



# Space Communications Network Services (SCNS)

**Bidders Site Visit briefing  
December 19, 2007**

**Gary A. Morse**

**NASA Station Director  
Merritt Island Launch Annex (MILA)**

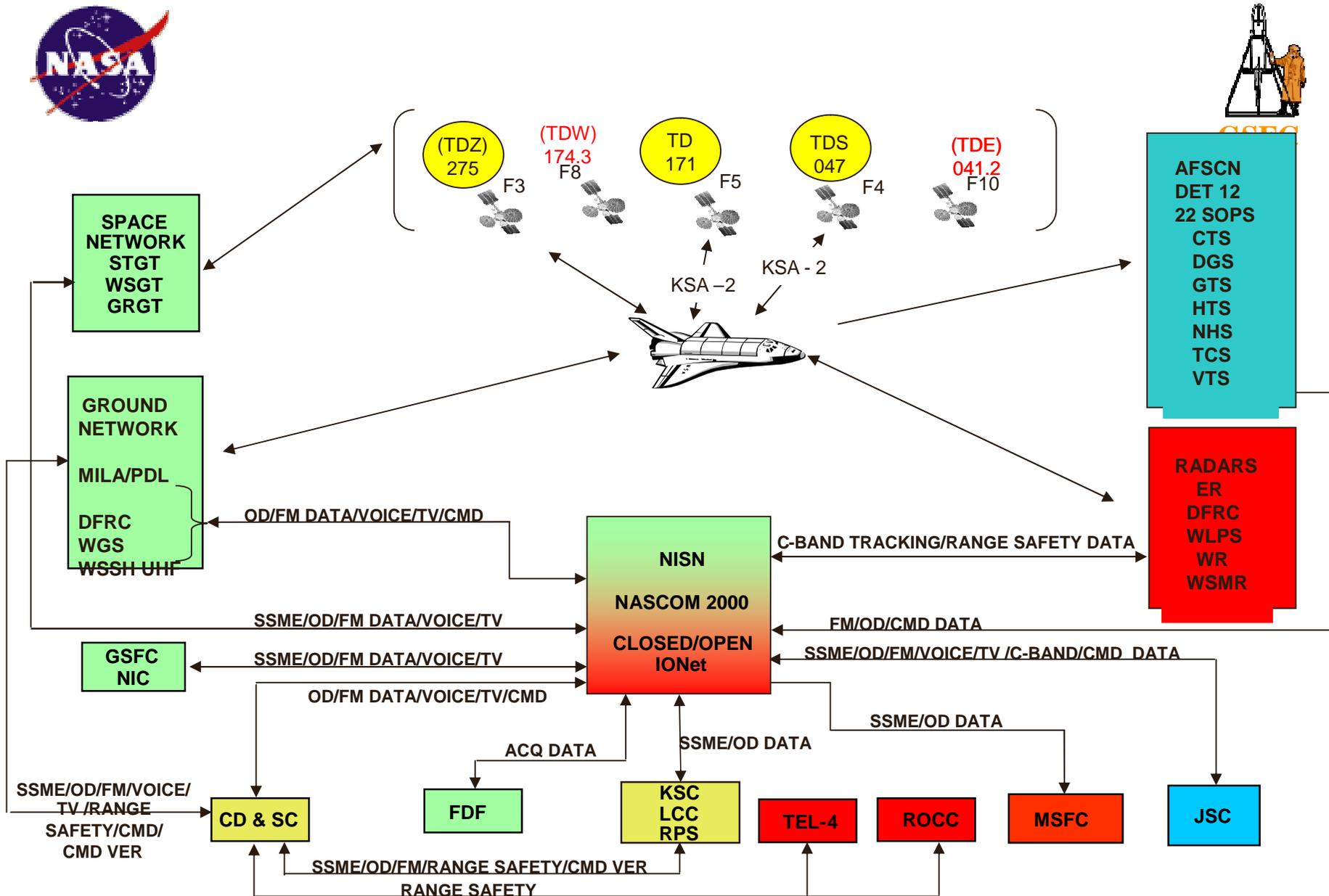


# FY08 Operational Network



<u>Commercial</u>	<u>Common Services</u>
Dongara	S-band Services
Hartebeesthoek	S-band Services
North Pole	S-band Services
Poker Flat	X & S-band Services
Santiago	S-band Services
South Point	S-band Services
Svalbard	X & S-band Services
<u>NASA</u>	<u>Unique Services</u>
ASF	NASA/University Partnership
McMurdo	Antarctic Services
