Large Aircraft Depaint Manipulator Initiative

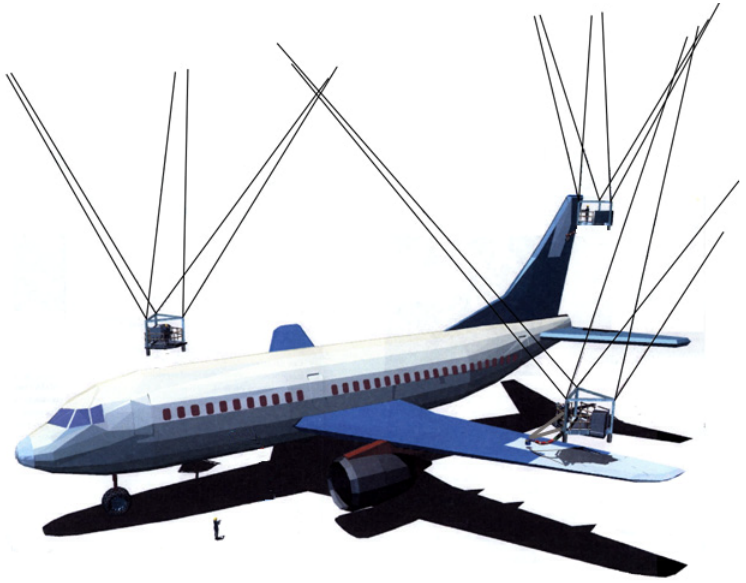
Materials and Manufacturing Directorate of the Air Force Research Laboratory

Aircraft Maintenance Platform

A Lightweight, Suspended, Multi-Axis Work Platform

DESIGN OVERVIEW

UTC Technology Corporation
220 Seventh Street, S.E.
Canton, OH 44702
(330) 455-1181



CONTACT: ADAM JACOFF, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
ADAM.JACOFF@NIST.GOV 301-975-4235

Current De-Paint Process Problems

PROJECT NEED

- **Existing equipment**
  - Difficult to maneuver accurately
  - Uncoordinated motions
  - Frequent collisions
- **Setup time**
  - Delays productive portions of de-paint process
- **Ground clutter**
  - Hinders efficient access of aircraft
- **Ergonomic issues**
  - Causes operator fatigue/injury
  - Lost labor hours (avg.. one per shift)
  - Damage to aircraft skins from trigger work-around and nozzle dwell time

AMP Project Goals

PROJECT NEED

DEPAINT PROCESS IMPROVEMENTS:

- **Reduce flow time by:**
  - Eliminating ground based scaffolding, hoses and other inefficient clutter
  - Improving positioning accuracy and efficiency in all phases of process
  - Increasing blasting time by reducing fatigue/injury, maximizing labor
- **Reduce direct costs:**
  - Requiring no heavy duty hangar structure, deploys from existing facilities
  - Reduce collisions caused by operator positioning errors
  - Manipulator integration for blasting will minimize fatigue/injury

