



STARGATE

Inflatable Crew-lock

Final Update and Safety Briefing



Whats Going On Fox23 News Team Visit





Whats Going On Senior Design Expo





Overview



- **Structures**
 - SME: Austin Bennett, Jackson Jandreau, Andrew Quinton
 - **Electronics & Pneumatics**
 - SME: Jake Briles, Josh Pankratz, Michael Raymer, Brandon White
 - **Deployment & Retraction Systems**
 - SME: Joey Lester, Madison Whiteley
 - **Safety**
 - SME: Michael Raymer
 - **Summary**
 - **Questions**
-



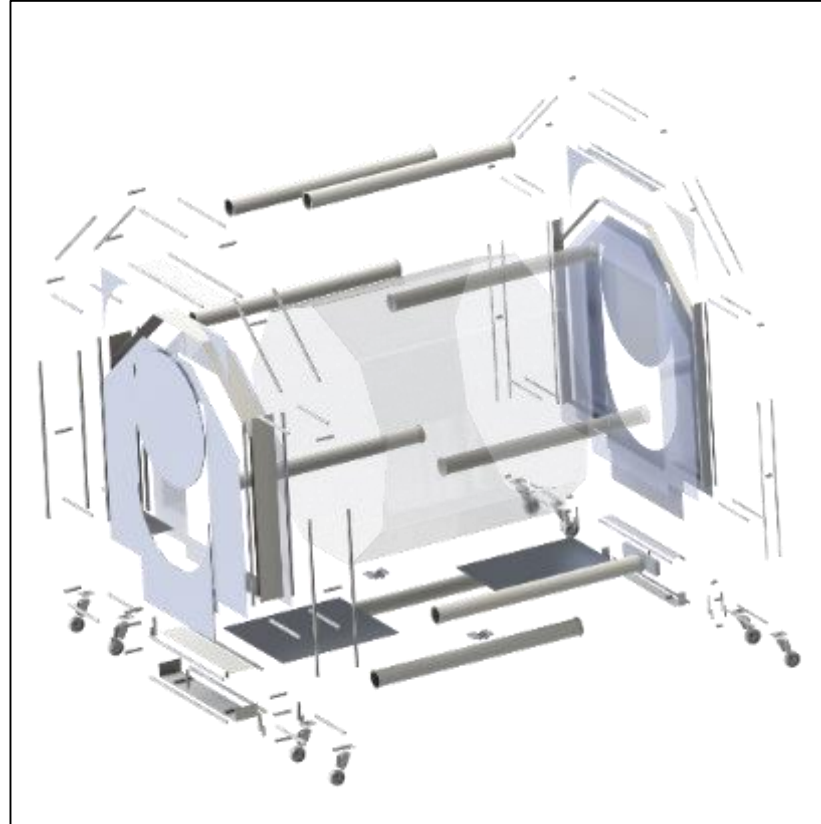
Overview



- **Each section will follow a specific pattern**
 - Overview
 - Introduction to topics and areas covered in section
 - Progress
 - Photos of progress in area
 - Stills & data from tests
 - Further Actions
 - List of items to be accomplished
 - Limiting Factors
 - Summary
 - Estimation of progress relative to end state
 - List of major milestones prior to delivery
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Structures Overview



