ARRAVT078

Progress on ARRA-funded Facility & Capability Upgrades for the Battery Abuse/Safety Laboratory

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NNSA National Nuclear Security Administration

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Overview

Timeline

- Project start
  15-Apr-2011
- Project end
  30-Sep-2012

Barriers & Risks

- Substantial building modifications
- Construction site "turned over to contractors"
- Limited testing activity
- Site returned to "owners"
- ES&H concerns
  - Safety
  - Industrial Hyiene
  - RCRA

Budget

- $4200K (100% ARRA)
- 100% Funded FY10

Partners

- CH2M Hill - Archictect Engineers (Englewood, CO)
- Engineering Constructors Inc. - General Contractor (Albuquerque, NM)
- JB Henderson - Mechanical Contractor (Albuquerque, NM)
- Del Rio Enterprises - Electrical Contractor (Albuquerque, NM)
- Bridgers & Paxton Consulting Engineers (Albuquerque, NM)

Objectives/Relevance

The SNL Battery Abuse/Safety Test Laboratory (BATLab) ARRA-funded Capabilities Upgrade Project provides support for those goals & objectives provided in the *DOE Energy Efficiency & Renewable Energy Vehicle Technologies Program Multi-Year Program Plan* [http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/vt_mypp_2011-2015.pdf]

- Challenges and Barriers (pp 2.1-2 - 2.1-3), specifically:
  - *Abuse Tolerance, Reliability and Ruggedness* - Section D. (p2.1-3)

The BATLab Upgrades will increase capability by increasing:

- Power (>50KW)
- Voltage (>400V)
- Current (>600A)
- Test throughput
- Test data reliability
  - replace obsolete equipment & instruments
  - provide simultaneous test capability
  - implement current A/V & data capture standards
  - install platforms with standardized processing operations & data formats
  - Safety

For tested cells, modules and packs.

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Approach:

The ARRA-funded BATLab Upgrade Project will meet EERE-VT Multi-Year Program Plan Challenges & Barriers by:

- ✓ The acquisition of modern equipment & instrumentation
- ✓ Implementation of standard test protocols & data processing
- ✓ Ugrade the physical plant (BATLab) to provide:
  - **Available Power :**
    - **480VAC 3Φ 60A (4X)**
    - **208VAC 3Φ 60A (4X)**
    - **208VAC 1Φ 30A (8X)**
    - **110VAC 1Φ 20A (26X)--6 remotely switched**
  - **HVAC:**
    - **Increase Air Evacuation Volume & Scrubbing Capacity**
    - **Increase Air Evacuation Service Points (8 ⇒ 14)**
    - **Increase Make-Up Air Capacity**
  - **Equipment, Instrumentation, & Analysis Capability Increase**
    - **Replace Obsolete Units**
    - **Add Ability to Test Units Simultaneously**
    - **Increase Quality & Quantity of Data Acquired**
      - **ADC (voltage, temperature, stress/strain)**
      - **Audio/Video**
  - **Safety Systems upgrade:**
    - **Fire suppression**
    - **Power distribution relocation**
    - **Intrinsically safe lighting**

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Accomplishments:
AARA Project/Task Update FY2011

ARRA Projects as of 02/25/2011

	TOTAL SPEND PLAN	FY 10 Costs	FY11 Costs YTD	FY11 Commits	Total FY 2010 Costs & FY 2011 Costs + Commits	Total % Spent	Total Remaining Funds for FY2011 & FY2012
148535 - ARRA Operating Project Labor	**400,000**	5,614	174,067	0	179,681	**44.9%**	**220,319**
148634 - ARRA Capital Equipment	**2,600,000**	1,014,967	132,876	901,340	2,049,183	**78.8%**	**550,817**
148804 - ARRA Facilities Project	**1,200,000**	57,278	110,496	336,340	504,114	**42.0%**	**695,886**
Totals	**4,200,000**	1,077,859	417,439	1,237,680	2,732,978	**65.1%**	**1,467,022**

One-Third of timeline completed

- Committed 60% of total funds
- Costed or committed 43% of Facility Upgrade funds
- Costed or committed 80% of Capital funds
- Costed or committed 50% of Capability Upgrade labor
- 55% Facilities upgrades complete

