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# REVIEW OF OCCUPATIONAL SAFETY AND HEALTH ASPECTS OF ELECTROMAGNETIC PULSE EXPOSURE


Lovelace Biomedical and Environmental Research Institute

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Final Report


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This report describes the nature of the typical occupational exposure to electromagnetic pulses (EMP) received by personnel working at EMP simulator facilities and summarizes the medical surveillance observations collected on those personnel. Data from both informal observations and from comprehensive annual physical examinations of approximately 600 workers exposed to various EMP's over a number of years disclosed no adverse health effects attributable to EMP exposure. It was concluded that sufficient no-effect findings from

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20. ABSTRACT (Continued)

both the human and animal experiences now exist to confidently allay fears of an EMP worker exposure hazard, at least for within a 10-year observational time frame.



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## TABLE OF CONTENTS



## LIST OF TABLES



## LIST OF FIGURES

## INTRODUCTION

Electromagnetic pulse (EMP) simulators have been in operation in this country since the early 1960's. Their mission involves the study of EM fields designed to simulate the intense electromagnetic transient that accompanies a nuclear explosion, which may involve field densities on the order of $10^5$ volts/meter with nanosecond rise and fall times. Because the nuclear EMP's large area of coverage can extend far beyond that of the blast, thermal or radiation components, especially for a high altitude detonation, the EMP represents a threat to electrical circuits and communications lines lying up to hundreds of miles from the point of detonation. Consequently, EMP testing of electronic systems' survivability/vulnerability for weapons-related and communications purposes has become a significant effort. Expanding programs to test and harden vital new systems against EMP damage or disruption have required new and more potent EMP simulators.[1]

Electromagnetic pulse site personnel work regularly in the vicinity of these extraordinary electrical fields and concern about possibly injurious effects and safe exposure limits has naturally been voiced.[2] Accordingly, the purpose of the present report is to describe the EMP worker's exposure environment and to summarize the observations of some of the medical surveillance programs conducted on this work force.

## EMP EXPOSURE ENVIRONMENT

To convey some appreciation for the nature of the EMP worker's exposure environment, Figure 1 depicts an aerial view of an Advanced Airborne Command Post (Boeing 747) undergoing EMP testing at the Air Force Weapons Laboratory (AFWL) Horizontal Dipole Facility on Kirtland AFB, Albuquerque, New Mexico. This simulator projects horizontally polarized pulses to the aircraft or other target within the "working volume" on the concrete pad. Other pulsers orient their E-fields (electric field intensity in volts/meter, V/m) in a variety of ways depending on the threat test's purpose. The Navy's EMPRESS (Electromagnetic Pulse Radiation Environment Simulator for Ships), located on a spit projecting into the Patuxent River at the Naval Ordnance Laboratory, Solomons, Maryland, can be configured to pulse large ships within its working area 300

