# 2009 DOE Hydrogen Program Review Presentation Fuel Cell Balance of Plant Reliability Testbed

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Project ID # fcp_14_sproat

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# Overview

## Timeline

- Start - Aug 2008
- Finish – July 2011
- 12% Complete

## Budget

- Total project funding
  - DOE $787,200
  - Contractor $196,800
- Funding received in FY08 - $0 (Grant started Aug 08)
- Funding FY09 spent to 3/31/2009 $26,775
- Projected Funding for FY09 - DOE $ 449,345 (2 of 3 testbeds to be built plus operational testing equipment purchased for all 3 test beds)

## Barriers

- Technology Validation: Project will generate a reliability database for candidate PEM fuel cell balance-of-plant components
- Education: Project will enhance the education of technical workforce trained in PEM fuel cell system technology

## Partners

- Lockheed Martin
  - Design & location of 1 of 3 testbeds
- Stark State College of Technology
  - Project lead & location of 2 testbeds built by students

# Relevance

BOP (Balance-of-Plant) - to have hydrogen used in fuel cells, a balance needs to be engineered for:

- Reliability
- Mean time between failure
- Training of technicians for maintaining fuel cell systems.

# Approach

- Development of test beds to address the challenge to the fuel cell industry of the durability and reliability of components that comprise the complete system (Balance of Plant).
- Development of the test plan to address the candidate balance-of-plant components and basic test bed design for long term operation.
- Utilization of collaborations with component manufacturers to develop and enhance final product performance.
- Develop statistical models for extremely small sample sizes while incorporating manufacturer validation data for future evaluation of candidate components.
- Real-time, in-situ analysis of critical components' key parameters to monitor system reliability.
- Utilizing the test beds to enhance the education of the technical workforce trained in PEM fuel cell system technology.

