A PROPOSED ZIPPER SYSTEM FOR SMALL WEAPONS (U)

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ABSTRACT

The unit should be no larger than 100 cubic inches in volume and should weigh about 10 pounds. Two units, in a dual system, could be placed in an 11-1/2-inch-OD space only 3-1/2 inches thick.

Power and trigger can be supplied from an X-unit, or other 28-volt DC input supplies such as rotary choppers and transverters can be used.

A look into other possible future Zipper units of considerably smaller dimensions is discussed.

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Case No. 755.00

April 12, 1957

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INTRODUCTION

With the realization of the desires for smaller nuclear warhead systems, it has become necessary to consider smaller Zipper units. DOE b(3)

A Zipper system which shows promise for these applications is described herein. DOE b(3)

The time delay is included in the system which is small and rugged; depending upon the power supply and timer unit selected, the system is capable of being relatively radiation-resistant.

REQUIREMENTS

A summary of the controlling requirements for this system analysis follows:

Applications

This Zipper is intended for use in 10- to 12-inch-small warheads used in guided missiles (NIKE AJAX, TERRIER, and possibly air-to-air missiles), a ballistic missile (LITTLE JOHN), a (high-g) rocket-assisted depth bomb (ASROC), and an atomic demolition munition (C-ADM). DOE b(3)

The criteria listed below include present information as to the extreme requirements which will be imposed on the Zipper by the above applications. Development of a miniaturized version of the XMC-825 with choice of power supplies such as a rotary-chopper converter, transverter or X-unit voltage supply may prove satisfactory.

Component CDR Desired

DOE 6(3)

June 1958 (Other Applications)

Development Models Required

DOE 1(3)

September 1957 (Other Applications)

Cognizant 1000 Organizations

DOE 6(3)

Systems	Project
1261	1225
1261	1222
1261	1810
1261	1810

SYSTEMS

Figure 1

The basic system considered herein is shown in block diagram form in Figure 1. The pulsed neutron source is the same small pulsed linear accelerator which has been developed for other weapon applications. DOE 6(3)

Energy for these pulses is stored in a capacitor similar to those being developed for X-units. The energy is switched to the transformer by a switch which is triggered by the output of the timer unit. The timer itself may be electronic or explosive in nature. The input to the timer may be obtained from several points in the weapon system as may be found most adequate, such as the

