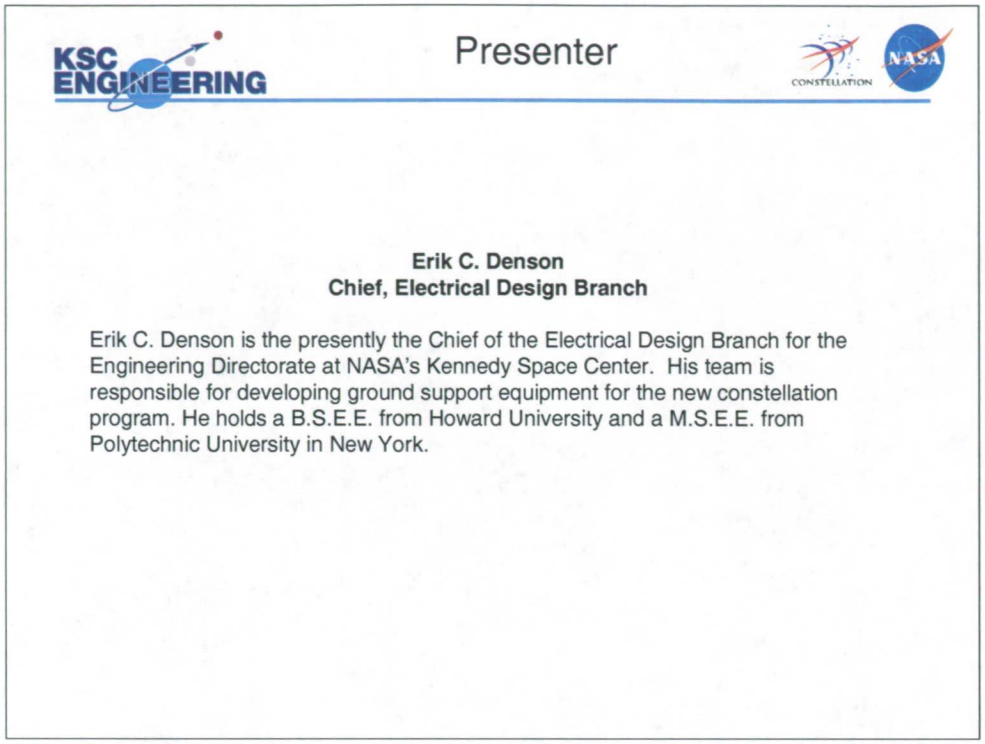

PREPARATION FOR FLIGHT.....
NASA's Constellation Program at the Kennedy Space Center
Erik Denson
Chief, Electrical Design Branch
NASA- Kennedy Space Center



Your Story…

Talk about how you became interested in Engineering & NASA.

KSC ENGINEERING

Constellation Program

CONSTELLATION NASA

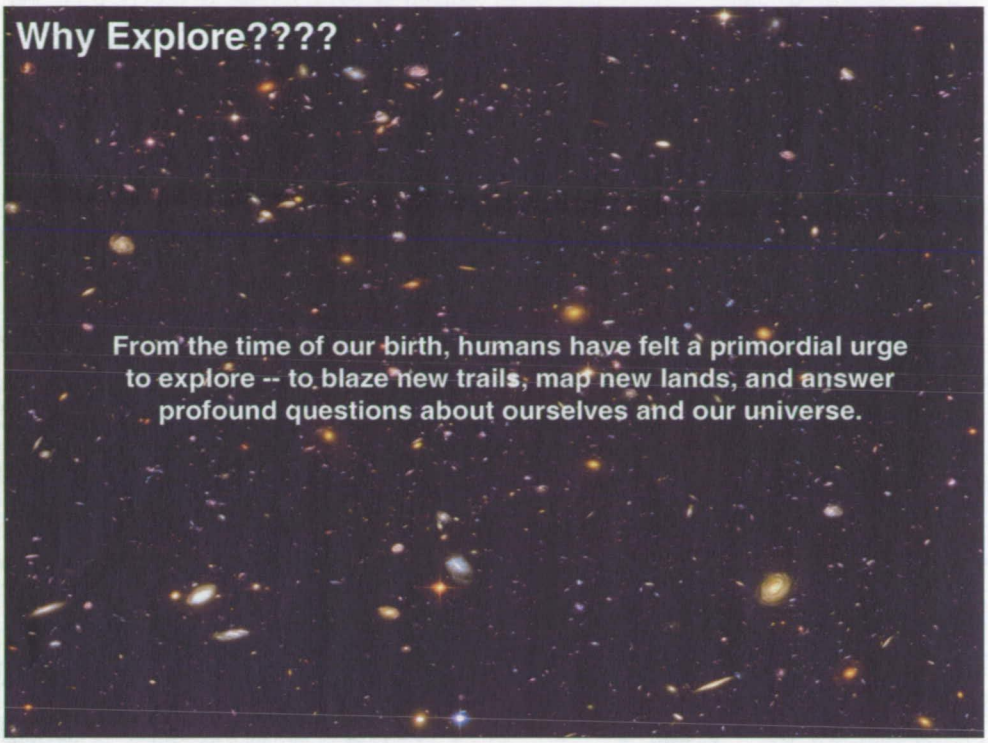
NASA is entering a new age of space exploration with the Constellation Program. The Constellation Program will take us back to the moon, mars and beyond. With this grand vision come great challenges. NASA is developing new technology and vehicles to take us there. At the forefront is the Crew Exploration Vehicle named Orion and the Crew Launch Vehicle named ARES I.

NASA is entering a new age of space exploration with the Constellation Program. The Constellation Program will take us back to the moon, mars and beyond. With this grand vision come great challenges. NASA is developing new technology and vehicles to take us there. At the forefront is the Crew Exploration Vehicle named Orion and the Crew Launch Vehicle named ARES I.

The Journey Continues.....

MOVIE

http://www.nasa.gov/mission_pages/constellation/multimedia/index.html



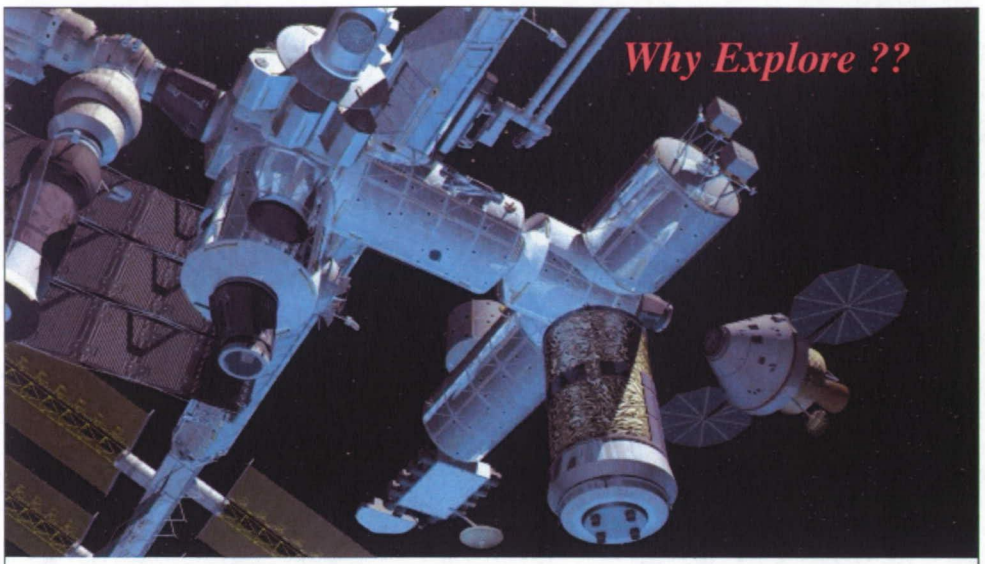
From the time of our birth, humans have felt a primordial urge to explore -- to blaze new trails, map new lands, and answer profound questions about ourselves and our universe.

