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SPEAR II Space Power Data Analysis

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Technical Report

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13. ABSTRACT (Maximum 200 words) This project provided data analysis and support for the SPEAR II payload tests at the NASA Plum Brook Station in June, 1990. It also provided support for test preparation and overall data review. Independent analysis of the payload chamber tests with and without plasma indicated that: (1) when plasma is not present, the probability of arcing in the pulse transformer approached zero monotonically and (2) with plasma present, pulse conditioning of the transformer was erratic and, at the highest voltages, arc-free operation appeared not to be attainable.				
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CONVERSION TABLE

	Meter	Kilometer	Inch	Foot	Yard	Mile
Length	1	0.001	39.3701	3.28084	1.09361	0.00062
	1000	1	39370.1	3280.84	1093.61	0.62137
	0.0254	0.00003	1	0.00333	0.00333	0.00002
	0.3048	0.00030	12	1	0.00119	0.00019
	0.9144	0.00091	36	3	0.00333	0.00057
	1609.34	1.60934	63360	5280	1760	1
	Square meter	Are	Hectare	Square kilometer	Square yard	Acre
Area	1	0.01	0.00010	—	1.19599	0.00025
	100	1	0.01	0.00010	119.599	0.02471
	10000	100	1	0.01	11960	2.47105
	—	10000	100	1	—	247.105
	0.81613	0.00816	0.00004	—	1	0.00025
	4046.86	40.4686	0.40469	0.00405	4840	1
	Cubic meter	Liter (Litre)	U.S. gallon	Cubic inch	Cubic foot	Imperial gallon
Volume	1	1000	264.171	61023.7	35.3147	219.978
	0.001	1	0.26418	61.0255	0.03532	0.21998
	0.00379	3.78532	1	231.001	0.13368	0.83270
	0.00002	0.01639	0.00433	1	0.00058	0.00360
	0.02832	28.316	7.48018	1728	1	6.22883
	0.00455	4.54596	1.20095	277.42	0.16054	1
	Gram	Kilogram	Ton	Carat	Ounce	Pound
Weight	1	0.00100	—	5.00000	0.03527	0.00220
	1000.00	1	0.001	5000.00	35.2740	2.20462
	—	1000.00	1	—	35274.0	2204.62
	0.2	0.0002	—	1	0.00705	0.00014
	28.3495	0.02835	0.00003	141.748	1	0.06250
	453.592	0.45359	0.00045	2267.95	16	1

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SECTION 1 INTRODUCTION

The subject contract started on May 17, 1990. The original objective of this effort was to provide support in the analysis of the SPEAR II experiments, with primary emphasis on the space tests. As it turned out, substantially more effort was expended in performing the chamber tests at the NASA Plum Brook Station and no data was obtained from the flight tests. Thus, the products of this effort were limited to involvement in and analysis of laboratory evaluations of the SPEAR II payload.

The capability of Pulse Sciences, Inc. to perform this function is based on extensive experience in studying the interactions between high voltage devices and simulated space plasmas in chamber tests.

SECTION 2
INSPECTION OF PAYLOAD AT SPACE DATA CORPORATION

Dr. Bayless, the PSI Program Manager, visited Space Data Corp. on May 24, 1990 to inspect the SPEAR II payload and to generally become familiar with its design and characteristics. He discussed the payload design with other program participants (including John Antoniadis, Doug Johnson, Randy Cooper, and Mark Wilkinson), reviewed the payload drawings, and participated in a payload status meeting.

SECTION 3 PARTICIPATION IN THE SPEAR II TESTS AT PLUM BROOK STATION

Dr. Bayless participated in the SPEAR II payload tests at the NASA Plum Brook Station during the period of June 15-18, 1990. He made contributions to the analysis of system fault modes that led to the payload malfunction and test termination on June 17. This included analysis of the electrical circuitry, component design and transient circuit response, and the definition of the possible scenarios that led to the malfunction.

Dr. Bayless also participated in the Plum Brook tests during the period of June 22-25. He contributed to the analysis of data pertaining to payload conditioning. In particular, he analyzed data that he obtained from the video monitors to determine the characteristics of the conditioning process.

Figure 1 shows plots of data taken during tests performed on the morning of June 24. The data was obtained by rating the intensity of transformer arcs, as viewed on the low-light video monitor, on a qualitative scale of 0-10, with 10 indicating the highest intensity and 0 indicating that no light was observed. The x-axis indicates the number of the flight sequence and the number of the test sequence. For these tests, a flight sequence consisted of 1 sec periods. Data recording was started after two 50 kV, one 80 kV and one 100 kV flight sequence had been completed. Individual curves are provided for nominal pulse transformer output voltages of 50, 80 and 100 kV.

