IRT 5363-001

RADIATION TESTING OF CELL #885

Final Report

By

D. E. Willis

Prepared for

COMSIP DELPHI INC.

Under

P. O. 4093

IRT Project 5363.00

August 23, 1979

8006300 400

IRT Corporation

Instrumentation Research Technology

7650 Convoy Court • P.O. Box 8[illegible]
San Diego, California 9[illegible]

714 / 565-7[illegible]
Telex: 69 5[illegible]

INTRODUCTION

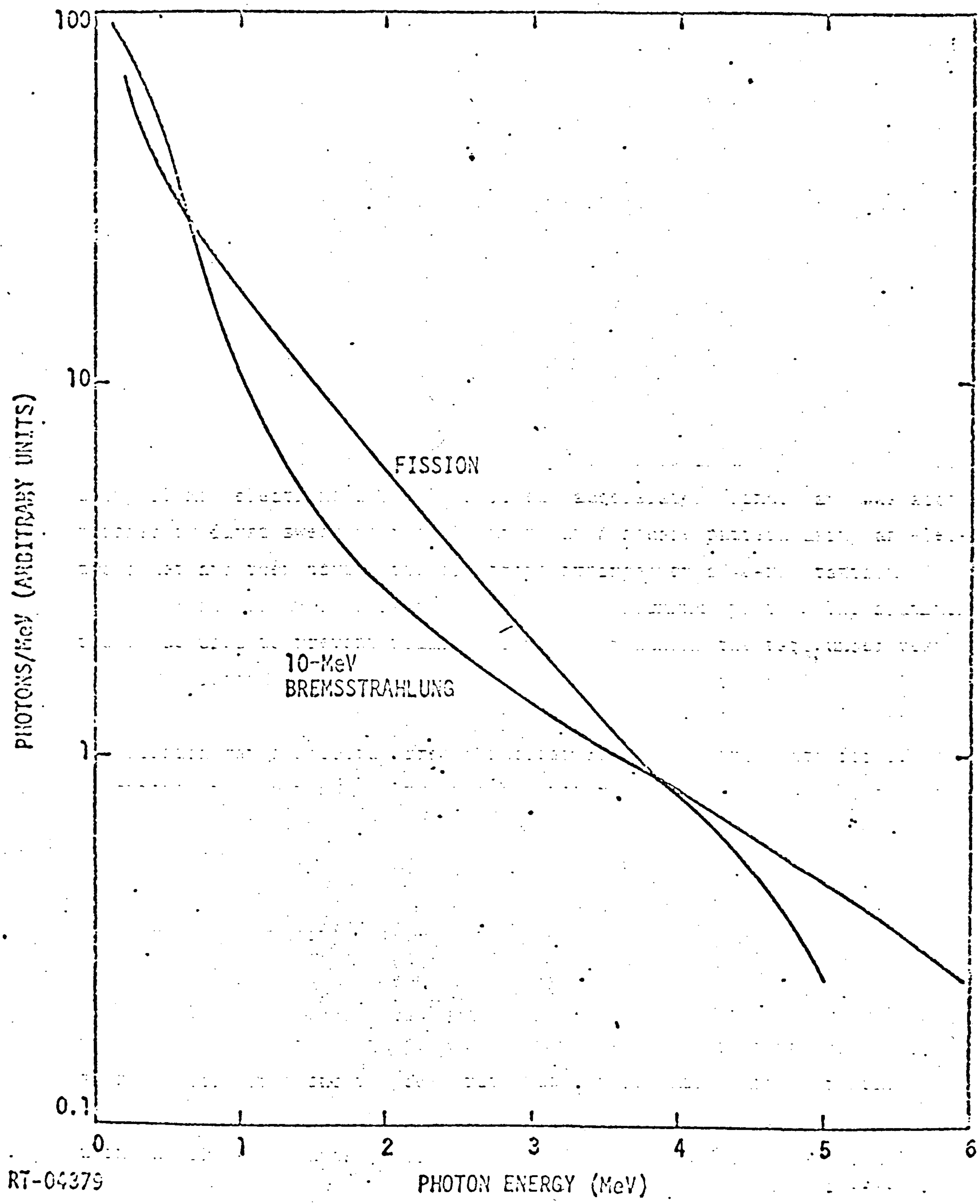
Radiation exposure of the Comsip Delphi Incorporated sample cell #885 was performed on July 19, 1979 using bremsstrahlung radiation produced from a tantalum converter. The cell was exposed to a total dose of 5×10^7 Rads (Air) at an average dose rate of 6×10^6 Rads (Air) per hour while maintaining a minimum cell temperature of 150°F.