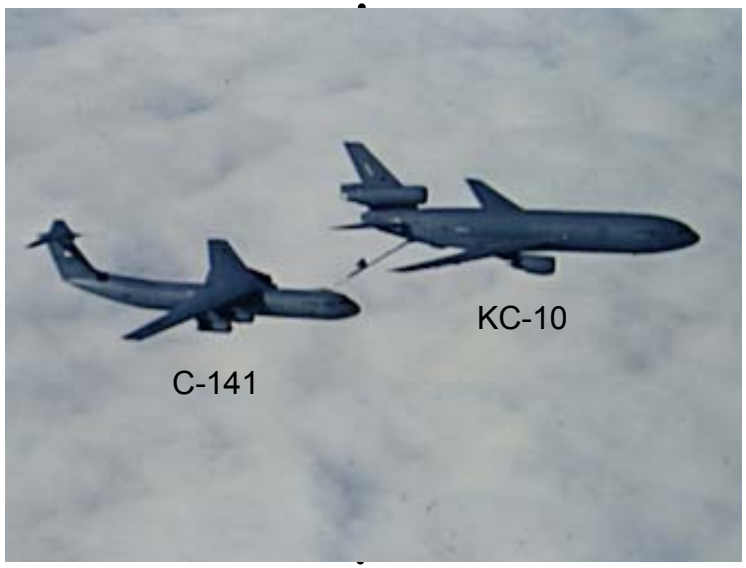
Targeted Aircraft

CARGO

TANKERS

C-130 HERCULES
LOCKHEED

C-141 STAR LIFTER
LOCKHEED



KC-135 STRATOTANKER
BOEING

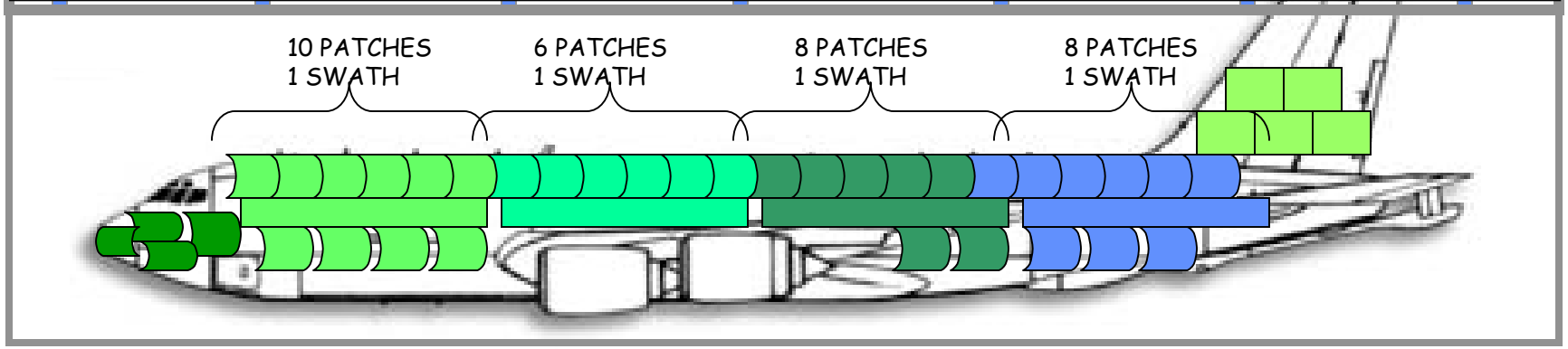
C-5 GALAXY
LOCKHEED

KC-10 EXTENDER
BOEING

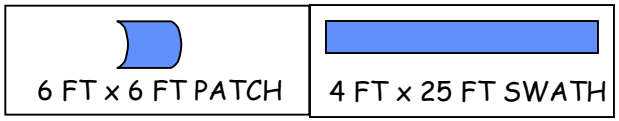
AMP Dry Media Blasting

OPERATIONAL AMP DEPLOYMENT

EACH COLORED SECTION REPRESENTS MORE THAN A SHIFT OF BLASTING



SECTION: 10 PATCHES = 360 ft^2
1 SWATH = 100 ft^2



CURRENTLY: 460 ft^2 @ **1 ft^2/min** = 460 minutes = **8 hours of continuous blasting**

OUR GOAL: **Three nozzles, faster access, better ergonomics, more trigger time...**
TWO SECTIONS = ONE OPERATOR FOR ONE SHIFT

Technology Transfer

TEAMING ARRANGEMENT

SPONSOR

AIR FORCE RESEARCH LAB

PRIME CONTRACTORS

US TECHNOLOGY CORP

JAMES GREGORY ASSOCIATES

TECHNOLOGY COLABORATORS

INTELLIGENT SYSTEMS DIVISION

AEROSYSTEMS CORP

US TECHNOLOGY CORP

CUSTOMERS

Oklahoma City Air Logistics Center

Hill Air Force Base, Utah
Ogden Air Logistics Center

BOEING

Robins AFB

LOCKHEED MARTIN

US Technology Corporation

TEAMING ARRANGEMENT

US Technology Corporation
220 Seventh Street, S.E.
Canton, OH 44702
(330) 455-1181

TEAM ASSET:

- 20 years of de-paint experience supporting over 600 aircraft
- Application sales and support for dry media stripping at ALCs and private sector

SUPPORT PROVIDED:

- Component specifications.
- Blast system
- Ganged nozzles
- Plastic media

AeroSystems Corporation

TEAMING ARRANGEMENT

TEAM ASSET:

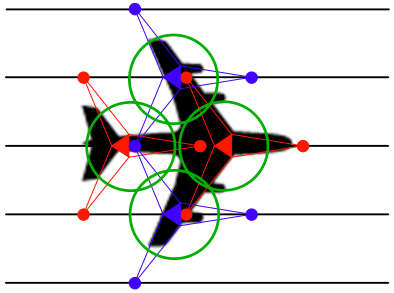
- 12 years experience developing and manufacturing overhead access platforms for aerospace industry

