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Satellite Battery Testing Status
Naval Weapons Support Center
Crane, Indiana

by

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ABSTRACT

Because of the large numbers of satellite cells currently being tested and anticipated at the Naval Weapons Support Center (NAVWPNSUPPCEN) Crane, Indiana, satellite cell testing is being integrated into the Battery Test Automation Project (BTAP). The BTAP, designed to meet the growing needs for battery testing at the NAVWPNSUPPCEN Crane, will consist of several Automated Test Stations (ATs) which monitor batteries under test. Each ATs will interface with an Automation Network Controller (ANC) which will collect test data for reduction.

DISCUSSION

FIGURE 1

Aircraft battery testing has been conducted at the NAVWPNSUPPCEN Crane since 1960. Over the years battery testing has expanded to include many test programs (manned 24 hours a day, 365 days of the year) including the National Aeronautics and Space Administration (NASA) Satellite Program. This test program has produced data from over 1800 satellite cells of various chemistries.

FIGURE 2

In discussions of NASA Satellite Battery Programs, acronyms are frequently used. Figure 2 clarifies these acronyms.

FIGURE 3

NASA currently supports testing of 140 cells (28 battery packs). All cells were manufactured by General Electric and range in sizes from four to 50 ampere-hours. LEO and GEO cycling are the primary test scenarios with one pack currently undergoing Power Profile Cycling. The favorable performance of some of these cells is exemplified by the successful completion of over 52,800 LEO cycles and 20 GEO cycles since 1976.

FIGURE 4

NASA has indicated the need to add two additional battery packs to the NAVWPNSUPPCEN Crane Satellite Battery Test Program in fiscal year 1986.

FIGURE 5

Other major satellite cell test programs being conducted at the NAVWPNSUPPCEN Crane consist of 173 cells for Air Force and Navy qualification testing of a new separator material proposed for future use in nickel-cadmium cells, and an Air Force Nickel-Hydrogen Data Base Program consisting of 57 cells to date. It is anticipated that more cells will be added to this test program later.

FIGURE 6

The BTAP currently being implemented at the NAVWPNSUPPCEN Crane is designed to meet the growing need for a sophisticated automated test facility capable of rapid data accumulation and reduction. Dynamic (real-time) control of power supplies to follow arbitrary voltage, current, and power time-varying profiles is scheduled for implementation this fiscal year.

FIGURE 7

The BTAP will consist of a network of existing data acquisition systems and newly procured systems used to monitor batteries under test and acquire data on voltage, current, temperature, pressure and other performance factors. An ATS also controls charge, discharge, open circuit, and short circuit times and events in accordance with a sponsor's test plan. Progress of the test can be examined at any time on a CRT terminal at each ATS. The CRT terminal also can be used to change some aspect of the on-going test, such as, the number of batteries under test (add new batteries, remove failed ones). In addition to analog voltage data acquisition, each ATS will have relays and D/A converters to enable the ATS to connect and disconnect strings of batteries from one or more power supplies automatically. An ANC will collect test data from each of the ATSS for storage on disc drives, and for both on-site and off-site archiving on magnetic tape to provide data backup and data security. Test procedures, data analysis, graphing, and report preparation using standard software packages will be provided via CRT terminals in engineering offices.

FIGURE 8

To date, those who have contributed to the BTAP system are the Navy, Air Force, and NASA.

FIGURE 9

With the existing data acquisition systems at the NAVWPNSUPPCEN Crane and those currently on order, the BTAP will begin operation shortly after the delivery of the ANC computer in December 1985.

CLOSING REMARKS

Through NASA support the NAVWPNSUPPCEN Crane has published many reports on satellite cell test projects. With continued NASA support and with the addition of new sponsors to the NAVWPNSUPPCEN Crane Satellite Cell Test Program (such as the Navy and the Air Force), test project data will continue to be published. Interested parties are encouraged to acquire clearance from the appropriate test program sponsor to be included on test report distribution lists.

