

PROCEDURES FOR TESTING OF ELECTRIC VEHICLE BATTERIES UNDER USABC

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The USABC battery test procedures were developed to characterize the performance of advanced batteries for electric vehicle applications relative to the USABC mid term and long term requirements. The challenges were to develop procedures that must be independent of any battery technologies and automobile specifications. The procedures were prepared by a team composed of USABC and DOE National Laboratories personnel and based on the experience and methods developed at Argonne National Laboratory (ANL), Idaho National Engineering Laboratory (INEL) and Sandia National Laboratories (SNL). The procedures were organized into four groups: Prerequisites; Performance; Life Cycle; and Safety and Abuse. The prerequisites specify steps that should be performed to assure that information required for testing a new battery is available. The performance tests include all of the core tests which will be used to evaluate energy and power. The life cycle test define steps to verify life cycle by using a combination of various performance tests. The safety and abuse study was completed and specific test procedures are being developed. Hundreds of contract deliverables have finished testing, are being tested or are scheduled for future testing. Test results and post test analysis provide valuable information and are guiding program managers and developers on making program plans and where to focus their research and development efforts.



PROCEDURES FOR TESTING OF EV BATTERIES UNDER USABC

Automotive Technology Development
Customers' Coordination Meeting
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CHALLENGES

USABC TEST PROCEDURES

- Must be technology independent
- Must be independent of automobile specifications
 - Battery developments precede auto design
 - Extreme competitive environment among auto companies

BACKGROUND

USABC TEST PROCEDURES

- Prepared by a team consisting of USABC and DOE National Laboratories
- Based on the experience and methods developed at ANL, INEL and SNL

OBJECTIVES

USABC TEST PROCEDURES

- Procedures were developed to characterize the performance of advanced batteries
- Battery performance is being evaluated against USABC targets

USABC TARGETS

	MIDTERM TARGET	LONGTERM TARGET
SPECIFIC ENERGY, wh/kg (C/3 discharge rate)	80	200
ENERGY DENSITY, wh/l (C/3 discharge rate)	135	300
SPECIFIC POWER, w/kg (80% DOD, 30 seconds)	150	400
POWER DENSITY, w/l	250	600
LIFE (years)	5	10
CYCLE LIFE (cycles, 80% DOD)	600	1000
PRICE AT 10,000 PACKS/YEAR (\$/kwh)	< \$150	< \$100
OPERATING ENVIRONMENT	-30 to 65 degrees C	-40 to 85 degrees C
RECHARGE TIME	< 6 hours	3 to 6 hours
CONTINUOUS DISCHARGE IN 1 HOUR (no failure)	75% of rated energy capacity	75% of rated energy capacity
POWER & CAPACITY DEGRADATION (% of rated spec)	20%	20%
EFFICIENCY (6 hour charge, C/3 discharge)	75%	80%
SAFETY	Safe under normal, accident and abuse situations	

ORGANIZATION

USABC TEST PROCEDURES

- Prerequisites
- Performance
- Life Cycle
- Safety and Abuse

PREREQUISITES

- Battery Pre-Test Preparation
- Readiness Review
 - Battery Ratings
 - Termination Conditions / Limits
 - End-of-Life Criteria
 - Charging Regime

PERFORMANCE TESTS

- Constant Current
- Peak Power
- Variable Power
 - FUDS Regime
 - Dynamic Stress Test (DST) Regime

