NASA Range Safety Program
2006 Annual Report

DEVELOPMENT, IMPLEMENTATION, SUPPORT OF RANGE SAFETY POLICY
CONSTELLATION

Constellation is the combination of large and small systems that will provide humans the capabilities necessary to travel and explore the solar system. Constellation will be made up of Earth-to-orbit, in-space and surface transportation systems, surface and space-based infrastructures, power generation, communications systems, maintenance and science instrumentation, and robotic investigators and assistants

In 2006, NASA named the new rockets that will carry the next generation of space explorers to the moon and beyond. *Ares*, the Greek god associated with the planet Mars, is a fitting title for NASA's new wave of exploration vehicles by that will one day carry explorers to Mars. The new crew exploration vehicle that will carry astronauts to the Moon, the International Space Station, and eventually to Mars was also named in 2006. This vehicle is called *Orion* after one of the brightest most recognizable star formations in the universe. By 2020, NASA astronauts will once again walk on the surface of the moon and prepare for their eventual journey to the planet Mars.

Ares I

Ares I is the vehicle that will send the next generation of explorers into space. Also known as the crew launch vehicle, this is a single, two-stage rocket derived from the Space Shuttle's solid rocket booster. The first stage is a reusable, five-segment, solid rocket booster much like the four-segment booster the Shuttle uses today. The solid rocket booster will power the rocket to approximately 200,000 feet where the first stage will separate and allow the second stage engine take over. The Ares I rocket is also capable of lifting more than 55,000 pounds into low Earth orbit. The prime contract for the first stage belongs to ATK Thiokol of Brigham City, Utah.

The second stage engine is a liquid oxygen/liquid hydrogen fueled J-2X, similar to the engine used on the second stage of the Apollo rocket. Sitting atop the five-segment booster is the Orion crew exploration vehicle. This capsule will be the short-term home for astronauts launched from Kennedy Space Center and will ferry crews to and from the Moon and the International Space Station. Pratt and Whitney Rocketdyne in Canoga Park, California is the prime contractor for the engine of the second stage.

Ares V

The Ares V, also known as the cargo launch vehicle, is 360 feet tall and capable of lifting more than 286,000 pounds to low Earth orbit. This lift is achieved by using two five-segment solid rocket boosters mounted on either side of a similar, but larger version of the Shuttle's external tank that is powered by five, RS-68, liquid oxygen/liquid hydrogen engines. This vehicle will be used to carry cargo and other equipment into orbit with a final destination of the Moon or even Mars.

The first stage and core stage will power the vehicle toward orbit until it is time for separation from the upper stage. This upper stage, known as the earth departure stage, is powered by a J-2X engine and is responsible for putting the vehicle into a circular orbit. Once this orbit is achieved, the Orion crew exploration vehicle will dock with the earth departure stage and begin its journey to the Moon and beyond.

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Orion Crew Exploration Vehicle

The Orion crew exploration vehicle will carry astronauts to and from the Moon, Mars, and the International Space Station. The capsule is designed in a similar fashion to that of the Apollo capsule of the past except this time it will be roughly three times larger. The vehicle is designed to be aerodynamically stable for nominal entries as well as emergency aborts.

This version of the crew exploration vehicle will have modern materials and manufacturing processes, advanced avionics, improved operational capability, and the ability to land on ground rather than water. The crew exploration vehicle rests atop the Ares I rocket and will be capable of docking with the International Space Station as well as the earth departure stage of the Ares V cargo launch vehicle. The primary contract to design and build Orion was awarded to the Lockheed Martin Corporation of Bethesda, Maryland in September 2006.

Lunar Surface Access Module

The lunar surface access module will carry astronauts to and from the surface of the Moon. It is launched into orbit within the Ares V configuration. A composite shroud or fairing protects the module when it sits atop the earth departure stage during launch. The Orion crew exploration vehicle will mate with the earth departure stage and lunar surface access module and move towards lunar orbit. Once this orbit is achieved, the astronauts will migrate to the lunar module and make their way to the moon's surface. The Orion vehicle will remain in lunar orbit while the lunar module descends towards the surface of the moon.

The lunar module is very similar to the lunar vehicle used for the Apollo missions, except this module is larger, with the capability of carrying four astronauts, and has the ability to land almost anywhere on the Moon's surface. When it is time for the astronauts to leave the Moon's surface, the lunar vessel will depart from the lunar surface access module and carry them back to Orion where they will make their final trip home.

Range Safety Challenges

As with all previous launches and programs, safety will continue to be an important issue to the Constellation Program and Range Safety. Not only is it important that these vehicles succeed in reaching areas of the universe that were once believed unreachable, but it is equally important to protect the public, the astronauts, and the workforce that make these dreams possible.

As we headed into 2006, we were already assisting the Constellation Program in defining range safety related requirements. This effort began with a complete review of the NASA Range Safety NPR 8715.5 to identify areas applicable to the program. The review was followed by the establishment of the Launch Constellation Range Safety Panel, co-chaired by Johnson Space Center/Flight Design and Dynamics Division and the 45th Space Wing Safety Office with NASA Range Safety and many other NASA and Air Force personnel as members. After panel members were determined, an initial technical interchange meeting was held at Kennedy Space Center in early 2006.

DEVELOPMENT, IMPLEMENTATION, SUPPORT OF RANGE SAFETY POLICY CONSTELLATION

Several questions still remain unanswered about the future of the Constellation program. Some of the most important issues related to Range Safety are as follows:

- Will the flight termination system include a linear shape charge extension to cover the aft segment of the solid rocket boosters for the test flights?
- What type of ascent and reentry requirements will be implemented?
- At what frequency will the flight termination system operate?
- Will the Constellation program implement any new technologies pertaining to the flight termination system, such as the enhanced flight termination system?
- What type of tracking and communications requirements will be implemented?

These are just a few of the important questions that must be answered by Range Safety to ensure public safety. The Constellation Program and Range Safety are committed to making the Constellation family of vehicles the safest and most reliable launch vehicles ever to launch from Kennedy Space Center.