Daring to Do Mighty Things: NASA's Jet Propulsion Laboratory (JPL) Teamed Approach to Construction Safety Management

Jeff Behar, MS, MBA, CIH
Barron J. Peeler, MPH, CAC
Jet Propulsion Laboratory, California Institute of Technology.

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NASA's OSMA's Structure and Culture

- NASA's Office of Safety and Mission Assurance (OSMA) assures the safety and enhances the success of all NASA activities
- OSMA includes the Mission Support Division, Safety and Assurance Requirements Division, and NASA Safety Center
- OSMA sets safety and health policy and requirements that flows down to JPL
- Construction Safety and fall protection falls under OSMA
- NASA prime contract identifies minimum safety requirements

Aviation Safety
Construction Safety and Fall Protection
EEE Parts
Electrical Safety
ELV Payload Safety
Facility System Safety
Fire Protection
GIDEP
Institutional Safety
Lifting Devices and Equipment
Meteoroid Environments
Metrology and Calibration
Mishap Investigation
Nondestructive Evaluation
Nuclear Flight Safety
NSRS
Orbital Debris
Pressure Vessels and Systems
Quality
Range Flight Safety
Reliability and Maintainability
Risk Management
Safety Culture
SMSR
Software Assurance
System Safety
Workmanship

OSMA
OFFICE OF SAFETY & MISSION ASSURANCE

JPL's OSMS Structure and Culture

- JPL's Office of Safety and Mission Success (OSMS)
- OSMS is an independent organization reporting to the JPL Director
- Occupational Safety Program Office (OSPO) is in the OSMS Directorate and is the organizational that implements the construction safety program at JPL
- Unique culture bigger than basic occupational safety drives safety at JPL

JPL Facts

- JPL is a unique national research facility that carries out robotic space and Earth science missions
- JPL is a federally funded research and development center managed for NASA by Caltech
- Our purpose unmanned space exploration
- JPL Outsources:
  - Operations and maintenance
- Multi-employer environment
- NASA ensures we are effective by requiring regular accountability
  - NASA Contract flow-downs

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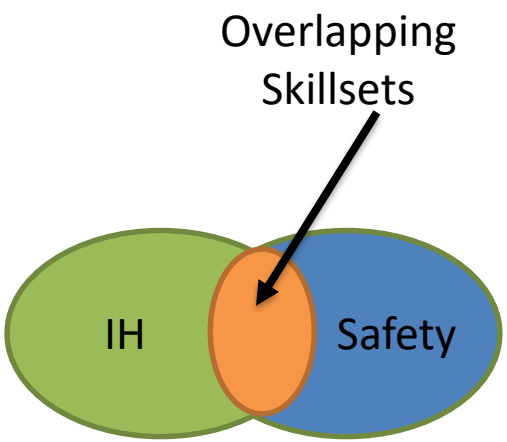
Why is Understanding Construction Safety Beneficial to an IH and How can JPL's Approach to Construction Safety Benefit an IH?

