Fighter/EW/Helo/Patrol Arc Fault Circuit Breaker Development

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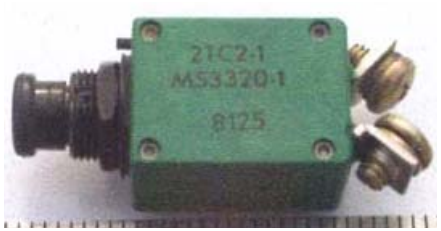
What is the Arcing Fault Problem

Problem Description

Thermal Circuit Breakers are not designed to detect arcing (sputtering) faults for aircraft to prevent electrical fires.

- Arcing faults are the predominate typed of fault on aircraft wiring and do lead to many maintenance actions and possibly fires such as Swissair 111.

- The FAA reports an average of 3 smoke in the aircraft events/day in the civilian aircraft fleet



Navy
Problem Definition

- NALDA average annual incident rate of 127.4 per aircraft type, 38 types of aircraft corresponds to an incident rate of 4841 per year.
- Naval Safety Center documented 30 In-flight Navy aircraft wiring fires which caused mission aborts.
- Existing thermal circuit breakers are not designed to detect arcing faults

Expected Payoffs

- **AFCB protects/provides maintenance information on power wires (15-20% of system wiring)**

  1 to 2 million organizational man-hours per year are spent troubleshooting and repairing aircraft wiring. With respect to power wiring incidents, AFCB technology will

  - reduce maintenance man-hours by 35% (70,000 hours)
  - reduce mission aborts and NMC hours by 35% ($9M/year)

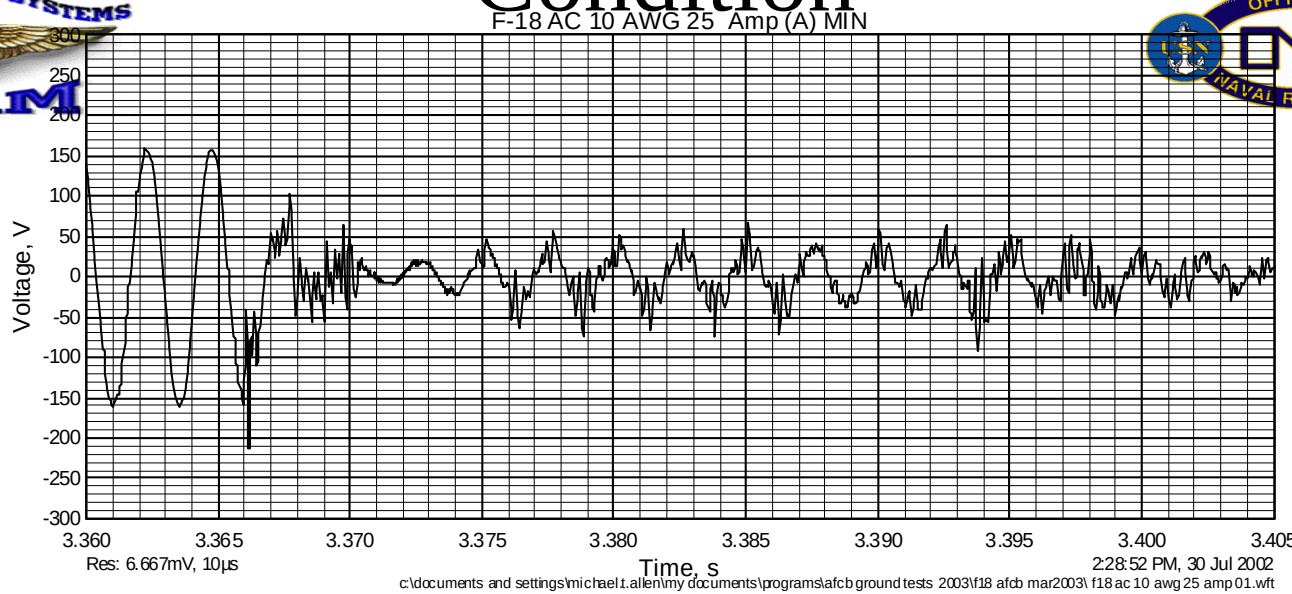
- ***AFCB will protect A/C wiring power system by detecting and isolating arcing fault which can cause smoke in the cockpit mission aborts and fires***