It's in our DNA to Explore and Learn.

This is a picture from the Hubble Space Telescope Deep Field Camera. There are much more beautiful pictures taken by the Hubble, but non more significant.

The picture was taken of a portion of the sky about the size of nickel at arms length. The exposure was taken over the course of days. The picture literally shows thousands to millions of galaxies. Contained in each Galaxy could be millions of solar systems. To put this in perspective, the Earth and our Solar System would not be visible in this picture We are just a grain of sand on the beach.

Even more amazing, this picture is a time machine. Many of the Galaxies in the picture may not exist today. How is this possible you may ask? The Galaxies are millions of light years away. There light is just reaching us now. This picture is millions of years old!



It's Not the Destination…… But the Journey!

We will learn a lot along the way….

Technology Innovation (GADGETS!!!)

Biomedical Research:

- Radiation
- Long term Exposure to Space & Weightlessness
- In-Situ Utilization - (Living off the land)

These innovations and research will turn into spinoffs that will create new jobs, new markets and new technology that improve and save lives and benefit all mankind.

KSC ENGINEERING

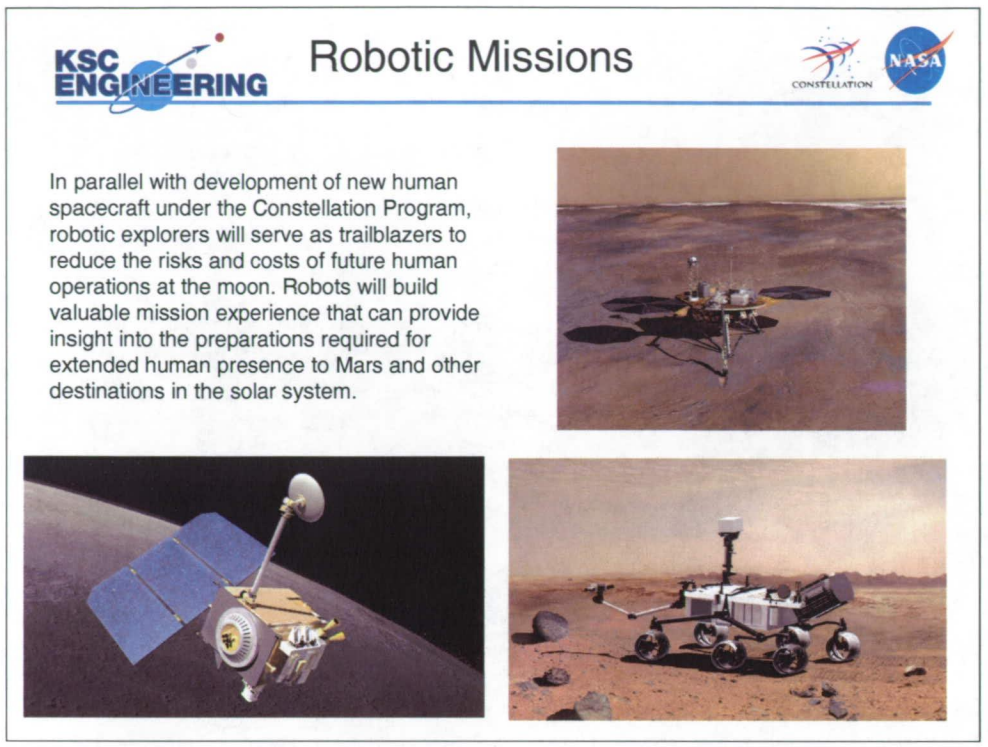
Constellation Program

CONSTELLATION NASA

Moon: By going to the moon for extended periods of time, astronauts will search for resources and learn how to work safely in a harsh environment -- stepping stones to future exploration. The moon also offers many clues about the time when the planets were formed. We plan to build a permanent lunar outpost.

Mars: Robotic missions have found evidence of a watery past, suggesting that simple life forms may have developed long ago and may persist beneath the surface today. Human exploration could provide answers to some profound questions.

Beyond: As humans and robots work together exploring the moon and Mars, NASA spacecraft will continue to send back scientific data from throughout the solar system, laying the groundwork for potential human journeys.



In parallel with development of new human spacecraft under the Constellation Program, robotic explorers will serve as trailblazers to reduce the risks and costs of future human operations at the moon. Robots will build valuable mission experience that can provide insight into the preparations required for extended human presence to Mars and other destinations in the solar system.

The first in this wave of robotic probes is the Lunar Reconnaissance Orbiter, or LRO. Its mission is to create high-resolution maps, seek landing sites, and continue to search for water ice and other useful resources. It will help us to determine the location of the lunar outpost.

In the continuing pursuit of water on Mars, the polar regions are a good place to probe, as water ice is found there. Phoenix will land farther north than any previous mission, at a latitude equivalent to that of northern Alaska. During the course of its three-month mission, Phoenix will dig down to an ice-rich layer that scientists calculate lies within inches of the surface. It will check samples of soil and ice for evidence about whether the site was ever hospitable to life.

Twice as long and three times as heavy as the Mars Exploration Rovers Spirit and Opportunity, the Mars Science Laboratory will collect Martian soil and rock samples and analyze them for organic compounds and environmental conditions that could have supported microbial life now or in the past.

The new Constellation Vehicles are ARES-I Crew Launch Vehicle and the ARES-V Heavy Lift Vehicle.

As seen here the vehicles are extremely large.

