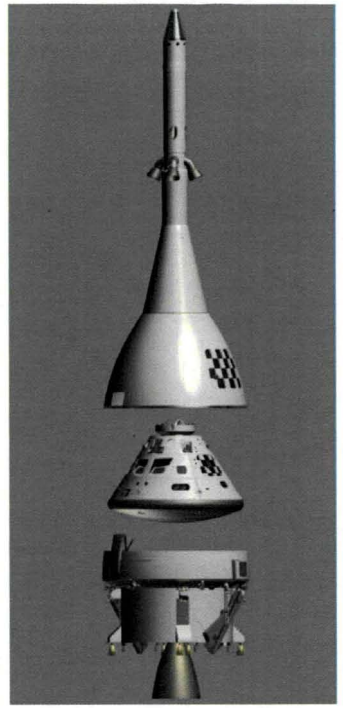
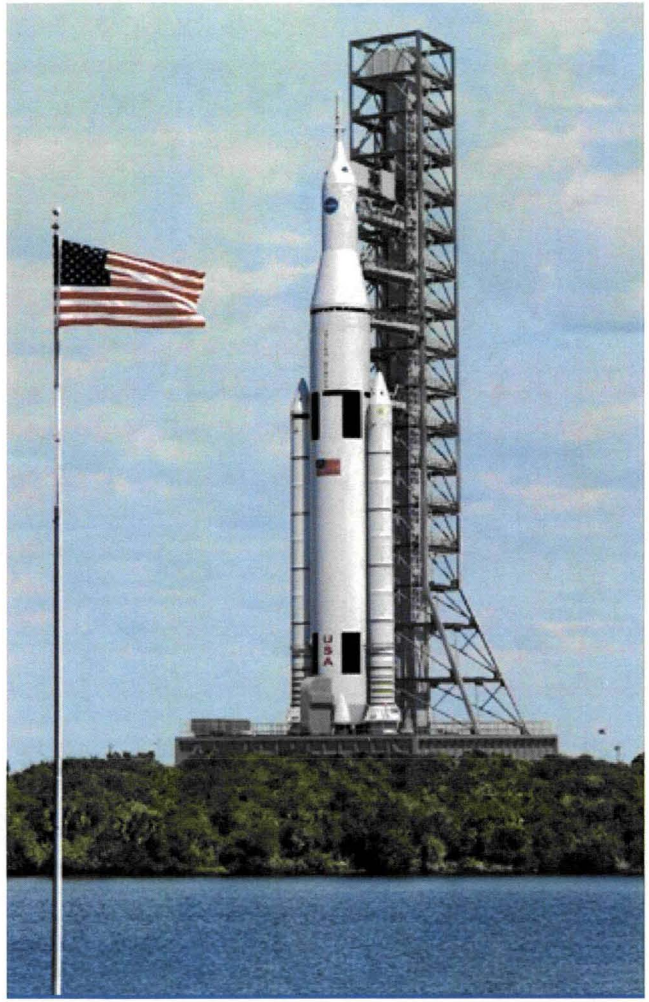


Avionics Projects at NASA's Kennedy Space Center Engineering Directorate

Felix.A.Soto-Toro@NASA.gov
Electrical Engineer
November 18, 2011

Animation of NASA's Space Launch System

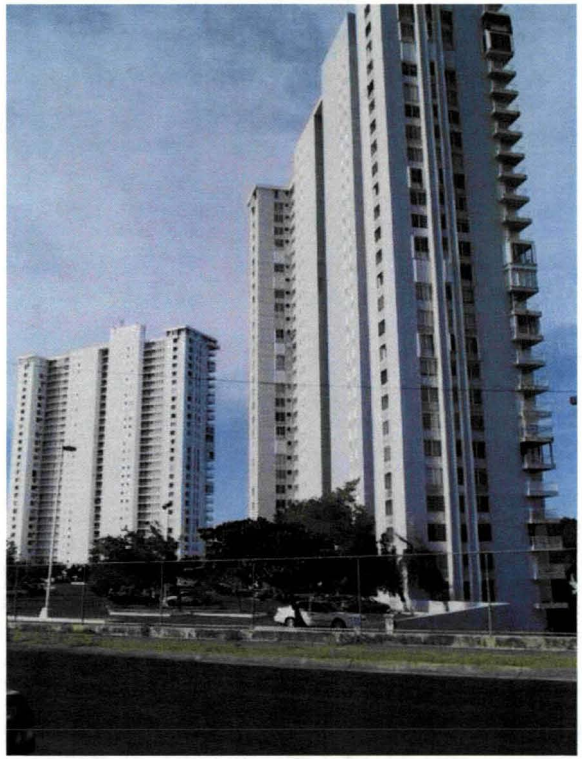


http://www.youtube.com/watch?v=IDQpFAUKgvI

Tall Buildings in Puerto Rico…

Torres en Punta Salinas
26 stories
96 m (319 ft)

Torre Dos Marinas
29 stories
113 m (373 ft)



Torre Aqua Luna
32 stories + base
119 m (393 ft)

Dimensions are approximated
Not to scale

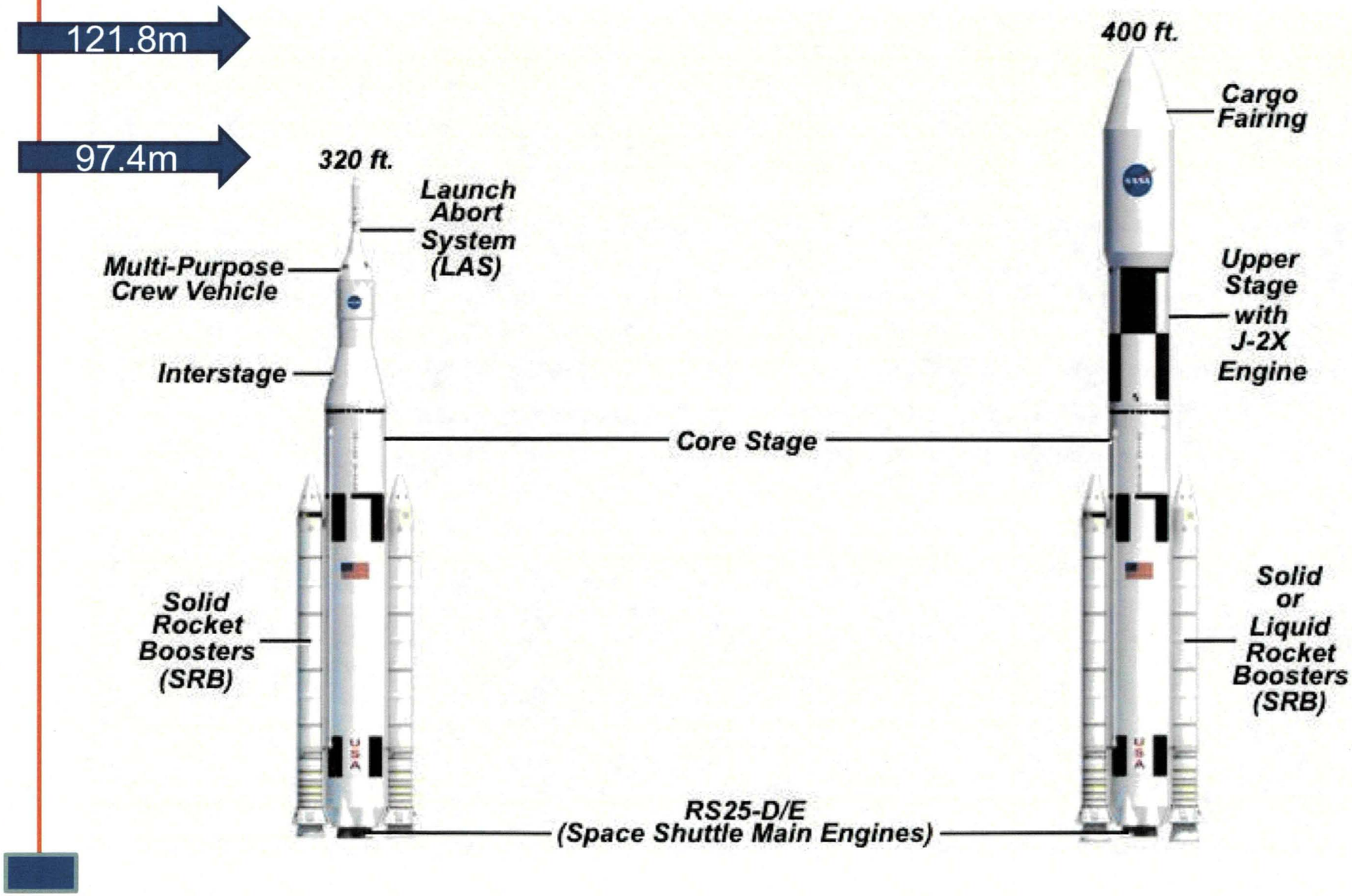
Comparing size of Space Launch System ?