SUPPORT PROVIDED:

- Component specifications
- Component purchases
- Platform fabrication
- Trolley system

NIST-Intelligent Systems Division

TEAMING ARRANGEMENT



INTELLIGENT SYSTEMS DIVISION

TEAM ASSET:

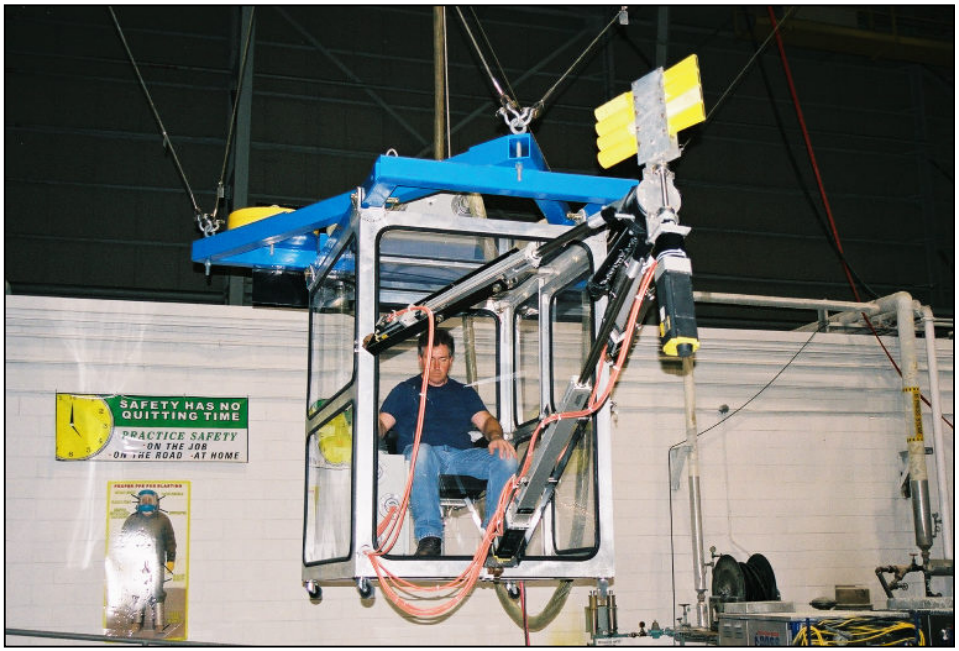
- 25 years experience developing automation for industry
- RoboCrane technology
- Demonstrations for large scale manufacturing applications

SUPPORT PROVIDED:

- System design
- Component specifications
- Controllers for AMP and Tripod
- Performance testing

AMP Payload Targets

OPERATIONAL AMP DEPLOYMENT



Personnel Deployment:

- **Two person "live load" (600 lbs)**
- **Hand tools and inspection devices**

- **Blast cab or basket**
- **Tripod manipulator**
- **Blast hoses**
- **Dry media blast pots**

Cargo Handling:

- **Precision (6 dof) cargo placement**
- **No personnel means double the safe working load**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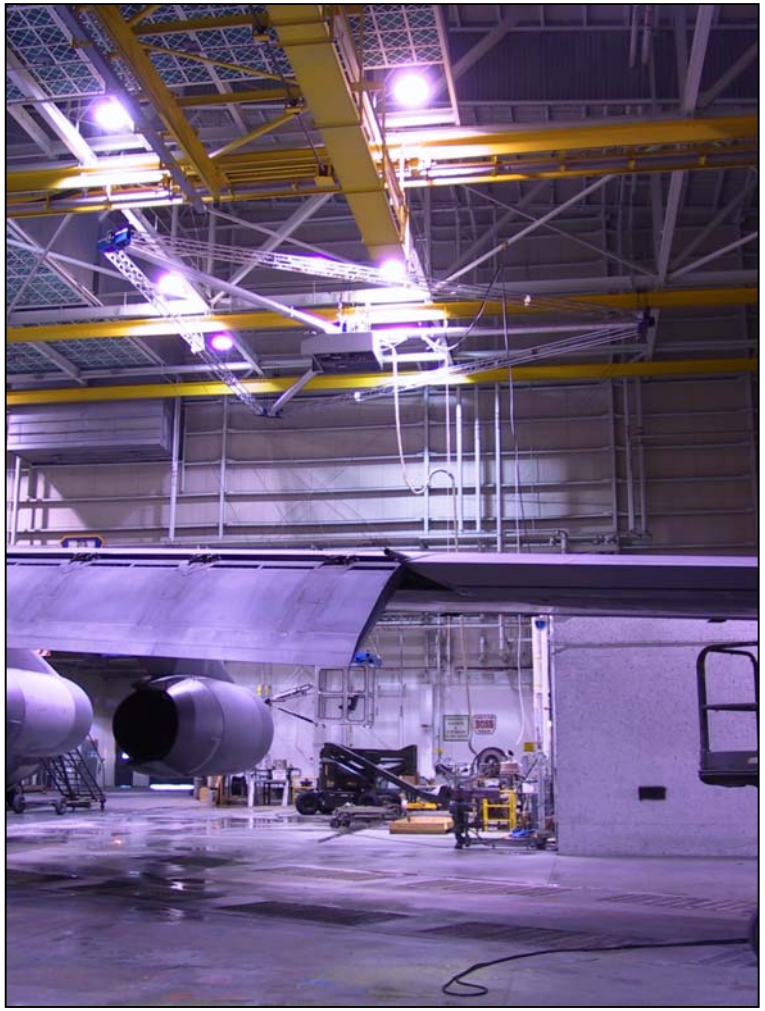
Warner Robins AFB, Bldg 50

