Multiple Shift Test Operations for Long Endurance Unmanned Aircraft

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Triton at a Glance

- Land Based Mission Control
- 360 degree sensor field of regard
- Wingspan - 130.9ft
- Length - 47.6ft
- Height - 15.4ft
- GTOW - 32,250 lbs.
- EO/IR, Maritime, ESM, and AIS Payloads
- Triton has an expected endurance in excess of 24 hours
- Testing across multiple weight bands requires 12 - 16 hour flights
- Brief, Setup, and Debrief times can add 4 hours to flight event
- Longer flights are well beyond single crew-day limits
- Requires multiple shifts
Communications Overview

- ICS provides backbone of test coordination
  - TD coordination channel (TD’s only)
  - Internal room channel
  - Discipline specific sidebar channels
  - Test Coordination (TD/Pilot)
  - Control Station/UA Radio Monitors

- Wall mounted radio in TM Trailer
  - SA to TD for Mx crew activities and coordination with the range
  - Backup means of coordinating test
  - Set to pre-coordinated, mission specific frequency

- Prepare for contingencies
  - Classified conference lines available between sites
  - Support personnel on-site
Notional Two-Shift Flight Schedule

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<th>Test Day</th>
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<td><strong>First Shift</strong></td>
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<td>First Shift Staff-Up</td>
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<td><strong>Second Shift</strong></td>
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<td>T-1 Brief with All Test Personnel (TDs, Engineers, Aircrew)</td>
<td>TD/Pilot Check-in with 1st Shift</td>
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<td><strong>Test Day</strong></td>
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<td>T-0 Brief for 1st Shift Personnel</td>
<td>Takeoff</td>
<td>Handover to 2nd Shift</td>
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<td>Flight Testing (4-6 Hrs)</td>
<td>Handover From 1st Shift</td>
<td>1st Shift Debrief</td>
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<td><strong>Day After Test</strong></td>
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<td>T+1 Debrief with TDs, Aircrew, and Monitors</td>
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Staffing Concerns & Lessons Learned

- Multiple shifts with multiple locations require more people
  - 8 TD/TCs
  - 6 - 8 Aircrew
  - Limited number of backups for each position
- Rescheduling flights
  - Need to plan staffing ahead of time for backup flight dates
  - Try to keep the same people at the same location
  - Changing shifts can disrupt crew rest & working schedules
- Mission rehearsal location versus test monitoring location
  - Best to have everyone in the same location for mission rehearsal
  - Need to allow for travel time prior to crew rest
Handover Procedure

- Handover based on experience with NASA Launch Control Room procedures
  - Brief expectations to test team during both T-1 and T-0 briefs
  - Stagger discipline arrivals by 10-15 minutes, no more than 3 disciplines at a time
  - Post the schedule in the briefing materials
  - Cover only test pertinent issues during handoff
    - Faults, troubleshooting steps/decisions, overall flow of test, things to keep an eye on, what’s next
  - Treat discipline swap just like a break request
    - Approval from TD required prior to start and notify on completion
  - Maintain one set of log sheets per station
Briefing Concerns & Lessons Learned

- Loss of attention/participation due to number and length of briefs
  - Some repetition between T-1 and T-0 briefs (Hazards, go/no-go, weather, etc.)
  - Briefed hazards grow as you increase number of test plans/points being executed
- Limit call in participation to flight required personnel only
Practice Makes Perfect

- Mission rehearsals are essential part of team training
  - Emphasize comms etiquette early
  - Required for participation in test event (Aircrew, TDs, Engineers)
  - Simulated data from hot bench (no orange wire parameters)
  - Required to practice any new maneuvers prior to executing in flight
- New participants are in an observation role for first mission
  - Become active participant at discretion of discipline lead, TD, and team lead
- TDs and TCs go through review board, shadowing, and TD/TC under instruction (UI) roles prior to leading an event
  - 2 days of lessons on system
  - Review of all policy documents
  - Open-book NATOPS exam
  - Minimum 4 events as TD UI (2 ground, 2 flight)
Results/Summary

• Triton has completed initial envelope expansion with zero mishaps/incidents
• Assess each event for lessons learned and implement them
• Develop a communication plan that works for your system
  • Have a plan for how to communicate when that system fails
  • Evolve the system as program progresses
• Schedule the briefings, major events, shift handoff times
  • Leave some white space
  • Plan around crew rest
• Ensure personnel are available where you need them for all planned and backup days
• Brief shift handoff procedures and have the team practice it
• PRACTICE, PRACTICE, PRACTICE