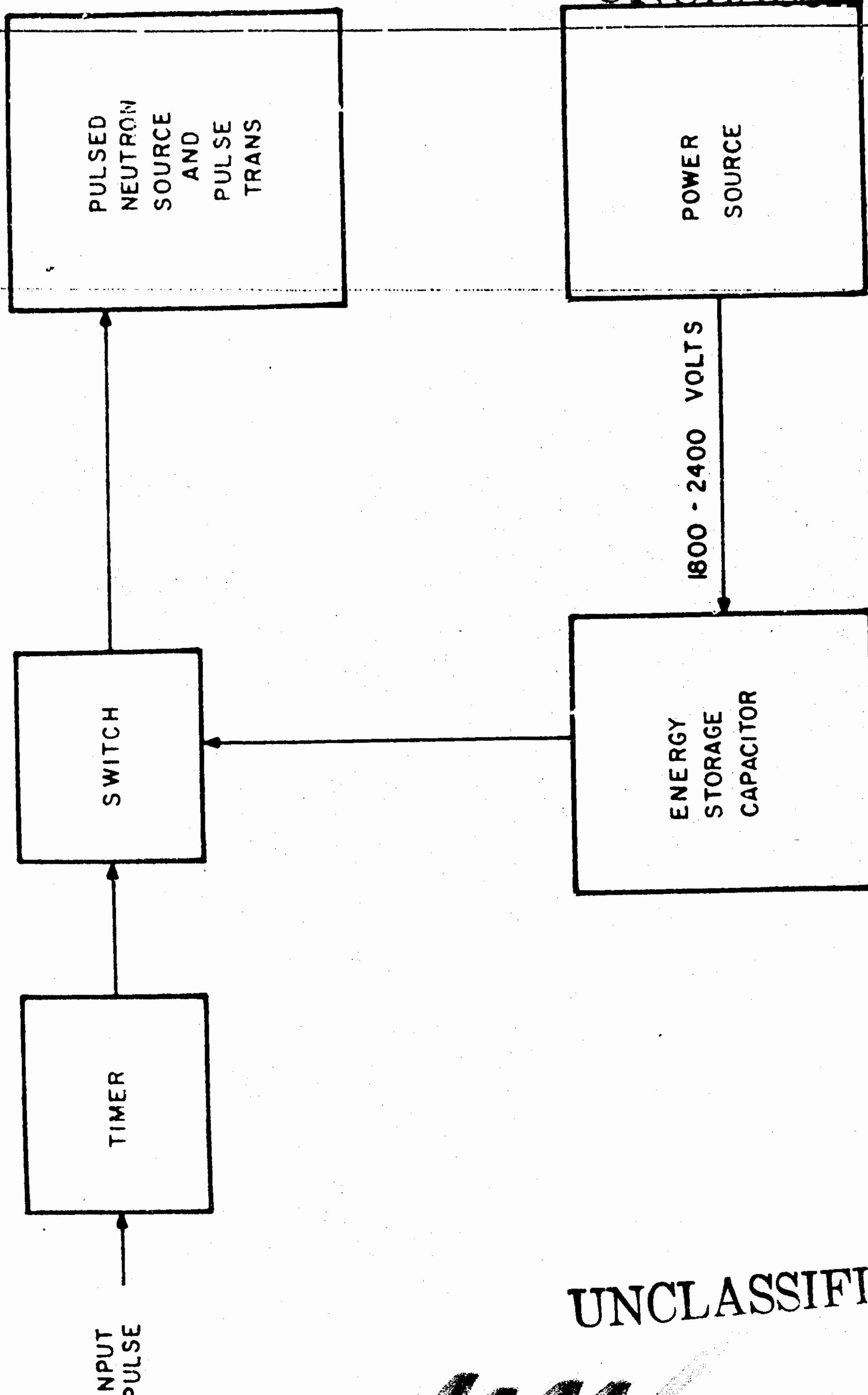

FIG. I NEUTRON SOURCE SYSTEM BLOCK DIAGRAM

FIG. 2 AN XR CIRCUIT TO OPERATE FROM AN X-UNIT CAPACITOR BANK

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FIG. 4

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unless considerable circuit complexity is incorporated with possible reliability losses such timers would, in production, be somewhat less accurate, perhaps ±0.4 to ±0.5 microsecond total variations. It is desirable not to make a timer more complex than the proposed circuit so the neutron pulse should be wide enough to account for ±0.5 microsecond timer variations.

Figure 5 illustrates neutron pulse requirements for a Zipper system.

The three circuits shown should exhibit similar reliabilities in the pulsed neutron portion of the unit. However, the remaining parts are different and can be analyzed on a "guess" basis, and a comparative reliability should be indicated.

For the circuit in Figure 2, the number of parts used is 17. The circuit in Figure 3 uses 22. The circuit in Figure 4 uses only 9 parts. Assuming equal failure rates in the various parts, this indicates that the unit using explosive time delay techniques is advantageous from the reliability standpoint. Whatever power supply is used would be again common for this comparison and only reflects in the actual reliability analysis.

By suitable development, the average part reliability should be so that failures occur at a 1 in 2000 rate or less. From this approximation, the best system, not including the power supply, should fail about 1 in 200 times or less and the poorest system about 1 in 98 or less. This compares favorably with the XMC-757 early analysis of a 1 in 50 to 70 failure rate where a large number of transistors used lowers the reliability considerably. One can conclude that the reliability in a dual system of any one of the three circuits, if used with an X-unit power source, should exhibit failure rates not in excess of 10^{-4} as is required in these systems.