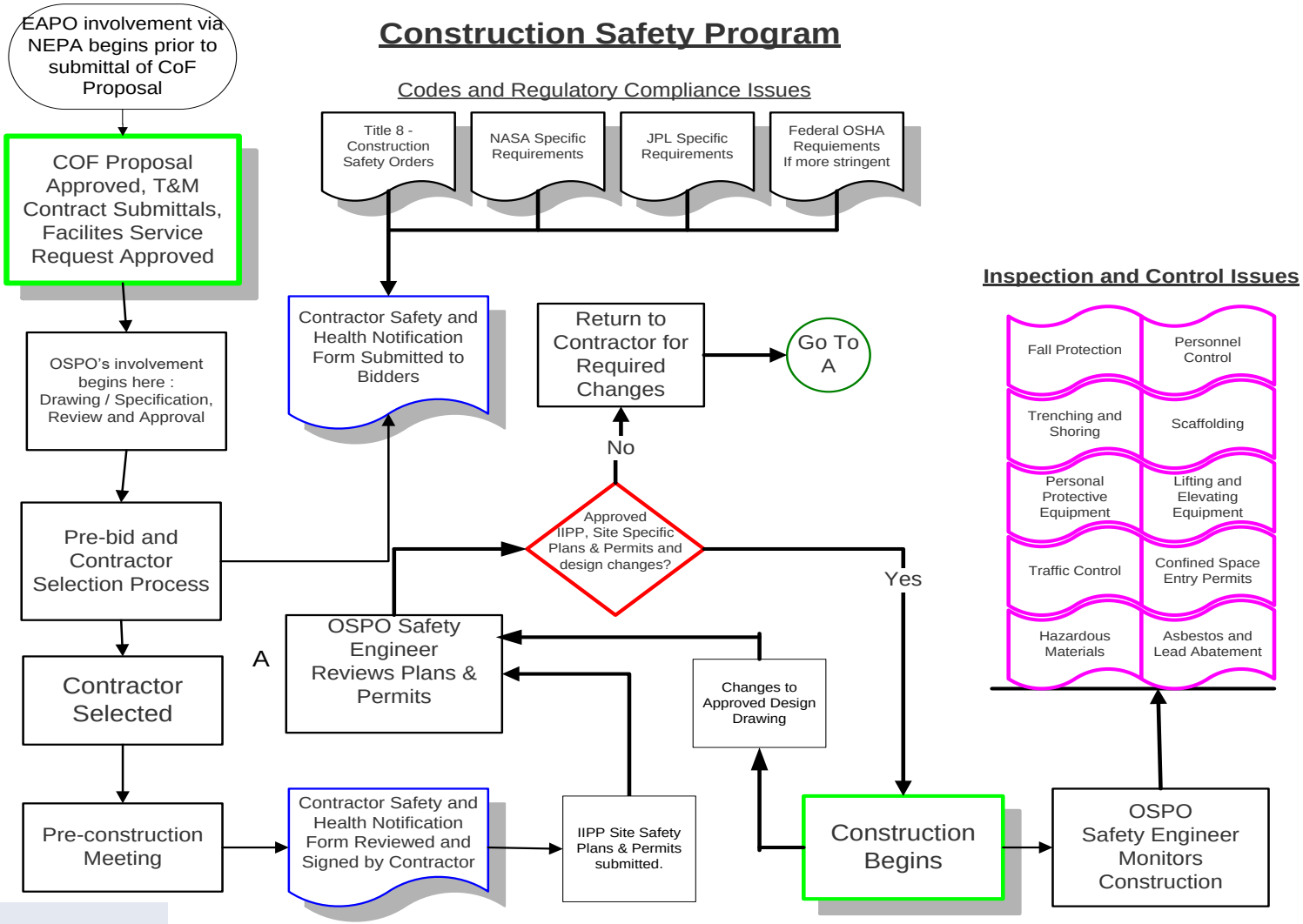
- Construction safety includes many IH issues
  - CSE
  - Noise
  - Particulate exposure
  - Welding (UV, Chromium,. Etc.)
  - Heat stress
  - Asbestos/Lead
  - Additive Manufacturing
- There is overlap
- IH's bring a unique valued perspective to construction safety
- Understanding both makes you a more valued professional
- JPL's Proactive approach of merging IH and Safety into the lifecycle of each construction project has been successful