MILA/PDL	Shuttle Pre-mission, Launch, Ascent, Landing, & Post-mission Services
Wallops	Shuttle Ascent Services
WSC	Lunar Services
<u>Partner</u>	<u>Mutual Benefit</u>
Fairbanks	Leverage Contingency Capacity
<u>Integration</u>	<u>Functions</u>
Greenbelt	Planning, Analysis, Testing
WSC	Monitoring, WAN, & Voice Scheduling & Acq Distribution

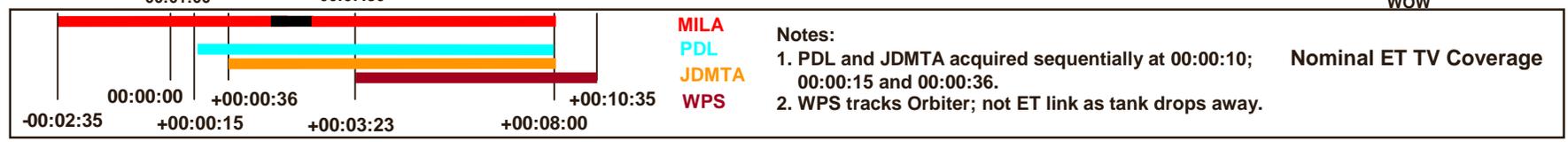
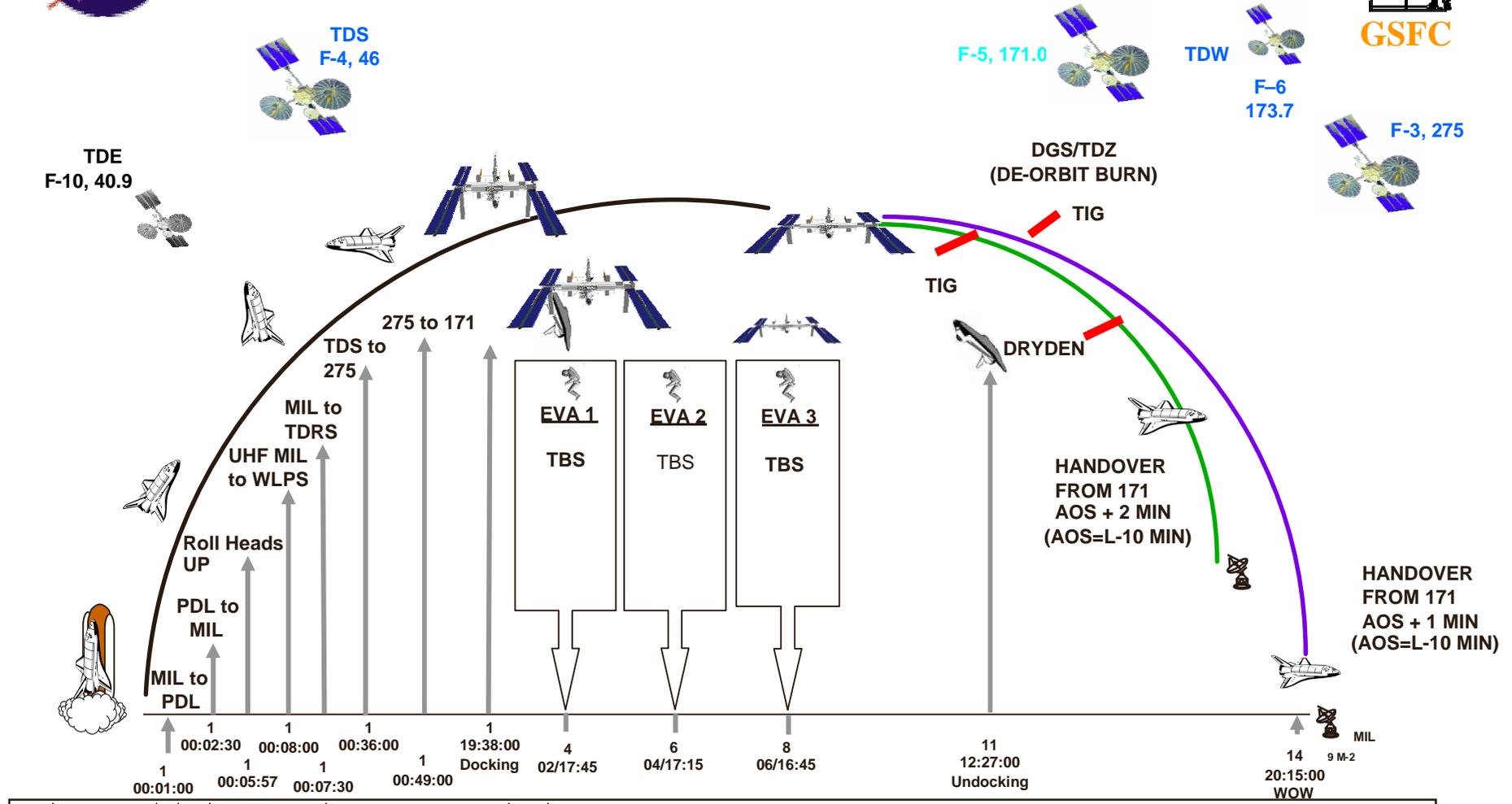
<u>Service Type</u>	<u>Operating Model</u>
○ S-Band	# Commercial
□ X-Band	# NASA
△ Ka-Band	# Partner
◇ Air to Ground Voice	★ Integration
# indicates no. of antennas	