TEST SETUP AND DOSIMETRY

The bremsstrahlung radiation environment used in this test was produced using 12 Mev electrons from IRT's linear accelerator (Linac) and was accomplished by first sweeping the electrons in a square pattern using an electromagnet and then having the electrons impinged on a 40-mil tantalum converter backed up by a 1-inch water-cooled aluminum plate. The aluminum plate was used to prevent primary electrons reaching the part under test which was located approximately twelve inches behind the plate. At 12 Mev, the bremsstrahlung spectrum from a tantalum converter very closely simulates the fission gamma spectrum from a nuclear reactor. Since data for 12 Mev electrons and a tantalum converter are not readily available, Figure 1 is presented for comparison purposes only. The higher energy electron would tend to shift the bremsstrahlung curve slightly upwards, whereas the lower-Z material, being somewhat less efficient, would tend to lower the curve.

Prior to exposing the cell, mapping of the gamma field was performed to determine the dose rate and dose uniformity. To do this, Far West dosimeters were located at the cell position and exposed to the gamma environment. The calibration indicated that the dose was uniform to within 10% over the cell area and the dose rate was 6×10^6 Rads (Air) per hour.

During the irradiation the temperature of the cell was monitored using an Iron-Constantan thermocouple. The output of the thermocouple was recorded on a strip chart which is attached to this report. At 150°F the thermocouple output is 2.3 mV and at the maximum temperature of 300°F the output is 6.9 mV.



RT-04379

Figure 1. Comparison of bremsstrahlung spectrum produced by high-energy electrons and tungsten converter with a fission gamma spectrum

CERTIFICATION OF TEST

IRT Corporation certifies that the tests described in this report were conducted using accepted engineering and scientific practices. IRT also certifies that the dosimetry was performed using standard dosimetric techniques.

Facility Manager
D. E. Willis

PNEUMATIC TEST REPORT

JOB 80-410 Doc't. No. 410-00[illegible]

TEST DATE 8-22-79 Rev. 1

CALIBRATION:

TEST GAUGE	CALIBRATION GAUGE
0	
50	
100	
200	

TEST RESULTS:

LINE NO.	DESIGN PRESSURE	TEST PRESSURE 1.25 X D. P.	DETECTABLE LEAKA[illegible]
cell	atmospheric pressure	60 psig	Adjustment scre[illegible] O-ring: no. Sample-side seal: no. Reference-side seal: yes, see Report N[illegible] 410-003

This system has been tested and found to be free from leaks at the above condi[illegible]

TEST INSPECTOR T J Bolle 8/22/79 Q.C. INSPECTOR [signature]

FORM APPROVED BY:	DATE:	REVISION:
[illegible]	[illegible]	[illegible]

Report - Effects of 5×10^7R on Thermal Conductivity Cell Seals

A model B-5 cell (cell #885) was assembled using various sealing techniques on each of the cell's O-ring sealing surfaces duplicating actual production configuration with the exception of deleting the use of RTV on the reference side plate seal. These techniques were used as follows:

1. The "O" ring seal over the adjustment screws was assembled per CDI Standard Practice, i.e., volume of silicon rubber slightly exceeds the volume of the groove so that there is some material extruded from the groove.
2. The Reference-side plate seal was assembled using normal industry practice of some 15% deflection of the "O" ring thickness but not filling the "O" ring groove.
3. The sample-side plate seal was assembled using RTV silicon to provide groove filling in addition to the squeeze used on the Reference-side plate.

Prior to radiation, the assembled cell was tested for leaks at 60 psig. A slight leak was noted on the Reference-side seal. The cell was then sent to IRT in San Diego for irradiation to 5×10^7R (si). After the induced radioactivity had decayed, the cell was returned to Comsip for evaluation.

Inspection of the returned cell yielded the following:

1. The "O" ring seals over the adjustment screws did not leak at 60 psig.
2. The "O" ring seal on the Reference-side plate leaked grossly. Disassembly on the seal showed a chunk of foreign material on the seal. The compression set induced by the radiation had decreased the pressure on the seal so that the seal leaked grossly at the site of the foreign material. Removal of

the foreign material left a compression set dent in the "O" ring that prevented remaking the seal. The "O" ring was replaced to allow testing of the remaining seals.

3. The Sample-side plate seal did not leak.
4. The integrity of the glass-metal hermatic seals remained.

Discussion: It is shown that silicon rubber bonds are broken by radiation and that these bonds are remade at a rate determined by temperature, time, and oxygen as a catylist. This action leads to compression set and loss of seal pressure. The silicon rubber is necessary in this particular application due to the high temperatures. Thus, to mitigate the effects of radiation, RTV is used to assure groove filling and such static seals survive both temperature and radiation.

Timothy J. Belke

Timothy J. Belke
Project Manager