TOO MUCH OF A GOOD THING

A DISCUSSION OF EXCESSIVE ACAWS IN THE E-2D AIRCRAFT

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Outline of Presentation Topics

- E-2D Aircraft / Cockpit
- Advisory Caution And Warning System (ACAWS)
- Ground and Flight Test Results
- Flight Test Footage
- Risk Mitigations
- Lessons Learned
- Questions
MISSION: Provide Airborne Early Warning (AEW) and Command & Control against projected 21st Century threats

Major Updates:
- Glass Cockpit
- Smart Air Data system
- Interconnected Avionics
- Propulsion Control and Monitoring

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Cockpit Modifications
(E-2C vs E-2D)
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• 58 total
• Lights only (*No aural tones*)
• Switch actuation to extinguish MC
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E-2D Cockpit

• 93 displayed, 200+ total
  (120 Advisories, 100 Caution, & 7 Warnings)
• Lights and aural tones
• MC/MW switch actuation required to extinguish light and aural tone
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Auxiliary Display Control Panel (AUX DCP)
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Control Display Unit (CDU)
Annunciation with an asterisk (*) after the ACAW requires aircrew to use CDU for specific information.
12 pages of ACAWS history always accessible
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Ground & Flight Test Results
Goods

- Aural cues direct aircrew attention to the visual ACAW
- Transients now latch
- Accessible history
  - Available to ALL aircrew real-time
  - Used for maint / debriefs
Ground & Flight Test Results

Others

ACAWS:
• Functioned as intended
  OR
• Erroneous = Wrong or inaccurate
• Nuisance = Annoying, Unpleasant
• Excessive = Erroneous + Nuisance

• Excessive ACAWS observed from start of ground testing
  • Contributed to RTB during 1st flight

• Situational Awareness and Workload correlation
Ground & Flight Test Results

Flight Test Specific Impacts

**Telemetry Station**
- Loss of SA
- Reduced effectiveness of communications

**Test Efficiency**
- Delayed start of test point
- Inadvertent KIOs
- Unplanned RTBs (10+)
Ground & Flight Test Results

Aircrew Safety Impact

Annoying
Distracting
Disrupting
Desensitizing
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Ground & Flight Test Results
Aircrew Safety Impact

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Aircrew Safety Impact

Annoying

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Ground & Flight Test Results

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<thead>
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Ground & Flight Test Results

Aircrew Safety Impact

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Flight Test Footage
Climb-out: Annoying, Distracting & Disrupting
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Negative-G: Desensitized

Engine Display (ED) / ACAWS
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Excessive nuisance ACAW indications will distract pilots from controlling the aircraft during high workload tasks, such as night carrier landings, and desensitize the aircrew from providing immediate response to actual critical alerts, or may cause unnecessary actions to be taken, resulting in potential loss of the aircraft and aircrew.
Risk Mitigation
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Risk Mitigation

- Thorough briefs / debriefs
- TM station backing up aircrew
- Aircrew read board
- Good old fashioned information sharing in aircrew cubicle spaces
- Kneeboard cards (KBC)
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**A DISCUSSION OF EXCESSIVE ACAWS IN THE E-2D AIRCRAFT**

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<tr>
<td><strong>COMPLETELY IGNORE</strong></td>
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<tr>
<td>FUEL FILT IMP BYP</td>
</tr>
<tr>
<td>FUEL FILT BYP</td>
</tr>
<tr>
<td>PWR LEVER FAIL</td>
</tr>
<tr>
<td>HP LMT FAIL</td>
</tr>
<tr>
<td>TMT LMT FAIL</td>
</tr>
<tr>
<td>COND LEVER FAIL</td>
</tr>
<tr>
<td><strong>PCMU POWERUP ANOMALIES</strong></td>
</tr>
<tr>
<td><strong>PCMU FAIL</strong></td>
</tr>
<tr>
<td>Indicates both channels powered up unhealthy. Power cycle PCMU until ACAW doesn't illuminate</td>
</tr>
<tr>
<td><strong>FF CTL DGRD ENG CTL DGRD CHAN FAIL</strong></td>
</tr>
<tr>
<td>If one channel is unhealthy after PCMU powerup, these ACAWS may be illuminated to indicate speed or torque faults. Fault Reset (3x) during start will clear the speed or torque faults.</td>
</tr>
<tr>
<td><strong>FF CTL DGRD ENG CTL DGRD</strong></td>
</tr>
<tr>
<td>The illumination of both may indicate a MV fault that the PCMU Fault Reset switch can probably clear.</td>
</tr>
<tr>
<td><strong>CONTINGENT ACAWS</strong></td>
</tr>
<tr>
<td><strong>PROP BETA LIGHT</strong></td>
</tr>
<tr>
<td>Ignore during engine start and when using reverse. Channel health change will require a Fault Reset. Steady illumination should be regarded as an actual failure of the Beta Light.</td>
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- Thorough briefs
- TM station backing up aircrew
- Aircrew read board
- Good old fashioned information sharing in aircrew cubicle spaces
- Kneeboard cards (KBC)
Lessons Learned
Lessons Learned – System Design

- Preliminary and Critical Design Reviews
  - System users must be present…but how many and what type?

- Does everything require an alert? (ie parking brake)
  - Meeting the Specification versus satisfying the Mission

- Initial implementation strategy
  - Start from a basic or proven system and modify to fit needs
  - Be wary of “Give me everything right now” approach
Lessons Learned – Planning & Execution

- No substitute for thorough knowledge of aircraft and systems
  - Applies to aircrew AND engineers

- Preflight Briefing
  - Discuss expected ACAWS for each test event (aircrew / TC)
  - Highlight crew duties (pilot flies, copilot troubleshoots)

- In-flight
  - Call out ACAW annunciation for aircrew and TM station SA
Lessons Learned – Fixing the Issues

• ACAWS history (enhancing feature)
  - Crucial to in-flight SA and post-flight troubleshooting
  - Should be included in all future designs

• Be flexible enough to implement work-arounds for continued program execution

• Remain disciplined on implementation
  - Use of the “roll-up ACAWS” due to real-estate limitations

(is all of this information really necessary?)
BOTTOM LINE

Challenges will exist, but proper up-front planning, risk mitigation, and good team communication can lead to safe accomplishment of test objectives…

…even through “Deedles”
Pilot: “And tower, do you have the current winds?”

Tower: “Yes I do...do you want them?”

Pilot: “Sure...”

Tower: “Winds are <deedle, deedle, deedle>” – short pause –

Pilot: “And tower, can you say again? One of my ‘deedles’ in the cockpit stepped on you.”