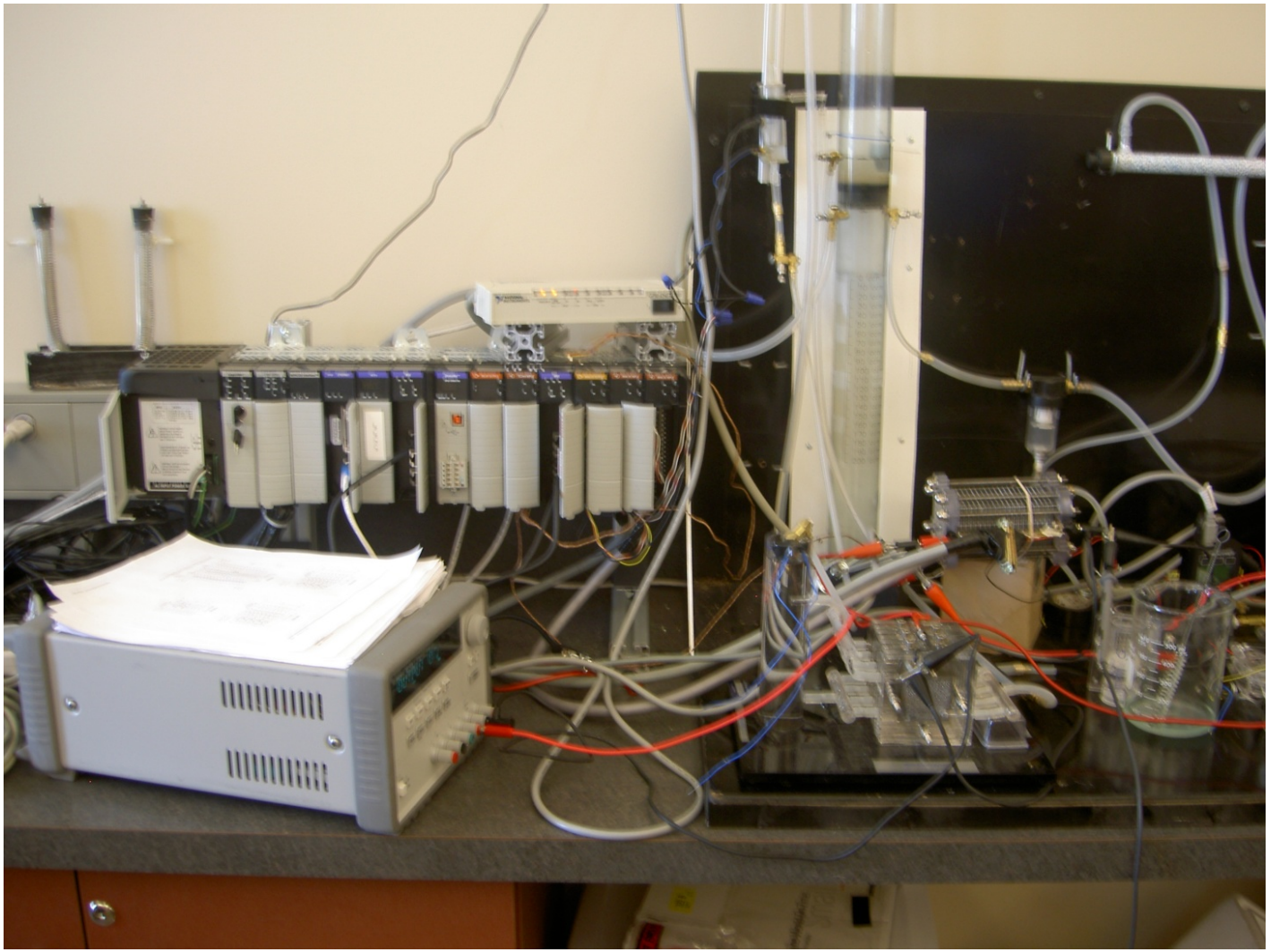
# Approach

| Task Number | Project Milestones | Task Completion Date | | | | Progress Notes |
|---|---|---|---|---|---|---|
| | | Original Planned | Revised Planned | Actual | Percent Complete | |
| 1 | Test Bed Design | 3/31/09 | | | 100% | |
| 2 | Renovation of College Facility | 3/31/09 | 5/30/09 | | | Due to turnover in project management at the college, this activity hasn't taken place, but will get underway in the second quarter. |
| 3 | College Test Bed Fabrication & Test | 6/30/09 | | | | |
| 4 | Parallel Test Bed Fabrication & Test | 6/30/09 | | | 25% | |
| 5 | Reliability Analysis | 6/30/11 | | | | |
| 6 | Failure Analysis | 6/30/11 | | | | |
| 7 | Consulting | 6/30/11 | | | | |
| 8 | Project Management & Reporting | 4/30/11 | | | | Due to turnover in project management, the College has just submitted the Hydrogen Safety Plan. |

