MEMORANDUM
31 December 1970

TO:
FROM: Dept. of
SUBJECT: Comments on Non-Lethal Weapon Brochure
REFERENCES: A. "Non-Lethal Weapon" Brochure,

B. Roth, E.M., "Electric Current", in NASA-CR-1205 (1), Washington, D.C., 1968. (UNCL.)

C. Walter, C.W., Electric Hazards in Hospitals, National Academy of Sciences, Washington, D.C., 1970. (UNCL.)

We have been much interested by the /brochure submitted by Mr. The principle of controlled electroshock can offer an effective solution to the personnel incapacitation problem.

It is unfortunate that the brochure is in the form of an advertising pamphlet rather than a scientific presentation. The brochure gives no definite engineering specifications, but we assume that has the following conditions in mind: (1) a single net with left and right halves connected to the System by a two conductor insulated cable; (2) projection of the net onto the subject in such a way that the subject would tend to grasp one half of the net with each hand and take the current in an arm-to-arm direction (rather than upper body to feet*); (3) five shocks per second to be delivered (about 0.5 joule each, duration of each pulse about 500 microseconds); and (4) the subject is healthy. The somewhat confusing numbers presented with Figure A of the brochure apparently make the key assumption that the circuit resistance is 10,000 ohms, presumably including the two series contacts between the net and the subject.

*A single conductor system using the ground loop would require that the shock-box itself be thoroughly grounded or the person holding the shockbox would be shocked just as severely as the subject.

[redacted] is correct that currents above 20 milliamperes will cause painful tetany of the muscles through which the current passes and that individual shocks of about 0.5 joule are not likely to kill healthy people. (Ref. B) Mr. [redacted] states that he has verified the effectiveness and safety of the repeated short pulses mentioned above by appropriate tests. Such a result seems reasonable, but it would be nice to see the report of his experimental procedure.

We question the reliability of the net-shockbox combination in incapacitation of a high percentage of subjects under field conditions. In order to be effective, tetanizing amounts of current must pass through muscles that will incapacitate the subject. In order to get to the muscles, the current must get through the skin somehow. A large area of firm contact with sweaty skin can have a resistance of a few hundred ohms; a small area of dry contact with light pressure can range up into millions of ohms. (Ref. B) If the net provided two contacts with the subject's body, amounting to a series resistance of one megohm or more, the shockbox would have to deliver a voltage of 20,000 volts or higher in order to force the required current through the skin. We doubt that a shockbox of the small dimensions specified by [redacted] could provide such voltages and energies. What if the subject is wearing a leather jacket, motorcycle helmet and dry leather gloves? What if part of the net happens to get into the subject's mouth? What keeps the net from shorting itself out? Why wouldn't a subject with painfully paralyzed arms start to run, thereby breaking contact?

Engineering details and extensive field test results of the system are necessary for evaluation of this approach.

The primary medical hazard of the system is the possibility of inducing ventricular fibrillation of the heart. Ventricular fibrillation is almost in-

variably fatal under field conditions. If [redacted] device included current limiting circuitry so that the energy in each brief pulse was limited to about 0.5 joule applied hand-to-hand, the risk of ventricular fibrillation in a healthy subject should be negligible. (Ref. B) If the subject happened to be "electrically sensitive" (due to coronary artery disease with irritable myocardium, pacemaker device, etc.) a much smaller shock could lead to unconsciousness within seconds and death within a few minutes. (Ref. C) [redacted] acknowledges such a possibility by noting that his device should be used on "healthy crooks" only. Most young people, aside from invalids, do not fall in the "electrically sensitive" category.

In summary, we feel that such a device is not likely to cause permanent injury to an active young adult subject, but we question its reliability as an incapacitation system under field conditions. Our engineering staff has roughed out a circuit diagram for a unit that would deliver 0.5 joule under the low resistance conditions assumed by [redacted] We will be happy to provide a copy of this diagram or comments on any other points that you may request.