The data shown in Figure 1 indicates that the transformer quickly conditioned at the lowest voltages. However, as the voltage was increased, the time required to achieve reliable conditioning increased. At the highest voltage, conditioning steadily improved, however, reliable conditioning was not

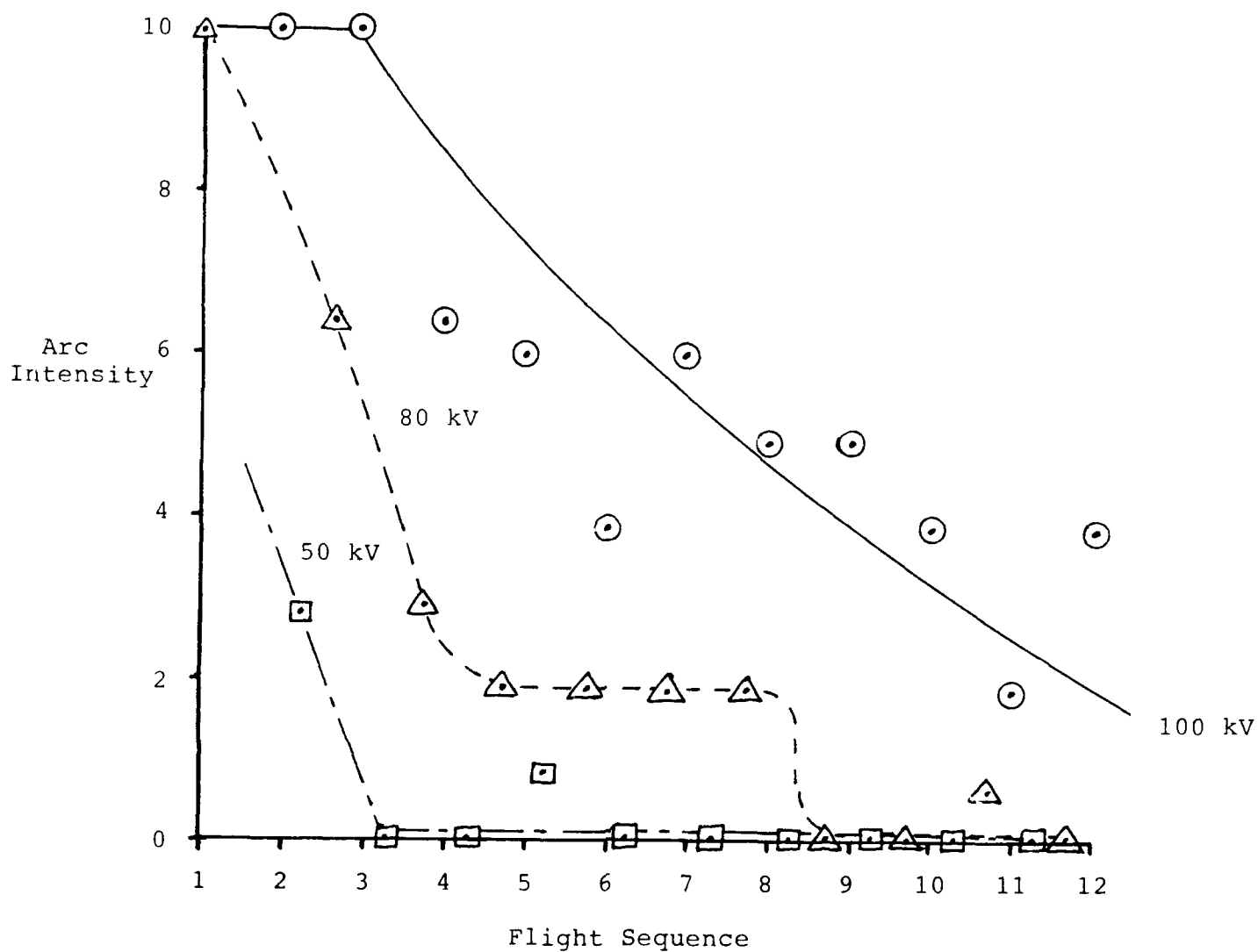


Figure 1. Results from the SPEAR II payload chamber tests without plasma.

achieved after thirteen 20-pulse bursts at that voltage (35 20-pulse bursts in total).

Figure 2 shows the results from tests on June 24 (8 p.m.) in which the SPEAR II payload was operated in a simulated space plasma. In this case the visually observed arc intensity was rated on a scale of 0-3 and the flight sequence was plotted along the x-axis.

These results indicate that the transformer conditioning proceeded more slowly and with less of a monotonic trend toward reliable conditioning. Even at the lowest voltage, it is seen that more pulses are required to reduce arcing to zero than was the case without plasma. But, after several sequences without arcing, more arcs were observed. At the highest voltage, the conditioning rate was slow and erratic; these results suggest that reliable conditioning may never be attained at 100 kV. Based on these results, which do not distinguish different pulse lengths, we conclude that some arcing should be expected when the SPEAR II pulse transformer is operated in a plasma environment.