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# STS-120 Mission Overview - IN Coverage



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# SSP Flight Rules



ASCENT AND INTACT ABORT LANDINGS AT KSC											
Site	Station ID	Type	Rqmt.	Ascent/RTLS		TAL	(Post Launch) KSC AOA & 1st Day PLS				
				28.5 Inc.	Higher Inc.						
Jonathan Dickinson Missile Tracking Annex (JDMTA)	JDIS	S-BD	TLM D/L Voice	1 of 2 M	1 of 2 M						
Ponce de Leon	PDL	S-BD 14	CMD U/L Voice	1 of 2 HD [1]	1 of 2 [2]						
	Fixed Dipole	UHF	Voice								
MILA	MILS	S-BD 30-1	CMD TLM Voice	1 of 2 M	1 of 2 M		1 of 2 HD				
	MLXS	S-BD 30-2	Voice	1 of 2 M	1 of 2 M		1 of 2 HD				
	TELTRAC Quad Helix	UHF	Voice	1 of 2 M	1 of 2 M		1 of 2 HD				
TDRSS	WSC	S-BD	CMD TLM Voice	M [3]	M [3]	M	M [6]				
			TRK	HD	HD		M [5]				
Wallops	WLPS	S-BD 34	CMD TLM Voice		HD						
	QUAD HELIX	UHF	Voice		1 of 1 HD						
Merritt island	MLAC MLMC MMTC	FPQ-14 MCB-17 MOTR	Radar TRK	2 of 7 M	2 of 7 M		Not Scheduled Accept Best Effort Call up				
Patrick	PATC	FPQ-14	Radar TRK								
Canaveral	CNVC	FPS-16	Radar TRK								
Jonathan Dickinson	JDIC	FPQ-14	Radar TRK								
MILA	MILS OR MLXS	S-BD	Ranging TRK								
Wallops	WLPC WLRC WLIC	FPQ-6 FPS-16 FPS-16 RIR-778	Radar TRK						2 OF 3 HD [4]		
	Air Force Satellite Communications Network (AFSCN)	NHS (BOSS)	S-BD					TLM CMD Voice			
		TCS (LION)									
DGS (REEF)											