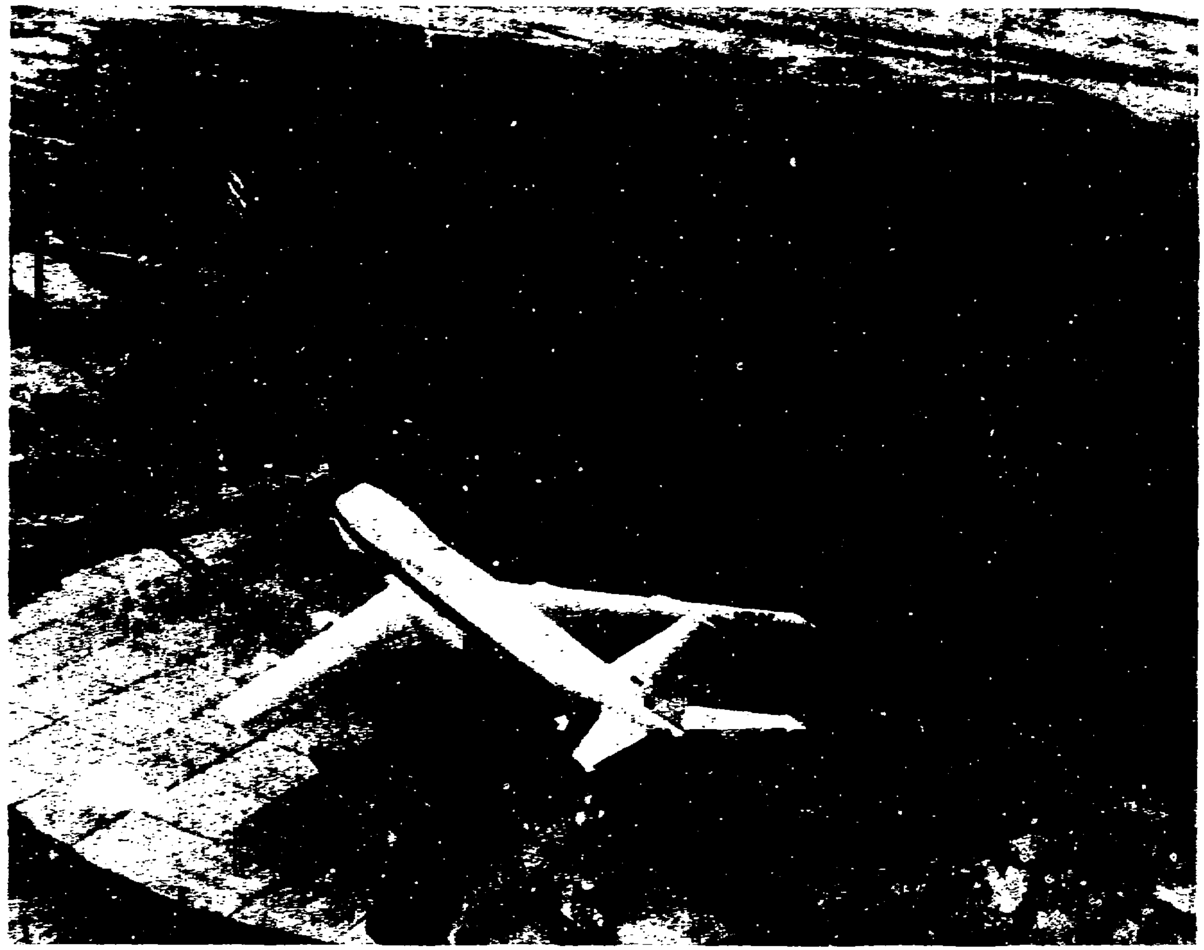

Figure 1. Advanced Airborne Command Post Undergoing Low-Level Electromagnetic Pulse Testing at Air Force Weapons Laboratory at the HDP Facility EMP Simulation Facility, Kirtland Air Force Base, New Mexico.

meters offshore, as well as aircraft flying overhead. The AFWL operates a variety of pulse simulators, including one which can be carried beneath a heli-copter to pulse airborne targets from above.[3]

The view of the Horizontal Dipole Facility shows some of the office and laboratory buildings and trailers located some distance, typically hundreds of meters, from the working volume of the pulser. Field mapping studies performed at ARES (Advanced Research Electromagnetic Simulator, another USAF/AFWL pulser) have shown that, although E-field intensities of $10^5$ V/m may be produced within ARES' working volume, the fields measured in or outside the buildings and trailers range from $10^2$ to $10^3$ V/m (the reduction, of course, being due to $r^{-1}$ distance attenuation plus structural shielding). For perspective, it is commonplace to measure ambient E-fields on the order of $> 10^4$ V/m beneath stormclouds[4] and 250 V/m approximately 30 cm from an electric blanket.[5]

Electromagnetic pulse site personnel not in the offices might be performing their duties within the test aircraft/missile/ship itself or in screened or underground rooms nearby. For undistorted recording, the electronic monitoring equipment itself must be protected against EMP interference; thus the thorough shielding required for this purpose likewise ensures that the instrumentation technicians tending the equipment receive something less than $10^3$ V/m per pulse. Shielding may also be provided by the metallic hull of a typical test object and by any additional screened enclosures within it needed to protect the monitoring devices and, thus, the technicians. It is seldom necessary for a worker to be in an E-field $\geq 10^4$ V/m in the normal course of his duties, except possibly during the pulser's initial installation and acceptance testing.

