Project Calypso

System Requirements Review

Objectives

- Introduce Team Members
- Decompose Statement of Need
- Present Business Case
- Conceptualize Operations
- Prescribe System Requirements
- Overview Program Structure
- Draw Conclusions

Team Members

Joshua Carver
Program Manager

Ryan Lundell
Airframe Lead

Jacob McMillin
Integration Lead

Caleb Lynch
Systems Engineer

Anthony Mclevsky
Avionics Engineer

Khaled Alhammadi
Propulsion Engineer

Tyler Phillips
Structures Engineer

Marcello Montes
Aerodynamics Engineer

Coast Guard needs to expand existing SAR fleet

Current assets used by Coast Guard

- SAR currently conducted by watercraft and helicopters
- Response rate limited by fleet size and base locations

Demonstrated need for additional aircraft

- A fleet of rapid-response UAVs provides initial rescue support
- Autonomous launch and delivery of life raft

Business Case

Jacob McMillin, Khaled Alhammadi

Incident response times need to be improved

- USCG targets 2-hour notification-to-rescue time
- UAS can reach victim during 30-minute prep time and locate target
- All-weather day/night SAR capability can be improved by Calypso

Increase operational knowledge to improve safety

- June 1997: USCG SAR team lost in action near Humboldt County, CA
- UAS can provide early information to manned craft and decrease risk
- Allows for real-time visual/thermal feed to rescuers

All-in-one SAR UAS adds missing capabilities to USCG

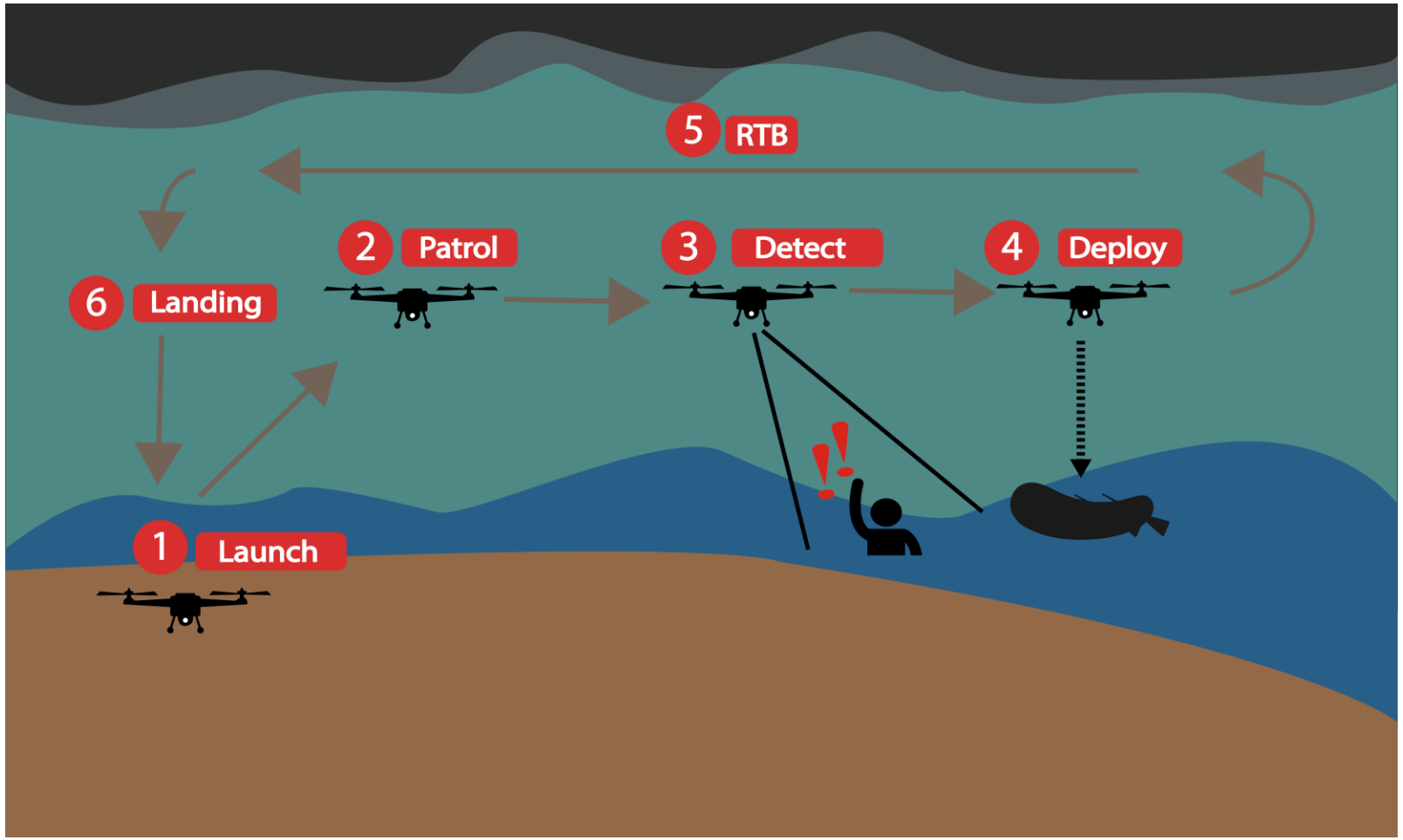
- Long standby capability not present in market
- Single airframe can accomplish both rescue and reconnaissance tasks
- Low system cost allows for mass-deployment