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FIG. 5 TIMING AND NEUTRON REQUIREMENTS

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Package

Preliminary unit layouts for possible applications in 11- and 12-inch-diameter weapons are shown in Figures 6 and 7.

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In order to accommodate for a gas-boosting bottle, a hole about 4 inches OD was provided in the package.

Unit volumes are:

Figure 6 110 cubic inches

Figure 7 124 cubic inches

(XW-35 only)

Unit weights are:

Figure 6 10.5 pounds

Figure 7 13 pounds

If the explosive timer is used in either case, the volumes reduce to

Figure 6 100 cubic inches

Figure 7 90 cubic inches

and the weights drop accordingly. (Figure 5 to 9.5 pounds.)

An all-encapsulated package is proposed. The package could probably be reduced to a thickness of 2-3/8 inches and a diameter of 11 inches with two bumps 3-1/2 inches OD protruding only 1 inch from the nominal 2-3/8-inch thickness. This could best be done with two units in a single package, but other techniques need to be investigated to determine what minimum package is possible.

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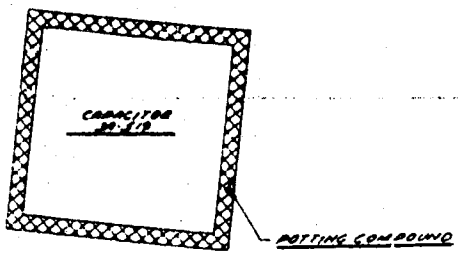
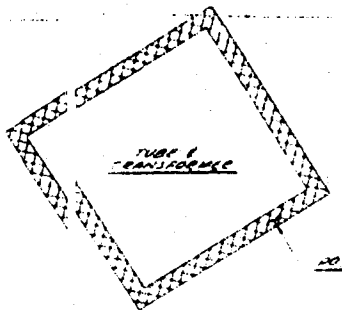
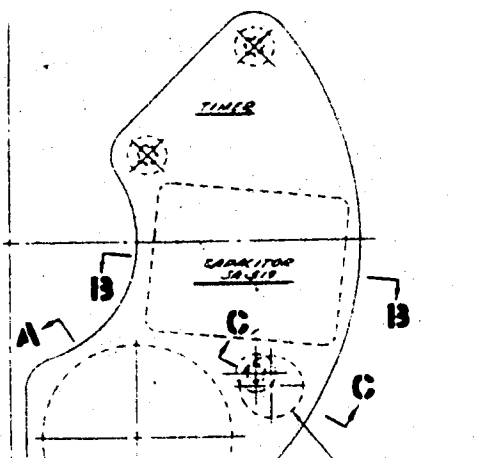
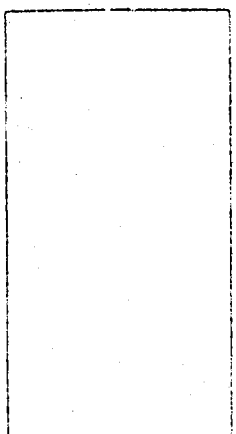