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Technical Accomplishments:
ARRA Equipment Acquisitions

Item	Unit cost	quantity	total	ACTUAL COSTS	Loaded
Electrical Test and Abuse Equipment					
Bitrode 48V/20A (8 ch)	$58,200	1	$58,200	$58,240	$60,511.360
Bitrode 100V/20A (4 ch)	$36,300	1	$36,300	$36,300	$37,715.700
Bitrode 20V/200A (2 ch)	$35,000	1	$35,000	$63,720	$66,205.080
Cell Level Tester (Maccor - 16 ch)	$40,000	1	$40,000	$41,775	$43,406.225
Pack Level Cycler (Bitrode)	$24,000	1	$24,000	$26,042	$27,057.638
Solartron ETS system	$50,000	1	$50,000	$54,645	$56,796.935
Gas Analysis Equipment					
FTIR	$80,000	1	$80,000	$74,170	$77,093.450
MS	$75,000	1	$75,000	$75,000	$77,925.000
Thermal Analysis Equipment					
Thermal Chamber	$6,500	4	$25,200	$24,264	$25,220.220
Thermal Test Enclosure	$20,000	1	$20,000		
Mechanical Abuse Equipment					
Hydraulic Systyem Controller (Crush)	$45,000	1	$45,000	$45,899	$47,689.061
Data Acquisition					
Data Acquisition System	$250,000	2	$500,000		
Data Processing/Display	$5,000	1	$5,000		
Calorimetry, Thermal Characterization					
Laser-based in-situ diagnostic system	$250,000	1	$250,000		
CT-Xray	$460,000	1	$460,000	$479,150	$497,960.760
ES ARC	$157,000	1	$157,000	$151,886	$157,864.760
EV ARC	$125,000	1	$125,000	$119,170	$123,848.440
Setaram C80 Calorimeter	$140,000	1	$140,000		
Microtrac	$49,950	2	$99,900	$99,900	$103,796.100
Glove Box	$46,905	1	$46,905	$47,257	$49,098.036
Equipment Total			$2,274,000	$1,382,848	$1,436,779
Load	3.9%		$88,686		
Total			$2,362,686		
Software development	$150,000	1	$150,000	$180,000	$150,000
Staff Support (50:50 Laser diag./2546)	$400,000	1	$400,000	$400,000	$400,000
Facilities	$1,200,000	1	$1,200,000	$1,200,000	$1,200,000

Costed

Committed (POs Issued--not delivered)

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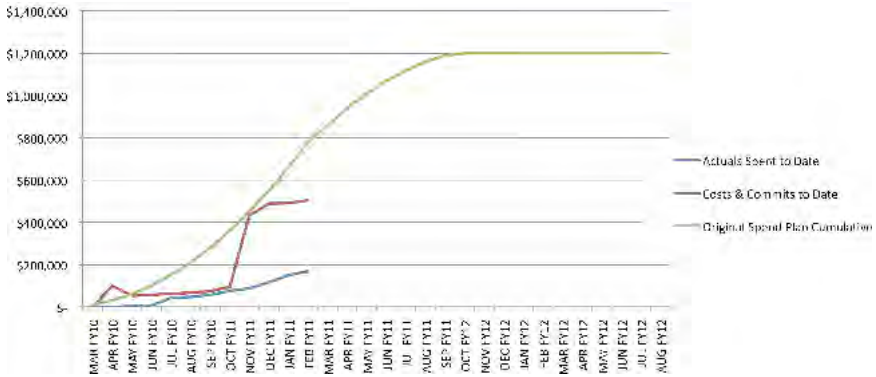
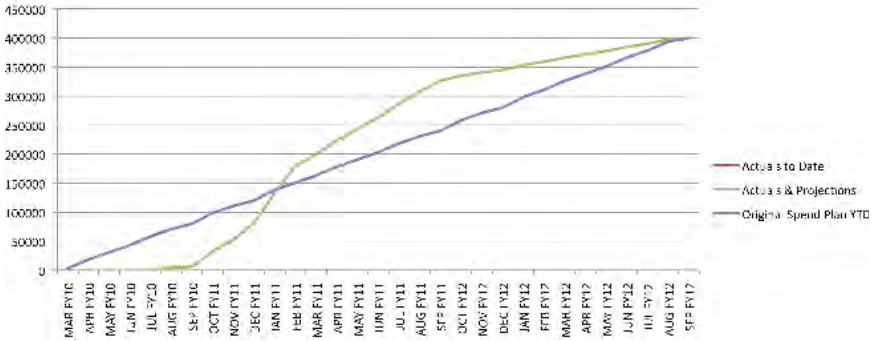
Accomplishments:
Budget Status