SLS Heavy-Lift
33 stories + base
121.8 m (400 ft)

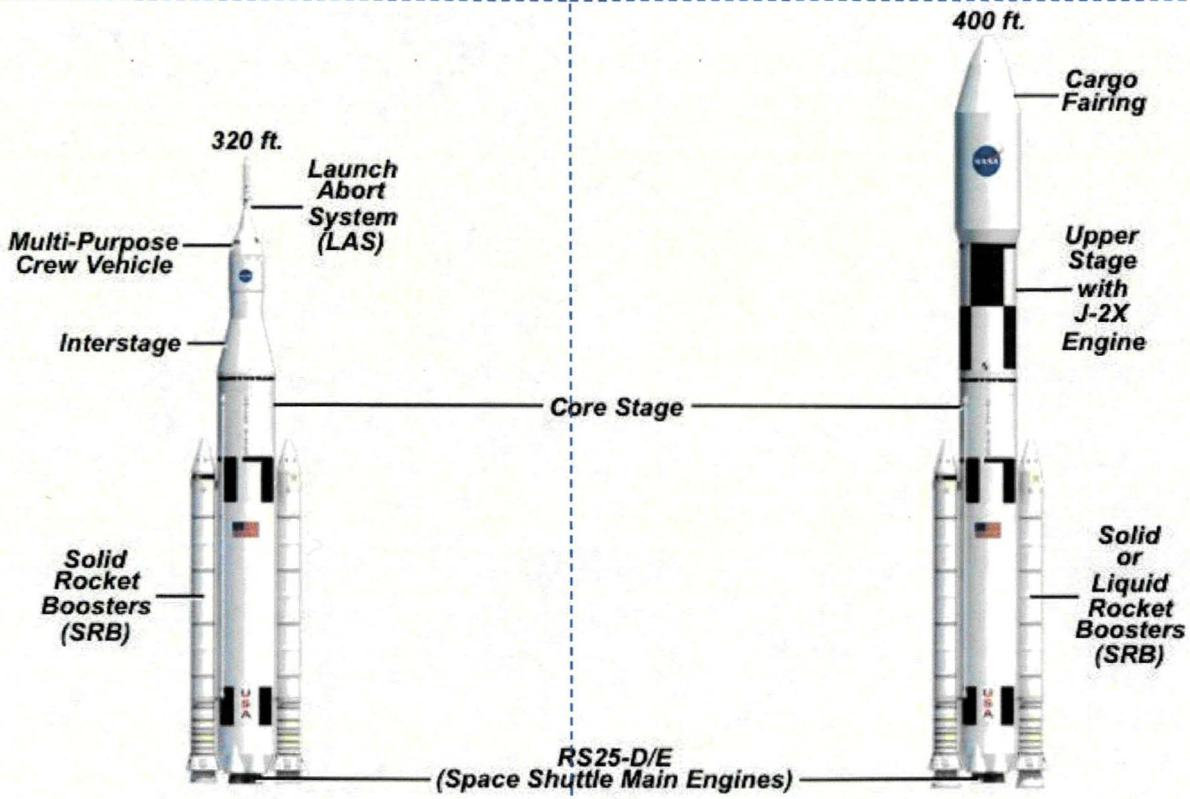
Torre Aqua Luna
32 stories + base
119 m (393 ft)

Dimensions are approximated
Not to scale

How tall is the Space Launch System (SLS) ?



Space Launch System (SLS) Capabilities



Initial Lift Capability 70 Tons (t)

- More than Double Any Operational Vehicle Today

Crew Configuration

- The SLS will transport the Multi-Purpose Crew Vehicle to entirely new destinations beyond Earth orbit, continuing America's human exploration of space.

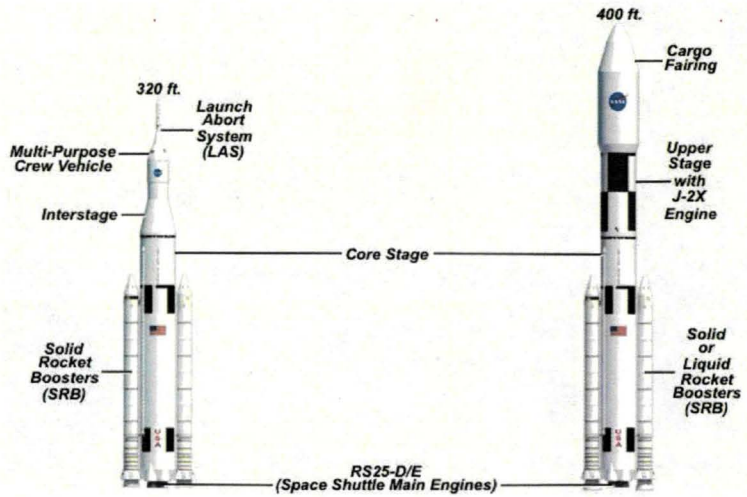
Evolved Lift Capability 130t

- More than Any Past, Present, or Future Vehicle

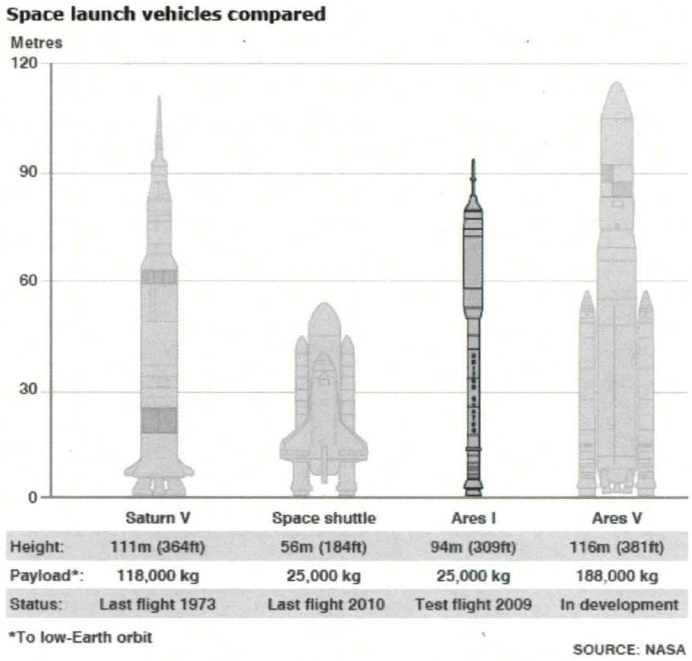
Cargo Configuration

- The flexible SLS can carry cargo, equipment, and science experiments to destinations beyond Earth orbit. This heavy-lift capability will be available to support missions of national importance.

