ERRATA

Original paper published in
The 1997 NASA Aerospace Battery Workshop Proceedings
NASA/CP-1998-208536, pages 83-112

PERFORMANCE OF NICKEL-CADMIUM BATTERIES ON THE GOES I-K SERIES OF WEATHER SATELLITES

Sat P. Singhal
Computer Sciences Corporation

Walter G. Alsbach
Jackson & Tull

Gopalakrishna M. Rao
NASA/Goddard Space Flight Center

A minor change was made to the second equation on page 98 and Table 4 (Page 102) was revised during the final preparation of the paper. These changes were inadvertently left out of the final proceedings. Corrected pages 98 and 102 are reproduced here in their entirety.

Battery Reconditioning

Spacecraft Batteries are reconditioned prior to the start of each eclipse season. The batteries are individually reconditioned by use of the following sequence after verifying that the other battery is connected to the spacecraft bus.

a. Turn off battery charging
b. Open battery discharge relay number 2
c. Inhibit the battery under voltage protection
d. Turn on battery reconditioning

The 139.6 ohm resistive load is connected across the battery, resulting in an initial C/48 (0.25 A) reconditioning discharge rate. The individual cell voltages of the selected battery are monitored throughout the reconditioning discharge period. When the first cell voltage reaches 0.5 ± 0.1 V, the reconditioning discharge is terminated. Figure 6 shows the battery reconditioning circuitry.

On-orbit reconditioning has been performed prior to 7 eclipse seasons for GOES-8, and 5 eclipse seasons for GOES-9. The batteries on GOES-10 were not reconditioned prior to the fall 1997 eclipse season.

Charge removed from the batteries during reconditioning was calculated using a different approach than that described earlier. During reconditioning, the nominal discharge current has a value of 0.25 A (C/48 rate). However, the step size for the discharge current telemetry is 0.06 A, too coarse to show discharge current changes as the battery voltage changes. Since the battery is being discharged by connecting it to a constant resistor (139.6 Ohms), the discharge current is given by the use of Ohm's law

$$I = V/R$$

and the charge removed as an integral of battery voltage, i.e.,

$$D\,(Ah) = (1/R) \int (V - 0\ 6)\, dt$$

where 0.6 represents voltage drop across the diode on discharge relay. In addition, since the reconditioning process continues for 60 - 65 hours, the voltage data for integration is sampled at 1-minute intervals at the beginning and end of the process (where the voltage is changing comparatively rapidly) and at 5-minute intervals during the middle 48 hour period.

Figure 7 shows the performance of GOES-8 battery 1 during its first reconditioning cycle (Fall 1994). The reconditioning was terminated when cell 12 voltage dropped to a value of 0.5 V. Corresponding data for battery 2 is shown in Figure 8.

Table 4 compares the results from all reconditioning cycles to date: seven for GOES-8 and five for GOES-9. The data show that the battery capacity has improved with time. The table also shows the end of discharge (EOD) battery voltage for each case.

Table 4. Battery Reconditioning Results for GOES-8 and -9.

		GOES-8		GOES-9	
		Ah Removed	EOD Voltage	Ah Removed	EOD Voltage
Fall 1994	Battery 1	13.89	25.1		
	Battery 2	13.97	23.9		
Spring 1995	Battery 1	14.98	19.7		
	Battery 2	15.14	19.1		
Fall 1995	Battery 1	15.05	20.3	13.81	22.9
	Battery 2	15.33	19.7	13.57	27.5
Spring 1996	Battery 1	15.62	18.1	14.96	18.9
	Battery 2	15.65	18.3	14.87	19.7
Fall 1996	Battery 1	15.30	19.3	15.03	19.3
	Battery 2	15.45	18.9	15.04	20.1
Spring 1997	Battery 1	15.72	16.3	15.49	17.7
	Battery 2	15.81	17.1	15.32	19.5
Fall 1997	Battery 1	15.41	18.9	15.13	18.7
	Battery 2	15.42	19.5	14.99	19.7