Team Approach for Construction Safety at JPL

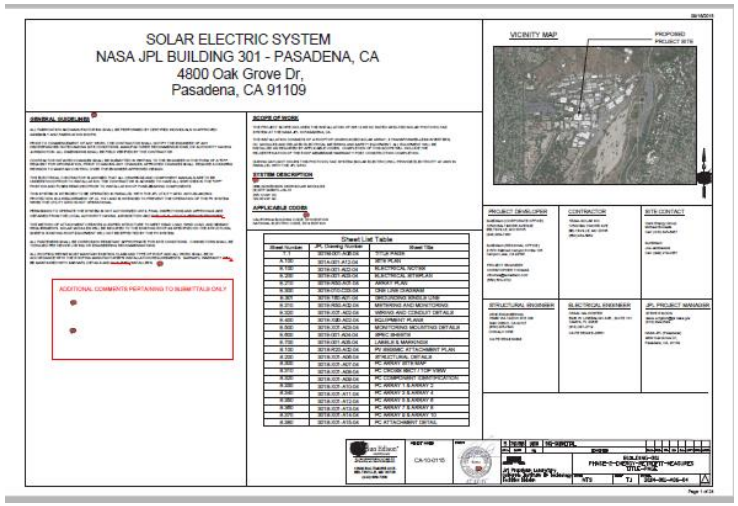
- The construction safety program leverages the talent and support of the following organizations:
  - Occupational Safety Program Office (OSPO)
  - Acquisition Division
  - Systems Safety Program Office
  - Environmental Affairs Program Office (EAPO)
  - Facilities Division
  - Fire Life Safety Authority Having Jurisdiction (AHJ)
  - Electrical AHJ
- Key organizations are involved throughout the lifecycle of the project - from project development to certificate of occupancy

JPL's Construction Safety Program Process Flow



Project Design Reviews

- Project design drawings are reviewed by the following disciplines:
  - Fire/Life Safety
  - Electrical Safety
  - Mechanical Systems
  - Construction Safety
  - Environmental
  - Other Subject Matter Experts (SMEs) are called in as the project needs dictate
    - Pressure Systems
    - Ventilation
    - Asbestos



Fixed Price Construction Projects

- 99% of our Fixed Price Construction contracts follow the three phases below:
  - Solicitation
  - Notice of Award (NOA)
  - Notice to Proceed (NTP)
- These phases are in line with Federal Acquisition Regulations

Pre-bid Documentation

- Safety documentation included with bid packages:
  - Additional General Provisions (terms and conditions) Safety and Health Special Conditions
  - 2885 Form - Contractor Safety & Health Notification (incorporates NASA Safety and Health Contract Requirements)
  - A-100 (Requirements for asbestos abatement work)
  - A-200 (Requirements for class 3 asbestos work)
- Covers
  - Cal/OSHA Title 8, Fed/OSHA, JPL and NASA specific safety and health requirements

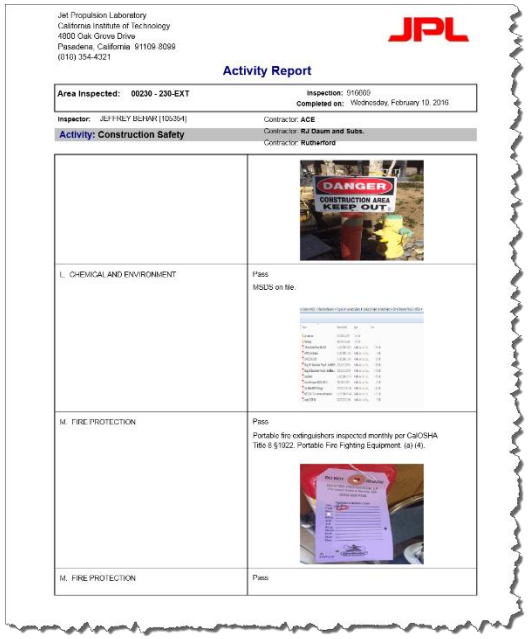
Pre-construction Meetings

- Key JPL Departments present:
  - Facilities
  - Occupational Safety Program Office (OSPO)
  - Acquisitions
  - Fire/Life Safety AHJ
  - Electrical Safety AHJ
  - Security
  - Fire Department
  - Environmental Affairs Program Office (EAPO)
- Purpose of this meeting is to outline project, safety and security requirements and clarify any questions contractor may have while working at JPL.