Some NASA Space Launch Vehicles



400 ft (121.8m)

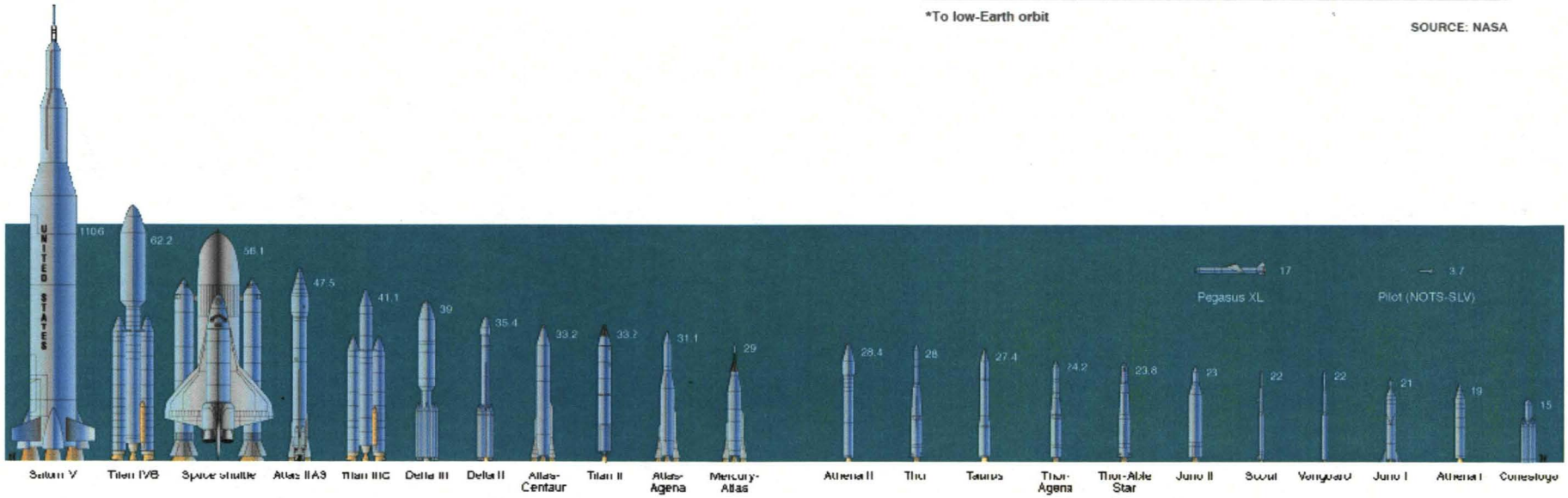


	Saturn V	Space shuttle	Ares I	Ares V
Height:	111m (364ft)	56m (184ft)	94m (309ft)	116m (381ft)
Payload*:	118,000 kg	25,000 kg	25,000 kg	188,000 kg
Status:	Last flight 1973	Last flight 2010	Test flight 2009	In development

*To low-Earth orbit

SOURCE: NASA

At 400 ft, SLS is taller than Saturn V by 36 ft. !



Dimensions are not to scale

THE GOVERNMENT OF THE UNITED STATES

2011

THE CONSTITUTION

LEGISLATIVE BRANCH

THE CONGRESS

SENATE HOUSE

ARCHITECT OF THE CAPITOL
UNITED STATES BOTANIC GARDEN
GENERAL ACCOUNTING OFFICE
GOVERNMENT PRINTING OFFICE
LIBRARY OF CONGRESS
CONGRESSIONAL BUDGET OFFICE

EXECUTIVE BRANCH

THE PRESIDENT , Mr. Barack Obama
THE VICE PRESIDENT

EXECUTIVE OFFICE OF THE PRESIDENT

WHITE HOUSE OFFICE
OFFICE OF THE VICE PRESIDENT
COUNCIL OF ECONOMIC ADVISERS
COUNCIL ON ENVIRONMENTAL QUALITY
NATIONAL SECURITY COUNCIL
OFFICE OF ADMINISTRATION
OFFICE OF MANAGEMENT AND BUDGET
OFFICE OF NATIONAL DRUG CONTROL POLICY
OFFICE OF POLICY DEVELOPMENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
OFFICE OF THE U.S. TRADE REPRESENTATIVE

JUDICIAL BRANCH

THE SUPREME COURT OF THE UNITED STATES

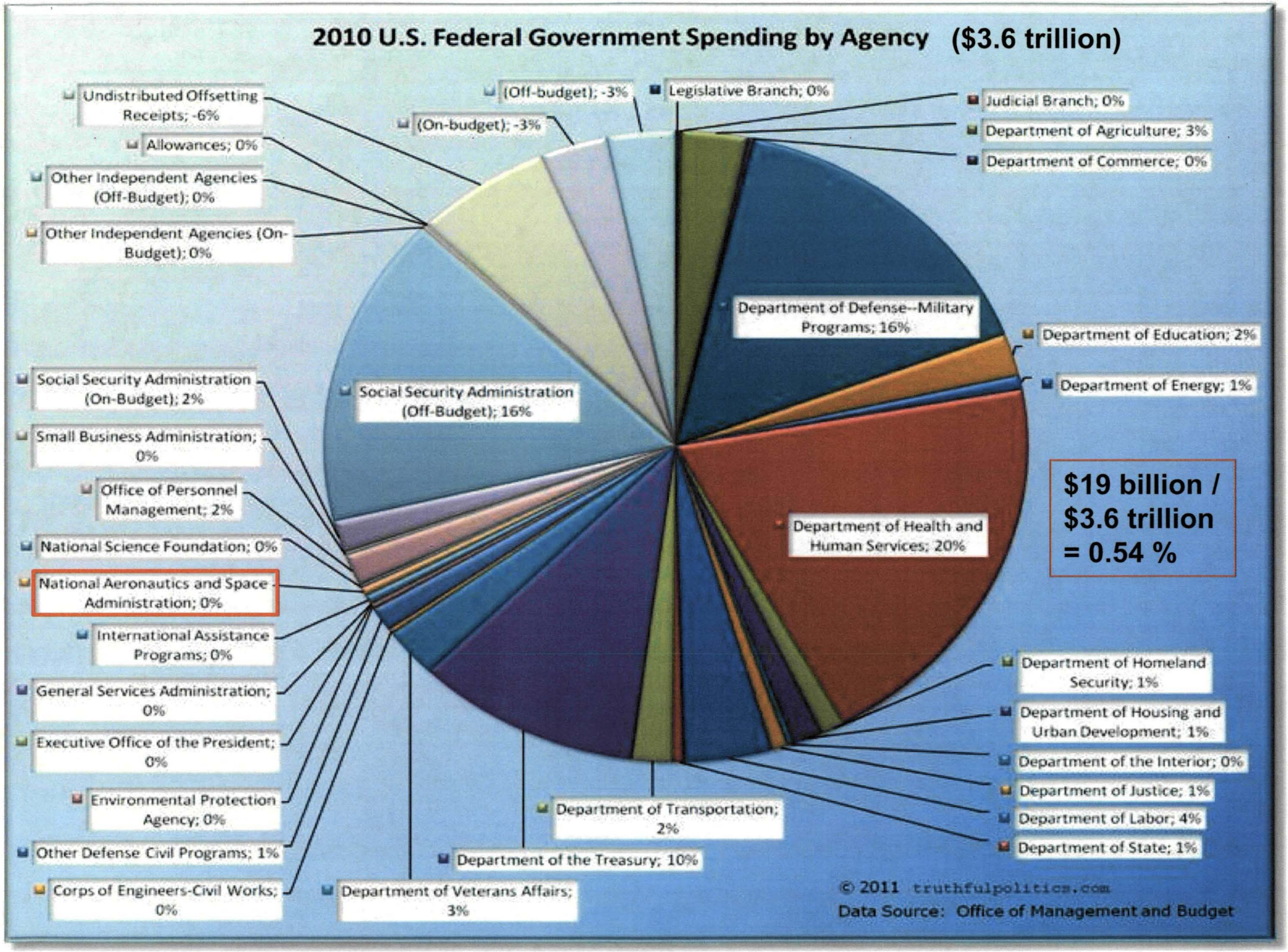
UNITED STATES COURTS OF APPEALS
UNITED STATES DISTRICT COURTS
TERRITORIAL COURTS
UNITED STATES COURT OF INTERNATIONAL TRADE
UNITED STATES COURT OF FEDERAL CLAIMS
UNITED STATES COURT OF APPEALS FOR THE ARMED FORCES
UNITED STATES TAX COURT
UNITED STATES COURT OF APPEALS FOR VETERANS CLAIMS
ADMINISTRATIVE OFFICE OF THE UNITED STATES COURTS
FEDERAL JUDICIAL CENTER
UNITED STATES SENTENCING COMMISSION

DEPARTMENTS

DEPARTMENT OF AGRICULTURE
DEPARTMENT OF COMMERCE
DEPARTMENT OF DEFENSE
DEPARTMENT OF EDUCATION
DEPARTMENT OF ENERGY
DEPARTMENT OF HEALTH AND HUMAN SERVICES
DEPARTMENT OF HOMELAND SECURITY
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
DEPARTMENT OF THE INTERIOR
DEPARTMENT OF JUSTICE
DEPARTMENT OF LABOR
DEPARTMENT OF STATE
DEPARTMENT OF TRANSPORTATION
DEPARTMENT OF THE TREASURY
DEPARTMENT OF VETERANS AFFAIRS