Overall

Capital



Capital Labor



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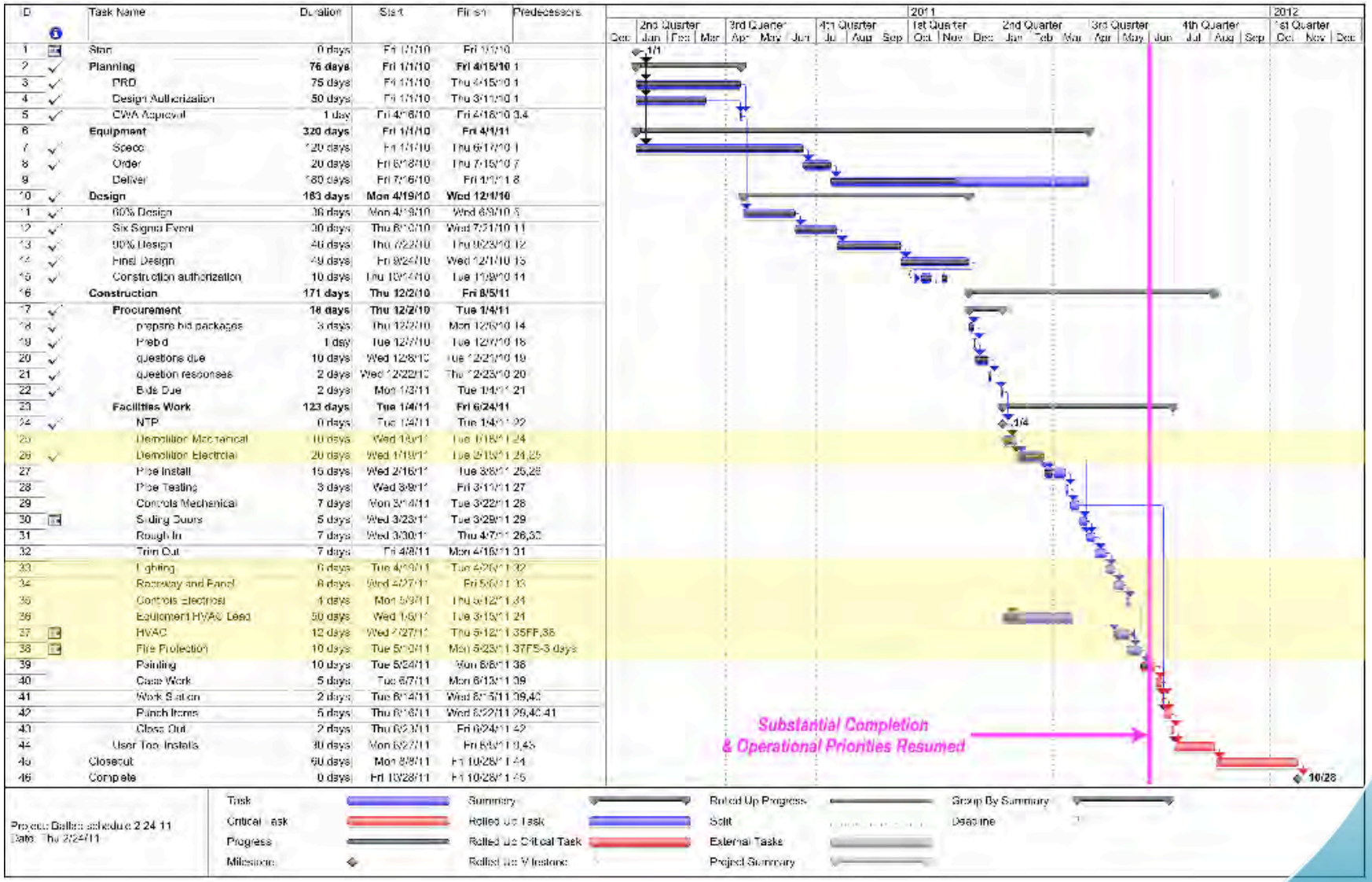
Milestones



