39.9(±9.0)	43.5(±6.3)
Number of Subjects with Elevated GTT	5	4	4
Number of Subjects with Labile or Benign Essential Hypertension	4	3	3
Number of Subjects Overweight	3	3	2
Number of Subjects with Documented Cardiovascular Disease	2	2	2
Number of Subjects with Elevated Triglycerides	4*	4	4
Number of Subjects with Type VI Hyper (pre Beta, lipoproteinemia on Lipoprotein Phenotyping (10)	--	4	4

*Normal range < 200 mg/100 ml

Table V

Listing of Medical Problems Experienced by the Five Subjects Participating in the Entire Study

	1971	1972	1973	1974	1975
Age of Subjects, Mean ±1 S.D.	38.4(±6.4)	39.4(±6.4)	40.4(±6.4)	41.4(±6.4)	42.4(±6.4)
Number of Subjects with Elevated GTT	3	3	3	3	3
Number of Subjects with Labile or Benign Essential Hypertension	2	2	3	3	3
Number of Subjects Overweight	2	2	2	2	2
Number of Subjects with Documented Cardiovascular Disease	2	2	2	2	2
Number of Subjects with Elevated Triglycerides	--*	3	3	3	3
Number of Subjects with Type IV Hyper (pre Beta) lipoproteinemia (10)	--	--	--	3	3

*Data on 2 subjects not available

Table VI

Yearly Triglyceride Values (Mean ± 1 S.D.) for the Five Subjects Remaining from the Original Study

	1971	1972	1973	1974	1975
Second Day Serum Triglyceride Levels (mg/100 ml)	134.3* (±63.7)	216.4+ (±64.8)	217.0+ (±111.6)	148.2** (±81.4)	133.6** (±86.7)
Third Day Serum Triglyceride Levels (mg/100 ml)	--	--	--	134.4** (±63.4)	129.3** (±62.5)
Fourth Day Serum Triglyceride Levels (mg/100 ml)	--	--	--	122.5** (±62.5)	121.6** (±63.0)

*Data for 3 measurements available only (normal < 150 mg/100 ml)

+New laboratory methodology used (normal < 200 mg/100 ml)

**Performed at NAMRL, Pensacola, Florida. Values verified by sample splits and duplicate runs by Regional Medical Laboratories, Pensacola, Florida. (normal < 160 mg/100 ml).

NOTE: Three of the five subjects have documented Type IV Hyperlipidemia noted in 1974 or 1975.

Table VII

Tests Deleted During 1974/1975 Examinations But Performed Previously (1971/1972) (1973)

TEST	REASON
Master's 3-lead exercise EKG	Replaced by treadmill EKG (Modified Bruce Method)
Caloric stimulation of oculovestibular reflex	Clinical indication by history or physical findings
Electromyography and nerve conduction velocity	Same as above
Skull series (X-ray)	Same as above
Antinuclear antibody test	Same as above
C-Reactive protein	Same as above
24-hour urine collection for 17-OH steroids, 17 ketogenic steroids, creatinine clearance	Same as above
Stool Ova and parasites, culture for euteric pathogenis	Same as above
Semen analysis (Note 1)	Same as above

(1) This will not be of value since several male subjects have had vasectomies.

Table VIII

Tests Added During 1974/1975 Examinations

ADDED TO PROTOCOL	SPECIFICS
Indicated clinical testing	Toxicology, X-rays, serum studies (See Table III)
Insulin response to glucose injection	Serum insulin levels by radioimunoassay
Complete lipid profile	Total serum lipids, free fatty acids, phospholipids
Serum lipoprotein electrophoresis	Classifications by WHO standards* of lipid abnormalities
Serial lipid studies over 3 days	Triglycerides and cholesterols
Serum endocrine studies	Especially as they relate to lipid and carbohydrate metabolism and sterility (See Table III)

*Reference (9)

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The previously reported evaluation of the health of civilians residing or working near the Wisconsin Extremely Low Frequency (ELF) Test Facility has been continued at the Naval Aerospace Medical Research Laboratory in Pensacola, Florida, in 1974 and 1975. The content of the previous report is reviewed and discussed, especially with respect to the reporting format and results obtained. Seven civilian subjects, five male and two female, five of whom are part of the original group of 24, participated in the continuing surveillance program. One new employee was added to the group in 1974, and one declined to participate in

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1975. Since none of the 24 matched control group volunteers were available after 1972, the format adopted for the original program was revised. Additional tests were added to further study lipid and carbohydrate metabolism to reflect the current interest in these parameters. Throughout the entire period of medical surveillance from 1971 to 1975, there was no evidence of any particular disease induction, physiochemical parameter alteration, nor aberration of psychological tests attributable to ELF electromagnetic field exposure.