Boeing/Insitu ScanEagle

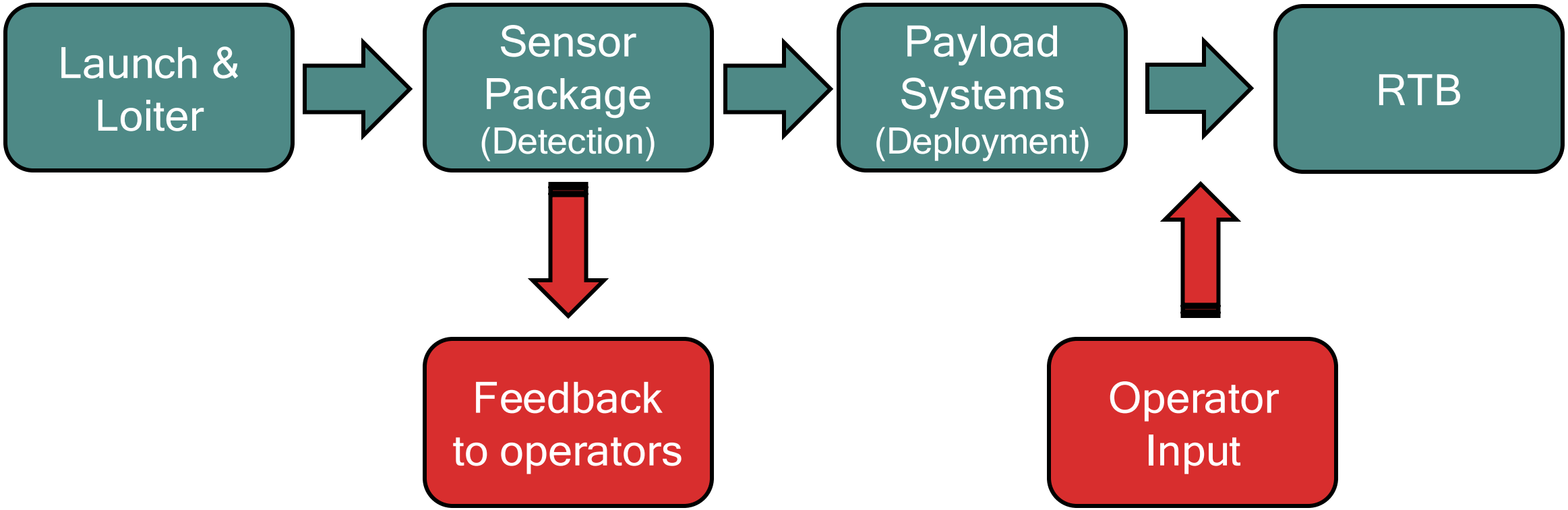
Concept of Operations

Marcello Montes, Caleb Lynch

Concept of Operations: Overview



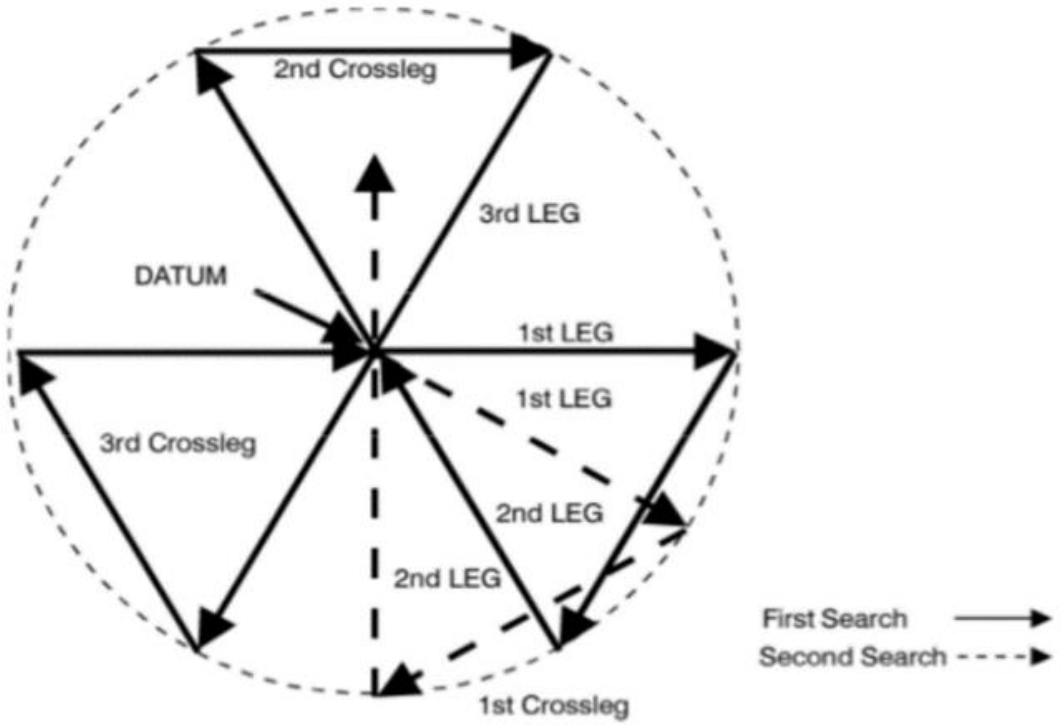
Information and Data Flow



Utilize Proven SAR Techniques

Victor Sierra Pattern

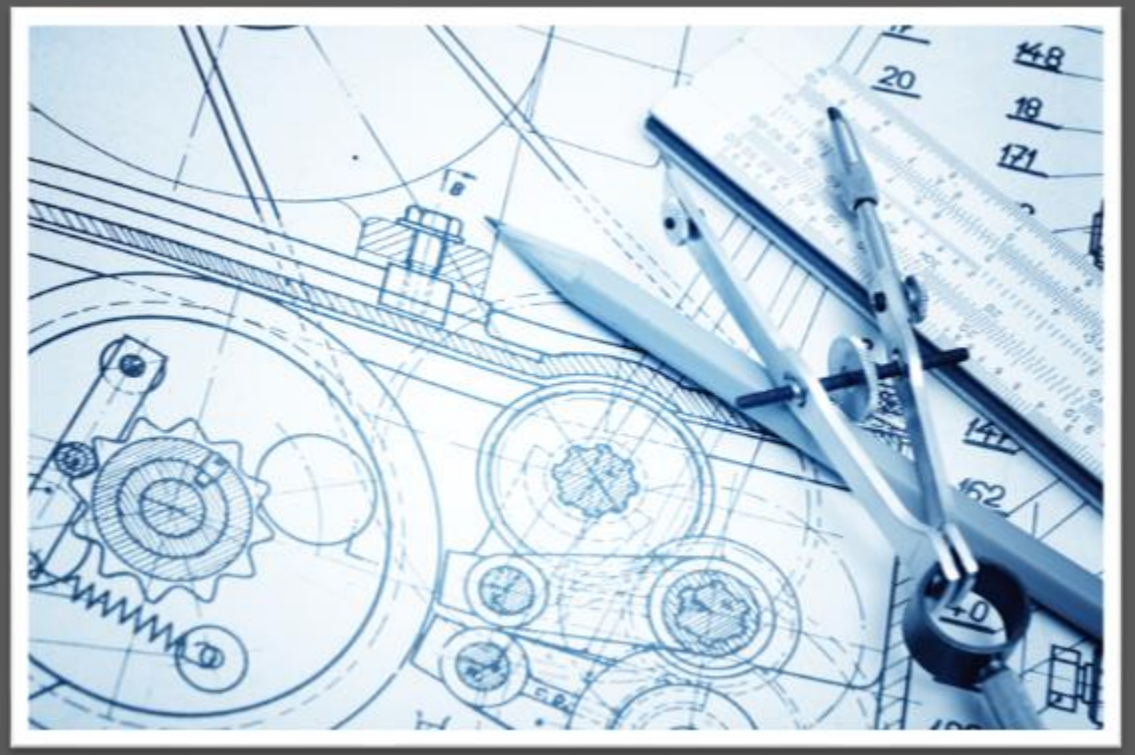
- Preprogrammed for autonomous search
- High Efficiency
- Accounts for:
  - Wind Drift
  - Current Drift
- Datum Generally Located at Last Contact



Sector Search Single-Unit (VS)

System Requirements

Ryan Lundell, Anthony Mclevsky,
Tyler Phillips



Performance Requirements

Operational Radius:	20 miles in 15 minutes
Search Time:	Minimum 30 minutes
Climb Rate:	Minimum 1000 ft/min
Load Factor:	Minimum 3.5-g
Maximum Altitude:	400 ft AGL
Dash Speed:	Minimum 100 kts

Payload and Weight Requirement

- 4-lb self-powered sensor payload
- Mechanical integration of gimbal
- Select a suitable life raft
- Deployment mechanism for life raft
- Maximum take-off weight of 25 lb.