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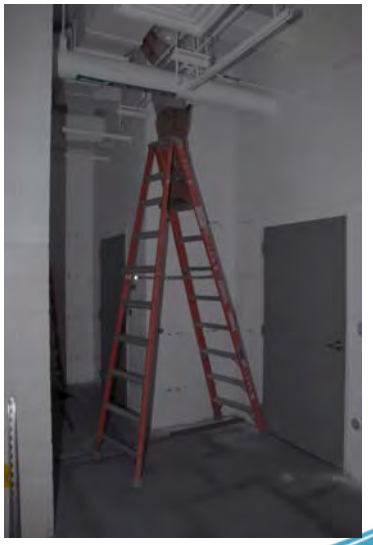
Battery Abuse/Safety Laboratory (BATLab) Before the Upgrade . . .

Accomplishments:

Battery Abuse/Safety Laboratory (BATLab)

During the Upgrade . . .



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Technical Accomplishments:
Equipment: Bitrode Battery Tester

Bitrode
innovation in charge™

(A Missouri Company)

- 600 VDC
- 30A
- 4 channels
- Modules
  - Over-charge
  - Over-discharge
  - Cycle testing
- Full Packs
  - Over-charge
  - Over-discharge
  - Cycle testing

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Technical Accomplishments:
Equipment: Wrightline Work Stations

EATON Powering Business Worldwide

wright · line An Eaton Brand

- Flexible:
  - 61” to 84” high
  - 20” to 42” shelf depth
  - 24” - 72” shelf width
- 1500 lb. load limit
- Shelf adjustment in 1” increments
- Sturdy casters … easily moved
- On-board power distribution
- Cable control

A Massachusetts Company

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Technical Accomplishments:
Equipment: Maccor Battery Tester 4200

MACCOR
BATTERY & CELL TEST EQUIPMENT WORLDWIDE

- 16 channels
- Remote cell sensors
- 5V, 10A
- Formation cycling
- Test cycling
- Complex load profiles
- Control:
  - State of Charge (SOC)
  - Charge /Discharge voltage
  - Charge /Discharge current
  - Charge/Discharge capacity

An Oklahoma Company

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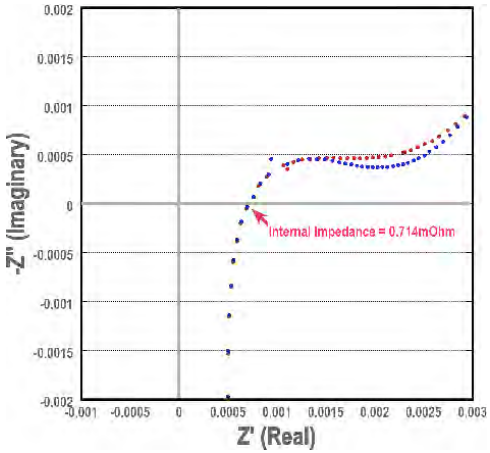
Technical Accomplishments:
Equipment: Computed Tomography Xray

North Star Imaging
(A Minnesota Company)

- 0.005mm resolution
- No. 6 size cell capability
- 2D image: real time
- 3D image: 2-3h
- Full visualization:
  - Rotation (3D)
  - Zoom
  - Contrast enhancement
  - ID “Z” number range

Technical Accomplishments:
Equipment: Electrochemical Instrumentation



- ±100V
- ±2A
- 0.1 pA Resolution
- EIS:
  - 1MHz - 1μHz
  - ± 100V
  - ± 2A
  - 0.1pΩ Resolution

Subsidiary of Ametek (A Pennsylvania Company)

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Technical Accomplishments:
Equipment: Real-Time Microcalorimetry