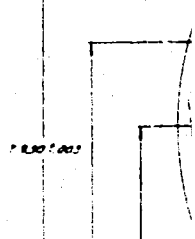
SECTION B-B

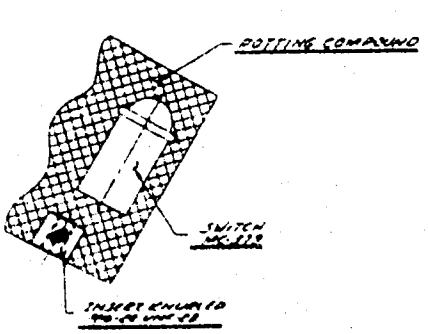






SECTION A-A

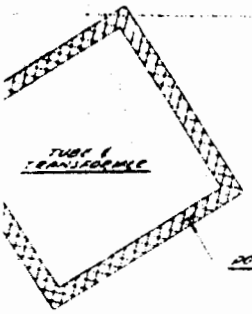




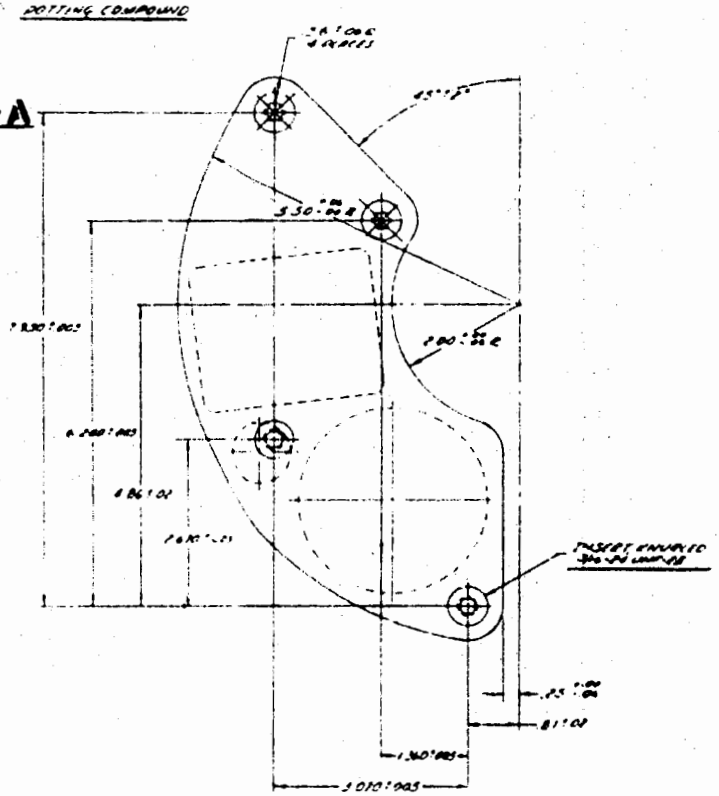
SECTION C-C

Ref. Sym: 7223 (380)