Saturn V was about 363 feet high and weighs 6.4 million lbs

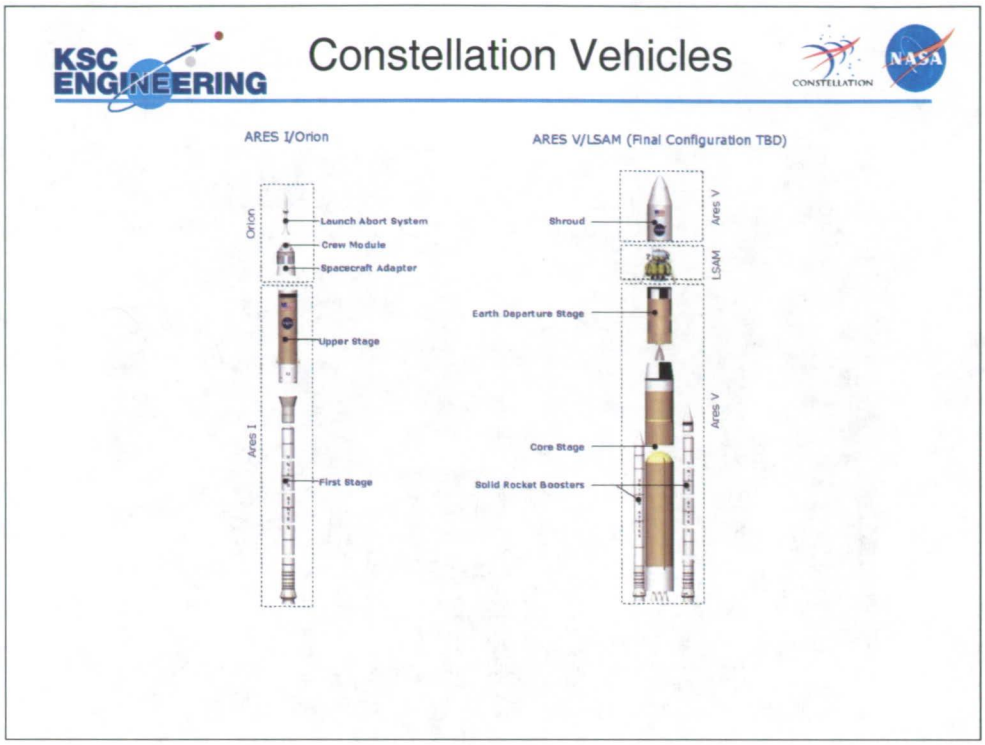
Space Shuttle is about 184 feet high and weighs 4.5 million lbs.

ARES-I will be approximately 321 feet and weigh 2 million lbs.

ARES-V will be approximately 357 feet and weigh 7.3 million lbs.

Why not use the Space Shuttle to go to the moon?

The Space Shuttle is designed to travel in low-Earth orbit (within a few hundred miles of the Earth's surface). It does not carry enough propellant to leave Earth's orbit and travel to the Moon. The Space Shuttle also is not designed to land on the Moon since it lands like an airplane and the Moon has no atmosphere. The Shuttle could be used to carry pieces of Moon or Mars vehicles to low-Earth orbit, where they could be assembled prior to beginning their mission



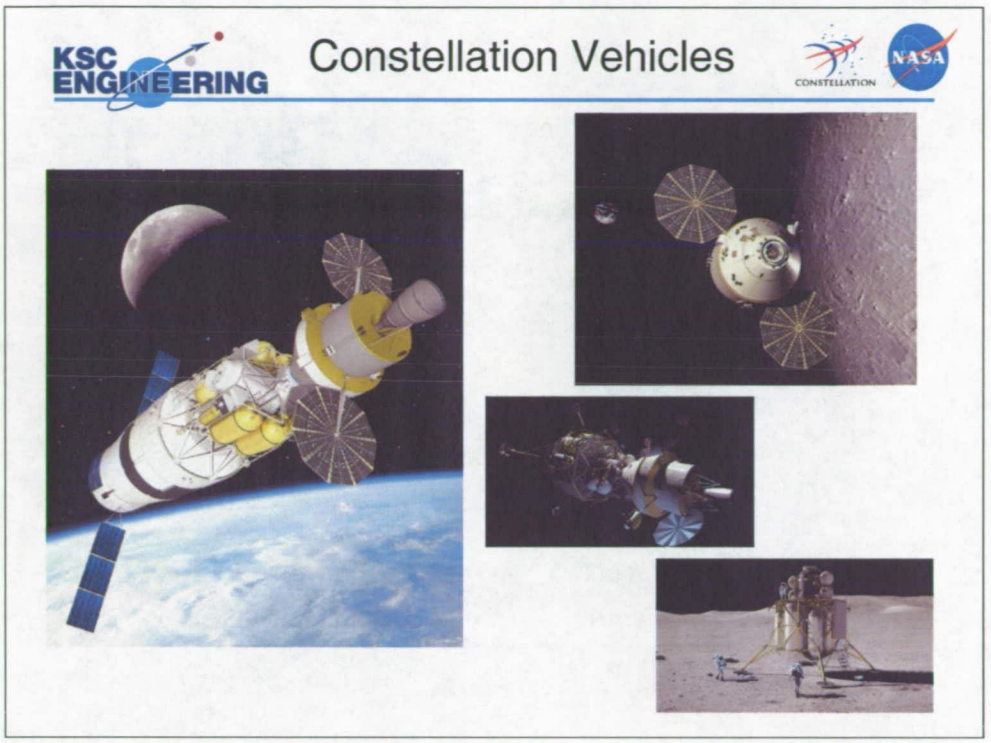
Apollo on Steroids. Old design with new technology and capability. These vehicles will take us to the International Space Station, the Moon and eventually Mars.

ARES-I will be the first built and will consist of the first & upper stage boosters, Orion (the Crew Exploration Vehicle), and launch abort system.

ARES-V will carry the Earth departure stage and the Lunar Surface Ascent Module (Altair)

Both vehicles will utilize upgraded designs from the shuttle program such as the Solid Rocket Boosters (SRB) and the Liquid Hydrogen & Liquid Oxygen Fuel tanks. J2X upper stage engines are a redesign from the Apollo era J2 engines.

Why the Apollo like design…. The physics didn't change. This type of design is better suited for longer and further distant missions.



Orion, The Crew Exploration Vehicle will be used to go to the ISS, moon and mars. It is larger than Apollo capsule. It can carry up to six astronauts to the ISS and four to the moon. Unlike the Apollo capsule, it has solar arrays and will be re-usable. It can land in water or the ground via parachutes.

Diameter – 16.5 feet

Habitable Volume – 380 cubic feet.

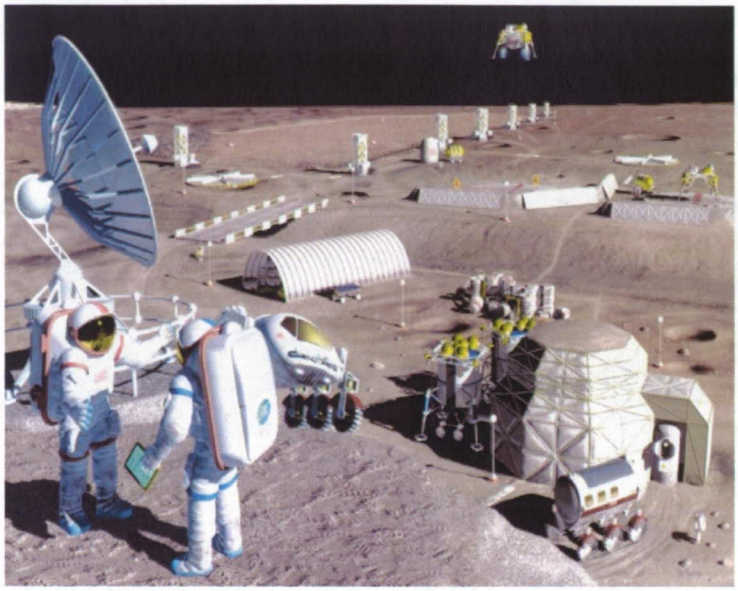
The Lunar Ascent Module (Altair) is still under design. It will be capable of transporting 4 astronauts to the lunar surface.