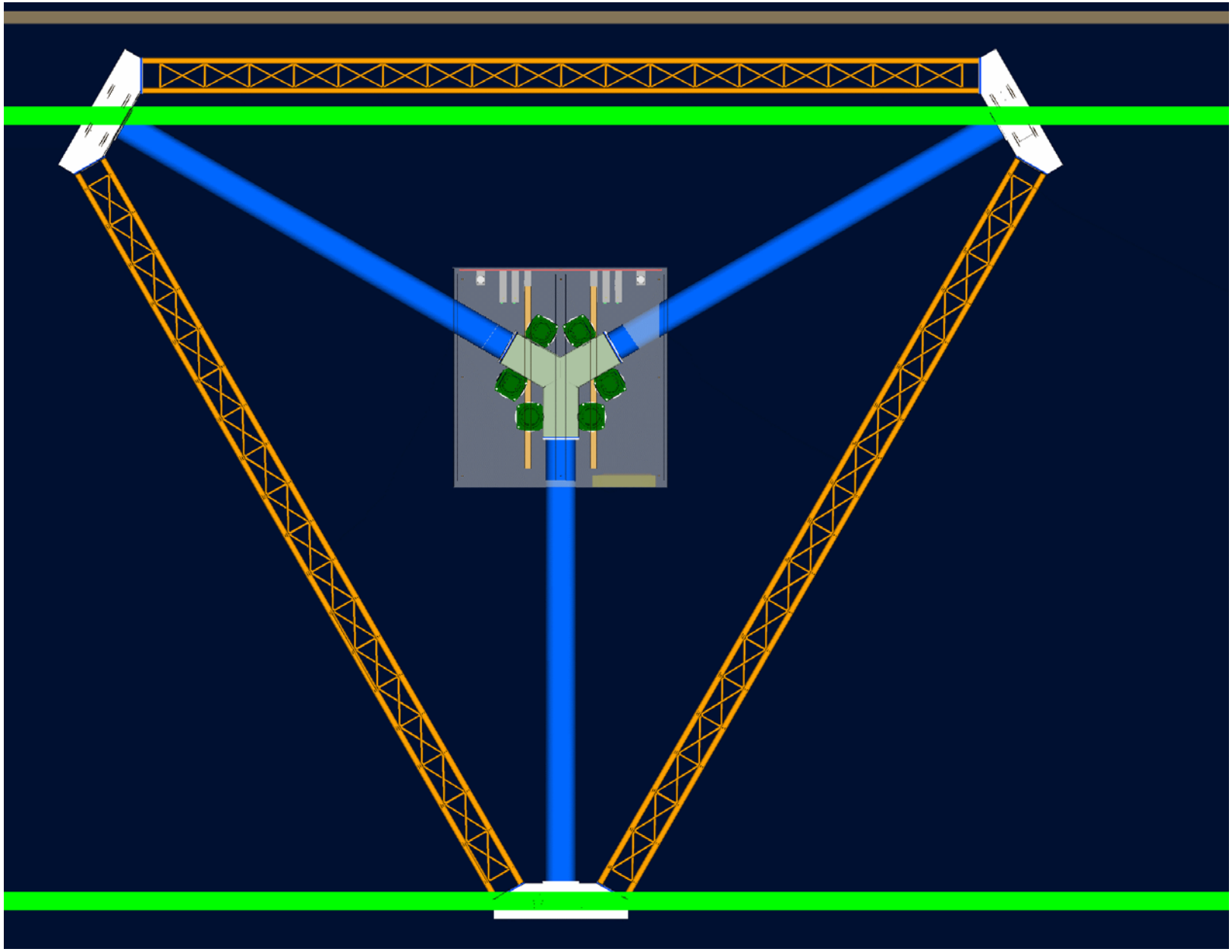
OPERATIONAL AMP DEPLOYMENT

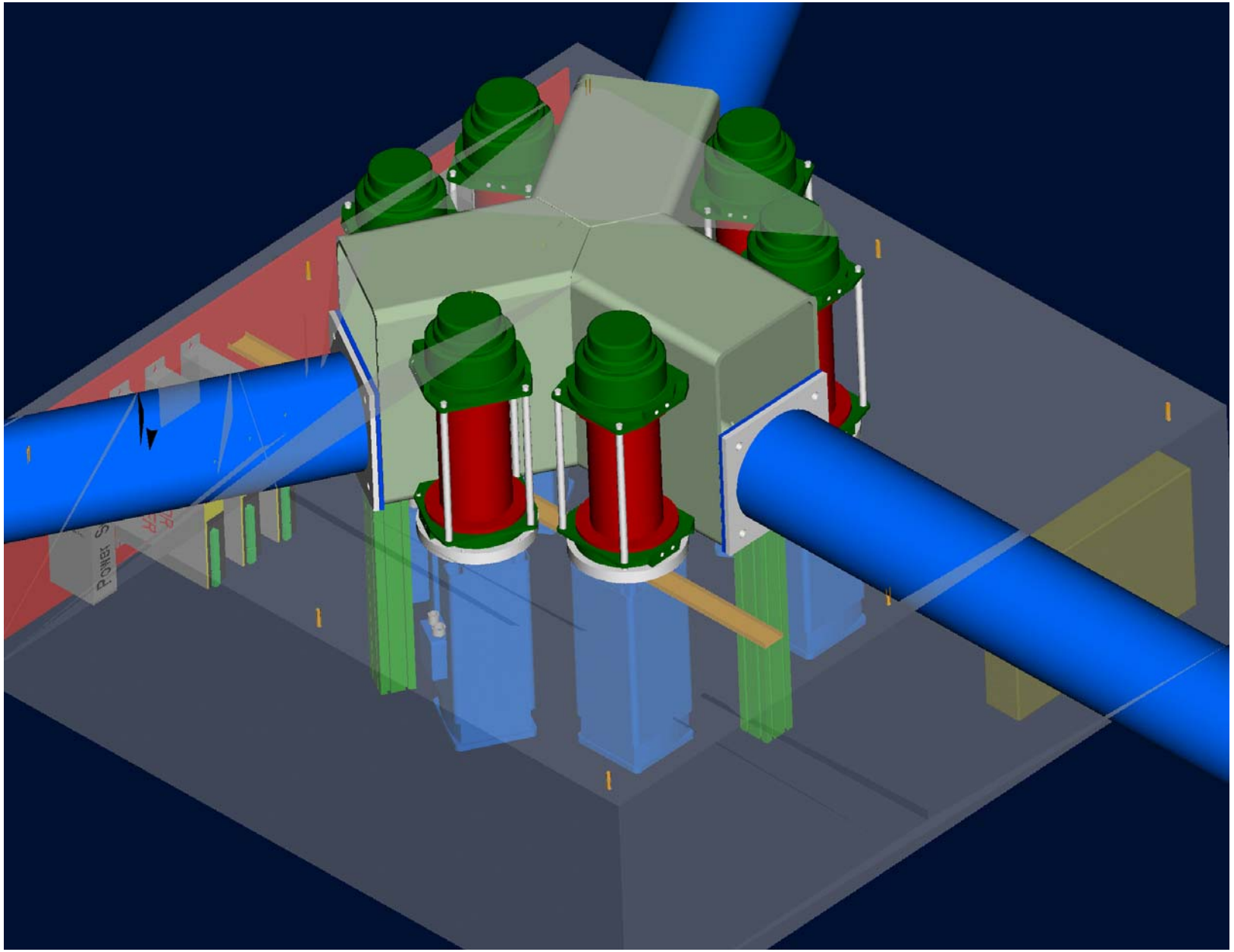


Warner Robins AFB, Bldg 50