Operational Requirements

- Autonomous launch and recovery
- 1 hour mission reset time
- 3-month standby period
- 250-flight airframe service life

Environmental Requirements

- Operate within temperature range of -20 to 40 degrees Celsius (-4 °F to 104 °F)
- Withstand a Beaufort level 7 wind conditions (28 to 33 kts)
- **Resist corrosion**
- **Must be able to float**
- **Failsafe to avoid injury of bystanders**

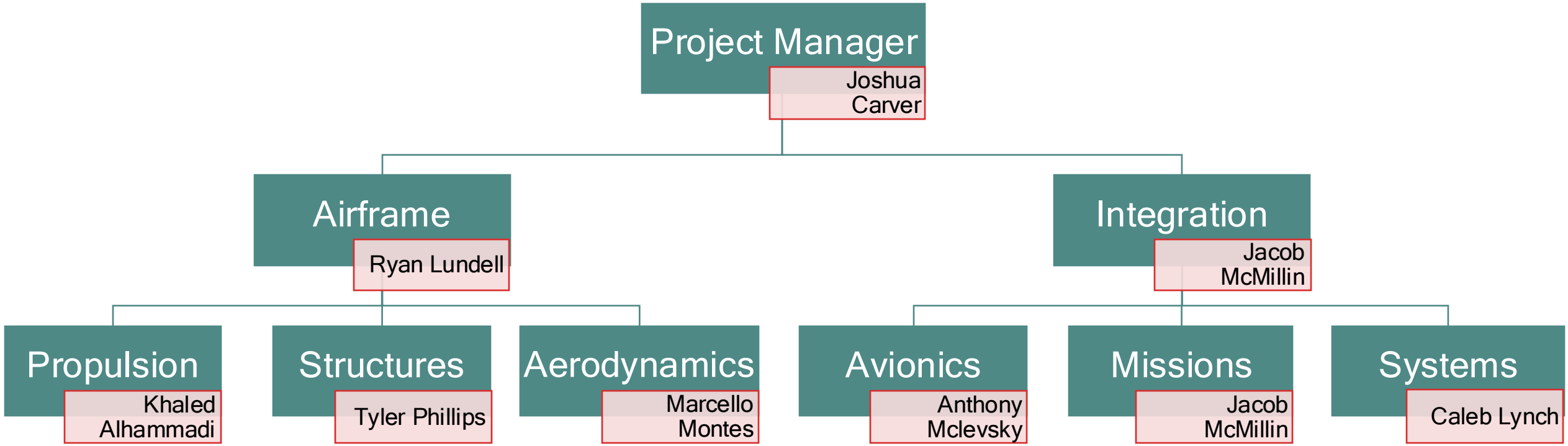
Size and Cost Requirements

- Mountable system on a 4 ft x 4 ft elevated platform
- Deployable every 30 miles along 500 miles of coast
- Order of magnitude less expensive than comparable aircraft

Programmatic Overview

Joshua Carver

Calypso Team Structure



Future Program Milestones

Design Concept Review

- Presentation Due: 02/28/2023
- Report Due: 02/28/2023

Flight Readiness Review

- Presentation Due: 04/06/2023
- Aerodynamic Model Due: 04/06/2023

Preliminary Design Review

- Capstone Symposium: 04/27/2023
- Presentation Due: 04/27/2023
- Report Due: 04/30/2023

Conclusions and Recommendations

Joshua Carver

Key takeaways and what‘s next?

Key Requirements

- 3-month standby
- Autonomous STOL/VTOL
- Low cost for mass-deployment

Team Organization

- Team positions assigned
- Action plan for key deliverables finalized

Recommendations

- Begin analyzing design concepts for aircraft and launch/recovery structure
- Identify OTS life raft for use in project, if possible
- Assemble & consider different design options
- Select primary & fallback design

Questions?

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References

"Alice King chatham - art to R&D," *Fact Sheets* Available: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/.