Additional important exposure parameters to consider, apart from the EMP's peak field intensity, are the pulse frequency spectrum and repetition rate. A typical EMP pulse has a rise time to peak intensity of less than 10 nanoseconds followed by an exponential decay lasting several hundred nanoseconds. The frequency content extends up to 100 MHz, but peak intensities occur below 10 MHz.[6]

The normal pulse repetition rate attainable by many EMP simulators is rather low: for instance, one pulse every several minutes. The interpulse interval is a function of the time required to recharge the condenser bank to the peak voltage desired (see Reference 7 for more on the pulse generators). Even longer interpulse intervals are commonly found in practice because of the time needed between tests to record results, reposition sensors, or even move the exposure target, depending on the test protocol. (Some of the small pulsers can be operated at a rate of several pulses per second, but they generally tend to produce lower peak E-fields over a given working volume, i.e., the trade-off due to technological constraints.) Consequently, a routine work day at a fully operational EMP facility is likely to entail exposure to fewer than 160 individual pulses (e.g., worst case = 20/hr x 8 hrs), each pulse producing peak field intensities of approximately $10^3$ V/m at the worker's location and each showing primary power spectra below 10 MHz. To serve as examples, estimated exposures during 1974 of personnel at six USAF-operated EMP simulators are presented in Table 1.

## EMP SAFE EXPOSURE CRITERIA

The pressures of the 1970 Occupational Safety and Health Act, employer concern for worker safety, and the accelerated pace of EMP simulator development during the early 1970's led to a variety of efforts to establish meaningful exposure standards for EMP site workers. However, there was very little in the way of precedent to go on since there was (1) no clearly applicable standard extant, (2) no documented finding of either human or animal EMP injury[7,8,9] and (3) no reasonably analogous exposure situation elsewhere.*

In 1971 the U. S. Air Force** formulated a provisional EMP safe-tolerance limit for personnel working at their pulser sites based on the acute thermal

*The present discussion pertains only to the "no-contact" exposure of a person to an electrical field while insulated from ground such that no net current flow occurs, although alternating currents may be induced. It does not consider the obvious electrical shock hazard of the direct two-contact case where the person forms a current path between a conducting portion of the circuit (or an efficient antenna) and ground.

**Much of the material describing the USAF's EMP programs and associated occupational health activities was excerpted from unpublished internal-use documents prepared and made available to me by Col. Wm. R. Godden and his co-workers, Dr. Jim Frazer, John Mitchell and Col. John Pickering, of the USAF School of Aerospace Medicine, Aerospace Medical Division (AFSC), Brooks AFB, TX 78235.

Table 1

U.S. Air Force 1974 EMP Test Programs

| Title of Test | ARES F-111 | VPD B52 | VPD | SIEGE Minuteman | RES Minuteman | TORUS Minuteman |
|---|---|---|---|---|---|---|
| Avg. No. USAF Personnel | 15 | 6 | 9 | 20[a] | 5 | 3 |
| Avg. No. Civilian Personnel | 225 | 10 | 80 | 35 | 50 | 35 |
| Max. Exposure/Pulse, V/m | 25,000 | 10,000 | 10,000 | 5,000[a] | 1,500[b] | 50,000[b] |
| No. Pulses Total | 4,000-5,000 | 585 | 1,969 | 20,000 | 3,800 | 1,000[c] |
| Freq. of Pulses/Day (max.) | 25 | 15 | 30-35 | 150 | 100 | 50 |
| Duration of Pulses (nanoseconds) | 575 | 200 | 200 | 1,300 | 60 | 400 |

[a]Significant USAF participation in the SIEGE program was limited to 1969 when USAF personnel were Test Conductor/Test Operator. After that time, participation was intermittent and confined to the role of Test Witness.

[b]On occasion, technicians performing field strength measurements were exposed to the levels shown. For the most part, however, exposure was substantially reduced by directing personnel away from the work area or by providing shielded enclosures (Faraday cages, metal-sided trailers and underground work stations).

[c]Estimated

burden concept and related to the 10 $mW/cm^2$ (100 joules $meter^{-2}$ $seconds^{-1}$) ANSI standard.[10] During the following year, Boeing Aerospace Co., Ballistic Missile Divison, one of the most heavily involved subcontractors in USAF EMP operations at the time, petitioned the Assistant Secretary of Labor-OSHA to promulgate a standard on EMP personnel exposure. This represented an effort by Boeing to place the authority and responsiblity for establishing EMP safe-exposure criteria with the Department of Labor-OSHA, and thereby assure that Boeing's duty to control employee exposures satisfied the employer requirements of OSHA Public Law 91-596 (Williams-Steiger Act of 1970). Boeing's petition included the proposal that the USAF provisional standard of 1971 be considered for adoption.