International Battery Calorimeters
(An Arizona Company)

- Measures heat input/output while charging or discharging cells
- Resolution: 10^{-6} calories
- Coin-Cells up to 2032
- Cylindrical cells up to 18650
- Other cell holders available

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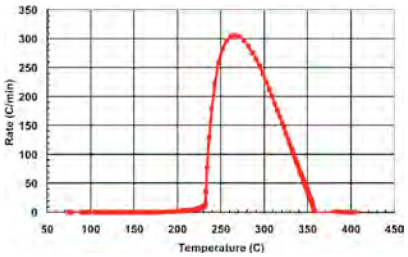
Equipment: ES- & EV- Accelerating Rate Calorimeters (ARCs)



- Thermal sensitivity
- Thermal runaway onset determination
- Total Enthalpy output
- Quantitative gas evolution
- Coupled with Sample Prep Glovebox:
  - Component contributions
  - Component interactions
  - Mechanism elucidation

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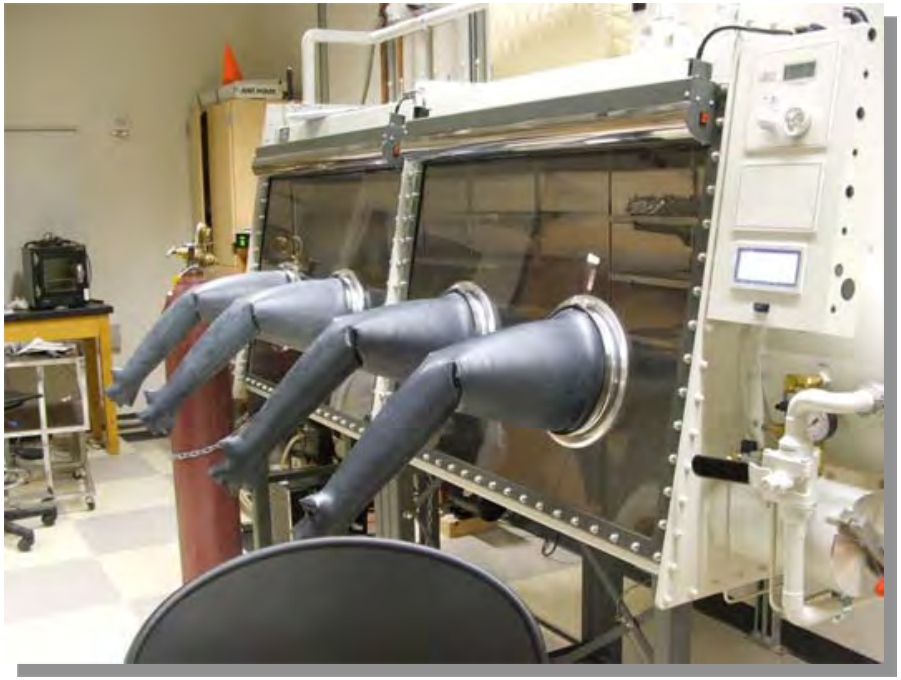
Technical Accomplishments:
Equipment: Glovebox

VAC
Vacuum Atmospheres Company

(A California Company)



- ✓ **Disassembly of fully charged Li-ion cells**
- ✓ **Partitioning of cell components**
- ✓ **Resealing cell components**
- ✓ **Assess cell component contributions (w/ARC)**

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Technical Accomplishments:
Equipment: Test Control
& Data Acquisition/Management System

A&D Technology Inc.

TEST US.