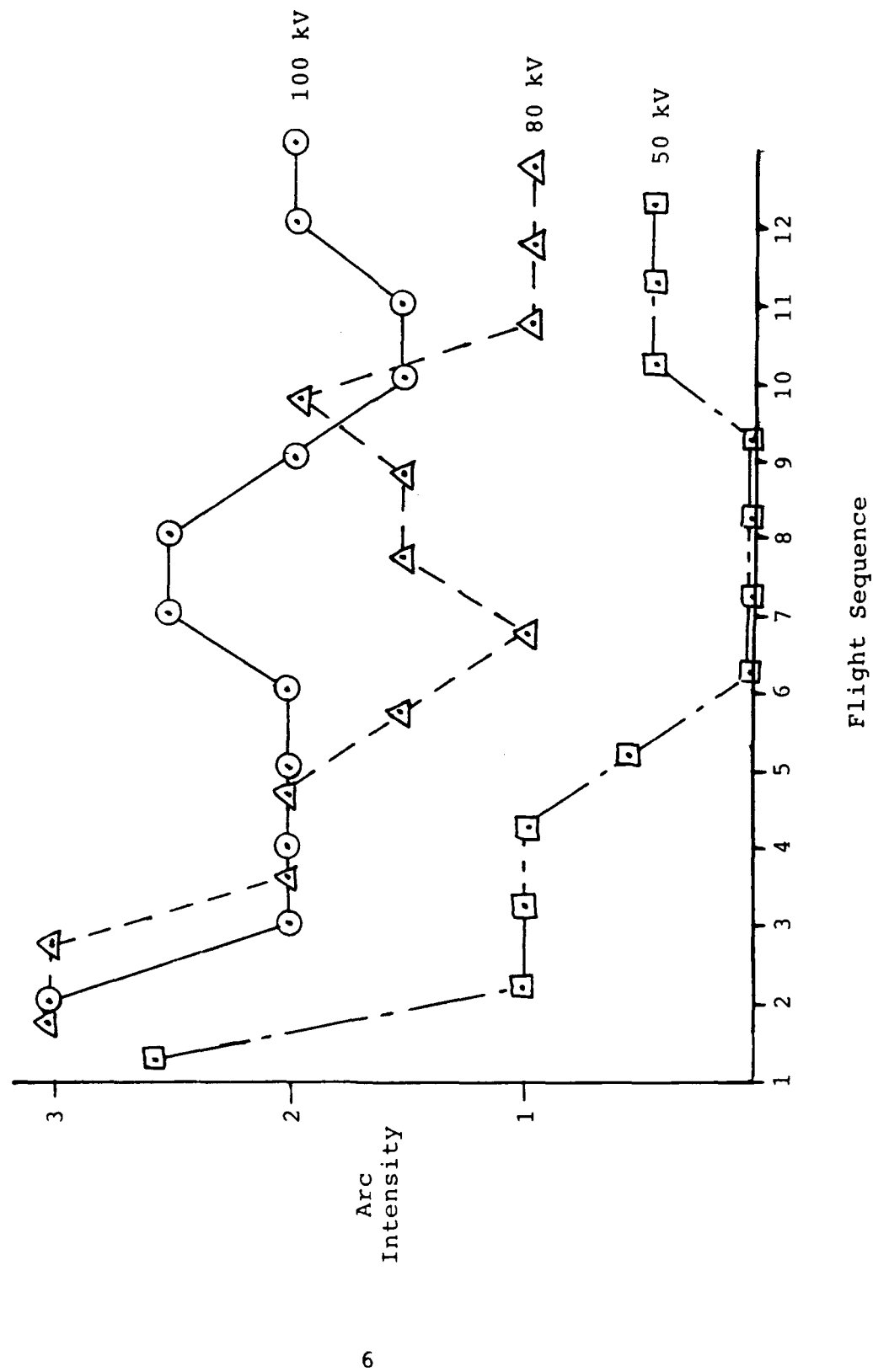


Figure 2. Results from the SPEAR II payload chamber tests with plasma.

SECTION 4
PARTICIPATION IN THE SPEAR II TESTS AT WHITE SANDS MISSILE RANGE

Dr. Bayless participated in the SPEAR II tests at WSMR during July 20-21, 1990. During these tests he contributed to test preparation by participating in: (1) definition and prioritization of test abort conditions and (2) discussions of expected test observations with other test observers. This test was aborted and, in a subsequent launch attempt, the payload had to be destroyed in mid-flight.

SECTION 5
PARTICIPATION IN THE SPEAR II PRODUCTS MEETING AT
W.J. SCHAEFFER ASSOC. DURING SEPTEMBER 24-25, 1990

Dr. Bayless participated in the SPEAR Products Review meeting at W.J. Schaeffer Assoc. on September 25-26, 1990.

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