In 1974 the Department of Labor-OSHA published a request for information inviting comment on the proposed standard and on the issue of whether any new standard on occupational exposure to EMP's should be issued at all.[11] Some 30 responses to the request were received from a variety of persons representing military, industry, academic, government and other affiliations.*

The consensus among the responses submitted to DOL-OSHA was that no new standard could or should be issued on occupational EMP exposure based on then current knowledge.[12] Many respondents commented on the lack of utility offered by the early USAF safe-exposure criteria proposed as a standard by Boeing because it provided no limits on pulse intensity. Also mentioned was the problem of defining the field's parameters adequately and then deriving an approved method of pulse measurement to determine compliance without infringing on non-EMP technologies (e.g., electric utilities, appliance manufacturers, X-ray and magnetic devices, etc.).

More generally it was acknowledged that the thermogenic hazards normally associated with microwave frequencies would be miniscule at present or contemplated EMP frequencies and field strengths since the relatively low frequency spectrum of the latter deposited negligible energy in the human body.[13] It was also noted that a comprehensive EMP standard would have to take into account

*The writer is grateful to I. J. Meyerson, Safety Manager, Boeing Aerospace Co. Ballistic Missile Divison, for his assistance and for providing copies of the responses submitted to the DOL-OSHA request for information.

the possibility that nonthermal electromagnetic bioeffects might occur, and this requirement would result in an even more complicated issue. Repeatedly it was implied that an appropriate rationale for predicting EMP bioeffects was lacking. Moreover, model or not, there were no reliable findings of EMP-connected illness or injury to either humans or animals, as many of the respondents pointed out.[7,8,9]

The USAF position in 1974 concurred with the majority of other inputs to the DOL-OSHA notice on the aforementioned points. The USAF Deputy Surgeon General concluded in a letter to OSHA dated March 27, 1974, that "...it would not be prudent to propose standards that are not based on scientific data, particularly when all known exposure experience shows no cause-effect relationship. A strong recommendation is made not to develop an EMP standard under the provisions of the Occupational Safety and Health Act until there is sufficient scientific data, including cause-effect relationships, to warrant development of a standard."

A further provision of the proposed EMP standard[11] was the stipulation that "Employees with cardiac pacemakers would not be permitted in areas where simulated electromagnetic pulses are being generated." No argument was received in response to this proposed restriction although specification of maximum safe-exposure guidelines for pacemaker-equipped persons was requested by some respondents. On the basis of USAF studies of the susceptibility of pacemakers to electromagnetic interference,[14] the USAF recommended a maximum E-field of 300 V/m for repetitive pulse operations (2 - 100 pps) in areas unrestricted to pacemaker wearers. Their tests showed that single EMP exposures caused no catastrophic failures even at 50 kV/m. The ease of controlling restricted areas around the pulse facilities weighed against the potential danger of pacemaker cutoff can be expected to result in continued close self-adherence to the less than 300 V/m guideline at the few "high" repetition rate EMP facilities.

Today, Air Force Regulation 161-42, dated 7 Nov 75, documents the permissible exposure levels (PEL) for personnel working in the vicinity of any radiofrequency radiation emitters and provides specific guidance concerning EMP operations. For that portion of the frequency spectrum greater than 10 MHz, the PEL is 10 $mW/cm^2$ (average power density) or 3600 $mW\text{-}sec/cm^2$ in any six-minute period. For that portion of the frequency spectrum less than 10 MHz, the PEL is 50 $mW/cm^2$ (average power density) or 18,000 $mW\text{-}sec/cm^2$ in any six-minute period. These PELS can be applied up to a single pulse maximum E-field intensity of 100,000 V/m. Thus, when applied to EMP operations, no single pulse exposure greater than 100,000 V/m shall be allowed and all exposures should be minimized where practical.

## EMP EMPLOYEE MEDICAL SURVEILLANCE

Most of the DOD agencies and their subcontractors involved in EMP operations have made efforts to provide for medical surveillance of their EMP personnel. In most cases this has involved the conduct of thorough physical examinations by a physician at least annually. The most active period of performing these examinations was between 1972-75. This was a time of rapid EMP project expansion amidst the aforementioned uncertainties about the potential hazards of EMP exposure and what safe-exposure limits, if any, would be needed.