8020 Structural Framing, Component Support Structure, Mobility, and Exterior

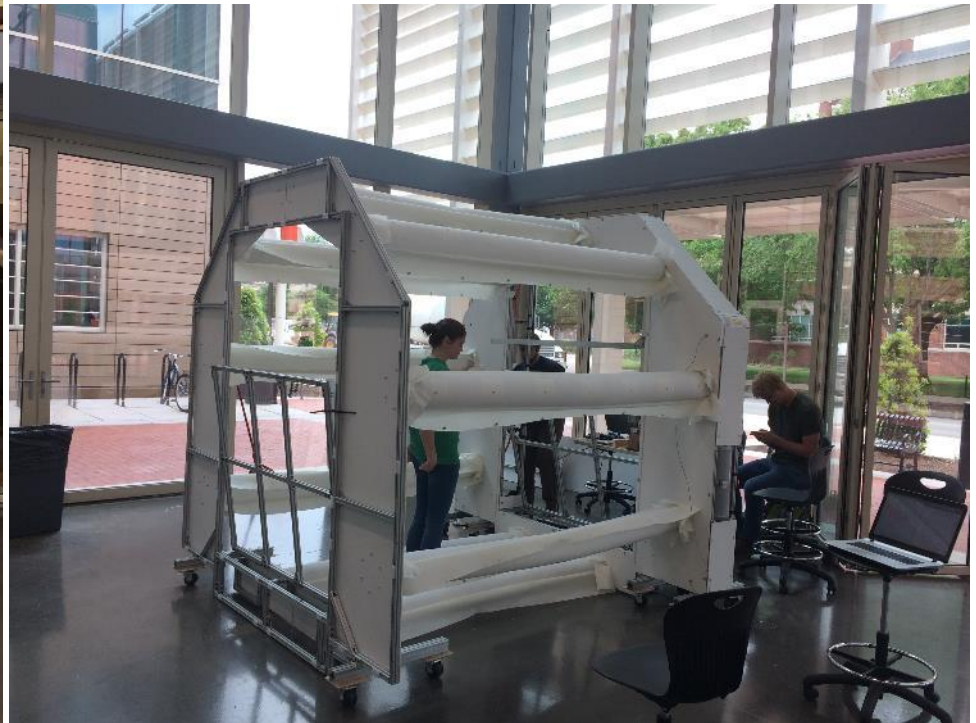
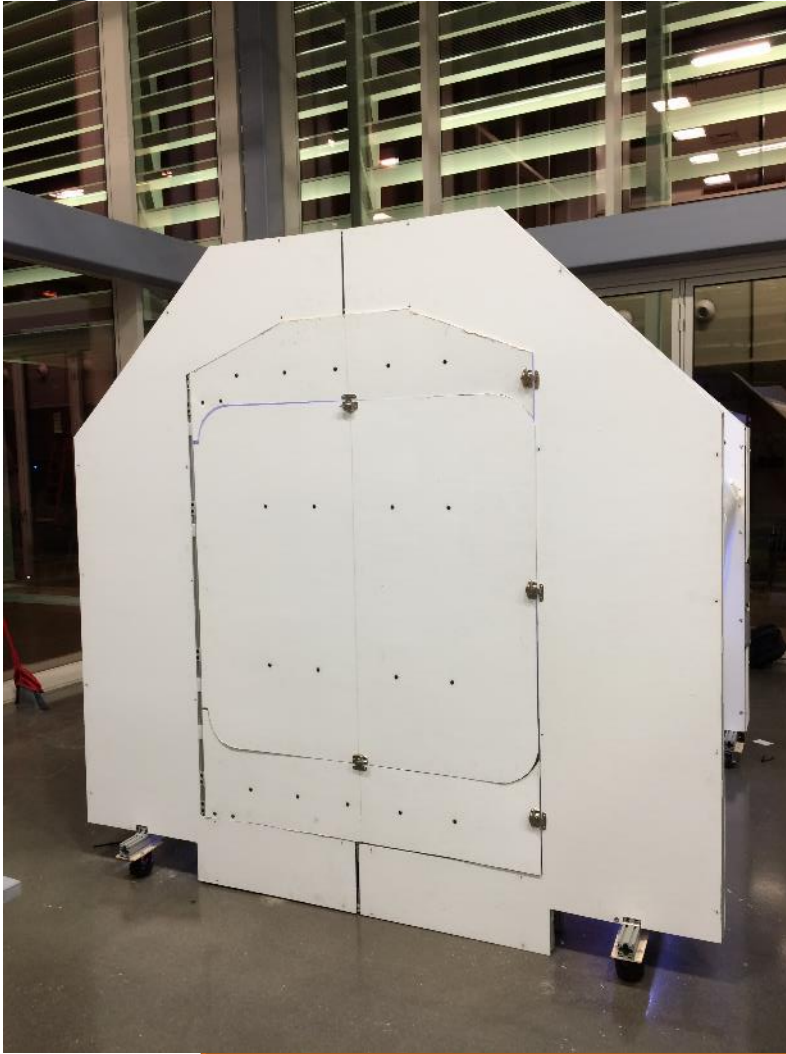