To go to the moon, Orion will rendezvous with the Earth Departure Stage and the LSAM in orbit. To go to Mars, another vehicle will be designed and similarly Orion will rendezvous with that vehicle in orbit, then travel to Mars.

KSC ENGINEERING

Lunar Outpost

CONSTELLATION NASA

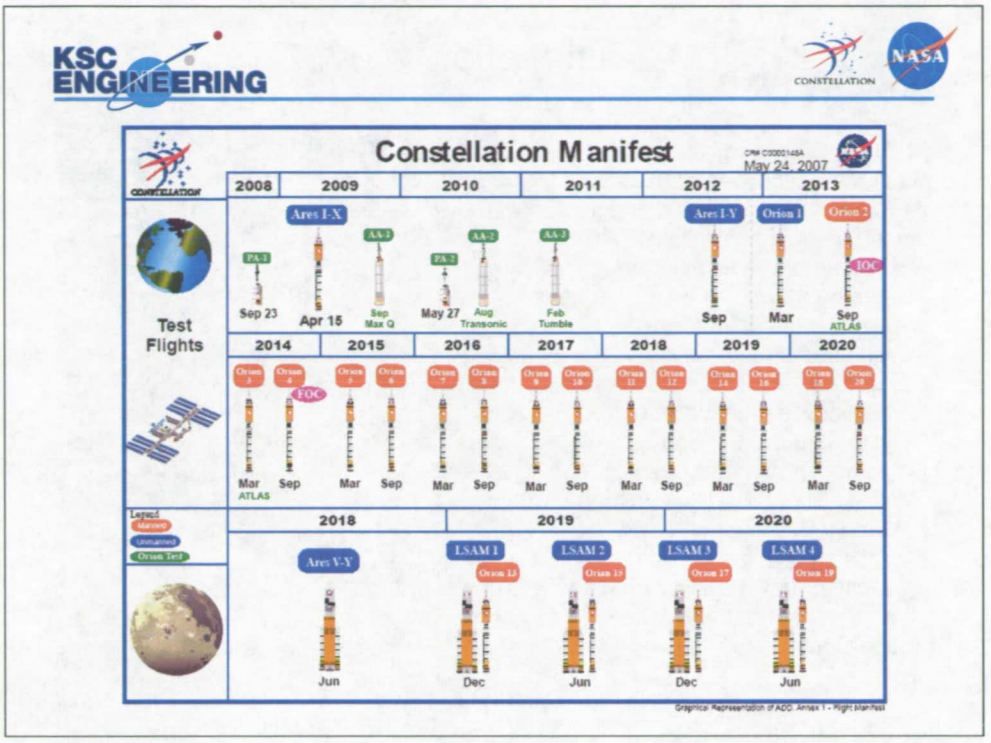


Requirements and technologies are being developed for the Lunar Outpost.

The lunar south pole is a likely candidate for the outpost site. It contains elevated quantities of hydrogen, possibly water ice. Several areas with greater than 80% sunlight and less extreme temperatures.

The outpost will be built incrementally.

We are going back to the Moon to Stay!

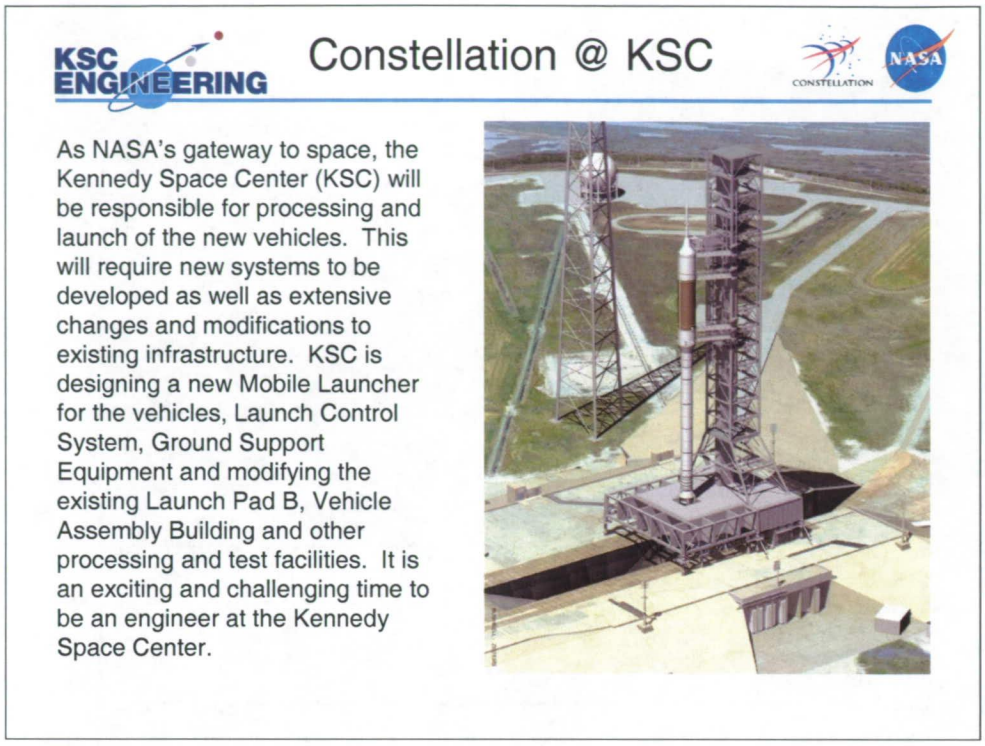


The Constellation manifest consist of a series of test flights, unmanned flights and manned flights.

The first test flight will be ARES I-X, in April 2009! It will have a dummy upper stage and dummy capsule.

The first manned flight will be 2013.

There will be a number of flights to the ISS with a return to the moon around 2019-2020.