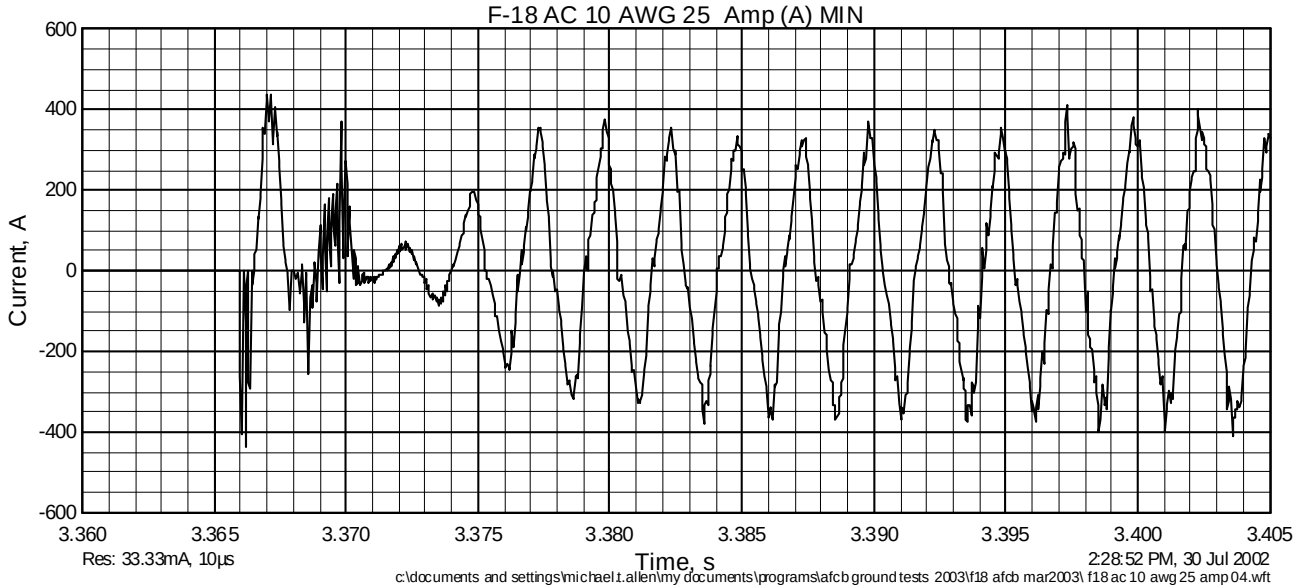
  reduce in-flight electrical fires and subsequent loss of aircraft by 80% ($27.3M/year)

