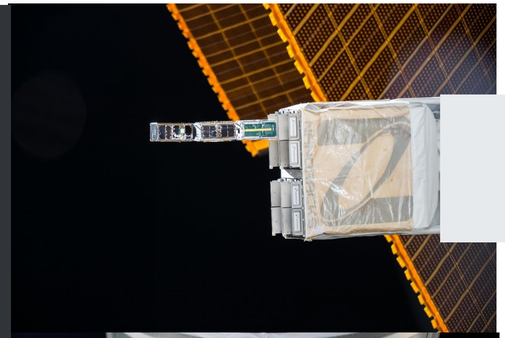
N A N O R A C K S

From NanoRacks to Satellite Developers: Lessons Learn for Spacecraft and Mission Design

CubeSat Developers Workshop, 2018

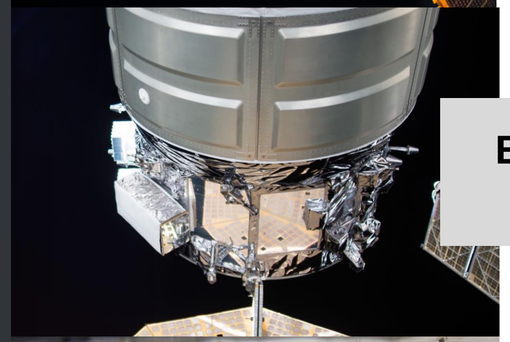
TRISTAN PREJEAN, Mission Manager
tprejean@nanoracks.com

NANORACKS SATELLITE PLATFORMS



NRCSD

Over 180 CubeSats deployed into low-Earth orbit via the NanoRacks CubeSat Deployer on the International Space Station

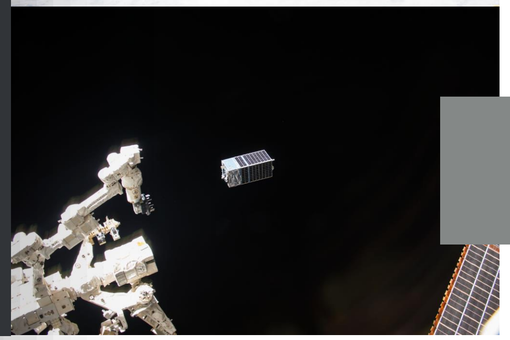


EXTERNAL CYGNUS

26 CubeSats deployed via the NanoRacks External Cygnus Deployer. Deploys from spacecraft after primary mission on ISS. ~450-480 km

DOUBLEWIDE

Designed for larger 6U CubeSats (2Ux3U)

