CLDP Human Systems Integration Workshop

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COMMERCIAL LEO DEVELOPMENT PROGRAM

Alerts
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Alerts Overview

- An alerting system helps ensure crew health and safety onboard a vehicle/habitat by keeping crew informed of threshold exceedances and noteworthy conditions.
- Referred to as *C&W*, *alarms*, *EWCA*, and *alerts.*
- Alerts can be automated, triggered by the system based on sensors and detection systems, or can be manually initiated by crew.
- Crew alerting typically involves sounds, lights, colors, and messages on hardware panels and displays.

Emergency – Time-critical event that requires immediate action and procedures to prevent loss of crew/loss of mission (LOC/LOM). Typically defined as Fire, Rapid Depress, Toxic Atmosphere

Warning – Notification of an event that requires immediate action.

Caution – Notification of an event that needs attention but not immediate action.

Advisory – A message that indicates a safe or normal configuration, indicates safe or normal operation of essential equipment, or imparts information for routine action purposes.

Common Conventions

- When a predefined alert threshold is passed:
  - Auditory tones and speech are annunciated
  - Hardware lights illuminate and flash for emergency
  - The alert message appears on a console and/or display
  - Crew press an acknowledge button to silence the alarm and proceed to working the issue.

- There are usually several dedicated displays for managing alerts that allow:
  - Sorting by class, timestamp, ack state, etc.
  - Coding to show what has been acknowledged, resolved, etc.
  - Direct links to malfunction procedures
  - Ability to inhibit (no message, no sound, no lights) and suppress (no sound, no lights)
  - The Artemis GUI standard contains a list of the most important alert parameters to be displayed.

Leveraging Prior Programs

- Alert design consistent with existing spaceflight programs will lead to reduced crew training and a safer environment
- ISS
  - Simple beeps and tones for Emergency, Warning, and Caution
  - ❖ ISS crew have noted these are sometimes hard to distinguish in the first seconds, especially when waking up.
  - Crew must float over to a C&W panel or laptop to get information about the tone.
  - For future, crew recommend prominent flashing lights and speech alerts
- Artemis Vehicle Tones (Orion, Gateway, HLS)
  - Emergency
    - Fire – siren
    - Pressure Loss/Toxic Atmosphere – klaxon
  - Warning – low/high alternating tone
  - Caution – continuous tone
  - Advisory – 2 beeps, self terminating (optional tone)

- Gateway and HLS plan to implement speech alerts in addition to tones
  - Commonly used in aircraft and studies show problems are more quickly understood, with highest benefits for crew not in front of a computer

Alert Requirements

- Governing/related requirements in CLDP-1130 draft:
  - [R.CLDS.030] OFF NOMINAL EVENT ANNUNCIATION
  - [R.CLDS.052] DETECT EMERGENCY PAD EGRESS
  - [R.CLDS.054] ALERT CREW OF FLIGHT TERMINATION
  - [R.CLDS.111] USE OF COLOR
  - [R.CLDS.113] ANNUNCIATIONS FOR EWC EVENTS
  - [R.CLDS.114] ANNUNCIATOR TEST
  - [R.CLDS.332] ALERT FOR APPROACHING LIMITS
  - [R.CLDS.401] MANUAL INITIATION OF EMERGENCY EVENTS
  - [R.CLDS.402] SILENCE ALARMS
  - [R.CLDS.410] ANNUNCIATION INHIBIT CAPABILITY

Final Takeaways

- A vehicle/habitat's alerting system is safety critical – good design is essential
- Alert system design consistent with existing spaceflight programs will lead to reduced crew training and a safer environment
- A safe, usable alert system requires solid engineering design with human factors and operations input
  - Too few alerts can leave crew unaware of system trends/problems, and unprepared to deal with severe, time-critical issues.
  - Too many alerts may unnecessarily raise workload, or quickly become a nuisance, leading to failure to respond

Thank you!