- **Estimated savings of $37.5M per year after full implementation.**

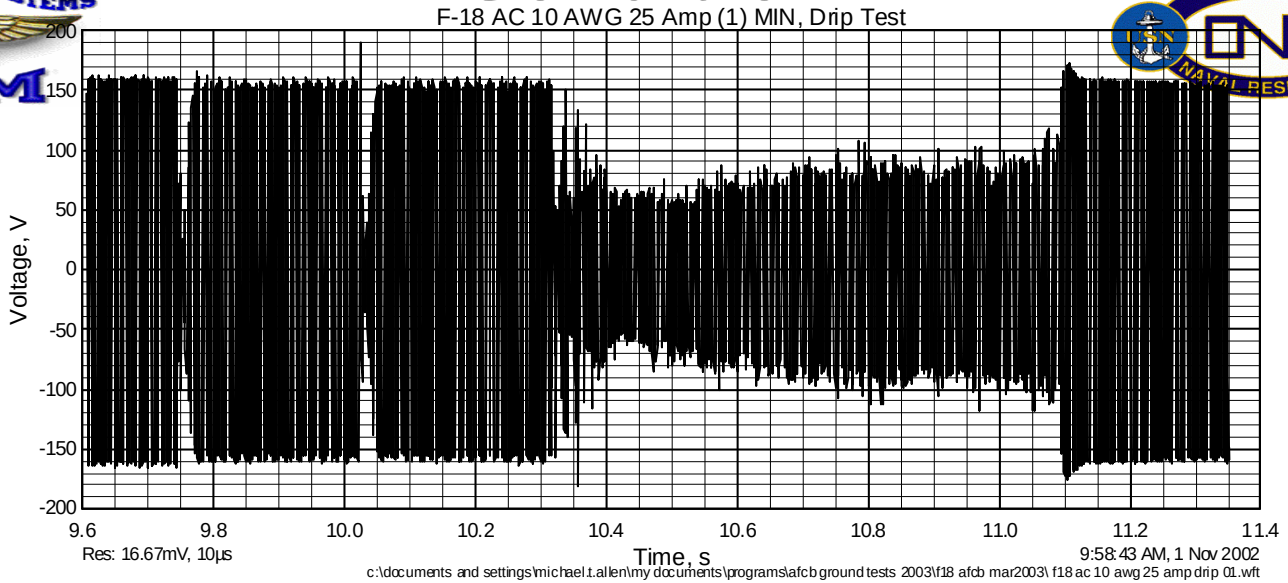
What Does An Arc Fault Current Waveform Look Like?

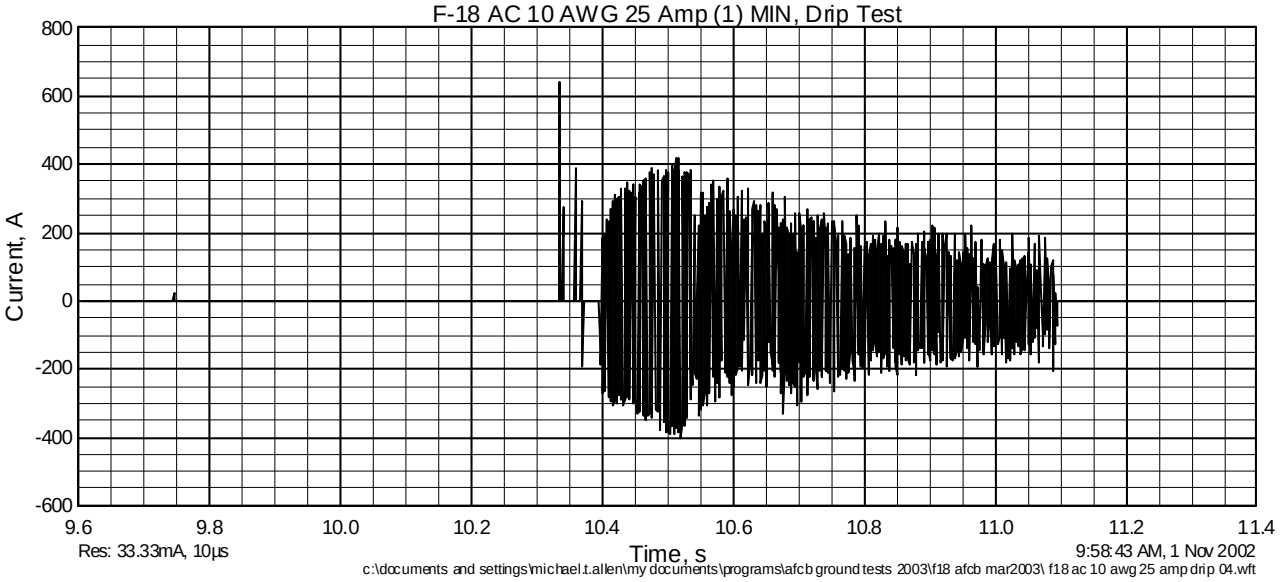
Fixed Wing AC Generator Dry Arc Condition