OPERATIONAL AMP DEPLOYMENT


APR 28 2003



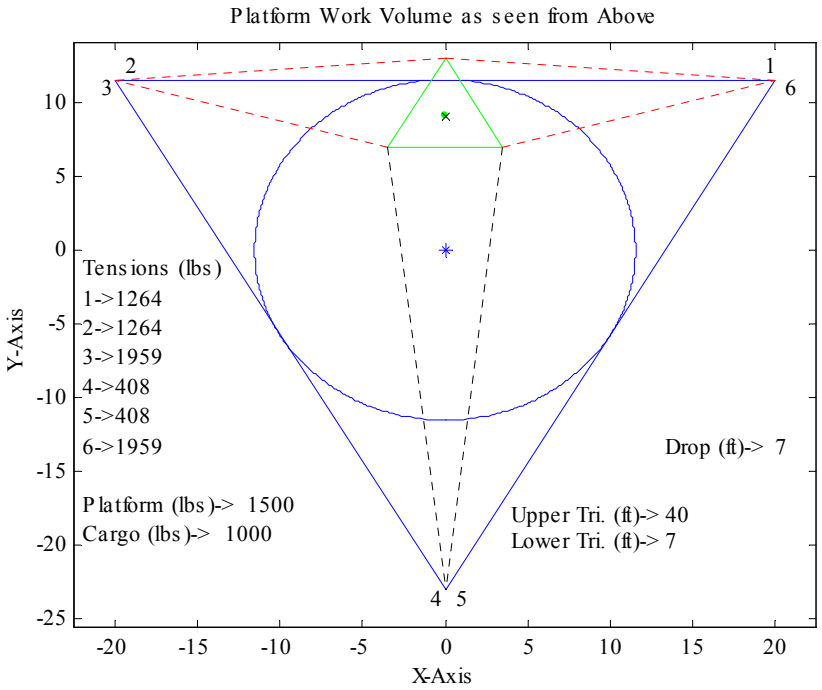



APR 28 2003

Maximum Cable Tension Calculations