"Application for medical certificate (form CG-719K) ------ instructions" Available: https://www.dco.uscg.mil/Portals/9/NMC/pdfs/forms/CG_719K.pdf.

"Boeing," *Autonomous Systems - ScanEagle* Available: https://www.boeing.com/defense/autonomous-systems/scaneagle/index.page.

Goff, A., "It's been 19 years since four local coasties were lost near Shelter Cove," *Lost Coast Outpost* Available: https://lostcoastoutpost.com/2016/jun/8/its-been-19-years-four-local-coasties-were-lost-ca/.

"Operations home," *United States Coast Guard (USCG)* Available: https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Response-Policy-CG-5R/Office-of-Incident-Management-Preparedness-CG-5RI/US-Coast-Guard-Office-of-Search-and-Rescue-CG-SAR/CG-SAR-1/SAR-Program-Information/.

"Welcome to the response web site - USCG AUX" Available: https://wow.uscgaux.info/content.php?unit=R-DEPT.

Figure References

Slide #	Item	Source
1	USCG Rescue Operation	Coast Guard medevac a man from Carnival Inspiration cruise ship (hlcopters.com)
5	USCG Cutter Goup	The Bell Eagle Eye UTAV ready to fly (newatlas.com)
8	Boeing/Insitu ScanEagle	Boeing ScanEagle Index
9	Life Raft Demonstration	Life Rafts - Bosss Marine
10	Operations Overview	Calypso Design Program
11	Information/Data Loop	Calypso Design Program
12	Victor Sierra Pattern	Coast Guard Search and Rescue: Lessons and Inspiration (recoveryreview.blog)
13	Design Blueprints	The biggest challenges in the career of an Engineer - Engineering Selection Blog
19	Team Collaboration	Build a smart development team to deliver your project | ELEKS
22	Progress Projections	3 Steps to Measure Your Progress - Executive Leadership Consulting

Category	Milestone / Task	Start By	Completed By	Assigned Team
SRR Presentation & Report	SRR Presentation: Draft	January 16, 2023	January 22, 2023	All
	SRR Presentation: Finalized	January 23, 2024	January 26, 2023	All
DCR Presentation & Report	Aircraft Sizing: Weight Estimation	January 28, 2023	Febuary 4, 2023	Airframe
	Aircraft Sizing: Constraint Analyis	January 28, 2023	Febuary 4, 2023	Airframe
	Aircraft Sizing: Thrust and Lift	January 28, 2023	Febuary 4, 2023	Airframe
	Aircraft Sizing: Aerodynamics and Propulsion	January 28, 2023	Febuary 4, 2023	Airframe
	Aircraft Sizing: Fuselage and Tail	January 28, 2023	Febuary 4, 2023	Airframe
	Concept Refinement: Mechanical Design	Febuary 5, 2023	Febuary 12, 2023	Integration
	Concept Refinement: Payload Layout/Weight and Balance	Febuary 5, 2023	Febuary 12, 2023	Integration
	Concept Refinement: Stability and Control	Febuary 5, 2023	Febuary 12, 2023	Airframe
	Concept Refinement: Finalize Design Options	Febuary 13, 2023	Febuary 16, 2023	All
	Downselect to Final Design	Febuary 13, 2023	Febuary 16, 2023	All
	DCR Presentation	Febuary 17, 2023	Febuary 28, 2023	All
	Conceptual Design Report	Febuary 17, 2023	Febuary 28, 2023	All
Aerodynamic Model and FFR	Design Refinement: Sizing and Aerodynamic Predictions	March 1, 2023	March 30, 2023	Airframe
	Design Refinement: Propulsion Selection and Structural Analysis	March 1, 2023	March 30, 2023	Airframe
	Design Refinement: Payload Integration and Interior Arrangement	March 1, 2023	March 30, 2023	Integration
	Design Refinement: Weight and Balace, Stability and Control	March 1, 2023	March 30, 2023	Integration
	Design Refinement: Technical Data Package	March 1, 2023	March 30, 2023	Integration
	Design Refinement: Performance, Endurance, Range, Margin	March 1, 2023	March 30, 2023	All
	Construct Aero Model	March 17, 2023	April 6,2023	All
	FFR Presentation	March 27, 2023	April 6,2023	All
PDR and Symposium	Aerodynamic Model Testing	April 7,2023	April 14,2023	All
	Result Evaluation	April 10,2023	April 23,2023	All
	PDR Presentation	April 14,2023	April 27,2023	All
	Capstone Symposium	April 16,2023	April 27,2023	All
	Preliminary Design Report	April 17,2023	April 30,2023	All

Calypso