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

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Sue Waggoner
Naval Surface Warfare Center Crane
(812) 854-4103
susan.waggoner@navy.mil
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

F-18 AC 10 AWG 25 Amp (A) MIN

Voltage, V

Time, s

Res: 6.667mV, 10µs

F-18 AC 10 AWG 25 Amp (A) MIN

Current, A

Time, s

Res: 33.33mA, 10µs
Fixed Wing AC Generator Wet Arc Condition

F-18 AC 10 AWG 25 Amp (1) MIN, Drip Test

Voltage, V

Current, A

Time, s

Res: 16.67mV, 10µs

Res: 33.33mA, 10µs

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c:\documents and settings\michael.allen\my documents\programs\afcb ground tests 2003\f18 ac 10 awg 25 amp drip test
Helo AC Generator Dry Arc Condition

H60 AFCB GEN 66 (Van)

Current, A

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

H60 AFCB GEN 180 (V dc)

28.24 Vdc Mean

H60 AFCB GEN 180 (I dc Positive)

50.07 Amps Mean
What Is Being Developed And Tested?
• 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
  – Boeing 767
  – Quantus 737
  – 10000 Flight Hours
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