AMP DESIGN CRITERIA

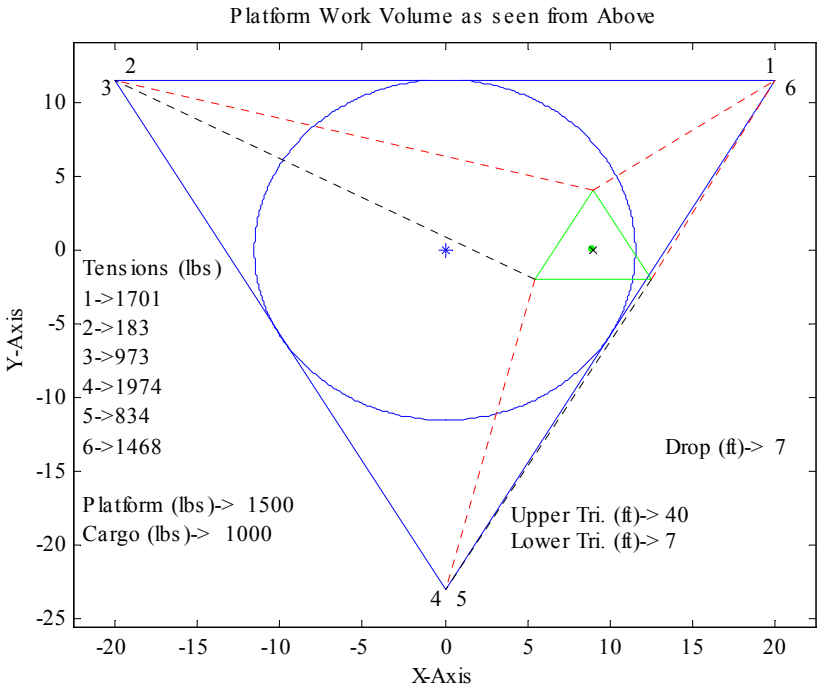
Lower Triangle: X=0 Y=9′ Yaw=0 Z=7′



(AMP *40′* configuration 011119-01)