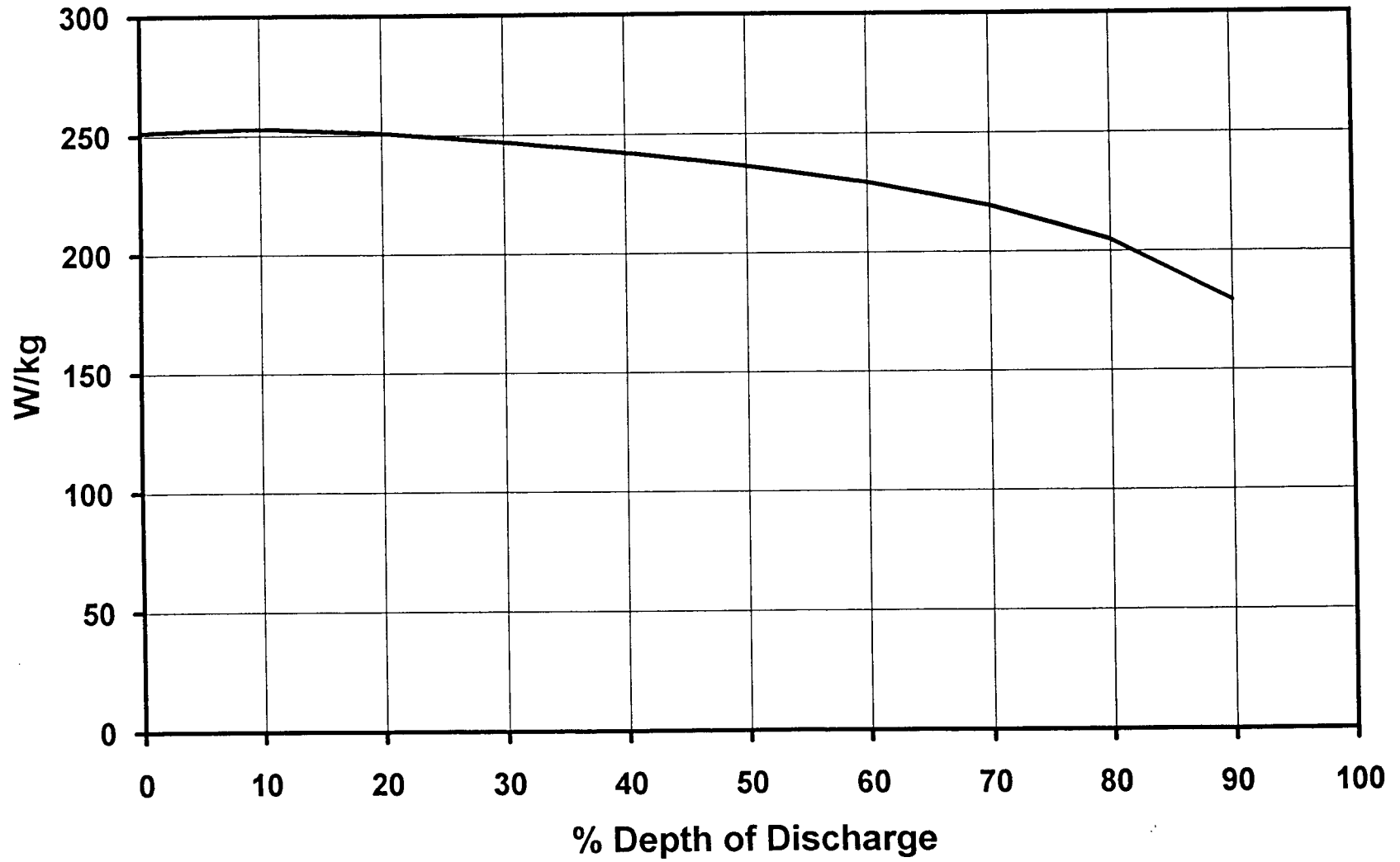
LIFE CYCLE TESTS

- Accelerated Aging
- Actual Use Simulation
- Baseline Life Cycle
- Reference Performance Test