Structures Full Scale Progress



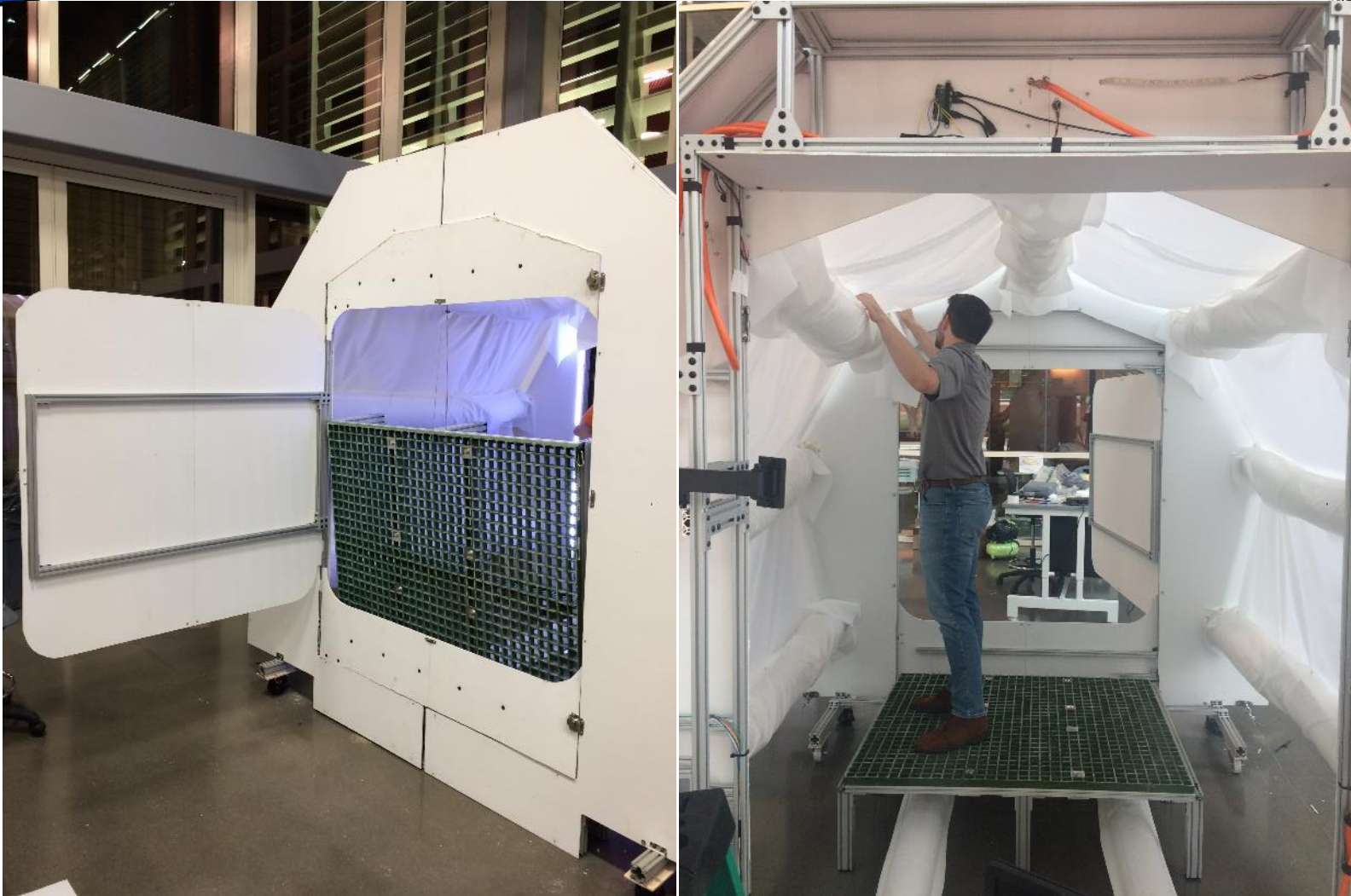


Structures Paneling and Framework





Structures Doors and Floors





Structures Progress Checklist



Development Objectives

- ✓ Scale Model
 - Material Selection
 - Construction
 - ✓ Finishing

- 8020 Superstructure
 - ✓ Static Dock Frame Construction
 - ✓ Mobile Bulkhead Construction
 - ✓ Wheelbase Installation
 - ✓ Deployable Floor Construction
 - Deployable Floor Finishing

- Exterior Finishing
 - Exterior Paneling Selection
 - Paneling Finishing
 - ✓ Door Construction
 - ✓ Door Installation

Integration Objectives

- ✓ Tube Integration
 - ✓ Development of Mounting Device
 - ✓ Production of Mounting Device
 - ✓ Integration

- ✓ Winch Integration
 - ✓ Development of Mounting Device
 - ✓ Integration

- Systems Integration
 - ✓ Space Allocation and Designation
 - ✓ Substructure Construction