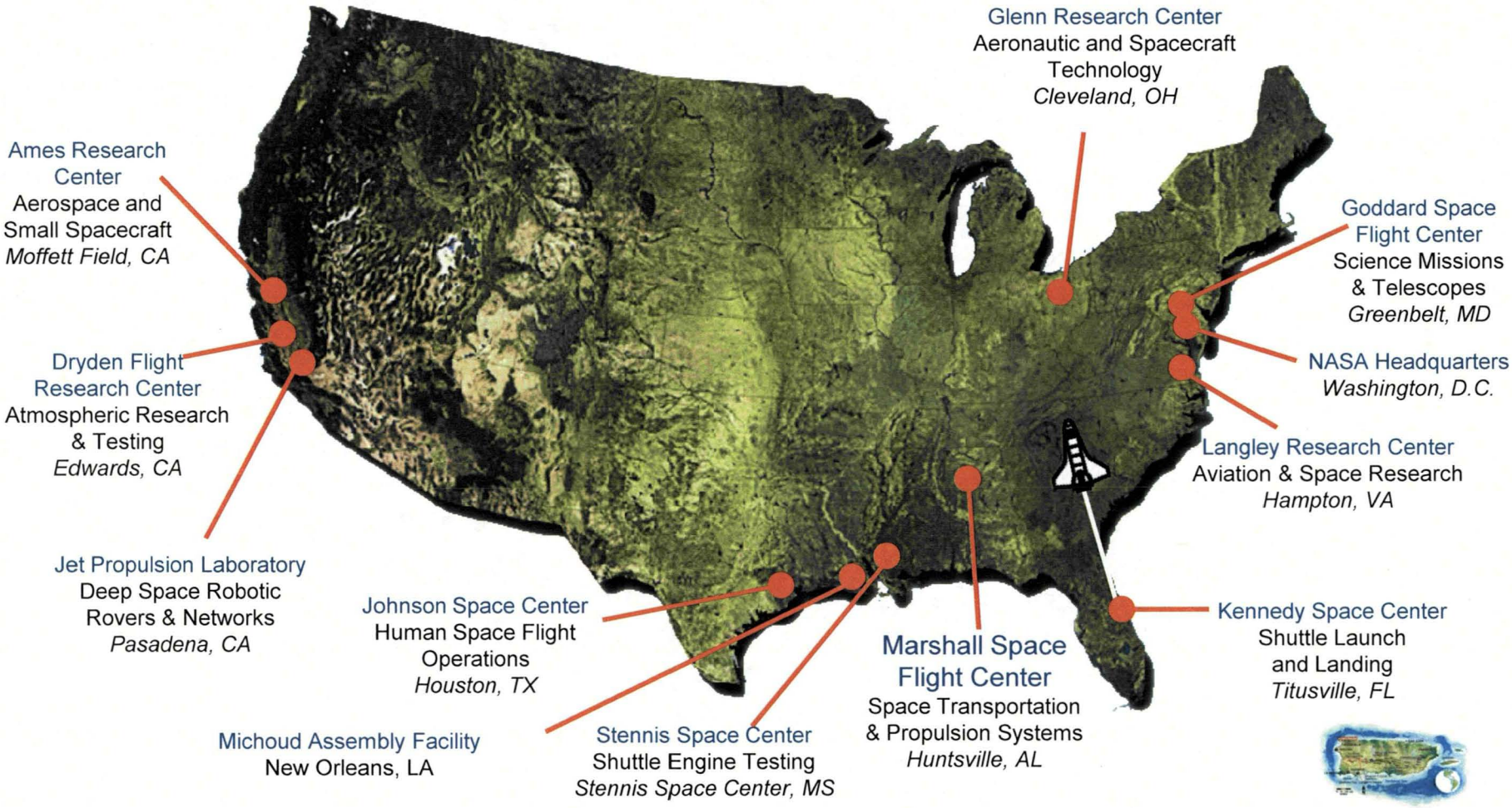
INDEPENDENT ESTABLISHMENTS AND GOVERNMENT CORPORATIONS

AFRICAN DEVELOPMENT FOUNDATION
CENTRAL INTELLIGENCE AGENCY
COMMODITY FUTURES TRADING COMMISSION
CONSUMER PRODUCT SAFETY COMMISSION
CORPORATION FOR NATIONAL AND COMMUNITY SERVICE
DEFENSE NUCLEAR FACILITIES SAFETY BOARD
ENVIRONMENTAL PROTECTION AGENCY
EQUAL EMPLOYMENT OPPORTUNITY COMMISSION
EXPORT-IMPORT BANK OF THE U.S.
FARM CREDIT ADMINISTRATION
FEDERAL COMMUNICATIONS COMMISSION
FEDERAL DEPOSIT INSURANCE CORPORATION
FEDERAL ELECTION COMMISSION
FEDERAL HOUSING FINANCE BOARD
FEDERAL LABOR RELATIONS AUTHORITY
FEDERAL MARITIME COMMISSION
FEDERAL MEDIATION AND CONCILIATION SERVICE
FEDERAL MINE SAFETY AND HEALTH REVIEW COMMISSION
FEDERAL RESERVE SYSTEM
FEDERAL RETIREMENT THRIFT INVESTMENT BOARD
FEDERAL TRADE COMMISSION
GENERAL SERVICES ADMINISTRATION
INTER-AMERICAN FOUNDATION
MERIT SYSTEMS PROTECTION BOARD
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NATIONAL ARCHIVES AND RECORDS ADMINISTRATION
NATIONAL CAPITAL PLANNING COMMISSION
NATIONAL CREDIT UNION ADMINISTRATION
NATIONAL FOUNDATION ON THE ARTS AND THE HUMANITIES
NATIONAL LABOR RELATIONS BOARD
NATIONAL MEDIATION BOARD
NATIONAL RAILROAD PASSENGER CORPORATION (AMTRAK)
NATIONAL SCIENCE FOUNDATION
NATIONAL TRANSPORTATION SAFETY BOARD
NUCLEAR REGULATORY COMMISSION
OCCUPATIONAL SAFETY AND HEALTH REVIEW COMMISSION
OFFICE OF GOVERNMENT ETHICS
OFFICE OF PERSONNEL MANAGEMENT
OFFICE OF SPECIAL COUNSEL
OVERSEAS PRIVATE INVESTMENT CORPORATION
PEACE CORPS
PENSION BENEFIT GUARANTY CORPORATION
POSTAL RATE COMMISSION
RAILROAD RETIREMENT BOARD
SECURITIES AND EXCHANGE COMMISSION
SELECTIVE SERVICE SYSTEM
SMALL BUSINESS ADMINISTRATION
SOCIAL SECURITY ADMINISTRATION
TENNESSEE VALLEY AUTHORITY
TRADE AND DEVELOPMENT AGENCY
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
U.S. COMMISSION ON CIVIL RIGHTS
U.S. INTERNATIONAL TRADE COMMISSION
U.S. POSTAL SERVICE


2010 U.S. Federal Government Spending by Agency ($3.6 trillion)
Undistributed Offsetting Receipts; -6%
Allowances; 0%
Other Independent Agencies (Off-Budget); 0%
Other Independent Agencies (On-Budget); 0%
(Off-budget); -3%
(On-budget); -3%
Legislative Branch; 0%
Judicial Branch; 0%
Department of Agriculture; 3%
Department of Commerce; 0%
Department of Defense--Military Programs; 16%
Department of Education; 2%
Department of Energy; 1%
Social Security Administration (On-Budget); 2%
Social Security Administration (Off-Budget); 16%
Small Business Administration; 0%
Office of Personnel Management; 2%
National Science Foundation; 0%
National Aeronautics and Space Administration; 0%
International Assistance Programs; 0%
General Services Administration; 0%
Executive Office of the President; 0%
Environmental Protection Agency; 0%
Other Defense Civil Programs; 1%
Corps of Engineers-Civil Works; 0%
Department of Veterans Affairs; 3%
Department of the Treasury; 10%
Department of Transportation; 2%
Department of Health and Human Services; 20%
Department of Homeland Security; 1%
Department of Housing and Urban Development; 1%
Department of the Interior; 0%
Department of Justice; 1%
Department of Labor; 4%
Department of State; 1%
$19 billion / $3.6 trillion = 0.54 %
© 2011 truthfulpolitics.com
Data Source: Office of Management and Budget