Contractors' Safety Submittal Review Process

- Injury & Illness Prevention Program (IIPP)
- Site Specific Safety Plan (SSSP)
- Experience Modification Rate (EMR)
- Asbestos & Lead Work Plans
- Fall Protection Plans
- Scaffold Safety Plans
- Lift Plans
- Training certifications
- OSPO notifies Acquisitions when all documents are accepted
  - Notice to Proceed (NTP) Issued by Acquisitions

Safety Management Tools

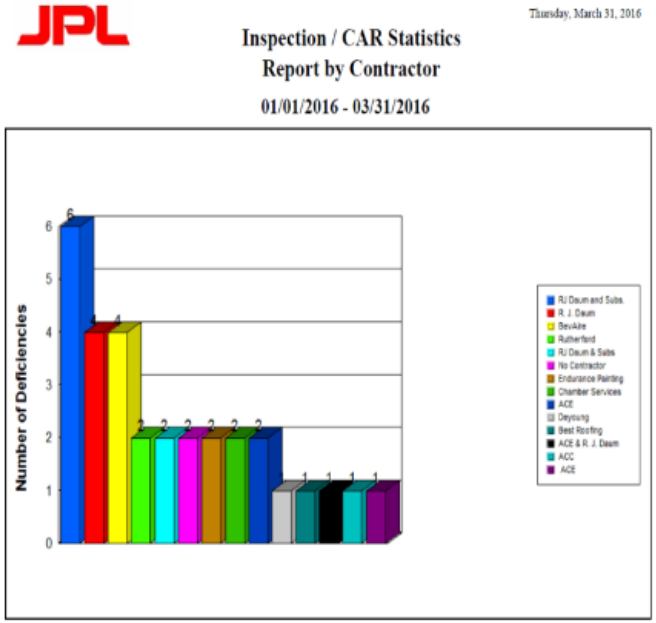


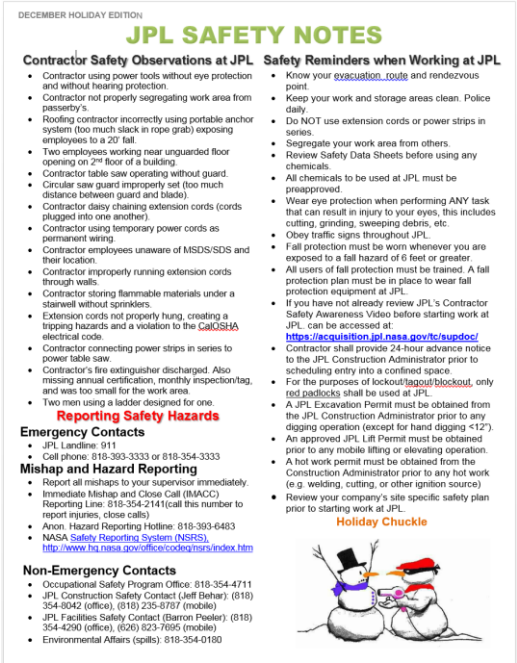
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109-8099
(818) 354-4321

JPL

Activity Report

Area Inspected: 00230 - 230-EXT	**Inspection:** 916669 **Completed on:** Wednesday, February 10, 2016
Inspector: JEFFREY BEHAR [105354]	Contractor: **ACE**
Activity: Construction Safety	Contractor: **RJ Daum and Subs.** Contractor: **Rutherford**
	DANGER CONSTRUCTION AREA KEEP OUT
L. CHEMICAL AND ENVIRONMENT	Pass MSDS on file.
M. FIRE PROTECTION	Pass Portable fire extinguishers inspected monthly per CalOSHA Title 8 §1922. Portable Fire Fighting Equipment. (a) (4).
M. FIRE PROTECTION	Pass