NOTES



SECTION A-A



LIST OF MATERIAL

XMC-B76
PROPOSAL

5Y F

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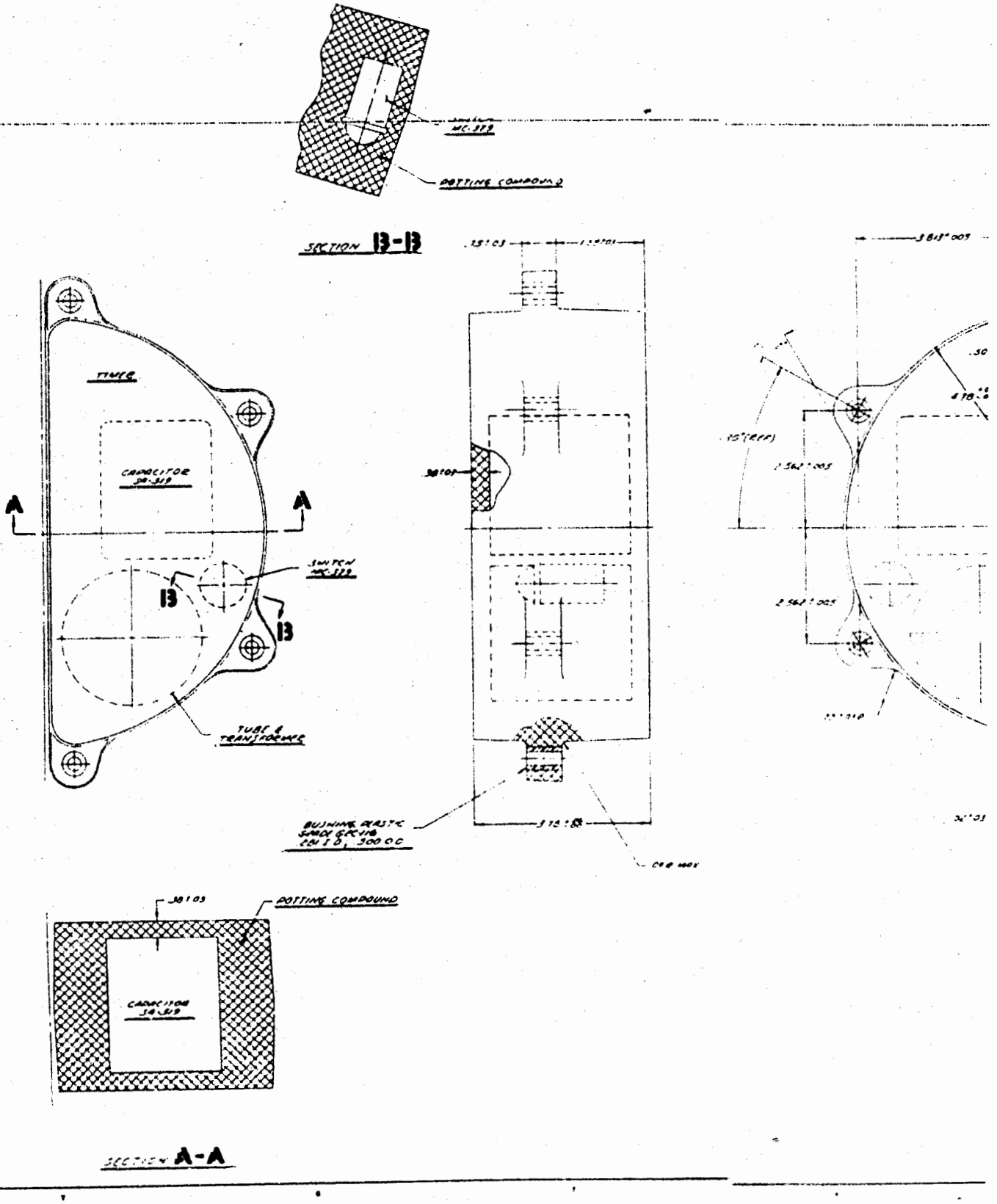

STATUS OF DEVELOPMENT

Neutron Source Tube

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They are 1-1/4 inches OD x 1-3/4 inches long and 1 inch OD and 1-3/4 inches long. Research on size requirements is being studied at UCRL (Berkeley) and at GEXR. The General Electric X-Ray Department is required to furnish breadboard units in April 1957, and will develop a suitable tube and unit for these applications.

A PIG is not desirable and efforts will be directed to removing it from the tube. The initial tube models do not use PIG's.

One transformer of the size required for these applications has been tested in oil. Considerable development of this part is necessary.

The timer circuit shown in Figure 2 has been built in breadboard form and has been tested. Preliminary data from HE experts have been found indicating that the probable accuracy of the HE timer is acceptable.

A modified SA-519 capacitor is planned for use as the energy-storage capacitor. Power supplies for use at 28 volts DC are being developed in Divisions 1469 and 1472.

A high-current, low trigger voltage cold-cathode tube is being developed in 1450. The tube is also being ruggedized to withstand high accelerations.

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POSSIBLE FUTURE SYSTEMS

On a considerably longer time scale, a system which does not require a separate power supply may be practical. Possible systems are shown in

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FIG. 8 PROPOSED XR CIRCUITS

[redacted] DOE b(3)

. The major problems in size will be related to dielectric strength of materials to protect the circuits from voltage breakdown since the tube should be developed toward a one-shot capability. This would lower the tritium in the tube to an extremely small amount so that the PIG may not be necessary. Tube efficiency should also be increased by lowering secondary emission from the target.

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