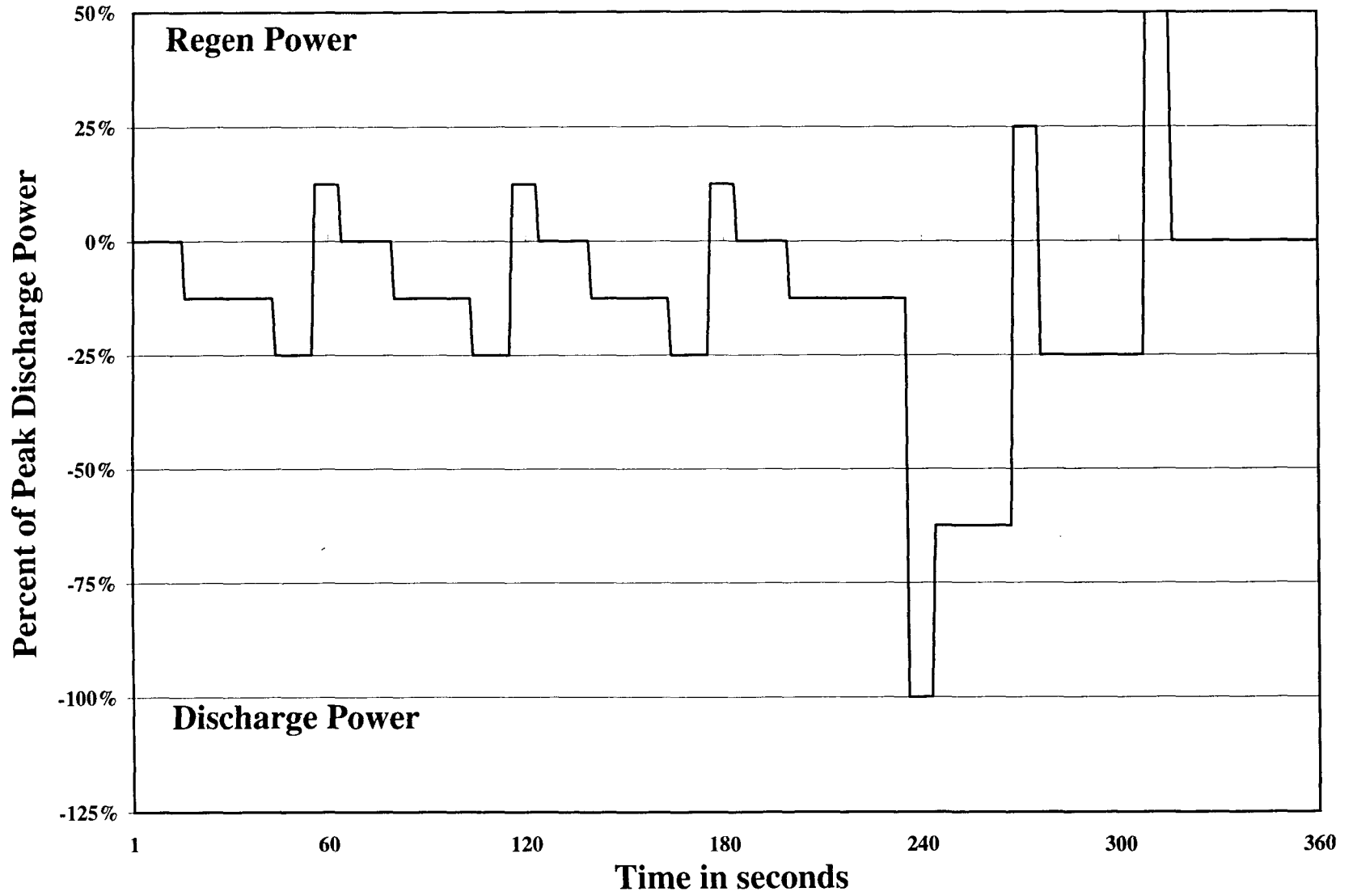
SAFETY AND ABUSE TESTS

- Initial study for safety and abuse testing has been completed
- Specific test procedures are being developed by SNL