DECEMBER HOLIDAY EDITION

JPL SAFETY NOTES

Contractor Safety Observations at JPL

- Contractor using power tools without eye protection and without hearing protection.
- Contractor not properly segregating work area from passerby's.
- Roofing contractor incorrectly using portable anchor system (too much slack in rope grab) exposing employees to a 20' fall.
- Two employees working near unguarded floor opening on 2nd floor of a building.
- Contractor table saw operating without guard.
- Circular saw guard improperly set (too much distance between guard and blade).
- Contractor daisy chaining extension cords (cords plugged into one another).
- Contractor using temporary power cords as permanent wiring.
- Contractor employees unaware of MSDS/SDS and their location.
- Contractor improperly running extension cords through walls.
- Contractor storing flammable materials under a stairwell without sprinklers.
- Extension cords not properly hung, creating a tripping hazards and a violation to the CalOSHA electrical code.
- Contractor connecting power strips in series to power table saw.
- Contractor's fire extinguisher discharged. Also missing annual certification, monthly inspection/tag, and was too small for the work area.
- Two men using a ladder designed for one.

Reporting Safety Hazards

Emergency Contacts

- JPL Landline: 911
- Cell phone: 818-393-3333 or 818-354-3333

Mishap and Hazard Reporting

- Report all mishaps to your supervisor immediately.
- Immediate Mishap and Close Call (IMACC) Reporting Line: 818-354-2141(call this number to report injuries, close calls)
- Anon. Hazard Reporting Hotline: 818-393-6483
- NASA Safety Reporting System (NSRS), http://www.hq.nasa.gov/office/codeq/nsrs/index.htm

Non-Emergency Contacts

- Occupational Safety Program Office: 818-354-4711
- JPL Construction Safety Contact (Jeff Behar): (818) 354-8042 (office), (818) 235-8787 (mobile)
- JPL Facilities Safety Contact (Barron Peeler): (818) 354-4290 (office), (626) 823-7695 (mobile)
- Environmental Affairs (spills): 818-354-0180