 - Total Systems Integration



Structures Further Action



Development Objectives

- 8020 Superstructure
 - Deployable Floor Finishing
 - Installation of locking mechanism
 - Installation of Deployment Assistance Tool
- Exterior Finishing
 - Paneling Finishing
 - Final Installation of 8020 superstructure Panels
 - Fabric patch to gaps between tubes and 8020 superstructure

Integration Objectives

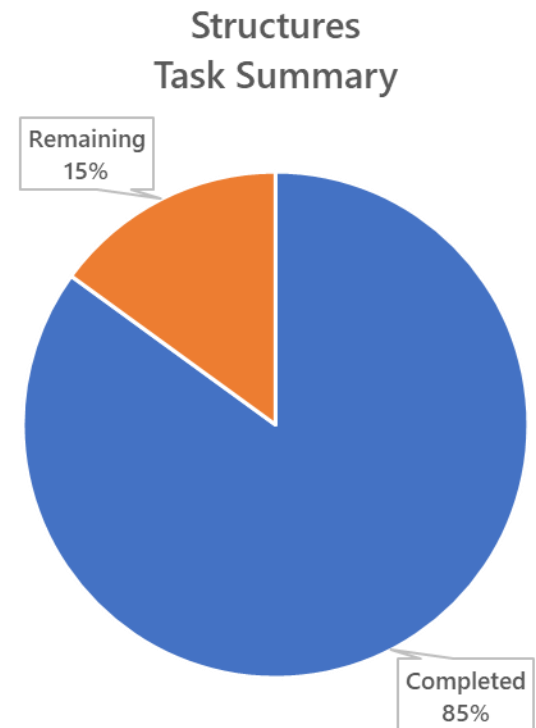
- Systems Integration
 - Total Systems Integration
 - Mounting Vacuum Pump



Structures Task Summary

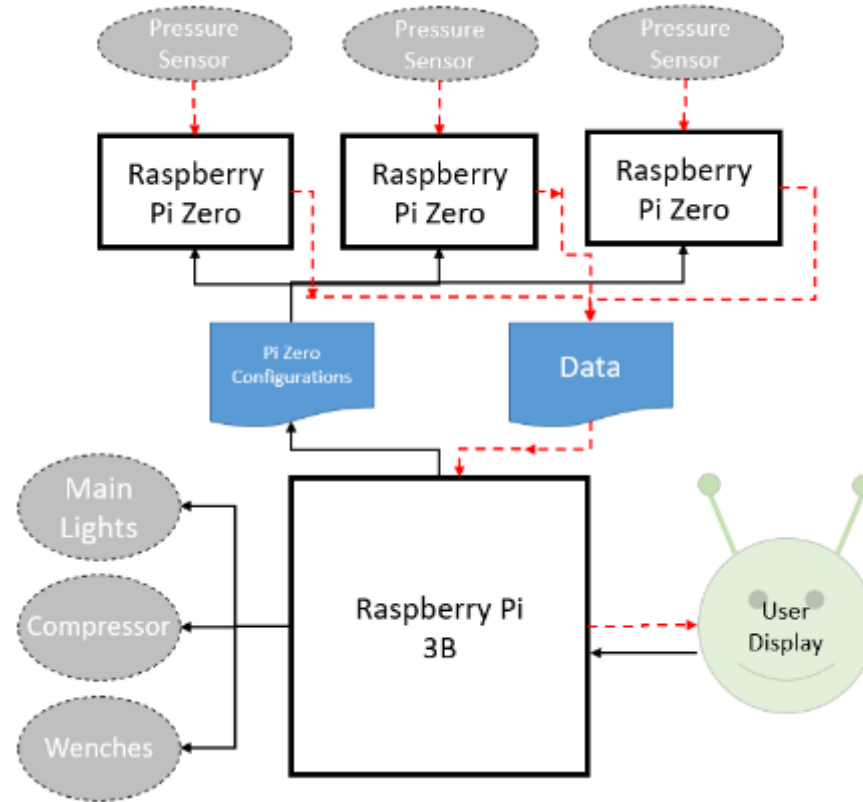


- **Final Non-trivial task – Vacuum Pump**
 - Failure if initial pump on 9 May (recovered & repurposed air mattress pump)
 - Replacement to be ordered and shipped, same day install
- **Trivial Tasks – Floor & Paneling**
 - All parts & equipment on site
 - Requires less than 8 man-hours to complete