NASA Facilities

National Aeronautics and Space Administration Created by Congress in 1958



NASA Organization Chart

Mr. Charles "Charlie" Bolden

- Advisory Groups NAC and ASAP
- Inspector General
- Chief Financial Officer*
- Chief Information Officer*
- **Office of the Administrator**
- Chief Scientist
- Chief Technologist
- Diversity and Equal Opportunity
- Education
- International and Interagency Relations
- General Counsel
- Legislative and Intergovernmental Affairs*
- Communications*
- Small Business Programs
- Chief Engineer
- Chief Health and Medical Officer
- Chief, Safety and Mission Assurance
- Independent Program and Cost Evaluation
- Mission Support Directorate
  - Human Capital Management
  - Strategic Infrastructure
  - Headquarters Operations
  - NASA Shared Services Center
  - Agency Operations
    - Internal Controls and Management Systems
    - Procurement
    - Protective Services
    - NASA Management Office
- Aeronautics Research Mission Directorate
- Exploration Systems Mission Directorate
- Science Mission Directorate
- Space Operations Mission Directorate
- Ames Research Center
- Dryden Flight Research Center
- Glenn Research Center
- Goddard Space Flight Center
- Jet Propulsion Laboratory
- Johnson Space Center
- **John F. Kennedy Space Center (KSC)**
- Langley Research Center
- Marshall Space Flight Center
- Stennis Space Center

Note:
* Center functional office directors report to Agency functional AA. Deputy and below report to Center leadership.

March 23, 2010

KSC Organization Chart

OFFICE OF THE DIRECTOR
(Robert "Bob" Cabana)

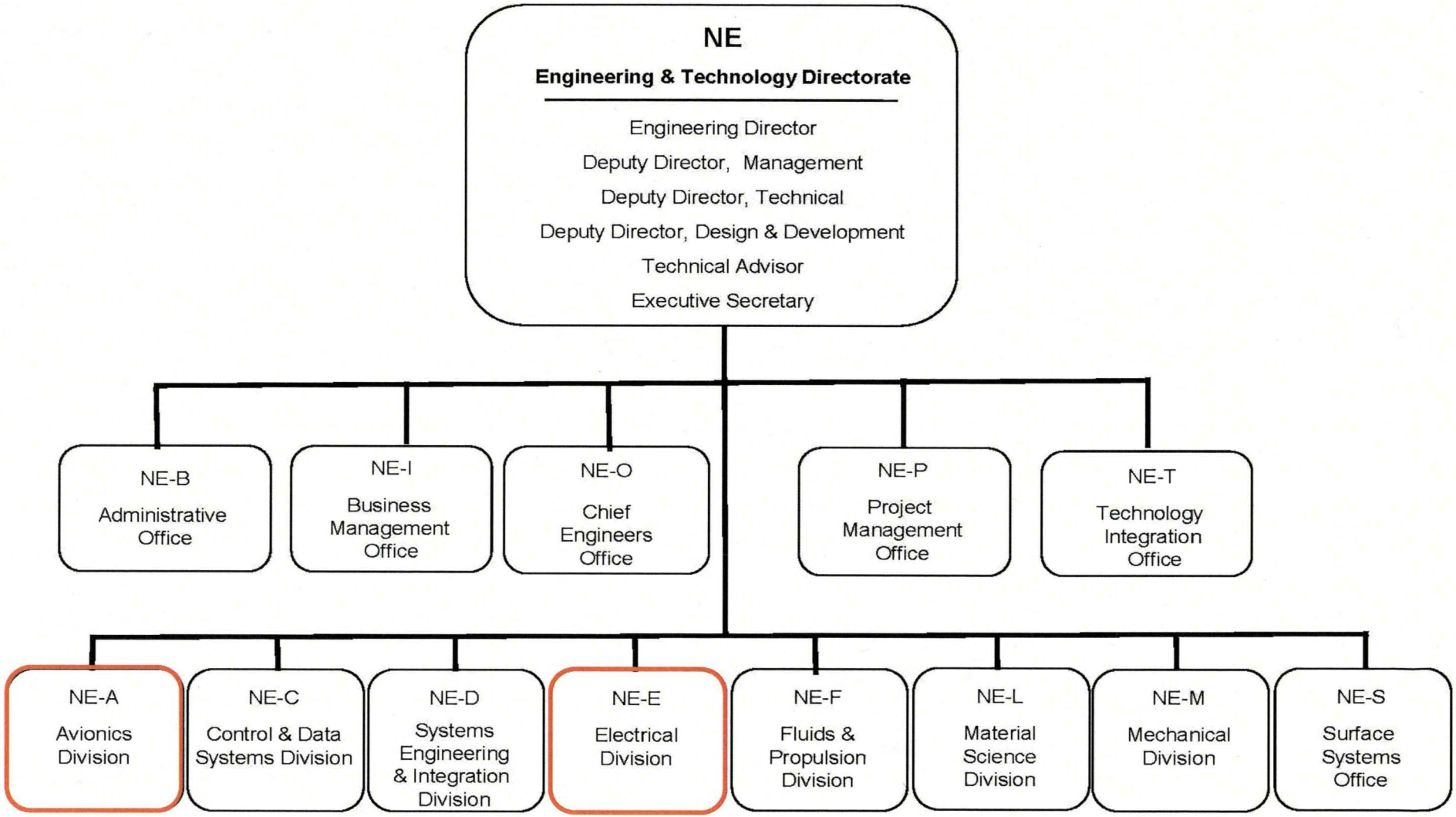
OFFICE OF THE INSPECTOR GENERAL*

- LAUNCH SERVICES PROGRAM
- COMMERCIAL CREW PROGRAM
- 21st CENTURY GROUND SYSTEMS PROGRAM
- SHUTTLE TRANSITION AND RETIREMENT OFFICE
- ISS GROUND PROCESSING AND RESEARCH PROJECT OFFICE
- INFORMATION TECHNOLOGY & COMM SERVICES DIRECTORATE
- GROUND PROCESSING DIRECTORATE
- SAFETY AND MISSION ASSURANCE DIRECTORATE
- ENGINEERING AND TECHNOLOGY DIRECTORATE
- CHIEF ENGINEERS
- OFFICE OF THE CHIEF FINANCIAL OFFICER
- EDUC AND EXTERNAL RELATIONS DIRECTORATE
- PUBLIC AFFAIRS DIRECTORATE
- PROCUREMENT OFFICE
- HUMAN RESOURCES OFFICE
- OFFICE OF DIVERSITY AND EQUAL OPP
- CENTER OPERATIONS DIRECTORATE
- OFFICE OF THE CHIEF COUNSEL

* Center positions that report to Agency functional AA/Chief; does count toward Center's SES headcount
# Center position reports to Director, Johnson Space Center; does NOT count toward KSC's SES headcount