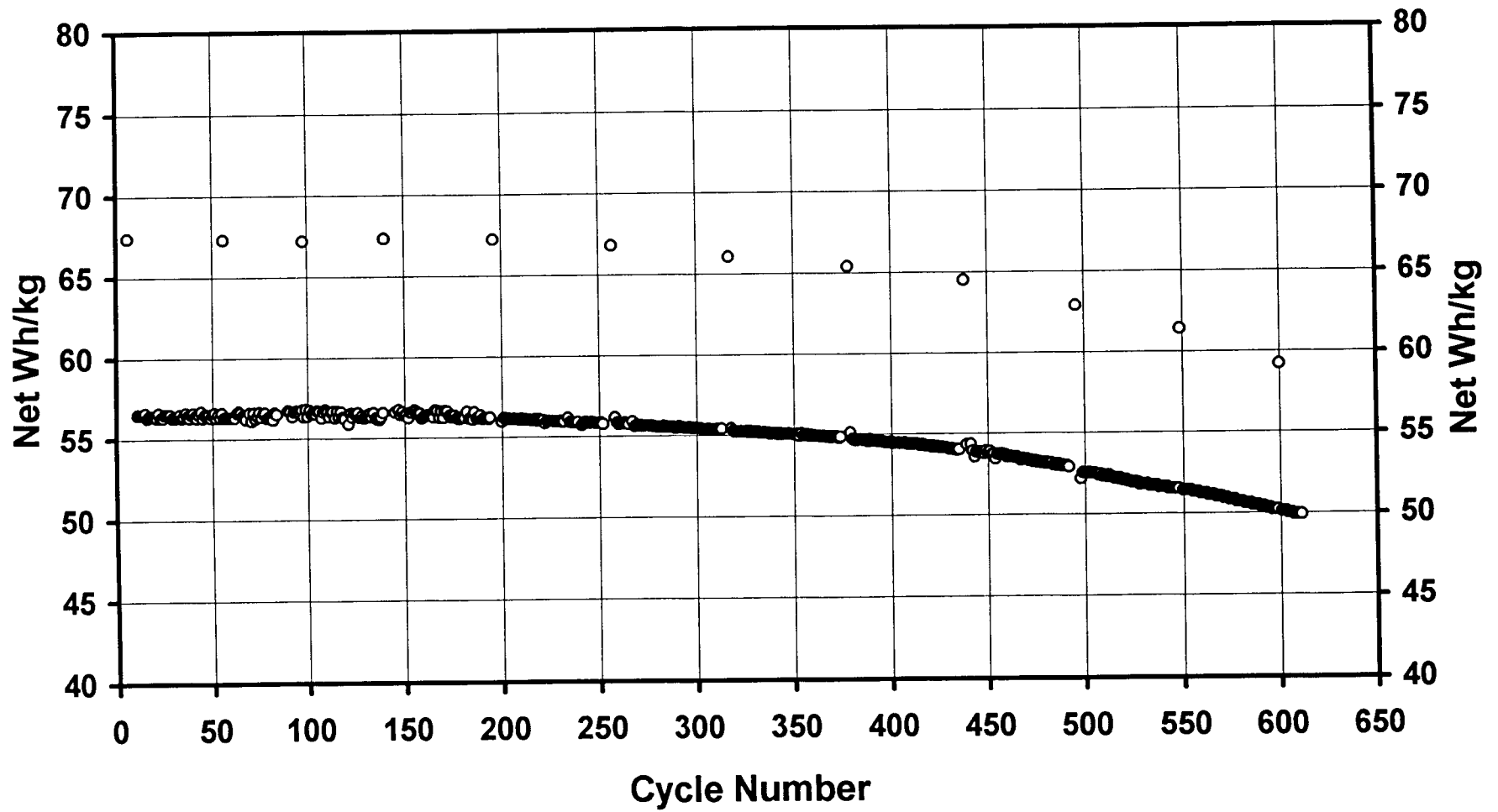
PEAK POWER TEST



DYNAMIC STRESS TEST (DST) CYCLE



DST LIFE CYCLE PERFORMANCE



ACCOMPLISHMENTS

USABC TEST PROCEDURES

- Published revised EV Battery Test Procedures Manual in January 1996
- Hundreds of contract deliverables have finished testing
- Test results and analyses are valuable to developers and program managers

FUTURE DIRECTION

USABC TEST PROCEDURES

- Continue to improve existing procedures
- Conduct selected abuse tests
- Perform testing to evaluate secondary use of EV batteries
- Develop and verify procedures to evaluate high power energy storage devices