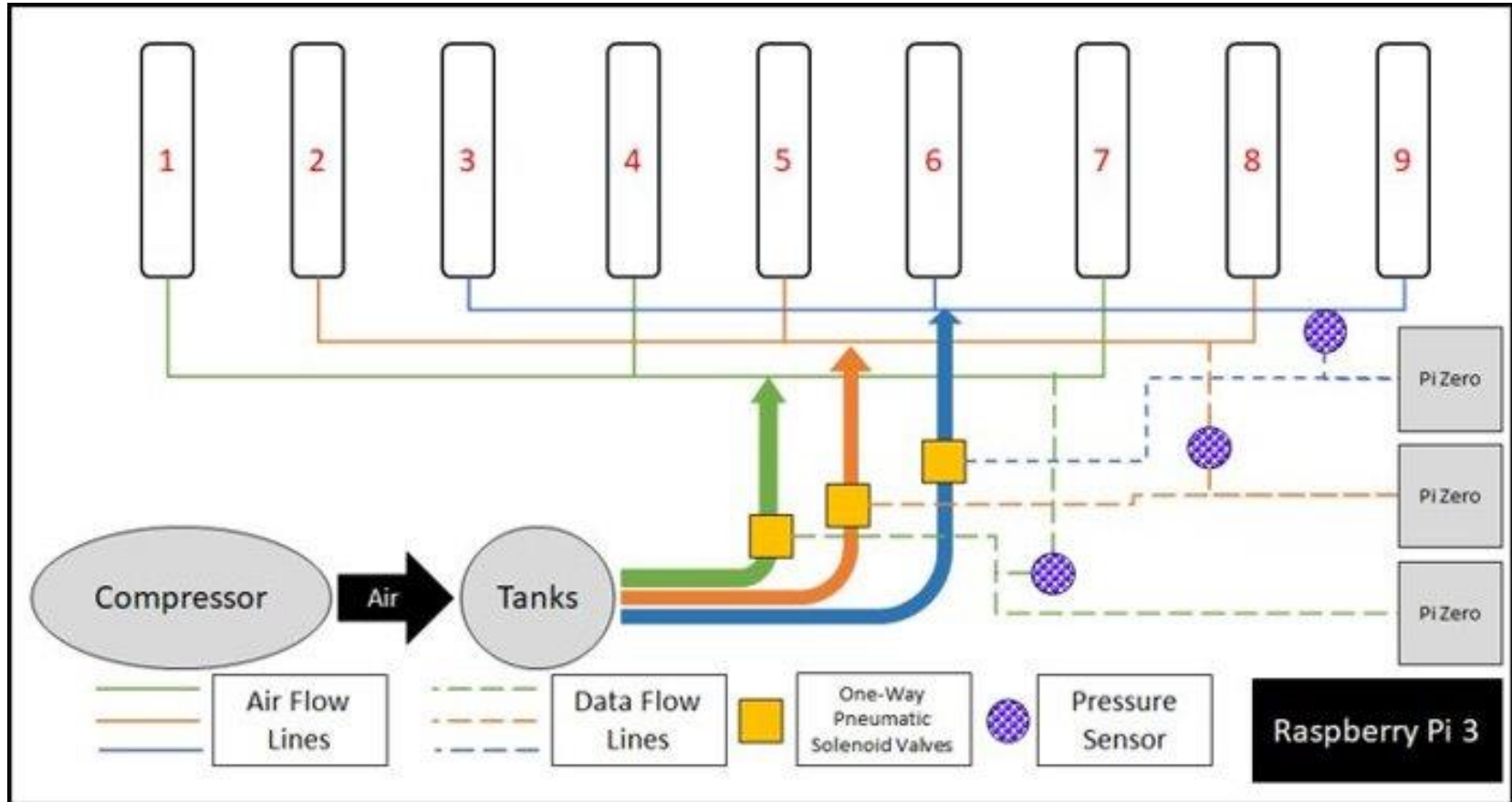
Electronics & Pneumatics Overview



Networked Electronic Components, Pneumatic Controls, and User Interfaces

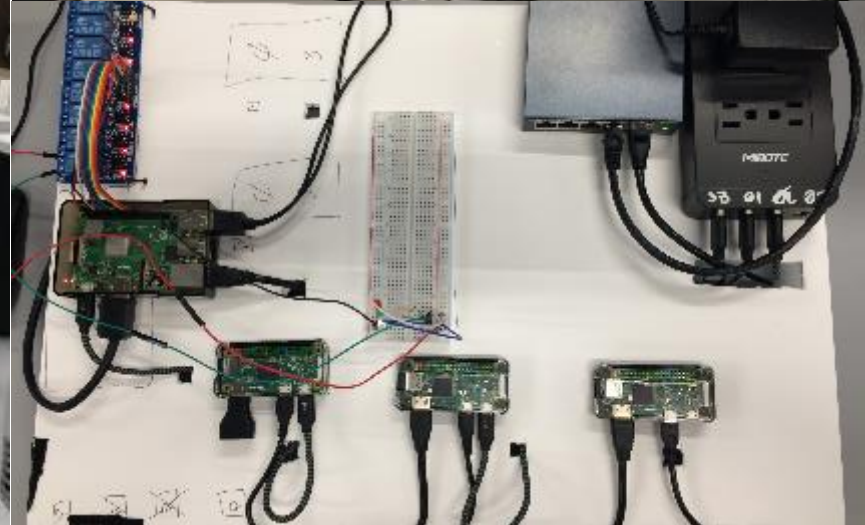
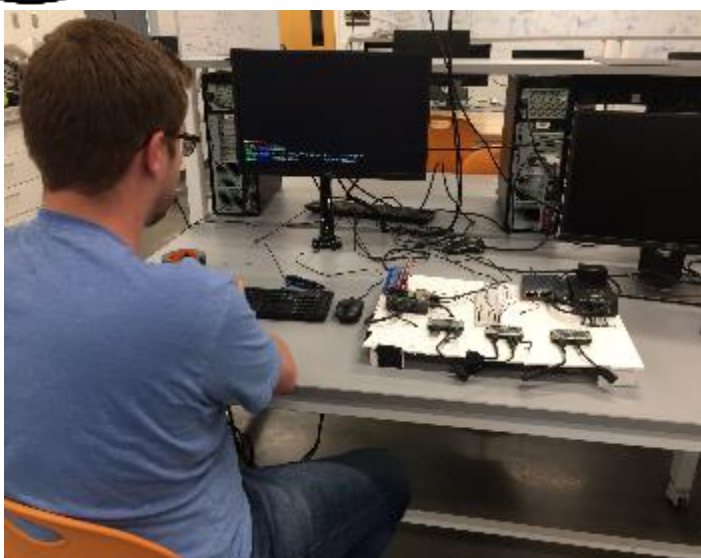


Electronics & Pneumatics Pressure Schematic Progress





Electronics & Pneumatics Progress





Electronics & Pneumatics Hypercoding Progress





Electronics & Pneumatics Progress Checklist



Programmatic Objectives

- Inflation Subroutine
 - ✓ Wench Controls
 - ✓ Relay Controls
 - ✓ Compressor Controls
 - ✓ Lighting Controls
 - Overall Logic
- Deflation Subroutine
 - As Above in Inflation Subroutine
- Normal Operations
 - ✓ Write Configuration File
 - ✓ Create and Rename Data Files
 - ✓ Network Pi Devices Together
 - ✓ Read and Store Data (Pi0 Code)
 - ✓ GUI
 - Final Review of Code

Integration Objectives

- ✓ Tube Integration
 - ✓ Read Pressure in Tubes
 - ✓ Minimize Pressure Losses
 - ✓ Data Reading Tests
- ✓ Wench Integration
 - ✓ Create Relay Circuit
 - ✓ Test Operation
- ✓ Pressure Lines
 - ✓ Create Relay Circuit
 - ✓ Test Operation
- ✓ Light Systems
 - ✓ Determine Lighting System for Use
 - ✓ Write Code for Lights
 - ✓ Test Lighting



Electronics & Pneumatics Progress Checklist



Programmatic Objectives

- Inflation Subroutine
 - Overall Logic
 - Finishing of fully automated routine
- Deflation Subroutine
 - As Above in Inflation Subroutine
- Normal Operations
 - Final Review of Code
 - Implementation of final comments, organization, and variable names