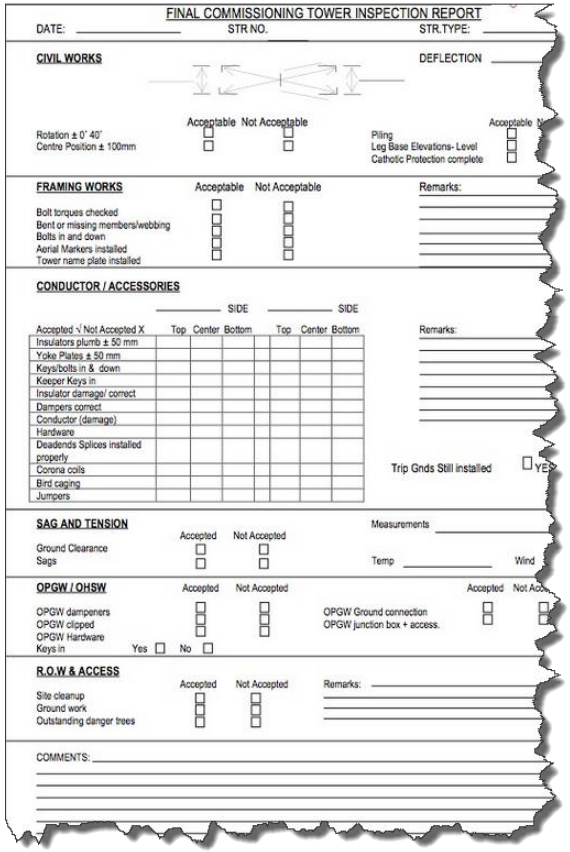
Safety Reminders when Working at JPL

- Know your evacuation route and rendezvous point.
- Keep your work and storage areas clean. Police daily.
- Do NOT use extension cords or power strips in series.
- Segregate your work area from others.
- Review Safety Data Sheets before using any chemicals.
- All chemicals to be used at JPL must be preapproved.
- Wear eye protection when performing ANY task that can result in injury to your eyes, this includes cutting, grinding, sweeping debris, etc.
- Obey traffic signs throughout JPL.
- Fall protection must be worn whenever you are exposed to a fall hazard of 6 feet or greater.
- All users of fall protection must be trained. A fall protection plan must be in place to wear fall protection equipment at JPL.
- If you have not already review JPL's Contractor Safety Awareness Video before starting work at JPL, can be accessed at: https://acquisition.jpl.nasa.gov/tc/supdoc/
- Contractor shall provide 24-hour advance notice to the JPL Construction Administrator prior to scheduling entry into a confined space.
- For the purposes of lockout/tagout/blockout, only red padlocks shall be used at JPL.
- A JPL Excavation Permit must be obtained from the JPL Construction Administrator prior to any digging operation (except for hand digging <12").
- An approved JPL Lift Permit must be obtained prior to any mobile lifting or elevating operation.
- A hot work permit must be obtained from the Construction Administrator prior to any hot work (e.g. welding, cutting, or other ignition source)
- Review your company's site specific safety plan prior to starting work at JPL.

Holiday Chuckle

Project Completion Acceptance Process

- Project Acceptance (work performed has met contract requirements) includes:
  - Review of contract /work scope vs. work performed
  - Submission of applicable required documents:
    - As Built Drawings,
    - Equipment submittals,
    - Operating manuals,
    - Inspection reports, and
    - Commissioning report
  - Training of staff
    - required when a project includes installation of equipment requiring maintenance (such as cooling towers, chillers, etc..).



FINAL COMMISSIONING TOWER INSPECTION REPORT

DATE: _____ STR NO. _____ STR.TYPE: _____

CIVIL WORKS DEFLECTION _____

	Acceptable	Not Acceptable
Rotation ± 0° 40'	☐	☐
Centre Position ± 100mm	☐	☐

	Acceptable
Piling	☐
Leg Base Elevations- Level	☐
Cathotic Protection complete	☐

FRAMING WORKS

	Acceptable	Not Acceptable
Bolt torques checked	☐	☐
Bent or missing members/webbing	☐	☐
Bolts in and down	☐	☐
Aerial Markers installed	☐	☐
Tower name plate installed	☐	☐

Remarks:

CONDUCTOR / ACCESSORIES

Accepted √ Not Accepted X	_____ SIDE Top	Center	Bottom	_____ SIDE Top	Center	Bottom
Insulators plumb ± 50 mm						
Yoke Plates ± 50 mm						
Keys/bolts in & down						
Keeper Keys in						
Insulator damage/ correct						
Dampers correct						
Conductor (damage)						
Hardware						
Deadends Splices installed properly						
Corona coils						
Bird caging						
Jumpers						

Remarks:

Trip Gnds Still installed ☐ YES

SAG AND TENSION

	Accepted	Not Accepted
Ground Clearance	☐	☐
Sags	☐	☐

Measurements _____

Temp _____ Wind

OPGW / OHSW

	Accepted	Not Accepted
OPGW dampeners	☐	☐
OPGW clipped	☐	☐
OPGW Hardware	☐	☐

Keys in Yes ☐ No ☐

	Accepted	Not Ac
OPGW Ground connection	☐	☐
OPGW junction box + access.	☐	☐

R.O.W & ACCESS

	Accepted	Not Accepted
Site cleanup	☐	☐
Ground work	☐	☐
Outstanding danger trees	☐	☐

Remarks: _____

COMMENTS: _____

Certificate of Occupancy (CO) Process

- This process involves JPL's Authority Having Jurisdiction (AHJ) functioning as an internal "building department" issuing a certificate of occupancy (CO) after the work has been approved
- The CO process includes:
  - Project walk
  - Completing/Inspecting/ Testing of life safety protection systems and electrical components by AHJs
  - Review of final drawings against applicable building and fire life safety codes
  - Standard and Compliance Group within the Facilities Section issues the CO for signature by AHJs

Small Time & Material Tasks/ Projects

- These are usually tasks rather than projects
- Typically no design review
- Typically no pre-construction meeting
- Time & Materials contractors are used
- These projects are spot audited for safety compliance
- These projects are very important to JPL's and NASA's overall mission because they provide working facilities where research, project support and project management for space missions are performed