Maximum Tension: 1,959 lbs

Lower Triangle: X=9′ Y=0 Yaw=0 Z=7′

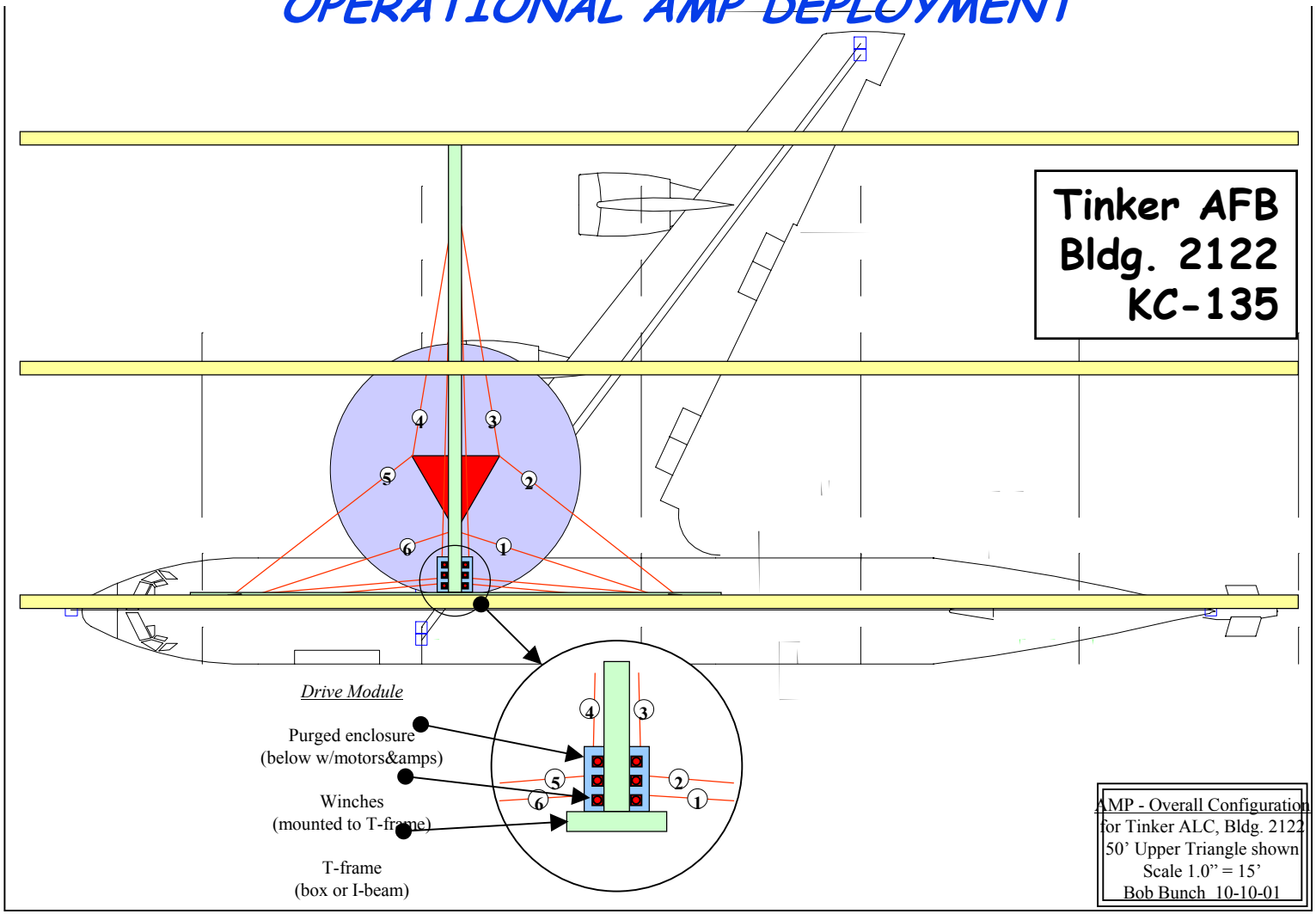


(AMP *40′* configuration 011119-02)