BATTERY DEVELOPMENT & TESTING

OVERVIEW

CHALLENGES

THE A&D SOLUTION

(A Michigan Company)

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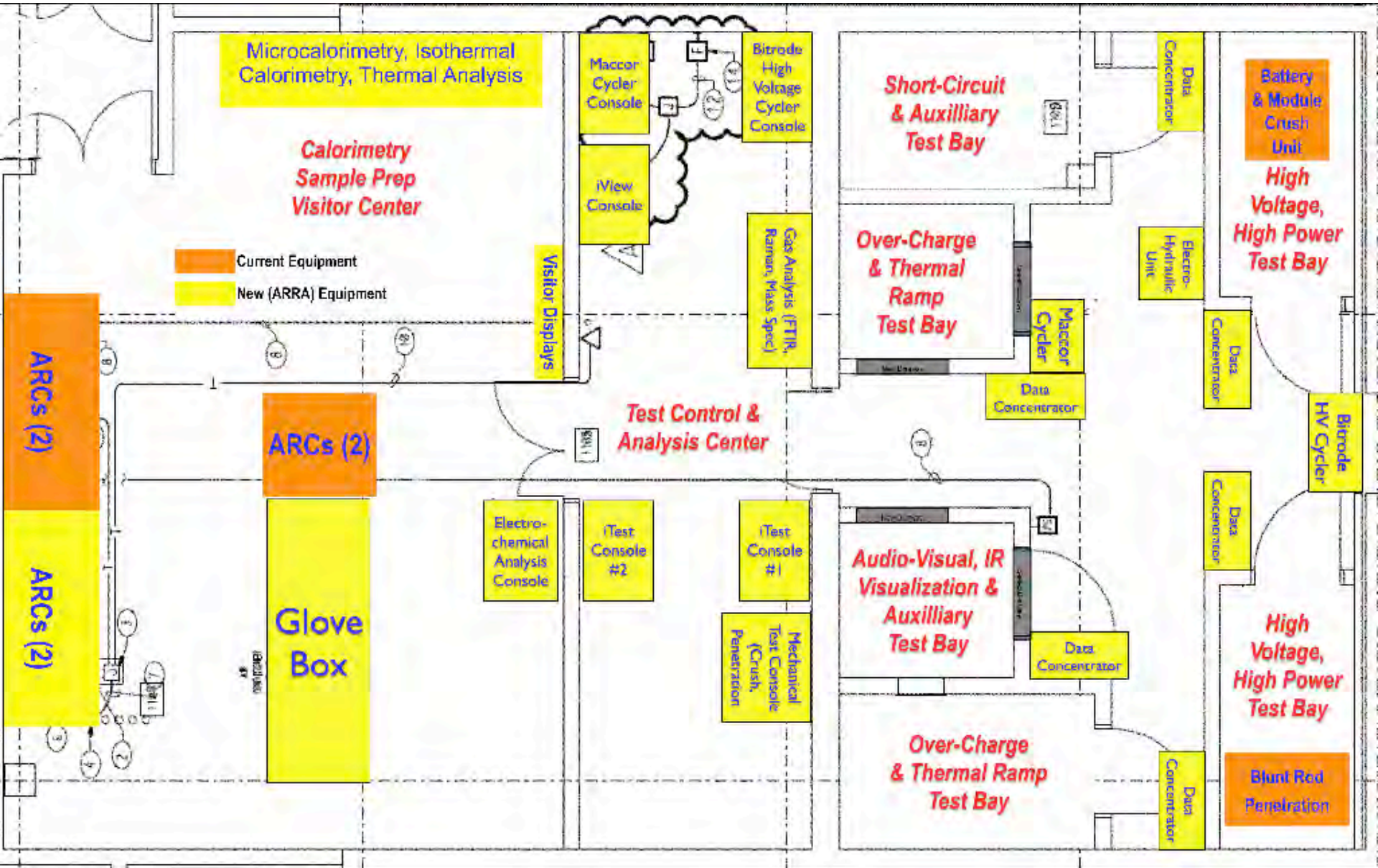
Accomplishments:

BATLab Layout . . . After the upgrade



Collaborations/Partnerships

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Future Work

- Complete facilities upgrade

1 July 2011

- Install & check-out new equipment on hand

  31 July 2011

- Resume unrestricted testing activities

  31 August 2011

- Complete Capital Equipment Acquisition

  30 September 2011

- Initiate upgraded testing productivity

  30 November 2011

Summary

At 33% of the project timeline:

- ✓44% of Capital Labor costed + 45% committed
- ✓44% Capital Equipment costed + 35% committed
- ✓14% Facilities Project costed + 28% committed
- ✓35% Overall Project costed + 30% committed
- ✓Limited testing continuing through project upgrades