The most extensive single base of physical examination data was accumulated by the Boeing Co. in conjunction with their operation of three EMP facilities for the USAF. Dr. Franz Bartl,* Boeing Director of Environmental Health, has overseen the collection of these observations since the inception of their EMP medical monitoring program in 1970. A total of approximately 400 different Boeing EMP employees had been examined as of December 1976. Annual physicals were repeated while each worker was assigned to an EMP facility. Thus some individuals were followed for as many as six repeat annual physicals during EMP service, and many of the subjects had previous occupational health and preemployment physicals on file from prior, non-EMP Boeing job assignments.

The occupational health examination form developed by Dr. Bartl especially for Boeing's EMP workers is shown in Appendix Table A-1. The Boeing exam incorporates the essential test areas specified by the USAF for its EMP personnel in 1972, an outline of which is presented in Appendix Table A-2.

*I am most indebted to Dr. Bartl for his cooperation in providing detailed information and records of Boeing's occupational health data.

The visual section of the USAF exam suggests their concern for possible lenticular effects such as might result from high level microwave exposure.[15] Otherwise the USAF exam was presumably designed to be as comprehensive as possible as a consequence of the dilemma encountered in trying to predict and selectively examine for signs of unknown, undemonstrated effects.

Two other employee groups having annual EMP occupational health exams, essentially similar in sample characteristics and type of exam performed to Boeing's group, were the USAF personnel and the employees of EG&G, Inc. who worked at one or more of the Kirtland AFB pulsers between 1971 and 1975. The series of approximately 40 USAF Kirtland AFB EMP personnel was followed up until early 1975 by Lt. Col. Frederic M. Brown, USAF, Chief of the Aeromedical Services Division of the Kirtland AFB Hospital. The approximately 40 civilian subcontractor employees of EG&G, Inc. were examined initially by Dr. F. G. Hirsch and subsequently by Dr. N. B. Kowalsky of Lovelace Clinic's Department of Occupational Health and Preventive Medicine.

Boeing maintained daily exposure logs on each EMP employee showing the number of pulses delivered and their approximate maximum intensity measured at the worker's station. Initially, Boeing applied a maximum E-field restriction of 1000 V/m for personnel exposures. This was raised to 5000 V/m about 1971-72, and finally to 50 kV/m in 1974. However, the logs reveal that the Boeing employees in practice rarely worked in a field greater than 1000 V/m due to the nature of their duties which generally required them to be within screened enclosures. Examples of their estimated cumulative exposure histories during 1974 are indicated under the SIEGE, RES and TORUS Minuteman tests shown in Table 1.

Less detailed exposure records were kept on the USAF and EG&G workers referred to above, but sufficient data were available to formulate the estimates for these individuals shown in Table 1 under the ARES and VPD pulsers. The values given are worst case estimates for isolated exposures from these two high energy pulsers; however, most exposures would have been substantially less within the screened shelters where most time was spent.

The respective occupational health physicians responsible for these three EMP subpopulations concurred in their conclusions that no adverse health effects were identified which could be attributed to EMP exposure. Boeing's 1974 summary of their negative findings was communicated in their comments to OSHA, noted earlier. Reconfirmation of Boeing's "no-EMP-effects" through the 1976 follow-up exams was personally communicated to the author by Dr. F. Bartl.

In 1974 the USAF Hospital (Kirtland AFB) and the Aerospace Medical Division (Brooks AFB) conducted a thorough review of all available occupational health records and the results of a continuous EMP exposure study conducted by the Armed Forces Radiobiology Institute.[16] In this experiment, rodents were subjected to a "worst case situation" of continuous EMP exposure, 447,000 V/m, 5 pulses per second over 38 weeks, for a total of $10^8$ pulses. There were no injurious findings and the authors concluded that "...humans exposed under similar conditions would show no acute injurious biological effects." The results of these reviews were summarized by Lt. Col. Brown who stated in a letter to the USAF Surgeon General dated 21 April 1975: "To date no physical abnormality attributable to EMP exposure has been detected by this facility. I am unable to hypothesize any expected ill-effects from EMP exposure. The medical literature does not provide any suspected adverse effects." Subsequently the USAF discontinued the annual EMP physicals (May 1975) on Kirtland AFB personnel and this position is reflected in the USAF Regulation 161-42, Radiation Health Hazards Control.

Bell Laboratories prepared an in-house memorandum, dated January 20, 1970, entitled "Electromagnetic Hazards to Personnel in EMP Simulations," in which they stated that over ten persons had been exposed at their facility thousands of times to pulses with peak intensities of 1-10 kV/m, hundreds of times to 10-50 kV/m and several times to pulses near 100 kV/m. No noticeable or unusual effects were reported from these exposures or later ones.