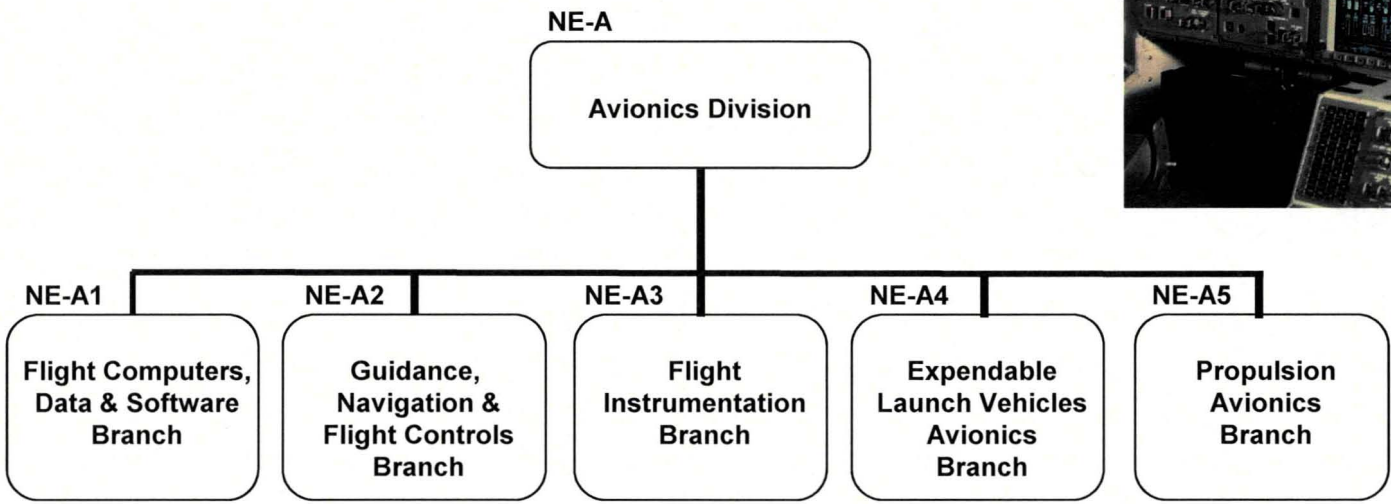
As of Aug 14, 2011

Engineering & Technology Directorate



October 2011

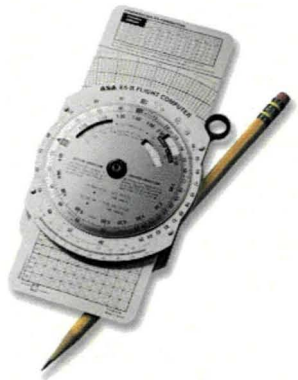
Avionics Division



- The Division's technical expertise and skill base for aerospace flight hardware, and Ground Support Equipment (GSE), and Avionics systems include:
  - Launch Vehicle and Spacecraft Avionics
  - Sensors and Flight Instrumentation
  - Guidance, Navigation and Flight Controls
  - Propulsion Avionics
  - Launch Vehicle and Spacecraft Flight Computers, Flight Software, and Data Handling
  - Avionics Development and Testing Lab

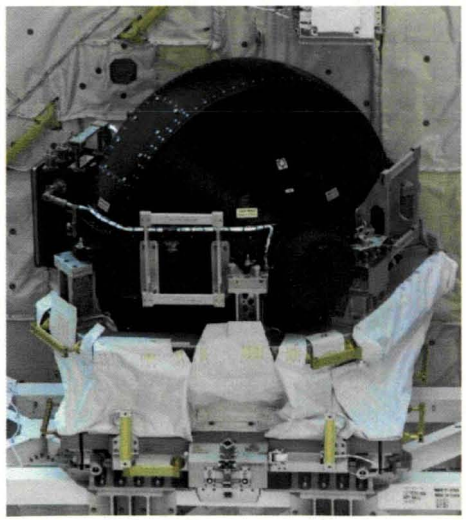
Flight Computers, Data and Software (NE-A1)

- Launch Vehicle and Spacecraft Data Processing System (DPS) (General Purpose Computers, Multiplexers/Demultiplexers , Multifunction Electronic Display System, etc.)
- Launch Vehicle and Spacecraft Flight Software
- Supports International Space Station (ISS) Flight and Ground Software, Command and Data Handling (C&DH)
- Supports ISS Ground Support Equipment
- Supports Space Station Utilization Experiment Processing (Payload Rack Checkout Unit Certified Operators)
- MPCV and SLS DPS and C&DH Avionics Systems and Software Design and Test Support (Flight and Ground)



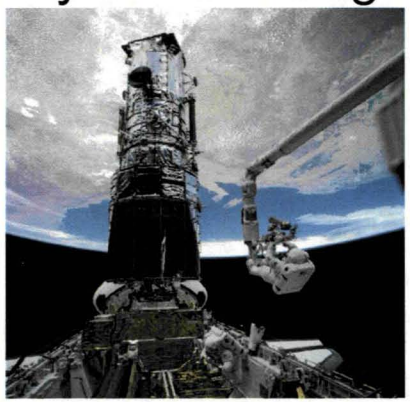
Guidance, Navigation and Flight Controls (NE-A2)

- Launch Vehicle and Spacecraft Guidance and Navigation (Inertial Measurement Units, Air Data, Accelerometer Assemblies, etc.)
- Launch Vehicle and Spacecraft Electrical Flight Controls (Aerosurface Servo Amplifiers, Ascent Thrust Vector Controller, etc.)
- Supports ISS Flight Controls (Rate Gyros, Control Moment Gyros)
- Flight to Ground Support Equipment
- MPCV and SLS GNC Avionics Systems Design and Test Support (Flight and Ground)



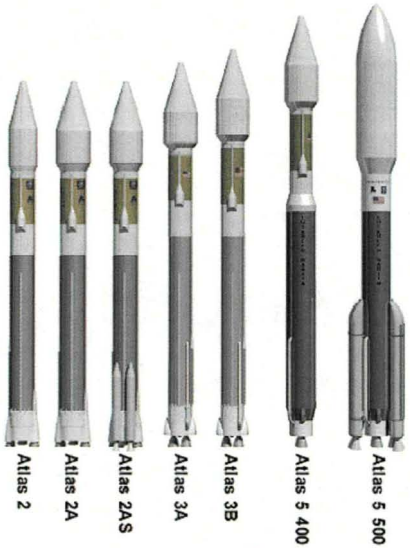
Flight Instrumentation (NE-A3)

- Launch Vehicle and Spacecraft Flight Instrumentation systems (Operational Instrumentation telemetry system, Modular Auxiliary Data System (MADS), Development Flight Instrumentation telemetry, etc)
- Supports ISS Flight Instrumentation systems (Wireless data transmission, Thermal, Pressure and Vibration Sensors and Effectors, etc)
- Supports ISS Robotics – Remote Manipulator Arm and Dexterous End Effecter, Robotics Workstation
- Launch Vehicle and Spacecraft Ground Support Equipment
- Supports Payload Ground Processing (Hubble, etc)
- MPCV and SLS Flight Instrumentation Avionics Systems Design and Test Support (Flight and Ground)



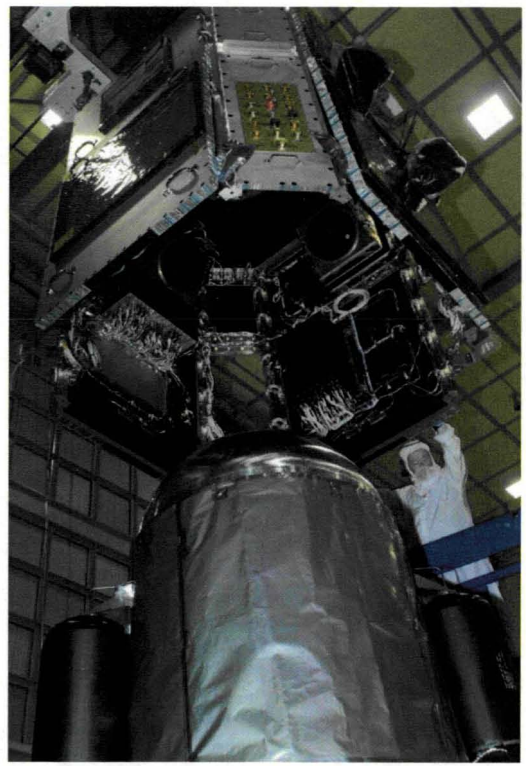
Expendable Launch Vehicles Avionics (NE-A4)

- Guidance and Navigation (Redundant Inertial Flight Control Assembly, Fault Tolerant Inertial Navigation Unit, Space Integrated GPS/INS, etc.)
- Flight Controls (Electronics Package, Thrust Vector Control, Fin Actuator System, etc.)
- Avionics (Power and Control, Rocketdyne Engine Relay Box, Booster Remote Control Unit, Ordnance Boxes etc.)