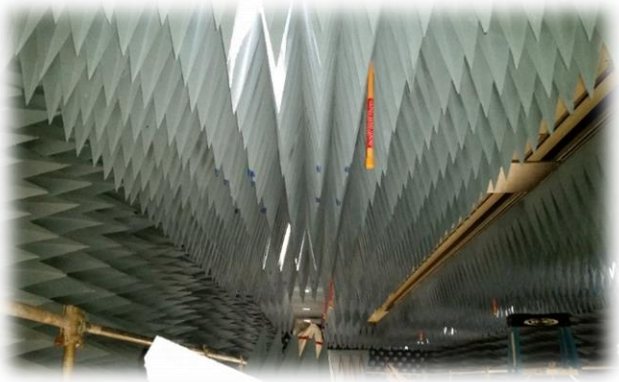
Repurposing of Space Projects

- Remodeling and repurposing spaces:
  - Laboratory redesign
  - Office remodels
  - Clean room reconstruction
  - Electrical and mechanical upgrades to meet research and project needs
  - Modular office
- Other
  - Hardscape work
    - ADA upgrades
    - Road work
  - Roofing jobs

Large Construction Project Examples

B212 Anechoic Chamber

- This $1.4M project included:
  - The reconfiguration of the Spacecraft Antennas Group building's ceiling, concrete foundation, steel erection, wall finishes, electrical, and lighting fixtures
  - Abatement of lead containing paint from structural members
  - Upgrade of the chamber crane system
  - Upgrade of the fire protection system
  - Replacement of radio frequency (RF) absorbing material in Anechoic chamber
- IH and Safety Engineering Challenges
  - Remote location
  - Project restrictions due to RF testing
  - Confined space entry issues
  - Roof work/fall protection issues
  - Lead issues



Space Flight Operations Facility (SFOF) Upgrade Project

- SFOF is our Mission Control Center
- Monitors and controlled all interplanetary and deep space exploration
- Operates 24/7
- National Historic landmark
- NASA's Deep pace Network (DSN) currently operated from this facility
- SFOF is mission critical
- Construction work to this facility has to be carefully planned and executed

Space Flight Operation Center Data Center Upgrade

- The data Center Project included:
  - Asbestos/lead abatement
  - Demolition
  - Subsurface work
  - Mechanical system upgrade
  - Electrical system upgrade
  - New building addition

- Challenges
  - Building is the main mission control station for critical space operations

West Arroyo Parking Structure (WAPS)

- The $17.5 million Project included:
  - The construction of new five-story, 1,500-stall, cast-in-place and post-tension 460,000-square-foot parking structure, concrete parking structure
  - Building relocation
  - Trenching
  - Road widening and hardscape improvements
  - 19 deck and five slab-on-grade pours
  - Steel, formwork, concrete finishing

- Challenges
  - Limited work area
  - Existing utility service lines ran the length of the 900-foot long parking structure's planned footprint, which conflicted with the new foundations
  - Relocation of electrical, sewer, water, storm, communications, natural gas, and compressed air lines
  - Fall protection issues

West Arroyo Parking Structure (WAPS)

- The project included 48 subcontractors and had a remarkable safety record, compiling over 105,000 man hours (equivalent to 13,125 days) without a lost-time injury

Defining Construction Project Success at JPL

- At JPL we consider a successful project if:
  - There are no recordable/lost time injuries or near misses
    - At JPL we have had no OSHA recordable construction related cases within the past 5 years
    - Our O&M Contractor >3300 days without a lost time incident
  - Any observed safety issues immediately corrected
  - Observed safety issues not repeated
  - Project meets schedule and budget
  - Quality meets expectations
  - Contractor(s) part of the “Team”
  - Contractor makes $ and wants to work at JPL again
  - Project does not impact mission critical operations
- How does your Company define construction project success?