- BATTERY/CELL TESTING SINCE 1960
- LARGE VARIETY OF CHEMISTRIES
- NASA SATELLITE BATTERY/CELL TESTING SINCE 1963
 - OVER 1800 CELLS
 - NICKEL-CADMIUM
 - SILVER-CADMIUM
 - SILVER-ZINC
 - LEAD-ACID

Figure 1

AMPTC: ACTIVE MAGNETIC PARTICLE TRACER EXPLORER

ERBS: EARTH RADIATION BUDGET SATELLITE

IUE: INTERNATIONAL ULTRAVIOLET EXPLORER

NOAA: NATIONAL OCEANIC ATMOSPHERIC ADMINISTRATION

TDRSS: TRACKING DATA RELAY SATELLITE SYSTEM

GOES: GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE

UARS: UPPER ATMOSPHERE RESEARCH SATELLITE

COBE: COSMIC BACKGROUND EXPLORER

REQUAL: PELLON SEPARATOR REQUALIFICATION

Figure 2. CLARIFICATION OF ACRONYMS

FLIGHT PROGRAM	NUMBER OF CELLS	RATED CAPACITY (A-H)	MANUFACTURER	SIMULATED ORBIT	CYCLES OR SHADOW PERIODS TO DATE	DATE TEST BEGAN
AMPTE	5	4	GENERAL ELECTRIC	LEO	765	10-83
ERBS	4	50	GENERAL ELECTRIC	POWER PROFILE	4,228	4-84
IUE	10	12	GENERAL ELECTRIC	GEO	18	8-77
IUE	5	12	GENERAL ELECTRIC	LEO	52,800	8,77
IUE	5	12	GENERAL ELECTRIC	LEO	10	10-85
IUE	5	6	GENERAL ELECTRIC	GEO	10	10-85
IUE	5	12	GENERAL ELECTRIC	GEO	20	4-76
NOAA	5	26.5	GENREAL ELECTRIC	LEO	14,000	7-82
NOAA	5	26.5	GENERAL ELECTRIC	LEO	900	8-85
TIROS-N	5	26.5	GENERAL ELECTRIC	LEO	52,800	1-78

Figure 3. CURRENT NASA TEST STATUS

FLIGHT PROGRAM	NUMBER OF CELLS	RATED CAPACITY (A-H)	MANUFACTURER	SIMULATED ORBIT	CYCLES OR SHADOW PERIODS TO DATE	DATE TEST BEGAN
TIROS-N	5	26.5	GENERAL ELECTRIC	LEO	52,800	1-78
TDRSS	5	40	GENERAL ELECTRIC	GEO	15	12-78
TDRSS	5	40	GENERAL ELECTRIC	GEO	12	3-80
GOES	5	6	GENERAL ELECTRIC	GEO	13	8-79
GOES	5	6	GENERAL ELECTRIC	GEO	9	9-82
GOES	5	6	GENERAL ELECTRIC	GEO	13	3-84
GOES	5	6	GENERAL ELECTRIC	GEO	4	3-84
GOES	3	6	GENERAL ELECTRIC	GEO	8	3-84
UARS	4	50	GENERAL ELECTRIC	LEO	500	10-85
REQUAL	34	50	GENERAL ELECTRIC	LEO	1,800	4-85
REQUAL	10	50	GENERAL ELECTRIC	GEO	..	4-85

Figure 3. (cont.) CURRENT NASA TEST STATUS

- COBE - 50 A-H, LEO
- UARS - 50 A-H, POWER PROFILE

Figure 4. FUTURE PLANNING (NASA)

- AIR FORCE/NAVY NICKEL CADMIUM SEPERATOR REQUALIFICATION - 173 CELLS
- AIR FORCE NICKEL-HYDROGEN - 57 CELLS TO DATE

Figure 5. OTHER TESTING

**BATTERY TEST
AUTOMATION PROGRAM
(BTAP)**

Figure 6.