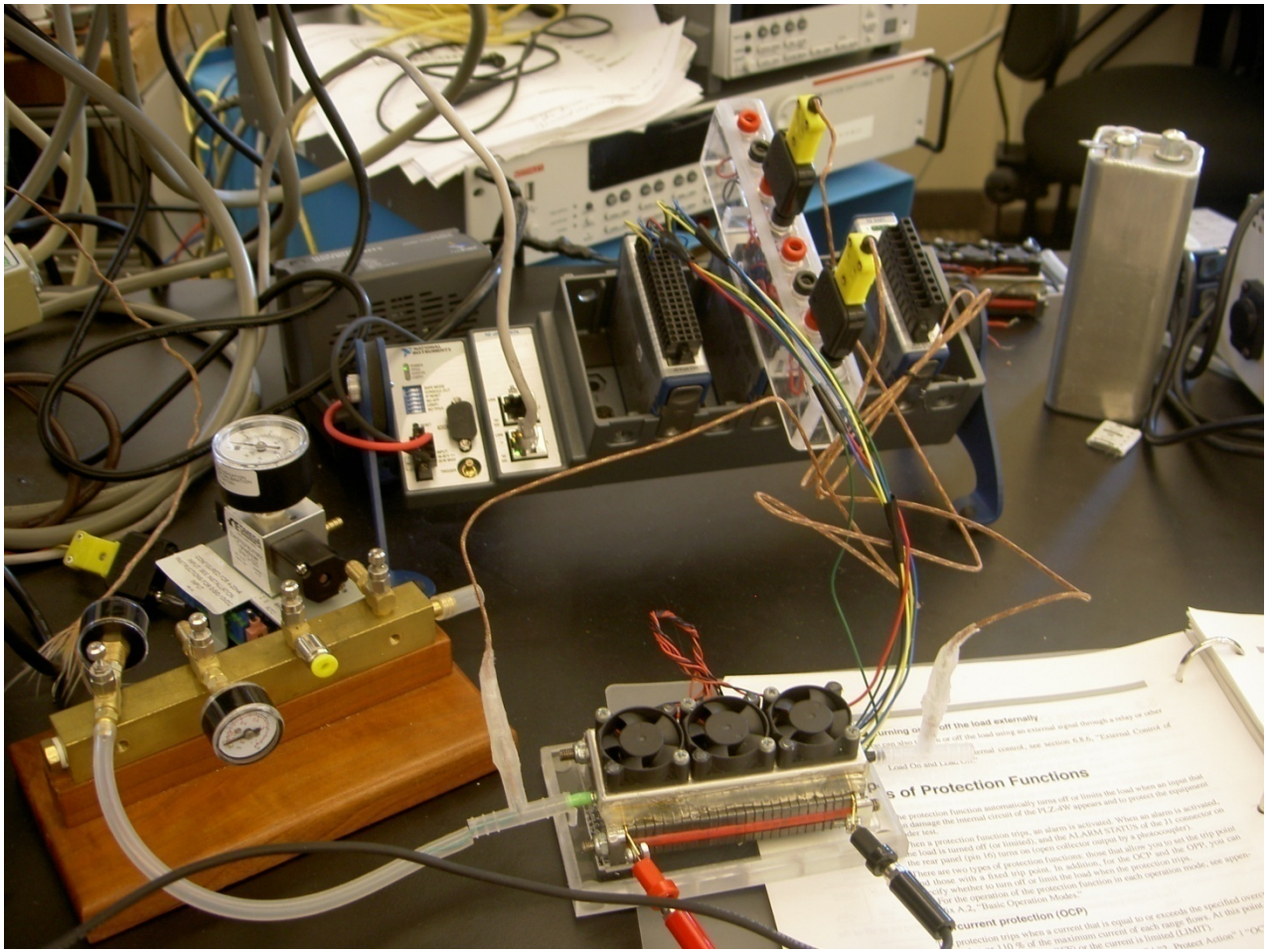
# Technical Accomplishments and Progress

- Test Plan generation
  - Analytical methods to measure the quality of components, real time and in-situ, have been documented.
  - Statistical models are in draft form and prepared for use.
  - 2 large northeast Ohio manufacturers have cooperated with efforts, in addition to smaller Ohio companies.
- Test bed parts are on order.
- Students are being trained on the construction and operation of the test bed.
- The Hydrogen Safety Plan has been implemented to ensure safe operation of the testbeds with hydrogen.