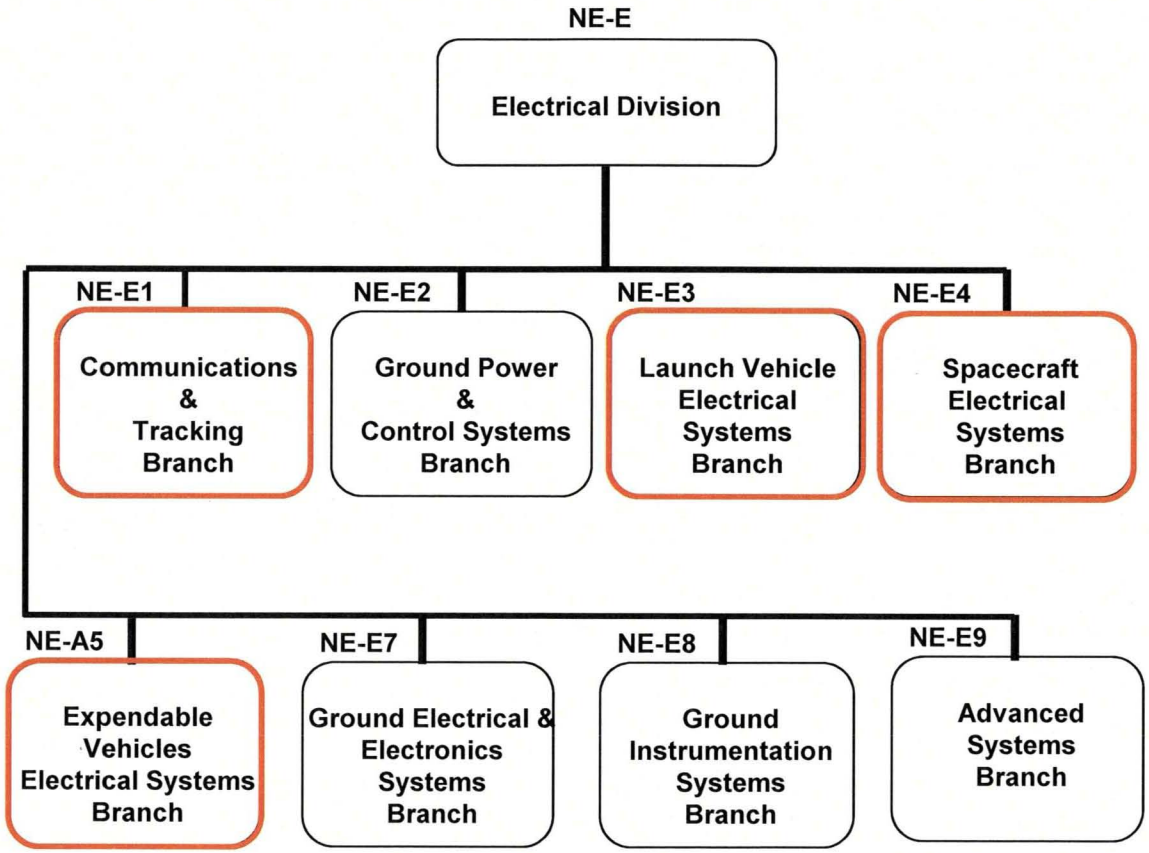


Propulsion Avionics (NE-A5)

- Launch Vehicle and Spacecraft Engine Avionics (Main Engine Controllers and Instrumentation, Engine Interface Units, Main Engine Software, etc.)
- Main Engine Avionics Ground Support Equipment
- MPCV and SLS Propulsion Avionics Systems and Software Design and Test Support (Flight and Ground)



Electrical Division



The Electrical Division provides Electrical Engineering and Systems expertise, knowledge, and leadership for the directorate and the center.

It is responsible for performing/managing design, fabrication, analysis, subsystem and system-level integration, operations and testing/qualification and sustaining of Electrical Systems for aerospace flight hardware and GSE, and support to failure analyses, mishap investigations, and applied technology development projects.

The Division also support Avionics related projects.

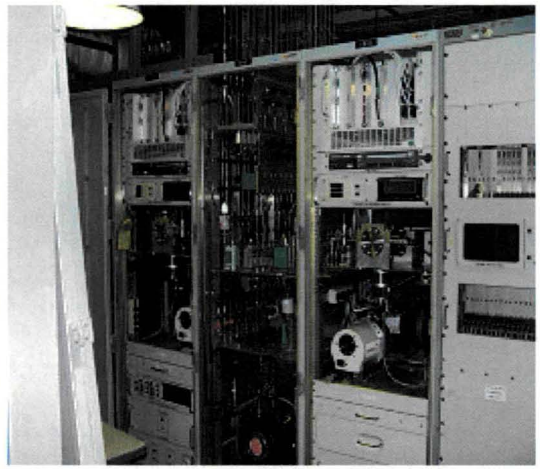
http://ne.ksc.nasa.gov/org/nee.htm

Communications and Tracking (NE-E1)

- Electromagnetic Measurement and Modeling
- Flight Communication Systems
- Flight Navigation Systems
- Remote Manipulator System and other space Robotic Systems
- Ground Navigation Systems
  - Ground Communication and Telemetry Stations
- Associated Ground Support Equipment

Launch Vehicle Electrical Systems (NE-E3)

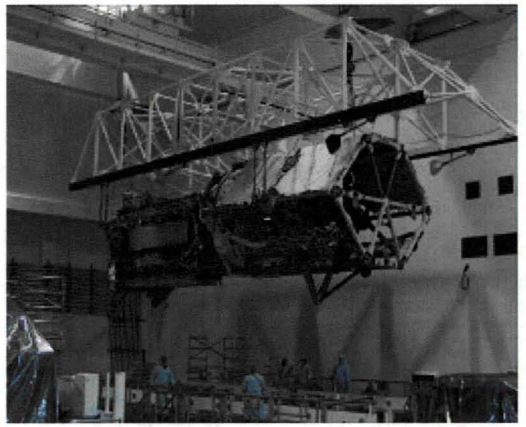
- Electrical Power Distribution & Control
- Ground Instrumentation Systems
- Spacecraft Electrical Systems
- Flight Termination Systems
  - Command Receiver Decoders
  - Destruct Systems
  - C-Band Transponders/tracking
  - Antennas, Couplers, RF Harnesses
- Payload Electrical/Payload Test
  - Payload Integration Hardware
  - Flight Harnesses
  - Electrical/ Avionics panels



Spacecraft Electrical Systems (NE-E4)

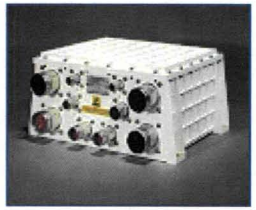
- ISS Electrical Power System Generation, Distribution, and Control
- ISS Ground Support Equipment Operation and Maintenance
- Spacecraft Electrical Power Distribution and Control
- Spacecraft Payload Electrical / Payload Test
  - Payload Integration Hardware
  - Flight Harnesses
  - Electrical / Avionics Panels
  - Payload Mission Unique Kits

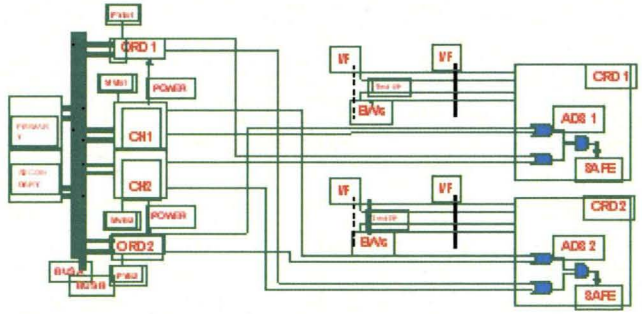
-
- KSC Representative to ISSP Boards
- Emerging Programs Electrical Systems Requirements / Design Reviews



Expendable Vehicles Electrical Systems (NE-E5)

- Instrumentation Systems
- Telemetry and RF Systems
- Flight Termination/Range Tracking Systems
  - Command Receiver Decoders
  - Automatic Destruct Systems
  - C-Band Transponders/tracking
  - Antennas, Couplers, RF Harnesses
- Power Distribution
- Ground Computer Systems and EGSE
- Mission Integration Electrical Support
- Launch Vehicle Certification