Integration Objectives

✓ COMPLETE



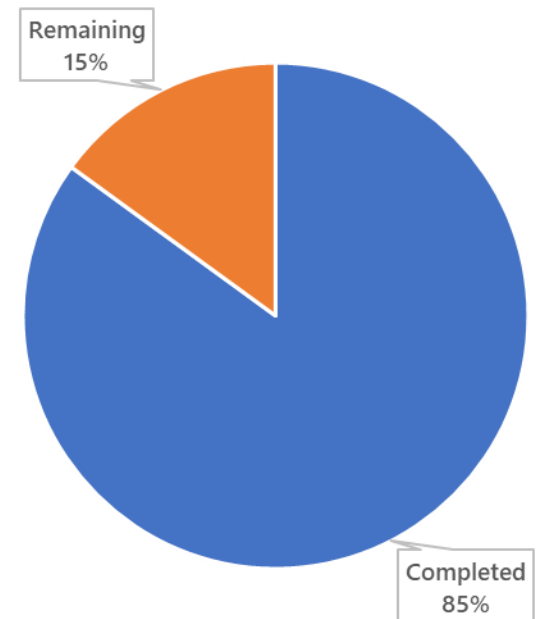
Electronics & Pneumatics Task Summary



▪ Finishing Automation

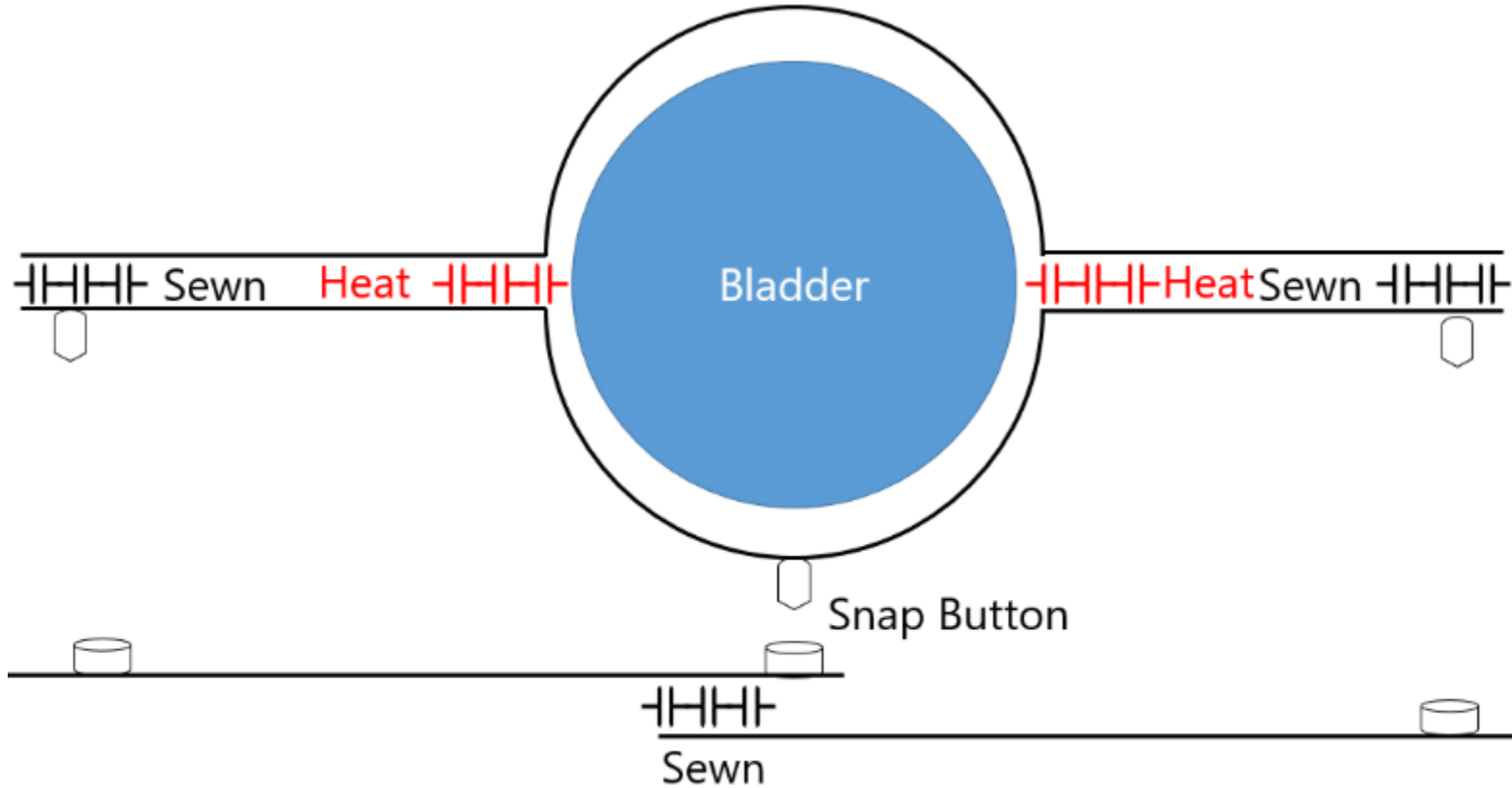
- System can be fully manually deployed with existing GUI and two technicians
- Automation architecture and pseudocode exists
- Finalization of control methodology and testing
- Finalization of Graphical Data Monitoring

Electronics & Pneumatics Task Summary





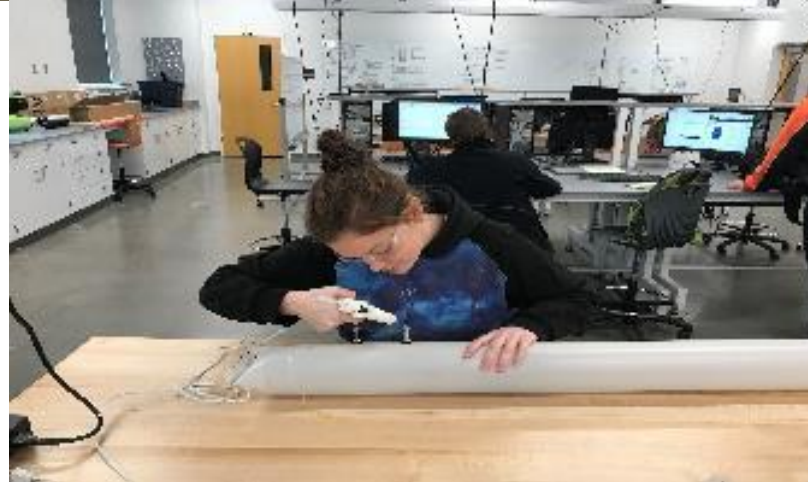
Deployment & Retraction Overview



Inflatables, Retraction Cables, and Related Systems



Deployment & Retraction Airbeam Progress





Electronics & Pneumatics Sewing and Installation



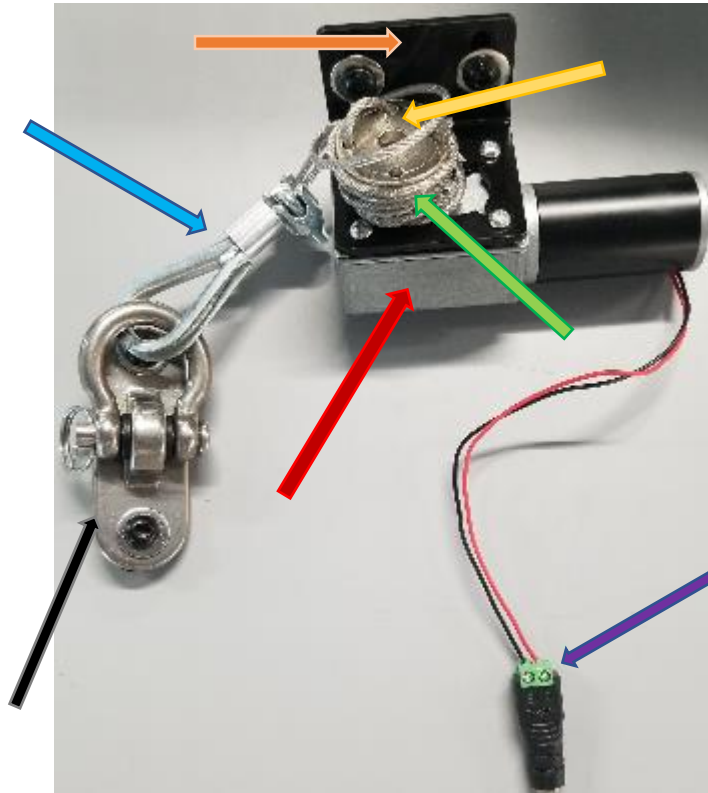









Deployment & Retraction Winch Integration Progress



Deployment & Retraction Winch Progress

- The Retraction System is comprised of:



-  - motor mounting bracket
-  - shaft spool
-  - wire loop fastener
-  - 7 ft of 3/16 aero wire
-  - swinging loop frame mount
-  - 12V 8RPM reversible motor
-  - 12V DC adapter connector



Deployment & Retraction Progress Checklist



Deployment Objectives

- ✓ Inflation Elements
 - ✓ Tube Development & Sensor Integration
 - ✓ Tube Deployment & DAQ Test
 - ✓ Development of 1/3 of Tubes
 - ✓ Construction of All Inflation Elements
- ☐ Inflation Testing
 - ✓ Extended Single Tube Testing
 - ✓ Force & Burst Pressure Testing
 - ✓ Single Pressure Line Test
 - ✓ Testing Multiple Line Deployment
 - ✓ Electronics Integration
 - ✓ Winch Controlled Deployment Test
- ☐ Complete Systems Test

Retraction Objectives

- ✓ Retraction Elements
 - ✓ Winch Sizing and Selection
 - ✓ Winch Torque Testing
 - ✓ Winch Mounding Mechanisms
- ✓ Retraction Testing
 - ✓ Winch Relay Circuit
 - ✓ Winch Electronics Test
 - ✓ Winch Structural Integration
 - ✓ Winch Controlled Reaction Testing



Deployment & Retraction Progress Checklist



Deployment Objectives

- Inflation Testing
 - Complete Systems Test
 - To be completed as code is written
 - Will continue up to delivery data

Retraction Objectives

COMPLETE



Deployment & Retraction Task Summary

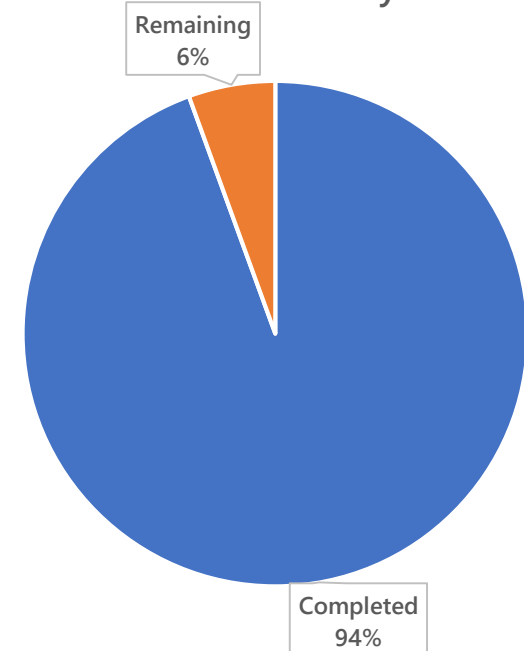


▪ **Finishing Automation**

- System can be fully manually deployed with existing GUI and two technicians
- Automation architecture and pseudocode exists
- Finalization of control methodology and testing

▪ **Bugfixing Expected to continue until just prior to Delivery to JSC**

Deployment & Retraction Task Summary





Safety Overview



Compliance, Guidelines, and Documentation



Safety Hazard Matrix Progress



P= Risk to Personnel A= Risk to Assets	Probability [Pr] Estimations				
	A: Frequent	B: Probable	C: Occasional	D: Remote	E: Improbable
Severity Classifications					
I: Catastrophic					
II: Critical					A02, P02, A07
III: Moderate					A04, P04, A07
IV: Negligible			P09	P05	A01, P01, P03, P06, P07, A08

Hazard Code	Hazard Description
01	Electrocution
02	Fire
03	CO2
04	Structural Failure
05	Minor Injury
06	Thermal
07	Pressure Vessel Rupture
08	Pressure Lines
09	Entering Confined Spaces

RAC: 1	Unacceptable – All operations shall cease immediately until the hazard is corrected, or until temporary controls are in place and permanent controls are in work.
RAC: 2	Undesirable – All operations shall cease immediately until the hazard is corrected or until temporary controls are in place and permanent controls are in work.
RAC: 3	Acceptable with controls – Division Chief or equivalent management is authorized to accept the risk with adequate justification.
RAC: 4-7	Acceptable with controls – Branch Chief or equivalent management is authorized to accept the risk with adequate justification

More Detail in Backup Slides



Safety Progress Progress





Safety & Documentation Progress



System Objectives

- ✓ Initial Safety Review
 - ✓ Initial Review of JPR 1700
 - ✓ Initial Development of Hazard Matrix
- ☐ Final Safety Review
 - ☐ Specific & Extensive Review of JPR 1700
 - ☐ Review & Update of Hazard Matrix

Administrative Objectives

- ☐ Documentation Development
 - ✓ Itemized Checklist of Applicable JPR Regulations
 - ☐ Systematic Review of Compliance with Regulations
 - ☐ Development of Technical Memorandum & Guidelines for the Safe Deployment, Employment, & Retraction



Safety Further Actions



System Objectives

- Final Safety Review
 - Specific & Extensive Review of JPR 1700 – Target Date: 05/12
 - Review & Update of Hazard Matrix – Target Date: 05/12

Administrative Objectives

- Documentation Development
 - Systematic Review of Compliance with Regulations – Target Date: 05/12
 - Development of Guidelines for Safe Usage – Target Date: 05/19