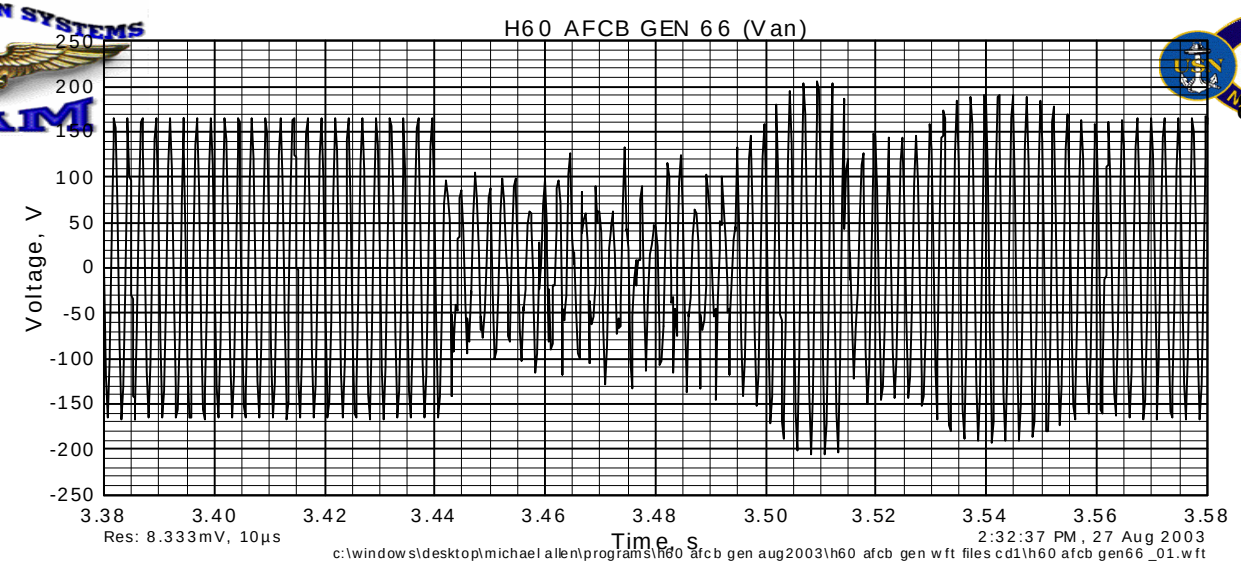


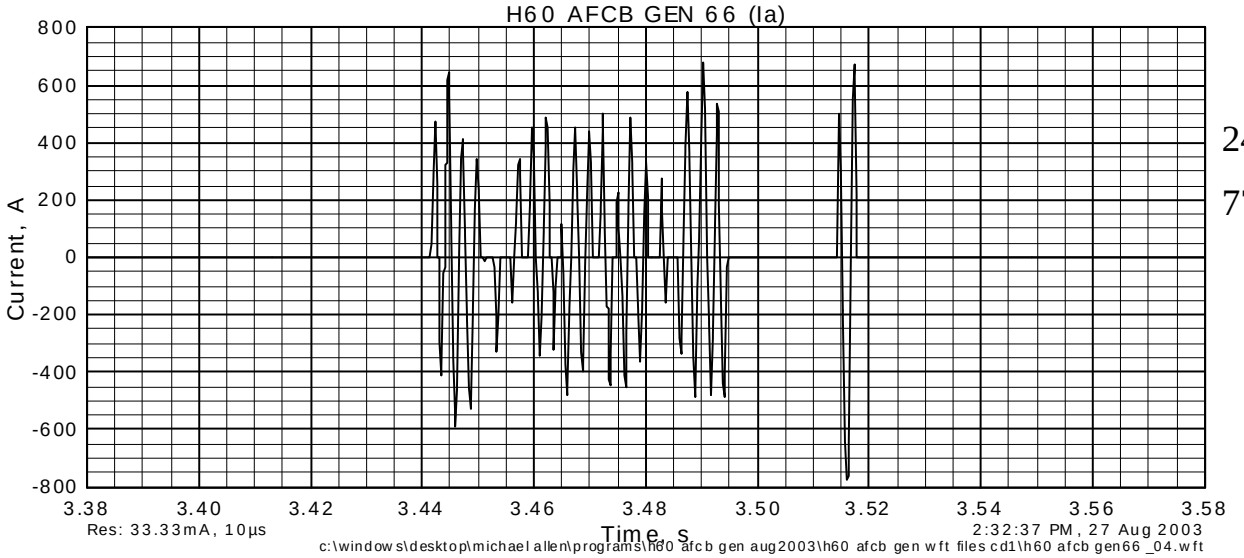
Fixed Wing AC Generator Wet Arc Condition





