NASA Facts

National Aeronautics and
Space Administration

John F. Kennedy Space Center
Kennedy Space Center, Florida 32899

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Improved imagery planned for return to flight

Additional cameras during launch to give more detail

How often have you said you would like to be a fly on the wall somewhere to get more information? The complex eyes of flies have many individual facets, each representing a separate light-detecting unit, and humans can only approach that capability through multiple cameras. For NASA, the more eyes the better.

When the Space Shuttle launches again, more cameras will be examining its ascent than ever have in the past. The reason is a major improvement in the tracking and imaging capabilities at Kennedy Space Center, primarily through additional cameras and digital resolution, as recommended* by the Columbia Accident Investigation Board in its report released in July 2003.

Cameras at KSC are sited for short-range tracking (T-10 through T+57 seconds), medium-range (T-7 through T+110 seconds), and long-range (T-7 through T+165 seconds. Around the launch pad, cameras focus on the external tank, solid rocket boosters and orbiter. For several miles up and down the coast, tracking cameras and long-range optical tracking systems capture ascent imagery.

This long-range tracking telescope on Playalinda Beach, north of KSC, uses two lenses: on top, a 400-inch lens for 35mm film, and on the bottom, a 200-inch lens for video.

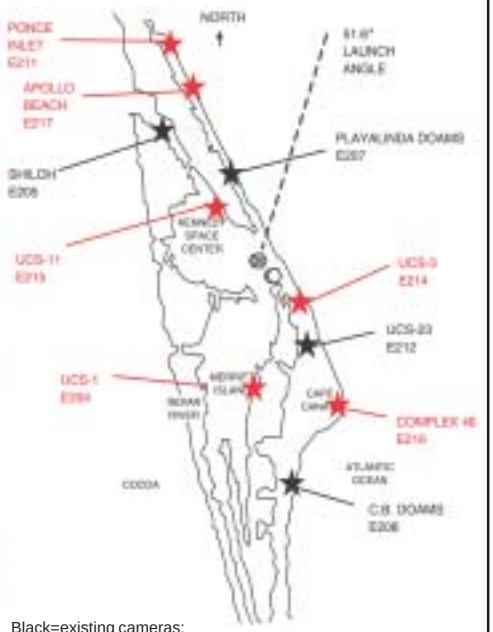
Previously, four **short-range tracking cameras** were used at the launch pads, on camera sites two (east side) and six (northwest). They are remote controlled from the Launch Control Center. Since it is such a tight shot, one camera is focused on the top half of the Shuttle and one focused on the bottom half. Cameras also view the hydrogen vent arm (above the external tank) and the underside of the orbiter's left wing, the one facing the camera. Other cameras view the area between the orbiter and the external tank to see any debris or ice that might form. For return to flight, two new camera positions have been proposed to the northeast of the pad. The addition of this tracker

ensures a view of the underside of the right wing and the area between the external tank and the orbiter to view any debris during its roll maneuver.

The pad cameras have 200-mm (focal length) lenses, running 100 frames per second (fps). Each camera is loaded with 400 feet of film.

Proposed Long-range Tracking Cameras

- North
  - E205 KTM 400°FL 100fps 1000' film load
    - 14 miles from pad
  - E207 DOAMS 400°FL 100fps 1000' film load
    - 7.75 miles from pad
  - E211 KTM 400°FL 100fps 1000' film load
    - 38 miles from pad
  - E215 KTM 400°FL 100fps 1000' film load
    - 8 miles from pad
  - E217 KTM 400°FL 100fps 1000' film load
    - 20 miles from pad
- South
  - E206 ATOTS 400°FL 100fps 1000' film load
    - 12 miles from pad
  - E208 DOAMS 400°FL 100fps 1000' film load
    - 20 miles from pad
  - E212 ATOTS 400°FL 100fps 1000' film load
    - 9.5 miles from pad
  - E214 KTM 400°FL 100fps 1000' film load
    - 4.75 miles from pad
  - E216 KTM 400°FL 100fps 1000' film load
    - 11 miles from pad



Black=existing cameras; red=proposed cameras

In addition to the video cameras around the launch pads are 42 fixed cameras with 16-mm motion picture film.

Medium-range trackers have been located at five sites, four along the coast and one near the Shuttle Landing Facility. Additional trackers are proposed at sites 2.25 miles and 3 miles north and west of the launch pads, for a total of seven. Placement at these sites will provide three views for triangulation, to better capture multiple views of the Shuttle during launch.

These cameras have 800-mm (32-inch) and greater lenses (80-inch and 120-inch), running 100 fps. Three of the cameras have 400 feet of film, two of the cameras have 1,000 feet. The additional tracking cameras have 150-inch lenses, with 1,000 feet of film.

Five **long-range trackers** have existed north and south of the pads, ranging14 miles north of the launch pads to Shiloh and Playalinda Beach, to 20 miles south at Patrick Air Force Base. One of the cameras previously sited at Patrick AFB, deemed too far south, has been dropped in lieu of an Advanced Transportable Optical Tracking System (ATOTS) on north Merritt Island. The proposed five additions will reach as far north as Ponce Inlet, 38 miles from the pads, and south to Complex 46 on Cape Canaveral, 11 miles from the pads. All the cameras will have 400-inch focal length and 100 fps capability to provide more data points to better track the Shuttle as it climbs to orbit.

Two of the cameras are part of the Distant Object Attitude Measurement System (DOAMS), located at Playalinda Beach and Cocoa Beach. A refurbished ten-meter focal length telescope was recently reinstalled in the Cocoa Beach DOAMS.

A unique feature of the tracking telescope on Playalinda Beach, north of the launch pads on Cape Canaveral National Seashore (see photo reverse side), is a robotic camera manned by a technician sitting on top and gently manipulating a joystick to map the Shuttle's trek through the sky.

"The joystick is so sensitive, it even responds to the heartbeat of the person using it," explains Bob Page, chairman of the NASA Intercenter Photo Working Group.

There are two lenses stacked vertically. The top is a 400-inch lens for 35mm film. The bottom is a 200-inch lens for video.

Improvement planned in backup imagery is a change from the standard analog video camera (640 x 480 resolution @ 30 fps interlaced) to a digital high definition camera (1280 x 720 resolution at 60 fps progressive).

Studies are underway as well to upgrade film cameras to high-speed digital cameras.

**Recommendation R3.4-1: îUpgrade the imaging system to be capable of providing a minimum of three useful views of the Space Shuttle from liftoff to at least Solid Rocket Booster separation, along any expected ascent azimuth.î*