Other reports of no EMP health effects were received by OSHA in 1974 from the Navy and several companies not already mentioned. At that time the Navy was monitoring about 40 individuals who, in the course of their naval duties, were regularly exposed to EMP's. Science Applications, Inc. had ten employees and Rockwell International's Electronics Group had 44 who were occasionally exposed. Small numbers (not specified) of occupationally exposed employees were also indicated by Physics International Co., Pulsar Associates, Inc. and

Avco. All of the above claimed no injury or illness experience associated with EMP exposure. Thus the overall total of EMP-exposed workers for whom no deleterious effects have been disclosed sums to something less than 600 (Table 2).

Table 2

Source and Approximate Number of Military and Civilian EMP Workers Forming Health Data Population

| Source | Approximate Number | |
|---|---|---|
| | Physical Exams | Personal Observations |
| Boeing Co. | 400 | |
| USAF Kirtland | 40 | |
| EG&G | 40 | |
| Bell Labs. | | 10 |
| U.S. Navy | 40 | |
| Science Applications, Inc. | | 10 |
| Rockwell International Elect. | | 44 |
| Physics International Co. | | ? |
| Pulsar Associates, Inc. | | ? |
| Avco | | ? |

## CONCLUSIONS

Experience with EMP worker exposures has accumulated now from more than 20 pulser projects, some of which have been in operation for over ten years. To date no adverse health effects of such exposure have been determined from either the repeated physical examinations performed or the personal observations of the nearly 600 individuals covered in this review. Furthermore, no reports by exposed employees of reliable motivational-emotional changes (e.g., psychasthenic syndrome) have been ascribable to the EMP exposure environment *per se*, unlike the psychic complaints of microwave-exposed subjects often mentioned in the Soviet literature.[17] Thus, sufficient no-effect findings from both the human and animal experiences seem now to exist to confidently allay fears of an EMP worker exposure hazard, at least for within a 10-year observational time frame.

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APPENDIX

Table A-1

THE BOEING COMPANY – MEDICAL SERVICES
OCCUPATIONAL HEALTH EXAMINATION

EMP 13. Site
14. Simulator
15. Visitor

NAME ______ LAST ______ FIRST ______ MIDDLE ______ SOCIAL SECURITY NO.: ______

DATE OF BIRTH: ______ DATE OF EXAMINATION: ______

MEDICAL FACILITY: ______

INSTRUCTIONS: Please answer this Confidential Questionnaire accurately. Check YES or NO in the proper spaces. Where indicated, fill in the number or other information requested.

| YES | NO | | |
|---|---|---|---|
| ___ | ___ | 333. | Do you work with electromagnetic pulses (EMP)? Name program (Res; Torus, etc.) ______ |
| | | T147 ___ | Indicate how many years you have worked with EMP. |
| | | T148 ___ | How many hours per week do you work with EMP? |
| ___ | ___ | 17. | Have you ever worked with ionizing radiation or x-ray? |
| ___ | ___ | 29. | Have you ever worked with radar, microwaves? |
| ___ | ___ | | Did you miss work last year because of illness? If YES, how many days: |
| | | 35. ___ | less than 3 days |
| ___ | ___ | 36. ___ | 3–9 days |
| | | 37. ___ | 10–21 days } Why? ______ |
| | | 38. ___ | more than 21 days |
| ___ | ___ | 81. | Do you frequently feel a loss of pep? (fatigue, chronic tiredness, "run-down") |
| ___ | ___ | 82. | Are you frequently ill? From what? ______ |
| ___ | ___ | 87. | Have you had anemia or a low blood count? If YES, when? ______ |
| ___ | ___ | 93. | Have you been bothered in the past 6 months with soreness in the mouth or bleeding gums? |
| ___ | ___ | | Any disease of metabolism? |
| | | 152. ___ | diabetes |
| | | 153. ___ | gout |
| | | 154. ___ | overactive thyroid |
| | | 155. ___ | underactive thyroid |
| | | 157. ___ | other (specify) ______ |
| ___ | ___ | | Any disease of the eye? |
| | | 158. ___ | glaucoma |
| | | 159. ___ | cataracts |
| | | 160. ___ | other (specify) ______ |
| ___ | ___ | | Tumor or cancer (specify) ______ |
| | | 167. ___ | benign (specify) ______ When? ______ |
| | | 168. ___ | malignant growth (cancer) (specify) ______ When? ______ |
| ___ | ___ | 170. | Disease of blood cells (specify) ______ When? ______ |
| ___ | ___ | 171. | Bleeding trouble? (difficulty clotting, etc.) |
| ___ | ___ | 225. | Have you noticed unusual swelling of your neck? |
| ___ | ___ | 226. | Do you have large glands or lumps in your armpit or groin? |
| | | | State any significant health problems during past years: 1. ______ 2. ______ 3. ______ |