Safety & Documentation Task Summary



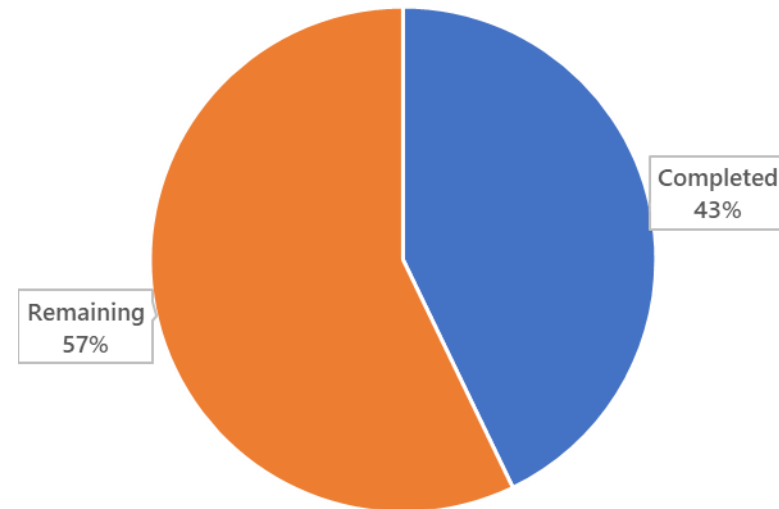
▪ Safety Review

- Review specific concerns today
- Convert JPR 1700 to Excel document, and review line by line for applicability and coverage
 - Itemized Checklist (?)

▪ Documentation Finalization

- Deployment checklists will be in progress until delivery, written as automation testing progresses

Safety & Documentation Task Summary





Summary Task Breakdown



- **Final Assembly on track for completion 10 May (Today!)**
- **Remaining work reliant upon testing of automation routines**
 - Manual routine exists, checklist & manual in development
 - Requires up to 10 man-hours to fully implement and bugfix
- **Full Safety Review**
 - Completion pending development of itemized checklist



Photos and Charts



Additional Information for the Curious



Hazard Summary

(1/5)



Hazard Description	Cause	Effect	Category		Mitigations
			Personnel	Assets	
01 Electrocution	<ol style="list-style-type: none"> Exposed wires Improper electrical setup 	<ol style="list-style-type: none"> Damage to electrical components Injury to personnel 	4E	4E	<ol style="list-style-type: none"> Careful attention during soldering, wiring, assembling. Inspection of electrical & wiring systems by one of the team's systems engineer.
02 Fire	<ol style="list-style-type: none"> Electrical components malfunction or complete failure resulting in overheating and catching fire. 	<ol style="list-style-type: none"> Injury or death to personnel. Damage to or loss of analog 	2E	2E	<ol style="list-style-type: none"> Students, OSU & NASA personnel assess equipment prior to testing for fire mitigation. Manual temp monitoring. There will be temperature sensors in the analog. These are monitored in real-time by the operator. Circuit breakers installed appropriately. Operator has direct control to cut power immediately. Sensors installed for smoke. Fire extinguishers on standby for immediate use



Hazard Summary (2/5)



Hazard Description	Cause	Effect	Category		Mitigations
			Personnel	Assets	
03 CO2	1. Too many personnel in the analog for too long	1. Headaches, dizziness, mental underperformance	4E	NA	1. CO2 sensor installed and routinely checked 2. Analog is properly ventilated, naturally, by having the dock portion open to ambient air
04 Structural Failure	1. Damage during deployment 2. Loss of beam pressure 3. 8020 beam failure	1. Damage to equipment/structure 2. Entrapment 3. Collapse causing injury	3E	3E	1. Quality control throughout construction 2. Routine inspections 3. Redundant structures 4. Pneumatic system continuously monitored by team's systems engineer via user interface 5. Emergency egress effective and briefed to personnel



Hazard Summary

(3/5)



Hazard Description	Cause	Effect	Category		Mitigations
			Personnel	Assets	
05 Minor Injuries	1. Sharp edges Trip hazards	1. Fillet or cover all sharp edges 2. Ensure power cords or analog components are not posing a risk to tripping personnel	4D	NA	1. Quality control throughout construction 2. Routine inspections 3. Redundant pressure lines/components
06 Thermal	1. Demonstration moved outside 2. Facility's AC not functioning 3. Lack of hydration	1. Dehydration 2. Heat stress 3. Heat exhaustion 4. Heat stroke	4E	NA	1. Utilize facility cooling equipment 2. Limited time outdoors 3. Ensure personnel's hydration



Hazard Summary

(4/5)



Hazard Description	Cause	Effect	Category		Mitigations
			Personnel	Assets	
07 Pressure Vessel Rupture	1. Exceeding allowable pressure limits of the tanks.	1. Low speed release of low pressure air 2. Sudden loud popping sounds	4E	3E	1. Monitoring pressure sensors, while staying well below vessel pressure limits & 0.5 psig threshold. 2. Routine inspections 3. Redundant layers of fabric for stress development This complies JPR 1700 6.11 Pressurized Gas and Liquid Systems
08 Pneumatic System Lines	1. Exceeding allowable pressure limits of pneumatic lines. 2. Hole puncture or tear.	1. Low-speed blasts of air.	NA	4E	1. Redundant pressure lines/components 2. Routine inspections This complies JPR 1700 6.11 Pressurized Gas and Liquid Systems



Hazard Summary (5/5)



Hazard Description	Cause	Effect	Category		Mitigations
			Personnel	Assets	
09 Entering Confined spaces.	1. Low ceiling. 2. Minimum walking space.	1. Minor body impact 2. Tripping, falling	4C	NA	1. Entry procedure. 2. Padding on exposed hard surfaces. This complies JPR 1700 6.10 Entering Confined Spaces and Controlled Areas



Photos





Photos





Photos





Photos





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