Helo AC Generator Dry Arc Condition

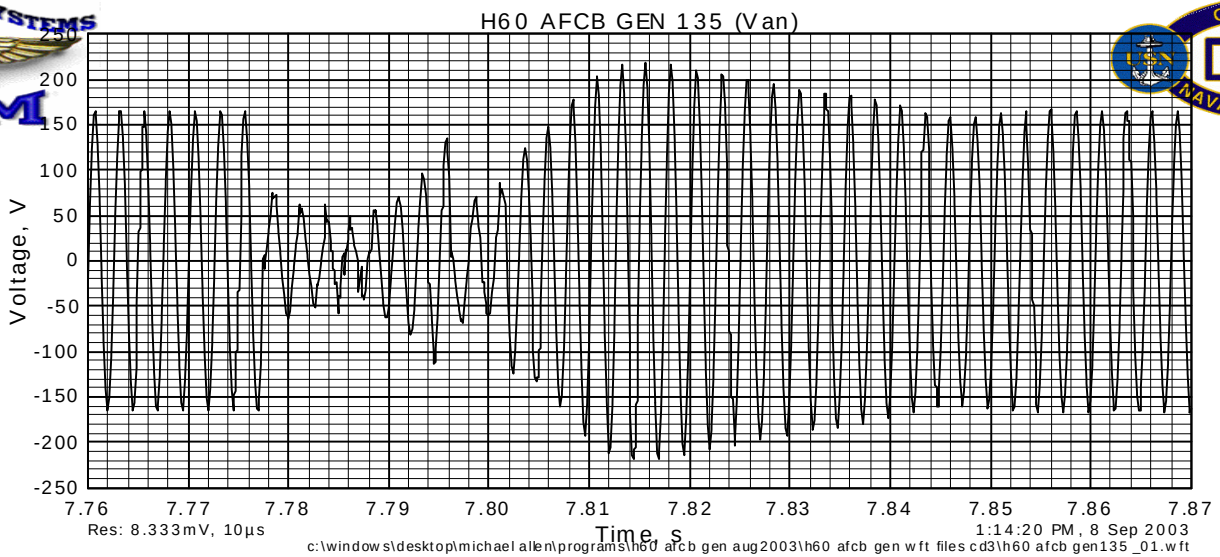


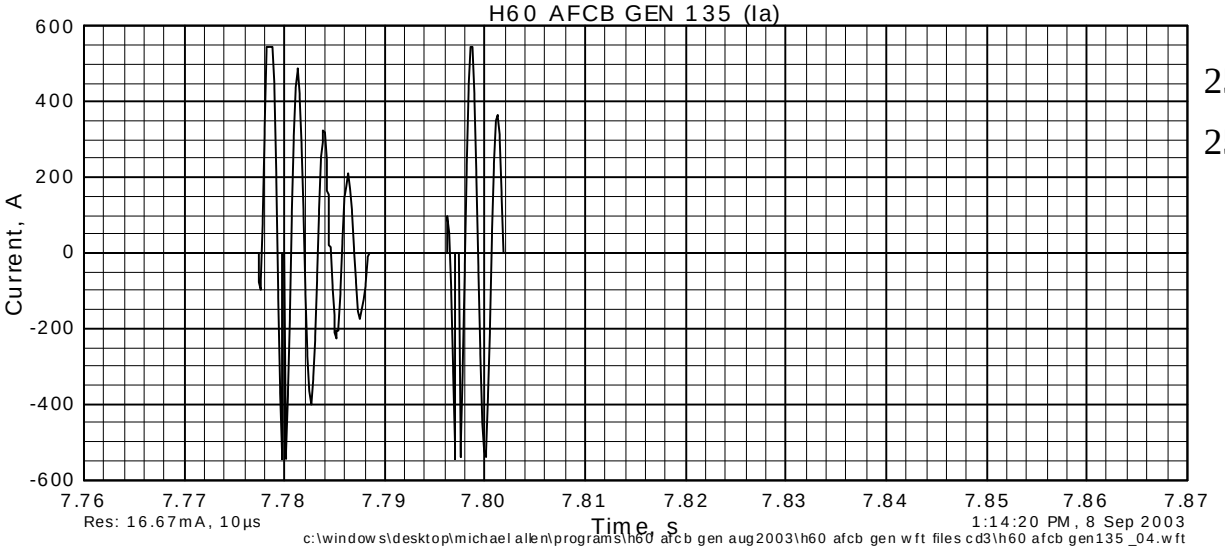


244 Amps RMS Current

77 msec

Helo AC Generator Wet Arc Condition

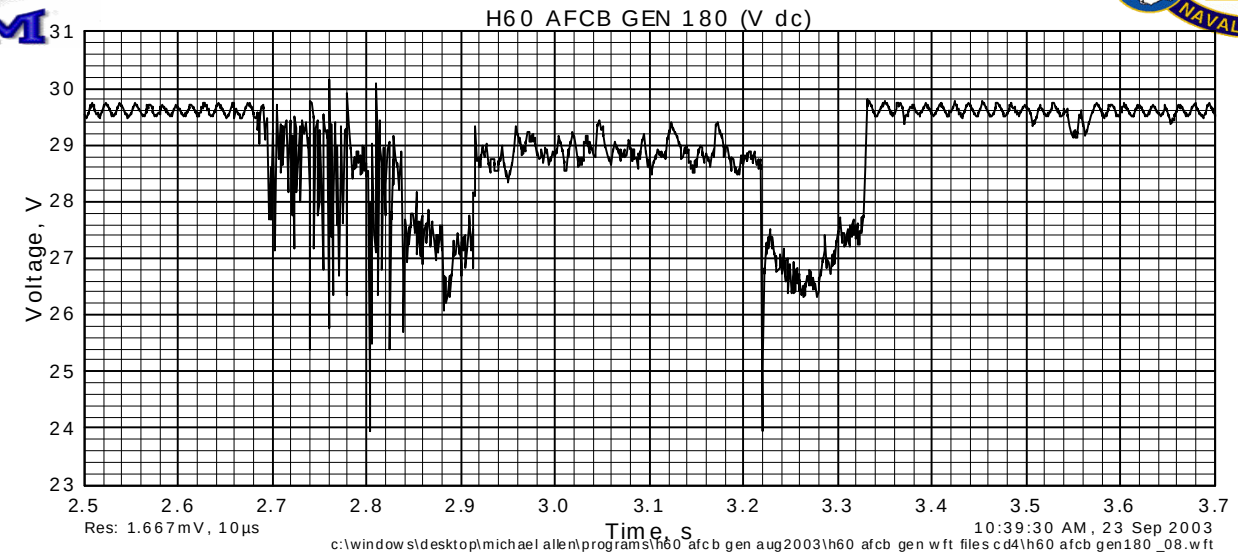




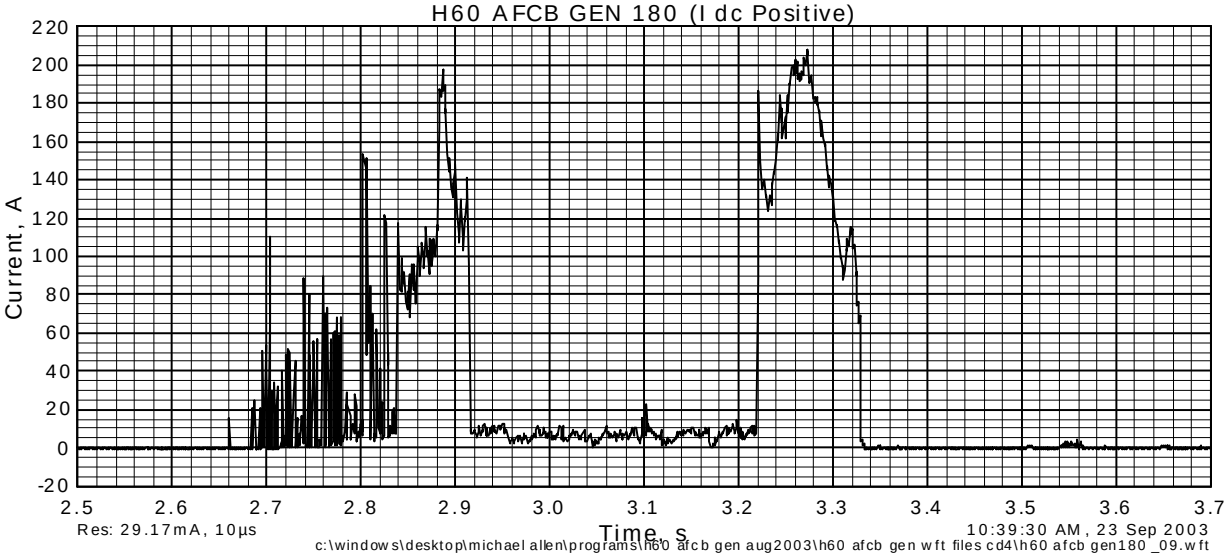
258 Amps RMS Current

25 msec

Helo AC Generator w/ 200 Amp T/R Dry Arc DC Condition



28.24 Vdc Mean



50.07 Amps Mean

What Is Being Developed And Tested?

Arc Fault Circuit Breaker
Developmental Timeline

Fiscal Year

00 01 02 03 04 05 06 07 08

Transport Aircraft

Development | *Lab Test* | *Flight Tests* | **Prod.**

ONR/FAA/AAIPT Component Impr Program

Fighter/Helo/Patrol A/C

Begin Devel | *Lab Test* | *Ground Test* | *Flight Test* | **Prod.**