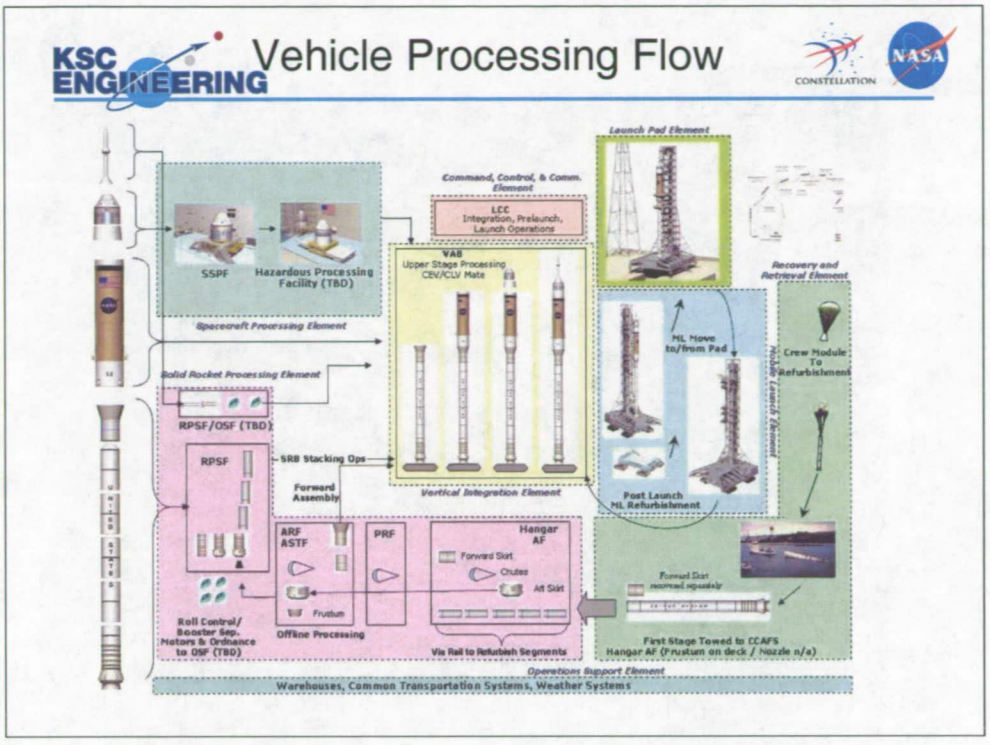


Roles of the NASA Centers…

Each NASA Center has an unique role in the constellation program from vehicle and engine design and testing to robotic and space communications and crew training.

KSC Role:

As NASA's gateway to space, the Kennedy Space Center (KSC) will be responsible for processing and launch of the new vehicles. This will require new systems to be developed as well as extensive changes and modifications to existing infrastructure. KSC is designing a new Mobile Launcher for the vehicles, Launch Control System, Ground Support Equipment and modifying the existing Launch Pad B, Vehicle Assembly Building and other processing and test facilities. It is an exciting and challenging time to be an engineer at the Kennedy Space Center.



The crew launch vehicle will be assembled and tested utilizing many different facilities, systems and capabilities at KSC before it is ready for launch. The process starts with the recovery of the re-usable components from a previous mission. These components are refurbished and processed along with the non-re-usable components in stages at the various facilities.

Existing facilities that were designed for the Apollo and Space Shuttle programs will be upgraded and modified for the constellation program. Some modifications will be extensive.

The SSPF (Space Station Processing Facility) and O&C (Operations & Checkout Buildings will be used to assemble and test Orion (CEV).

The Assembly Refurbishment Facility (ARF) and the SRB Rotation, Processing and Surge Facilities will be used to process the Solid Rocket Boosters for both vehicles.

The Vehicle Assembly Building will be used to stack, integrate and test all components before rollout to the launch pads.

The Launch Control Center will house the new Command and Control System.

Launch Pads A&B will modified for the new launch vehicles. Pad B is undergoing modifications first.

Other Facilities such as the Engineering Development Lab and Launch Equipment Test Facility are being used to design and test new subsystems.

KSC ENGINEERING

VIE

CONSTELLATION NASA

Vertical Integration Element

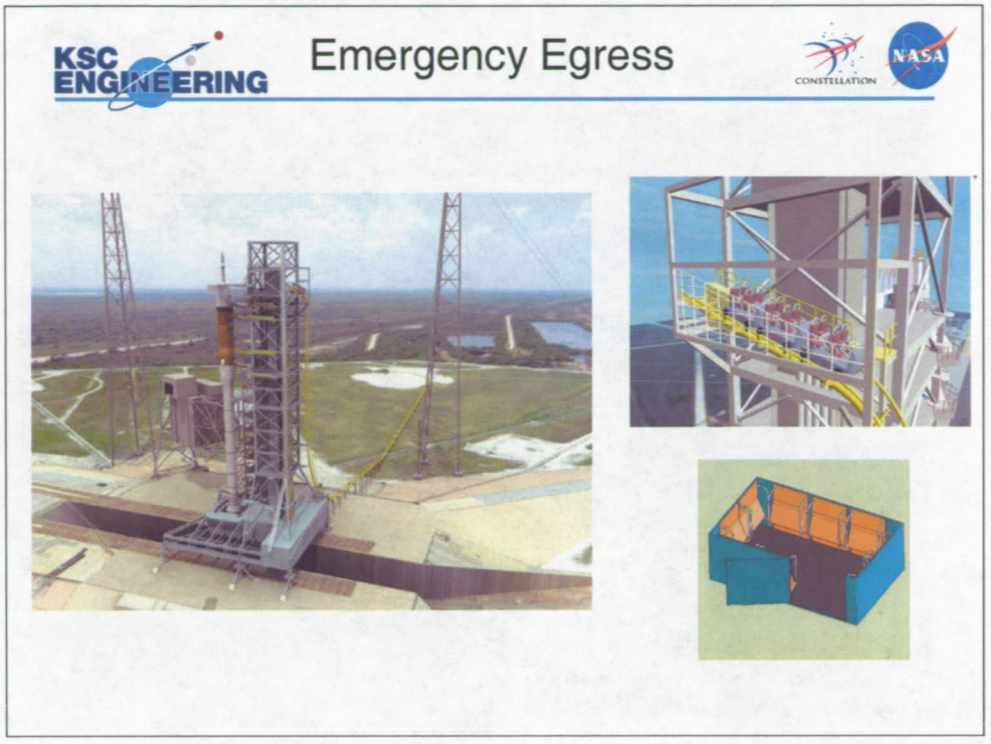
(Vehicle Assembly Building (VAB)

As previously mentioned. The Vehicle Assembly Building will be used to stack, integrate and test all components before rollout to the launch pads. Solid rocket booster segments, upper stage booster and Orion Service and command module will be lifted by cranes and stacked on a new mobile launcher. All systems will be checked here before rollout to the pad. Modifications to platforms, cranes and checkout systems in the VAB will be required.

A “Clean Pad” concept is being used for the constellation system. Many of the systems that reside on the pad will be moved inside of the new mobile launcher. This will reduce maintenance on systems exposed to the environment and duplication of hardware at the VAB. The systems travel with the vehicle.