# Prior to Hydrogen Safety Plan and Testbed Student Instrumentation Work



# Pre-Testbed Student Work



# Technical Accomplishments and Progress

## Reliability Testbed

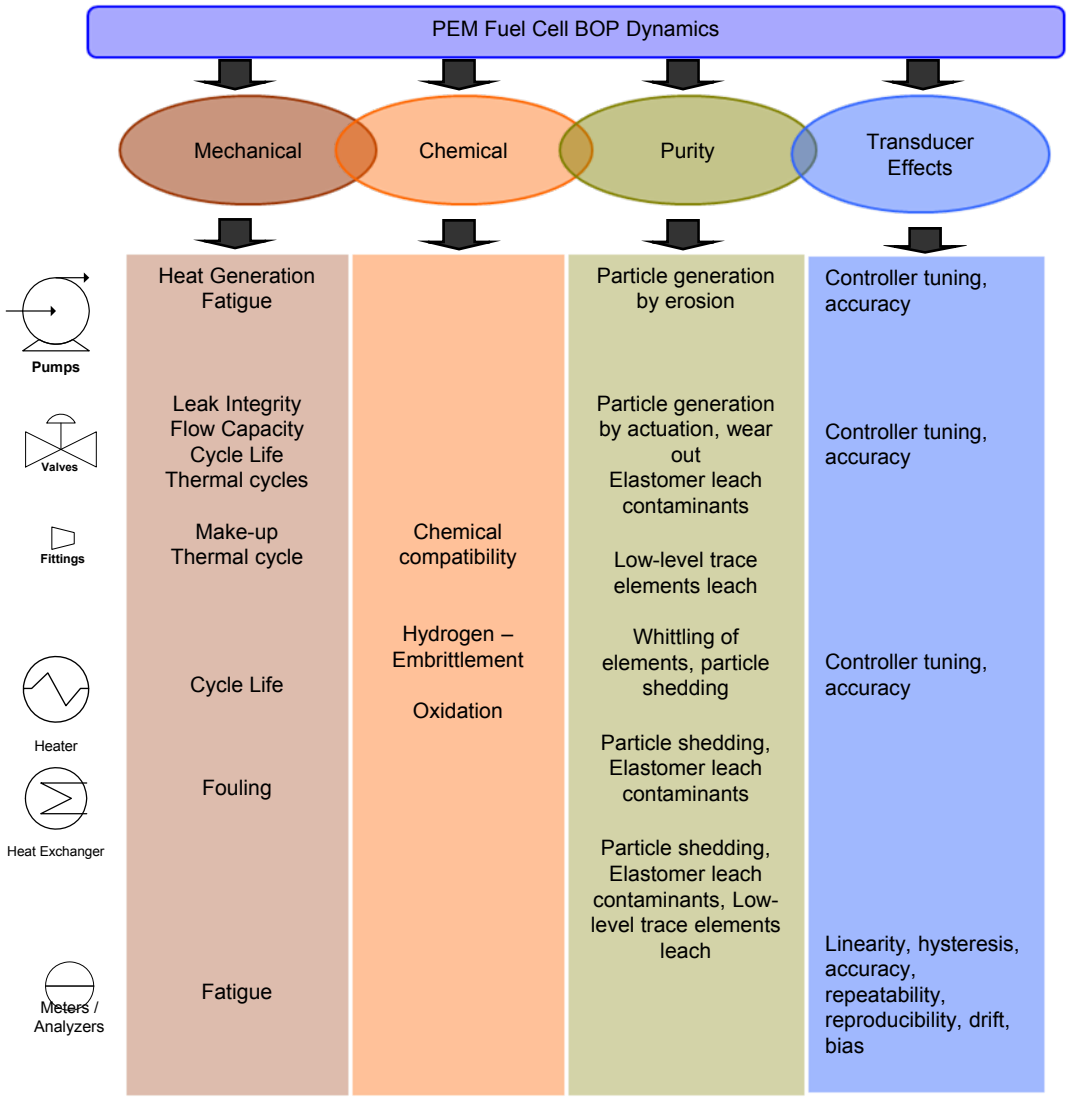
*What is Reliability*?

Reliability - The ability of an item to perform the required function, under stated conditions, for a period of time.