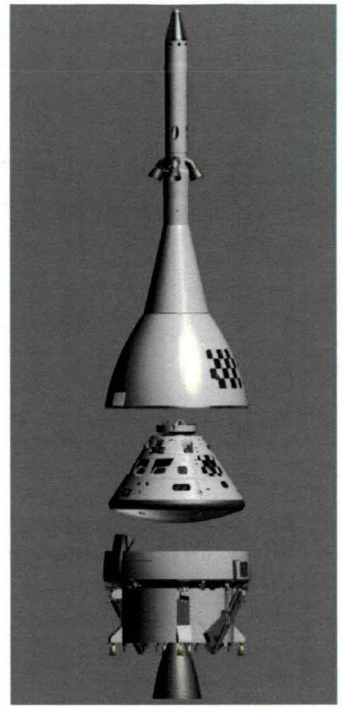




Kennedy Space Center Contractors

	Name	Website
1	ABACUS	http://imcs.ksc.nasa.gov/
2	ANALEX	http://www.qinetiq-na.com/
3	BOEING	http://www.boeing.com/index.html
4	C&C International Consultants	http://www.ccintercomputers.com/index-7.html
5	DYNAMAC	http://www.lssc.nasa.gov/
6	IHA	http://mesc.ksc.nasa.gov/Default.html
7	MEI	http://www.meicompany.com/
8	OAO	http://www.odin.lmit.com/ksc/
9	Pratt & Whitney Rocketdyne	http://rkdn.ksc.nasa.gov/
10	QuinetiQ North America	http://www.qinetiq-na.com/
11	Rede-Critique	http://redeinc.com/
12	SAIC	http://www.saic.com/
13	Space Gateway Support	http://sgscloseout.ksc.nasa.gov/
14	URS	http://isc.ksc.nasa.gov/
15	United Space Alliance (USA)	https://usa2.usa-spaceops.com/

¡ MUCHAS GRACIAS !



Avionics Projects at NASA's Kennedy Space Center Engineering Directorate

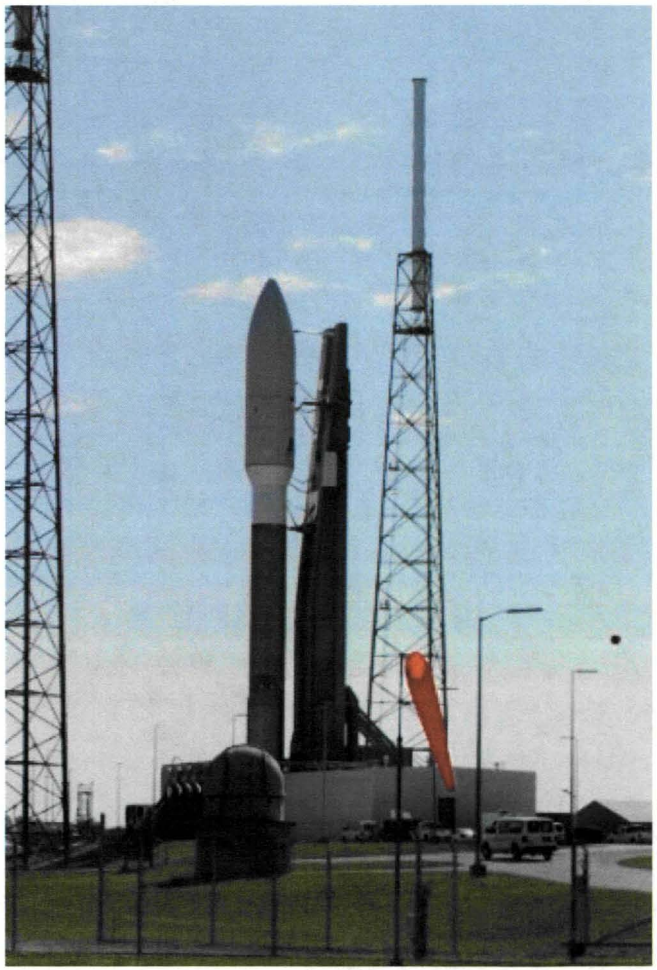
Felix.A.Soto-Toro@NASA.gov
Electrical Engineer
November 18, 2011

Backup Slides

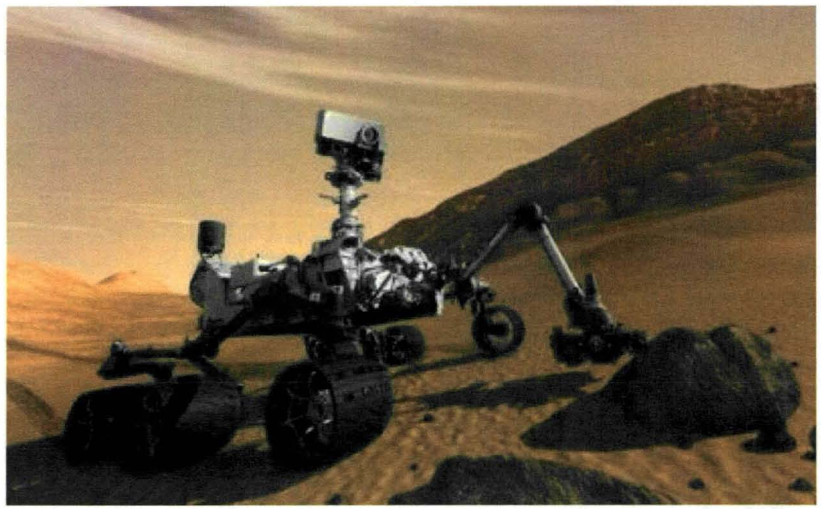
Some Puerto Rico based Institutions with direct or indirect relationship to NASA

Animation of Curiosity's Mission Video

Launch window:
November 25, 2011 thru December 18, 2011

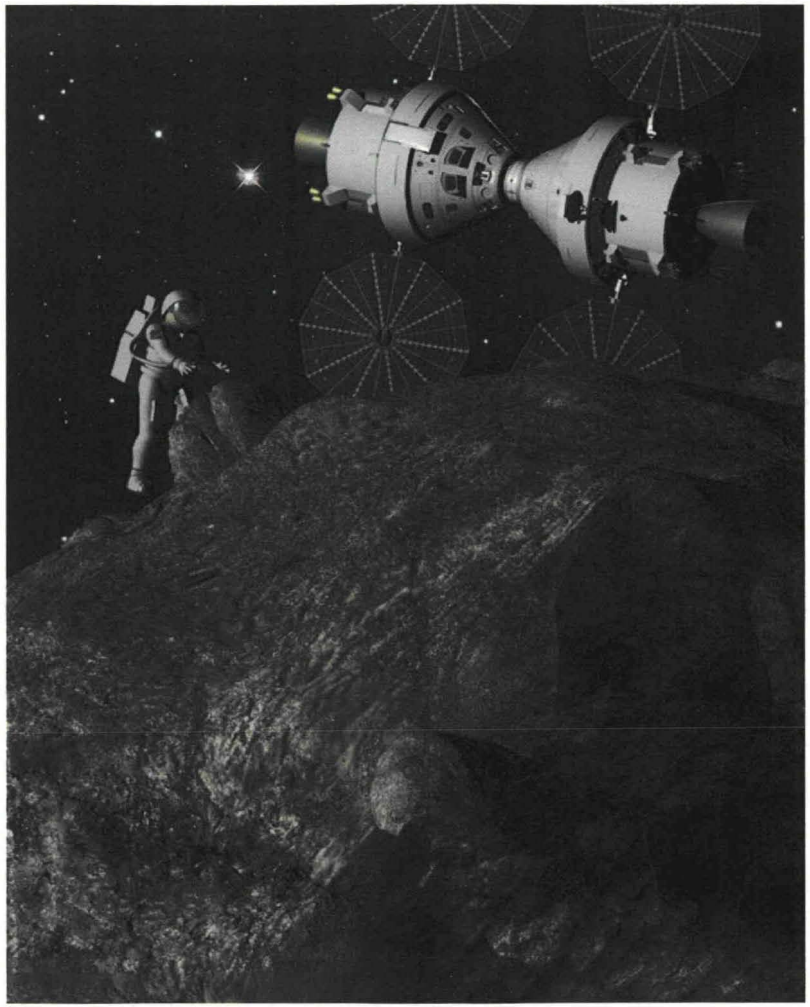


Landing window:
August 2012 thru September 2012



http://www.youtube.com/watch?v=q8o0TgEUjOI

DigitalSpace: Visualization of human crewed mission to an asteroid, the "NEOnauts" (Summer 2007)



http://www.youtube.com/watch?v=hMdAJq7zZK0