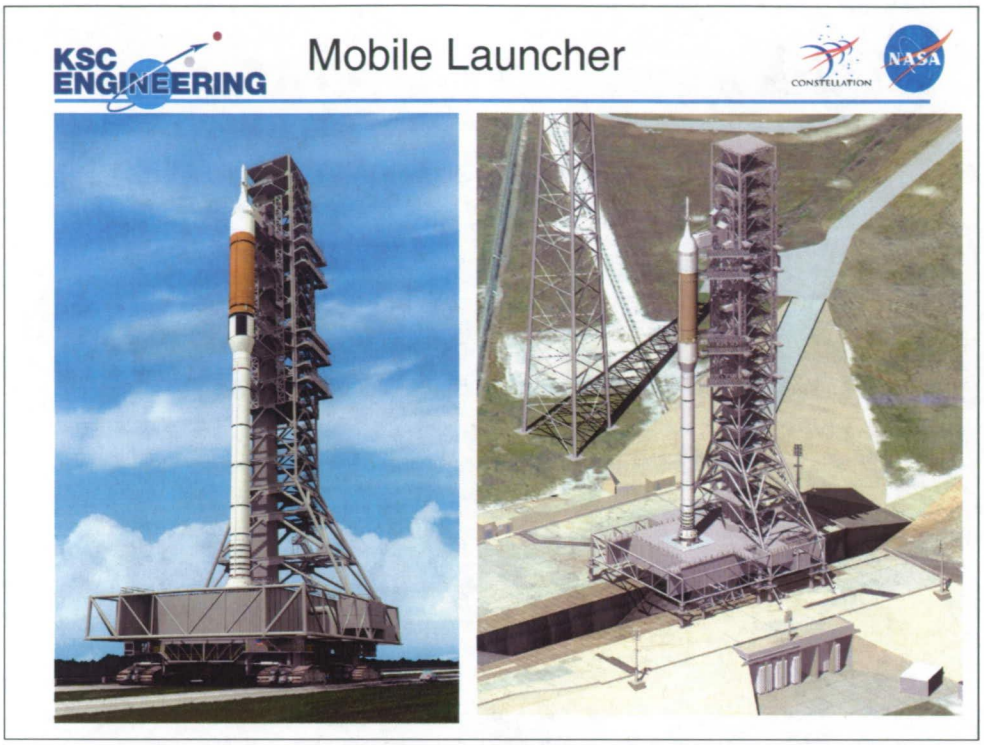
Because of the height of the new vehicles, a new lightning protection system that will be built.

The cryogenic fuel systems (liquid hydrogen & oxygen) from the shuttle program will be modified for the constellation program as well as the sound suppression water system, gaseous nitrogen & oxygen systems and environmental control systems.



A new Emergency Egress system is being developed at the launch pad and mobile launcher. A 300 foot high roller coaster like system will take the astronauts to safety in case of emergency.

Who would like to take a ride on this coaster.. I think we should charge admission for this ride. 300 feet high wow!

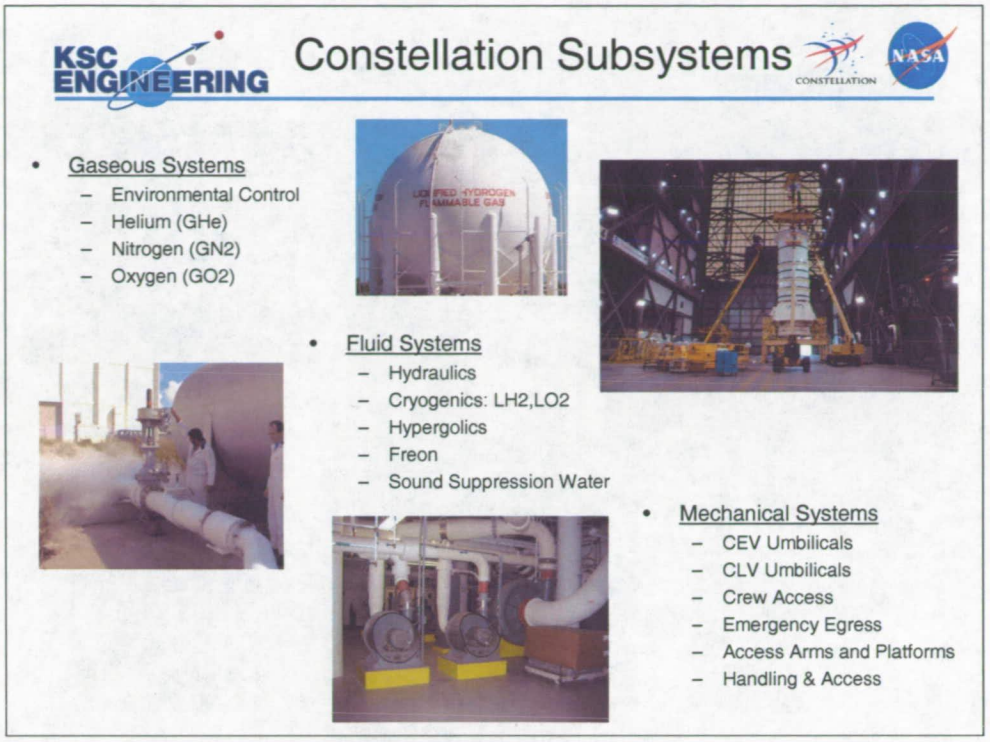


A completely new mobile launcher is the biggest effort at KSC. It will definitely be another modern marvel.

As mentioned before, most of the systems required to process and launch ARES I will reside in the mobile launcher base and up & down the tower. Electrical, power, fluid and gas connections will be made at the base of the mobile launcher. Communications, Command & Control, Electrical and Fluid infrastructures will be installed along the tower. A number of umbilicals carrying fuel, fluids, gases, power and data will be connected to the vehicle from the tower. The tower will contain three electrical rooms and a number of access platforms.

The entire system will be carried from the Vehicle Assembly Building to the Launch Pad using the same crawler transporter that was used for the Apollo and Space Shuttle programs.

The design and development of the entire mobile launcher and it's subsystems is the responsibility of KSC!



There are over 70 subsystems that will be modified or upgraded for the constellation Program at KSC touching every discipline of engineering.

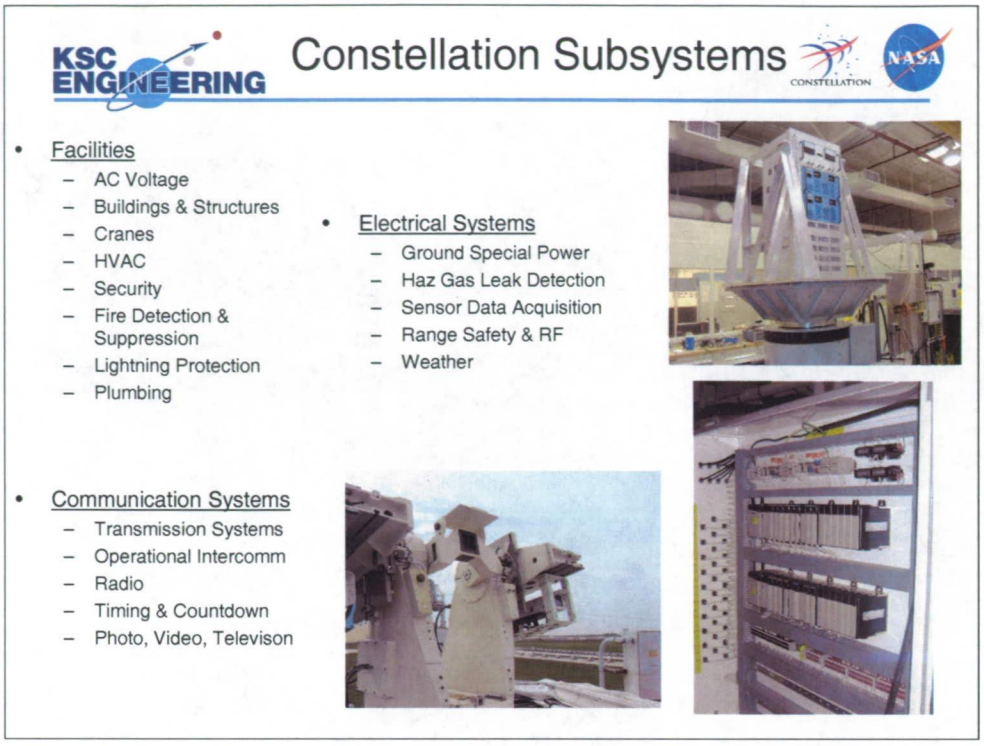
They include Gaseous Systems, Fluid & Mechanical Systems