*Candidate Balance-of-Plant Components*

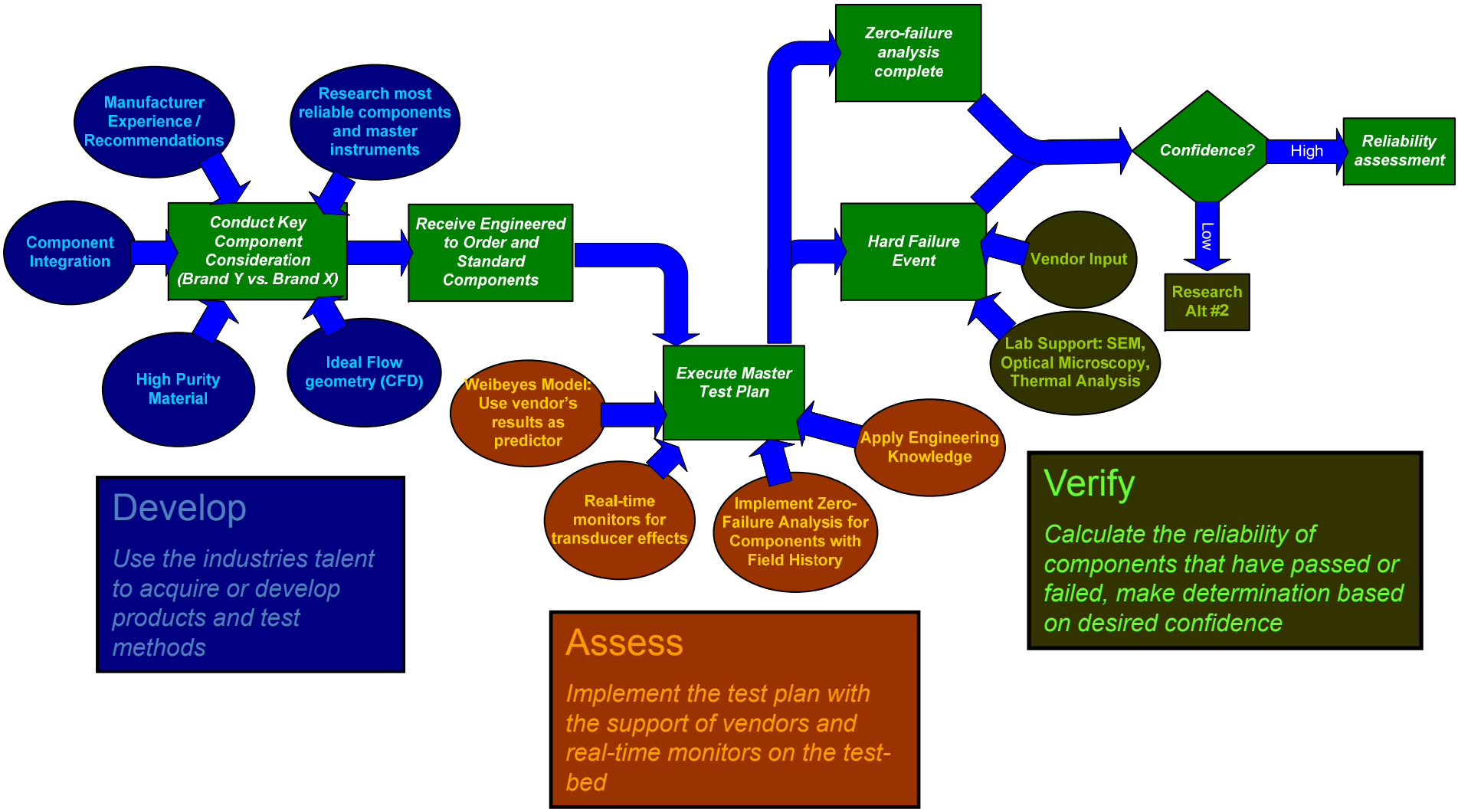
COTS – Commercial Off-The-Shelf Components.

- High production products such as piping, fittings, etc. where past history is available.
  - Use Weibull and Weibayes Analysis for those components with previous history. This procedure incorporates test and field data (vendor reliability and quality analysis) to demonstrate the component product meets the reliability target at the desired confidence level.
- Low production units with no manufacturer reliability data.
  - End-of-life component data and Forensic Failure Analysis will be the most important test data.



# Technical Accomplishments and Progress

## Test Methodology – real-time confidence update



# Collaborations

- Lockheed Martin
  - Subcontractor
  - Initial Test Bed Design
  - Parallel Test Bed Construction
  - Failure Analysis
  - Reliability Analysis
- Industry Dialogue
  - Parker
  - Swagelok
  - National Instruments
  - Rockwell Automation
  - Microchip Technology

# Proposed Future Work

- Execute test plan.
- Construct two reliability testbeds.
- Begin acquiring real time, in-situ data from the operation of the testbeds.
- Address failure analysis and reliability analysis as failures occur.

# Project Summary

**Relevance:** BOP - to have hydrogen used in fuel cells, a balance needs to be engineered for reliability and technician training for fuel cell system.

**Approach:** Develop BOP testbeds, collaboration with component manufacturers to enhance product performance, and train technical workforce in PEM fuel cell systems.

**Technical Accomplishments & Progress:** Test Plan generation.

Students are being trained on the construction and operation of the test bed, and the Hydrogen Safety Plan has been implemented to ensure safe operation of the testbeds with hydrogen.

**Technology Transfer/Collaboration:** Active partnership with Lockheed Martin and industry dialogue with Parker, Swagelok, National Instruments, Rockwell Automation, Microchip Technology and others ...

**Proposed Future Work:** Execute Test Plan; construct two reliability testbeds by students; begin acquiring real time, in-situ data; address failure analysis and reliability analysis of BOP components.

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# Acknowledgements


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