Maximum Tension: 1,974 lbs

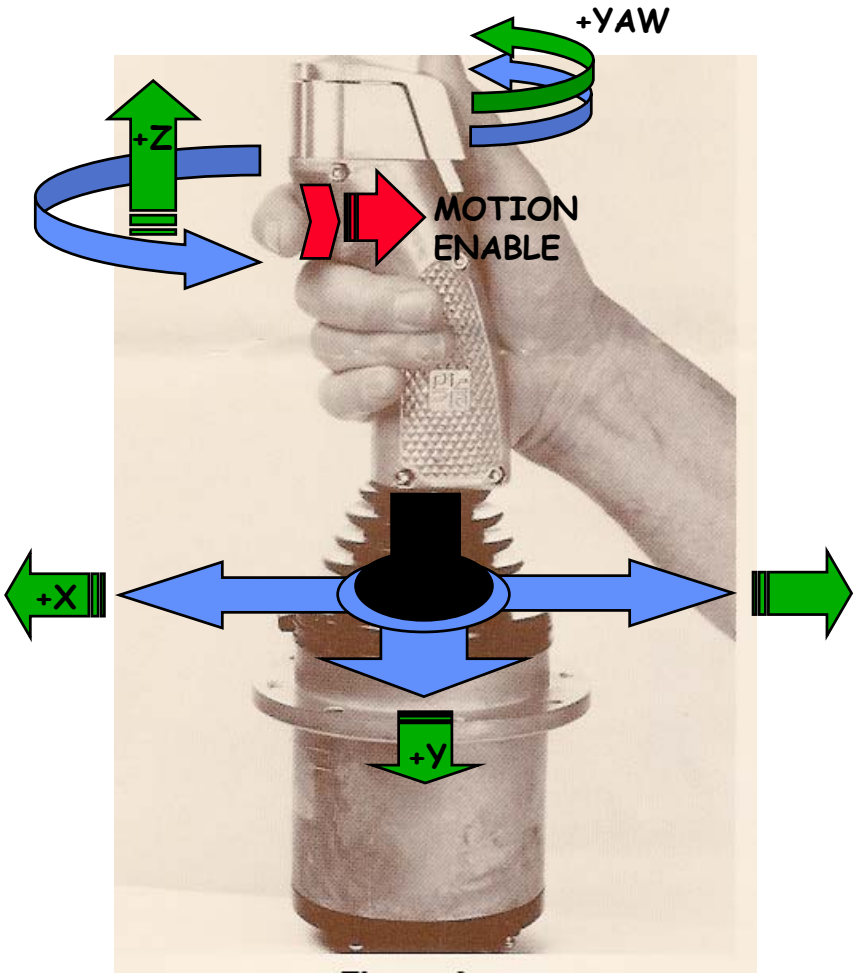
AMP Workvolume

OPERATIONAL AMP DEPLOYMENT



Platform Joystick

HUMAN-MACHINE INTERFACE COMPONENTS



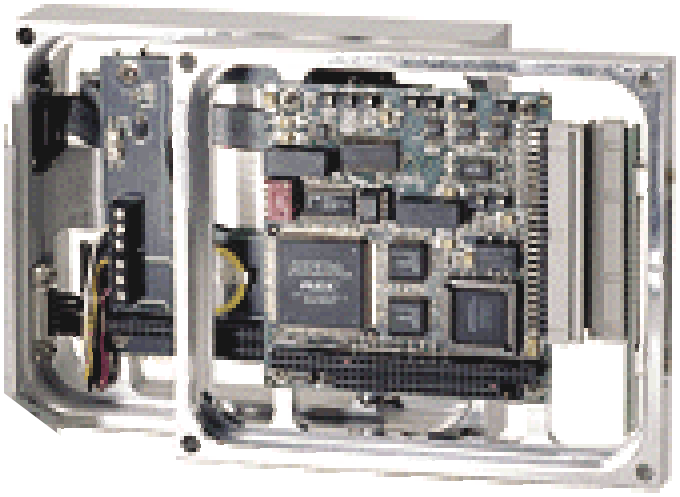
P-Q Controls Inc.

[Model 220]

- **4-DOF (X, Y, Z, Yaw) w/digital trigger**
- **Industrial quality**
- **Inductively coupled mechanisms**
- **Intuitive Platform Velocity Inputs:**
  - X: lean left - lean right
  - Y: push forward - pull back
  - Z: grip twist (open/up - close/down)
  - Yaw: (about Z) rotate via thumb
- **Trigger provides motion enable**
  - Trigger engage generates a 'controller run' to begin 'servo', release brakes and enable amplifiers, acceleration limited motion.
  - Trigger release generates a 'controller stop' to decelerate, then brake & disable amp.

PC/104 Industrial Computer

CONTROLLER COMPONENTS



686 GEODE (PENTIUM)
W/FLASH & NVRAM
ANALOLOG I/O
CAN BUS/RS-232
24V POWER

Real Time Devices IDAN PC/104

FEATURES:

- Established PC-104 form factor
- Established PC-104 vendor
- Compact design
- Rugged construction
- Shock mounted
- Solid state disk
- Battery backed RAM
- Closed, heat-sink enclosure
- High temperature band
- Modular configuration
- Interchangeable cards
- Wide variety of capabilities

AMP Payload

OPERATIONAL AMP DEPLOYMENT


U.S. AIR FORCE
0021
164TH AW