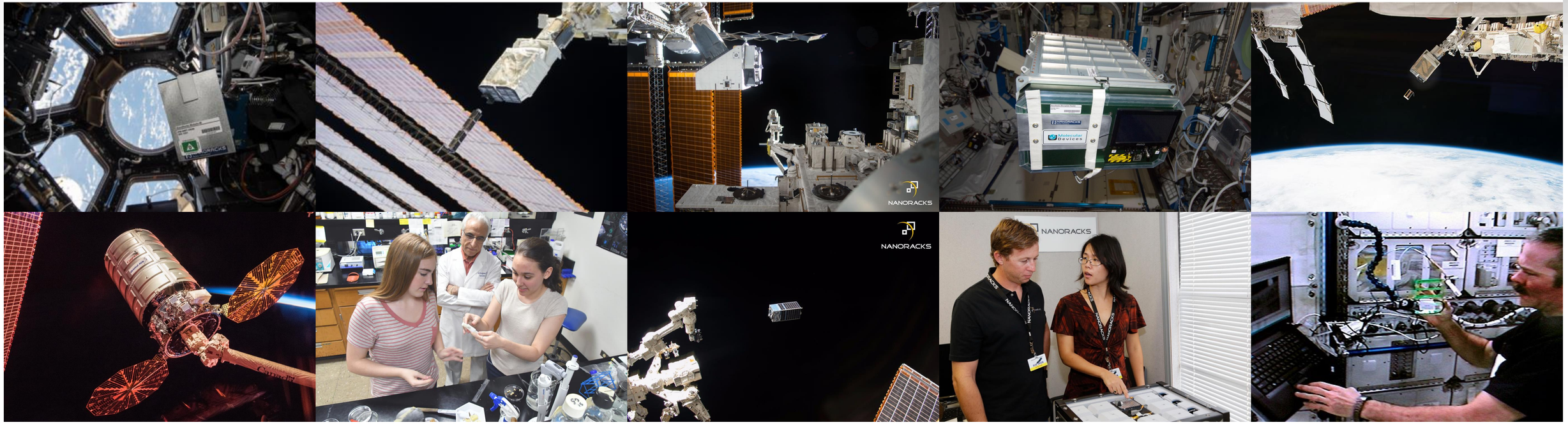


KABER

Our MicroSat Deployer – offering Space Station deployments for satellites up to ~90 kg.

LESSONS LEARNED IN LOW EARTH ORBIT

- REGULATORY LICENSING
- PAPERWORK
- MATERIALS SELECTION
- BATTERY TESTING
- INHIBIT ARCHITECTURE
- DESIGN FOCUS



NAVIGATING THE LICENSING PROCESS

Did you know:
Licensing issues are the primary cause of launch delays for satellite developers

PLANNING

- Determine the correct licensing path for your spacecraft
- Begin the application process before anything else
- Promptly respond to all correspondence

IMPLEMENTATION

- Consider budgeting for a licensing consultant
- Connect with other develops who have already been through the application process

BATTERY TESTING

BATTERY TESTING FOR HUMAN-TENDED PLATFORMS

- Select EPS based on launch & deployment type
- Decide upon in-house or vendor testing
- Don’t switch between cell- & pack-level testing
- Pack-level will fail open-circuit voltage test
- > 80 Wh will require thermal runaway testing

CHOOSING THE RIGHT MATERIALS

NANORACKS BILL OF MATERIALS		
QTY	**USAGE**	**DESCRIPTION**
1	OUTGASSING/CONTAMINATION	TML: <1%; CVCM: <0.1%
2	RE-ENTRY SURVIVABILITY	<15J; 1:10,000 Casualty
3	OFFGASSING/FLAMMABILITY	Crew safety – inside ISS
4	DURABILITY	Corrosion susceptibility, margins of safety, surface coatings, etc
5	TOXICITY	THL: </= 1

PAPERWORK

PAPERWORK: IT'S A PART OF THE PROCESS

BE PROACTIVE

- Paperwork is often an afterthought when it should be a priority
- Completing paperwork early allows time for troubleshooting
- Usually if paperwork is on schedule, hardware is on schedule

DOCUMENT EVERYTHING

- Pictures & videos are worth thousands of words
- Keep flight safety paperwork organized & concise
- Records of Assembly (ROA)

HAZARD-DRIVEN INHIBIT ARCHITECTURE

CHARACTERIZE PAYLOAD HAZARDS

- Nominal crewed flight requires 3 electrical inhibits
- However, a lack of hazards sometimes allows fewer inhibits
- Redundant inhibit scheme prevents unforeseen hazard control violations

TYPES OF HAZARDS

- Propulsion systems
- Pressurized systems (>100 psi)
- Toxic materials
- Lasers
- High-temperature systems
- Radio frequency power density

MAINTAINING DESIGN FOCUS

SPACECRAFT SUBSYSTEM DESIGN

- Focus on critical subsystems
- Consider outsourcing manufacturing
- Maintain industry standards if possible

PAYLOAD MISSION DESIGN

- Focus on the science/technology of the payload
- In-house design & production of entire spacecraft is difficult
- Therefore, use COTS subsystems if possible

N A N O R A C K S

THANK YOU

TRISTAN PREJEAN, Mission Manager
tprejean@nanoracks.com