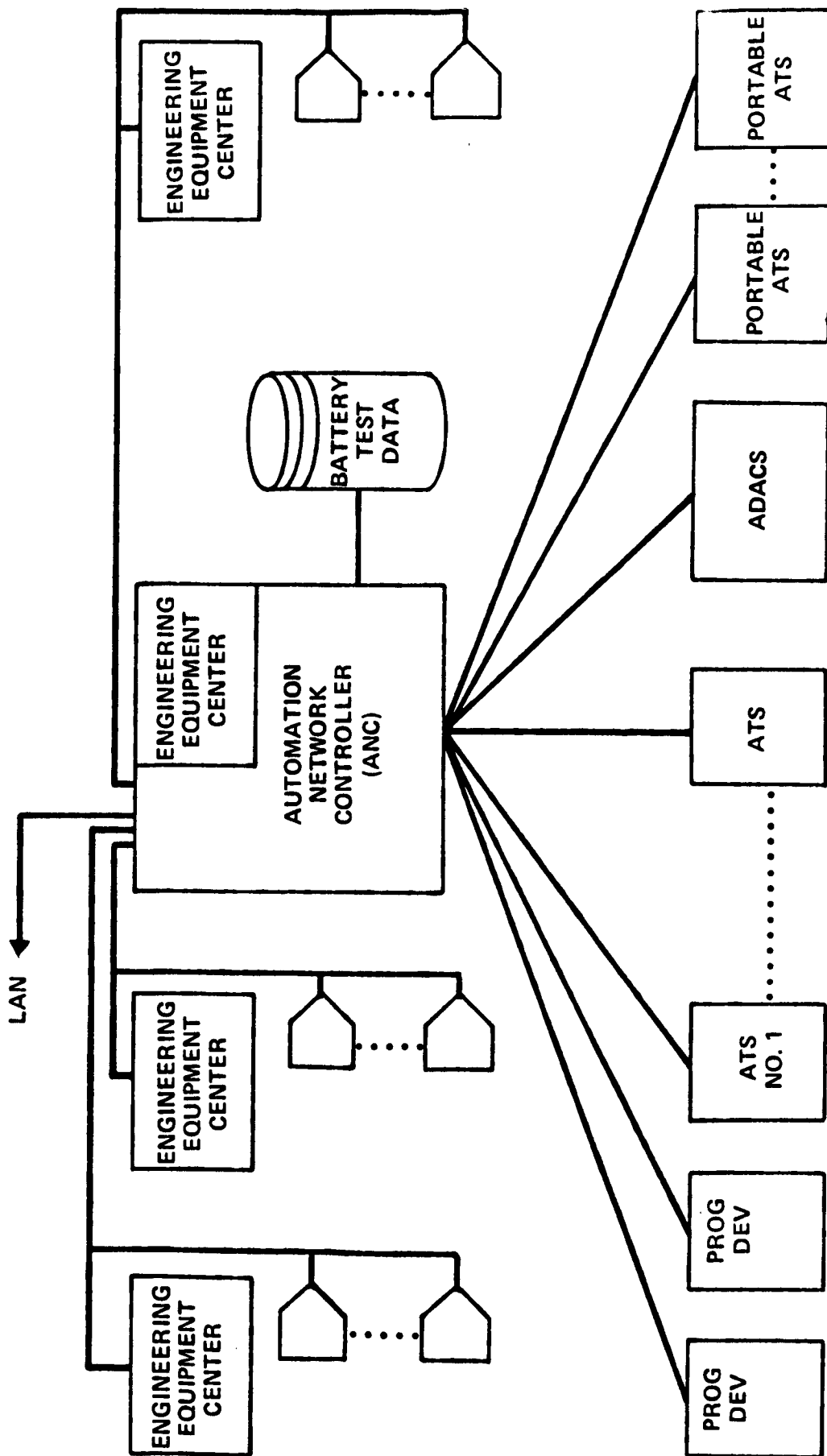


Figure 7. Battery Test Automation System

● NAVY

● AIR FORCE

● NASA

Figure 8. BTAP Participants

- **EQUIPMENT DELIVERY - DECEMBER 1985**
- **DATA REDUCTION CENTER OPERATIONAL - FEBRUARY 1986**

Figure 9. Automated Network Controller Progress