

SPACE RADIATION STUDIES AT THE WHITE SANDS MISSILE RANGE FAST BURST REACTOR

A. De La Paz

(Nuclear Weapon Effects Division, Army Missile Test and Evaluation,
White Sands Missile Range, New Mexico)

The White Sands Missile Range Fast Burst Reactor (FBR) has been employed in the performance of various types of space radiation tests. The FBR is operated by the Department of the Army to provide the radiation environment in support of requirements of experimenters from private industry, government agencies and their contractors. The FBR is an unreflected and unmoderated reactor employing an alloy or uranium-10 weight percent molybdenum as the fuel material. The reactor core, consisting of a stacked array of fuel rings, and the control components, including a safety block, control rods and burst rod, are all made of the same fuel material.

The FBR is operated at either an outdoor site or inside an underground reactor cell having approximately a 50 x 50 ft floor area and a height of 20 ft. Because of the size of the reactor cell, most of the experiments are conducted with the reactor in the cell. Outdoor reactor operations are conducted where large items, such as vehicles, are to be irradiated, or when the distance from the experiment to the reactor is to be large. In the usual case, where the reactor is in the cell, the experiment being studied is placed on an experimenter table through which the reactor core protrudes. A safety shield surrounds the reactor core assembly and serves to prevent movement of the experiment to a point where it could touch the reactor fuel surface. The FBR can be operated in either a burst or steady-state mode, depending on the experimenter requirements that apply.

The experiment being studied is instrumented and the necessary cabling is run from the reactor cell to the experimenter room at the reactor facility where the response of the experiment to radiation is observed, recorded and evaluated. Included with the instrumentation of the experiment is the dosimetry measurement techniques that are provided. Normally, the neutron fluence is measured by use of sulfur foils and the gamma measurements are made with calcium fluoride or lithium fluoride thermoluminescent dosimeters. Dosimetry support for experimenters using the reactor facility is provided by the Nuclear Weapon Effects Division. This support includes the foils and dosimeters and the counting and analysis necessary to obtain the required dosimetry data. The neutron and gamma output characteristics of the reactor are presented in Figures 1 and 2.

Space radiation studies conducted at the FRB include radiobiological experiments, dosimetry studies and transient radiation effects studies on electronic systems and components. Radiobiological experiments conducted using the FBR have involved the evaluation of the behavioral response of animals subjected to the radiation

environment associated with a reactor burst operation. In one category of experiments rhesus monkeys, trained to perform tasks such as maintaining a moving platform on a stable basis, are subjected to a radiation burst which gives them a dose of approximately 2500 Rads to the head. The response and performance of the animal is followed for an extended period of time. Studies of this type are being carried out at lower doses to the animal. In addition, studies have been carried out using baboons instead of rhesus monkeys. For the most part, however, radiobiological experiments are conducted with the rhesus monkeys because of the more extensive performance degradation data that can be obtained as compared to the baboons. An additional complicating factor involved with the baboons is that more elaborate measures must be taken to insure that the animal is restrained so that it cannot move in a manner such that it would alter the reactivity state of the reactor. Radiobiological experiments have also been conducted at the reactor facility with other animals; for example, dogs and laboratory rats.

Performance of space radiation studies on electronic systems and components is a major use of the reactor facility. Individual components, such as transistors or diodes, are placed in very close proximity to the reactor, approximately six inches from the core centerline, and receive the programmed radiation deposition depending on the fission yield associated with the reactor burst operation. Performance of experiments of this type is expanded to include entire electronic systems, such as missile guidance packages.

Modification of the FRB facility is planned for 1971 which will include provision for an internal irradiation cavity within the reactor core for high intensity radiation deposition of small components. In addition, the operational capability of the reactor is being upgraded to provide progressively higher radiation doses to experiments in either the burst or steady-state mode of operation.

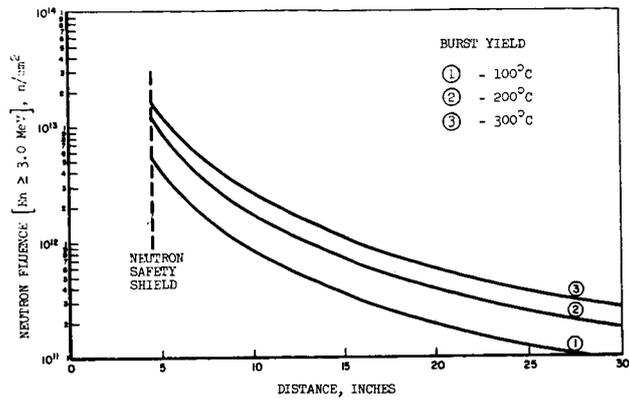


FIGURE 1 - NEUTRON FLUENCE AS A FUNCTION OF DISTANCE FROM THE CORE CENTERLINE

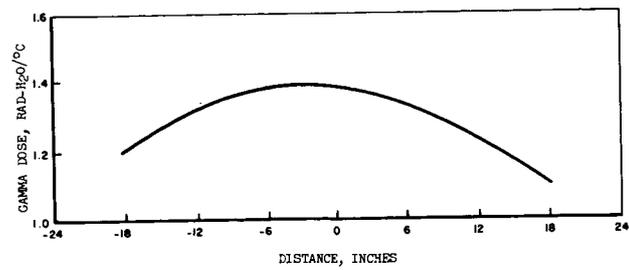


FIGURE 2. GAMMA DOSE PER $^\circ\text{C}$ AS A FUNCTION OF VERTICAL DISTANCE FROM CORE MIDPLANE. (FREE FIELD MEASUREMENTS AT 1 METER)