AFCB - MS14105

- Qualified for Commercial Transportation and Military-Commercial Derivatives
- Originally trying to get from household circuit breaker to a large MS24571 circuit breaker
- Industry fitted arc fault circuitry into a MS14105 and MS3320

AFCB Testing

- Defining Arcing Waveforms
- Defining Electrical Load Waveform
- EMI Testing
- Temperature Altitude Testing
- Vibration Testing
- Electrical Testing
- Flight Testing

Flight Tests

- NAVAIR
  - C-9B — 500 Flight Hours – Six AFCB
  - H-53 — 25 Flight Hours – Six AFCB
  - F/A-18, H-60, P-3 — Planned for FY07
- FAA
  - Boeing 727 — 50 Flight Hours – 20 AFCB
- Industry — 10000 Flight Hours
  - Boeing 767
  - Quantus 737

AFCB Transition Plan

- Transition for legacy aircraft through retro-fit on typical 30 month inspection phase
- Transition through retrofit or preferred spare part
- Transition Starts in FY07 depending upon company tooling capability
- Transition Platforms

•H-53	PMA-261
•P-3C	PMA-290
•F/A-18	PMA-265
•H-60	PMA-299

Project Highlights

- Arc Faults have been a constant problem for the past 10 years
- Timeline
  - 6.3 development in FY02
  - ready for transition to E&MD in FY07
- AFCB selected as part of the Core Program under FNC-TOC (6.3 funds)
- Cooperating with Air Force and FAA investigating the problems of arc faults in aging wiring systems with transition opportunities exist within Navy, other Government agencies, and industry