Example - Fueling the vehicle:

Cryogenic (LH2 & LO2) systems provide fuel to the upper stage of the vehicle.

thru mechanical umbilicals. CEV uses hypergolic fuel

Note: (LH2: -423F, LO2: -297F)



EXAMPLES:

Facilities:

KSC has 203 generators, 100 UPS units, 216 substations

Control Systems for cranes are being updated (PLC Control) – 85 cranes

Communication Systems:

High Definition Cameras (Over 70 cameras per pad)

Video Tracking Systems

Digital Voice Systems

Electrical Systems:

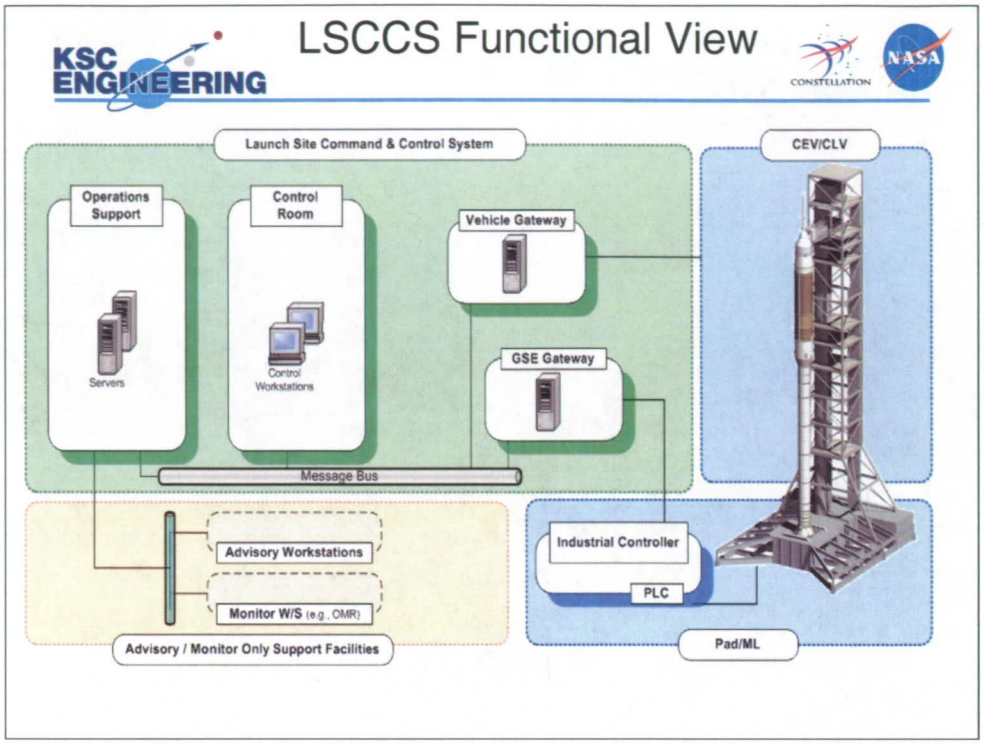
Ground Special Power provides power to Orion (CEV) and ARES (CLV) as well as GSE.

Sensor Data Acquisition measures pressure, stress, temperature, vibration, acoustics.

Weather systems: Lightning detection, rain, hail, wind.

The Launch Control Center is the central brain for launch activities. The LCC will house the new Launch Site Command & Control System.

The LSCCS provides Command, Control and Monitoring of Vehicle Subsystems and Ground Support Equipment for Test, Checkout, Processing and Launch.



The Launch Site Command and Control System (LSCCS) supports Test, Checkout, Processing Launch

Key concepts:

Open Software Architecture using well defined, standard interfaces between the system components.

Interfaces will be based on **industry or agency standards** when available and applicable.

Integration of mature COTS software and hardware technology capable of providing functionality common between LSCCS and commercial industry .

Service Oriented Architecture (SOA) provides common high level services

LSCCS Architecture Functional View

KSC ENGINEERING

CONSTELLATION

NASA

Control Room Workstations

Architecture:
Windows/Linux based workstation

Functions:
- -Thin-Client Displays
- -Light-Weight Client Displays
- -Application Display Client

Application/Display Servers

Architecture:
Unix/Linux based, multi-processor, mid-range server

Functions:
- -Integrated Ctrl App
- -Subsystem Ctrl App
- -Light-Weight Display Server
- -Thin Client Server
- -Application Data Publishing

Gateway Servers

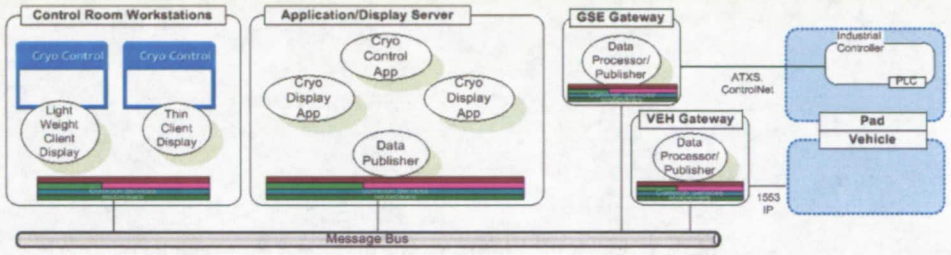
Architecture:
Unix/Linux based, multi-processor, mid-range server