FOR PHYSICIAN USE ONLY – DO NOT WRITE BELOW THIS LINE

Physical and Laboratory finding:

**VISION**

| Distant Vision (uncorrected) | Near Vision (uncorrected) | Peripheral Vision |
|---|---|---|
| T18: rt. 20/ | T22: rt. 20/ | T24: (Circle one) |
| T19: lt. 20/ | T23: lt. 20/ | 1. Normal |
| | | 2. Abnormal |

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T30: Slit lamp: 1. Normal 2. Abnormal ____________________

O. D. O. S.

Lens opacities

## LABORATORY

| Urine | | Blood | |
|---|---|---|---|
| Sp. Gr. ________ | T177. Albumin ________ | T75. RBC ________ | T67. WBC ________ |
| Reaction | T178. Sugar | T66. HGB ________ | T68. Hemat ________ |

T79.–T81. Micro ____________________

| T69 | T70 | T71 | T72 | T73 | T74 |
|---|---|---|---|---|---|
| P | L | M | E | B | Immature |
| | | | | | |

Platelet Count: ____________________

Lee White Coagulation Time: ____________________

Ivy Bleeding Time: ____________________

Blood Chemistry to include: (attach results)
- T96: Total Bilirubin (mg%): ____________________
- T107: Uric Acid (mg%): ____________________
- T103: LDH: ____________________
- T102: SGOT: ____________________

T84: Chest x-ray, AP: ____________________

T85: ECG: ____________________

Audiogram: (attach results)

## PHYSICAL EXAMINATION

| No. | | Normal | Abnormalities |
|---|---|---|---|
| T34. | Eyes | | |
| T35. | Fundi | | |
| T36. | Nose | | |
| T37. | Ear | | |
| T38. | Throat | | |
| T39. | Teeth | | |
| T40. | Tongue | | |
| T41. | Gums | | |
| T42. | Neck | | |
| T43. | Thyroid | | |
| T44. | Lungs | | |
| T45. | Heart | | |
| 9–10 | Blood Pressure | | |
| T46. | Peripheral blood vessels | | |
| T47. | Abdominal organs | | |
| T48. | Abdominal masses | | |
| T49. | Abdominal tenderness | | |
| T50. | Inguinal hernia | | |
| T51. | Genitalia | | |
| T52. | Rectum | | |
| T53. | Motor & reflexes | | |
| T54. | Cranial nerves | | |
| T55. | Sensory nerves | | |
| T56. | Extremities | | |
| T57. | Spine and back | | |
| T58. | Joints | | |
| T59. | Lymph nodes | | |
| T60. | Skin | | |
| T61. | Emotional/Mental | | |

R-36193 REV. 8/72

EMP 13. Site
14. Simulator
15. Visitor

DIAGNOSIS (IN ORDER OF IMPORTANCE)

Primary Diagnosis:

Second Diagnosis:

Third Diagnosis:

☐ QUALIFIED

☐ DISQUALIFIED: Issue a Medical Recommendation ______________________

☐ OTHER: ______________________

Signature ______________________, M.D. ______________
Date

Physician's Comments and Follow-Up Notes: ______________________

______________________

______________________

______________________

[illegible] REV. [illegible]

Table A-2

USAF Physical Examination for Personnel Employed in the Electromagnetic Pulse Program

1. Medical history (SF 93).
2. General physical inspection.
3. Sightscreening, including visual acuity, external examination of the eye and eye movements, depth perception, visual fields, examination with the ophthalmoscope and slit lamp.
4. Chest x-ray, anteroposterior.
5. Audiogram.
6. Electrocardiogram.
7. Hematology, including a complete blood count with the differential count to include mature and immature lymphocytes, platelet count, PTT, protime.
8. Blood chemistry, to include total bilirubin, uric acid, LDH and SGOT.
9. Urinalysis, to include color, appearance, reaction, specific gravity, albumin, sugar and microscopic examination.

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