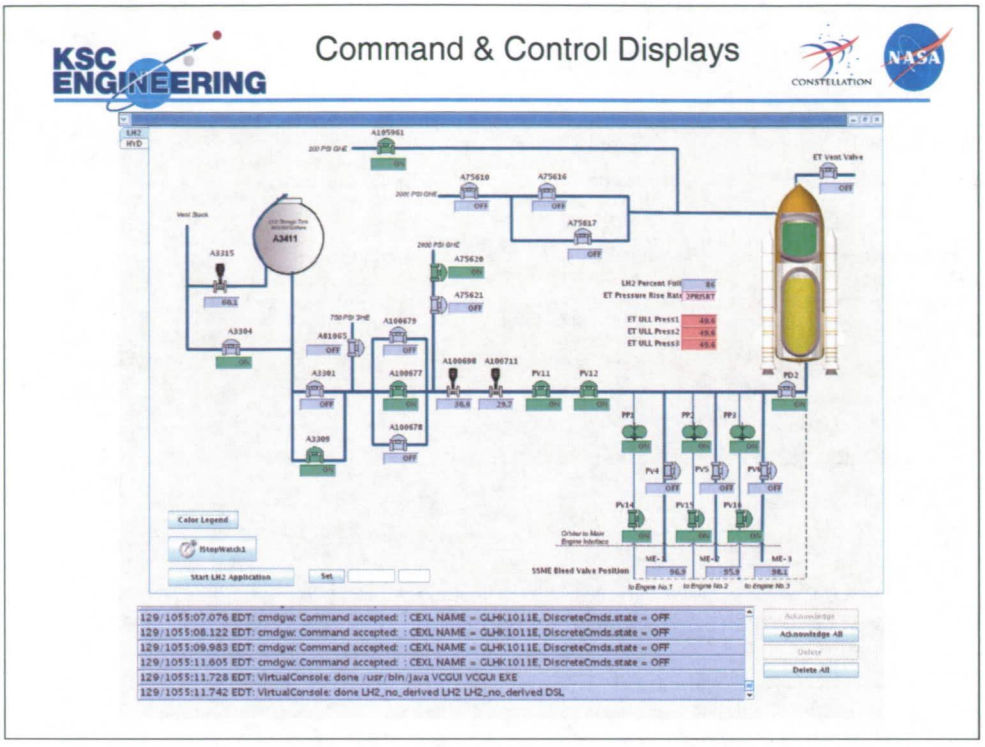
Functions:
- -Reactive Control
- -Emergency Veh Safing
- -Safety Interlock
- -Command Processing
- -Data Processing/Pub
- -COM/DECOM

Industrial Controllers

Architecture:
Industrial Controller with Embedded control system.

Functions:
- -Critical Item Mgmt
- -Closed Loop
- -Component Control
- -High Rate monitor/ rate reduction





Screen Capture of the Cryogenic LH2 Fast Fill application.

The screen shot is a Java Swing desktop application. A data publisher publishes actual shuttle data stream data to the display.

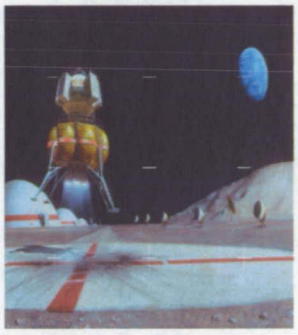
We are also developing a web enabled prototype that runs the display in a browser.

KSC ENGINEERING

What's Next???

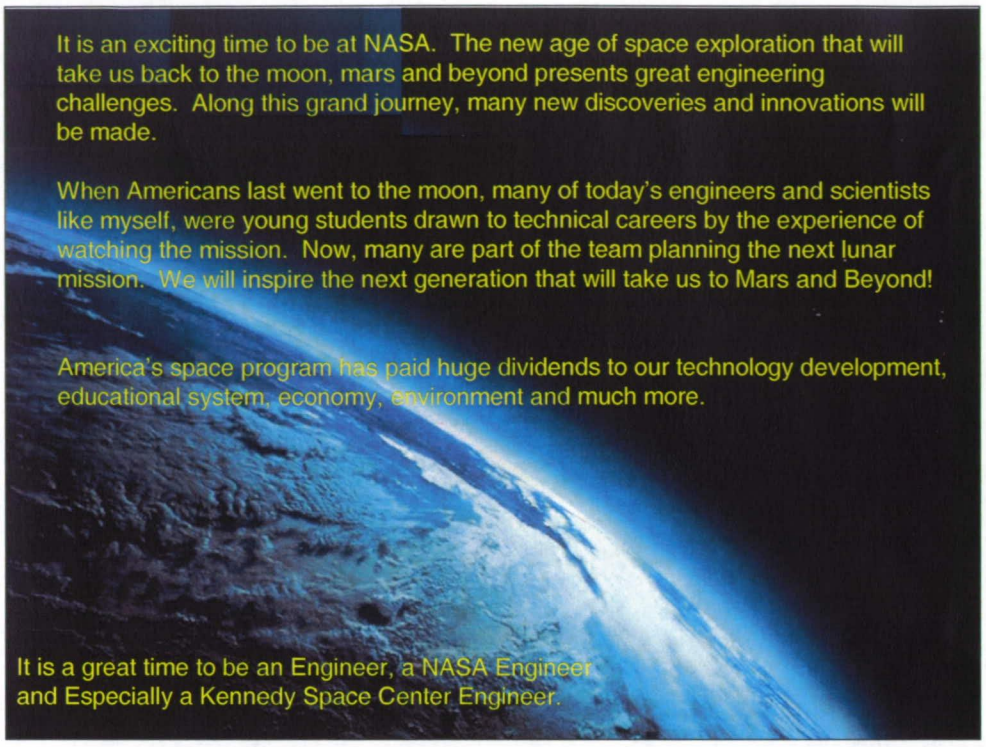
CONSTELLATION NASA





Our Only Limitation is Our Imagination


It is an exciting time to be at NASA. The new age of space exploration that will take us back to the moon, mars and beyond presents great engineering challenges. Along this grand journey, many new discoveries and innovations will be made.
When Americans last went to the moon, many of today's engineers and scientists like myself, were young students drawn to technical careers by the experience of watching the mission. Now, many are part of the team planning the next lunar mission. We will inspire the next generation that will take us to Mars and Beyond!
America's space program has paid huge dividends to our technology development, educational system, economy, environment and much more.
It is a great time to be an Engineer, a NASA Engineer and Especially a Kennedy Space Center Engineer.

KSC ENGINEERING

CONSTELLATION NASA

BACKUP

KSC ENGINEERING

CONSTELLATION NASA

Constellation Information:

http://www.nasa.gov/mission_pages/constellation/main/index.html

Presenter- Erik Denson

Erik C. Denson
Chief, Electrical Design Branch
NASA, John F. Kennedy Space Center, FL
Email: Erik.C.Denson@nasa.gov (321) 867-6537

Erik C. Denson is the presently the Chief of the Electrical Design Branch for the Engineering Directorate at NASA's Kennedy Space Center. His team is responsible for developing ground support equipment for the new constellation program. Mr. Denson joined NASA in 1990 and has over 18 years of design and development experience on voice, data, video and communication and tracking systems, including a system that provided supported Virgin Atlantic's Global Flyer mission which was the first solo, non-stop, non-refueled circumnavigation of the Earth flown by Steve Fossett. Erik participates in various outreach activities and served 12 years as a mentor for NASA's SHARP Program. He holds a B.S.E.E. from Howard University and a M.S.E.E. from Polytechnic University in New York. Mr. Denson is a member of Tau Beta Pi, NSBE, the National Association of Black Scuba Divers and is trained in underwater archeology and a PADI Divemaster.