END OF MISSION - 2ND DAY PLS THROUGH NOMINAL EOM						
Site	Station ID	Type	Rqmt.	KSC	Edwards	WSSH
TDRSS	West	S-BD	TLM CMD Voice	M	M	M
	East		M			
	Any		TRK	M	M	M
MILA		Ranging	TRK	HD		
	MILS	S-BD 30-1	TLM CMD Voice	1 of 2 HD [7]		
	MLXS	S-BD 30-2	Voice			
	Teltrac Quad Helix	UHF	Voice			
Merritt Island	MLAC	FPQ-14	Radar TRK	2 of 5 HD		
	MLMC	MCB-17				
	MMTC	MOTR				
Patrick	PATC	FPQ-14				
Canaveral	CNVC	FPS-16				
Dryden	ATF1	S-BD	TLM CMD Voice		1 of 2 HD [8]	
	ATF2		Voice		1 of 3 HD	
	Parabolic Dish	UHF	Voice			
Pt. Pillar	PTPC	FPQ-6	Radar TRK			
Vandenberg	VDHC	FPQ-14	Radar TRK		2 of 7 M	
	VDLC	TPQ-18				
	VDSC	FPS-16				
	VDMC	MOTR				
Dryden	FRCC	RIR-716	Radar TRK			
	FDRC	RIR-716	Radar TRK			
*WSSH	WSSH	UHF HELIX	Voice		1 OF 1 HD [9]	[9]
White Sands Missile Range	HOLC	FPS-16	Radar TRK			2 of 3 M
	WSSC	FPS-16				
	WSMC	MOTR				

HD = Highly Desirable  
M = Mandatory

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# MILA & PDL

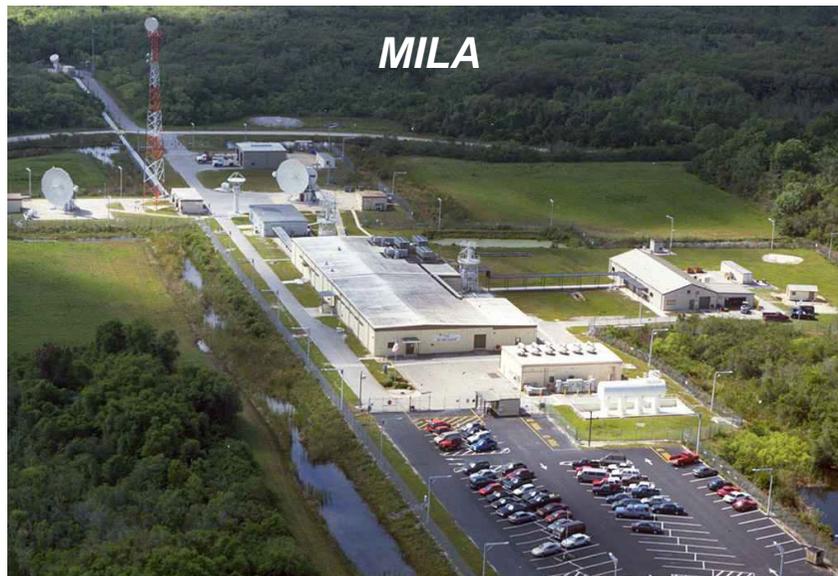


- MILA

- Antennas
  - Collins 9m S-band (2 ea)
  - ViaSat 4.3m S-band
  - TelTrac UHF
  - Quad Helix UHF
- Contractual Parameters
  - NENS prime - 16/5 Routine Operations
  - Extended hours for critical support

- PDL

- Antennas
  - ViaSat 4.3m
- Contractual Parameters
  - UHF Omni
  - NENS prime - 8/5 maintenance
  - Shuttle only
  - Extended hours for Shuttle missions





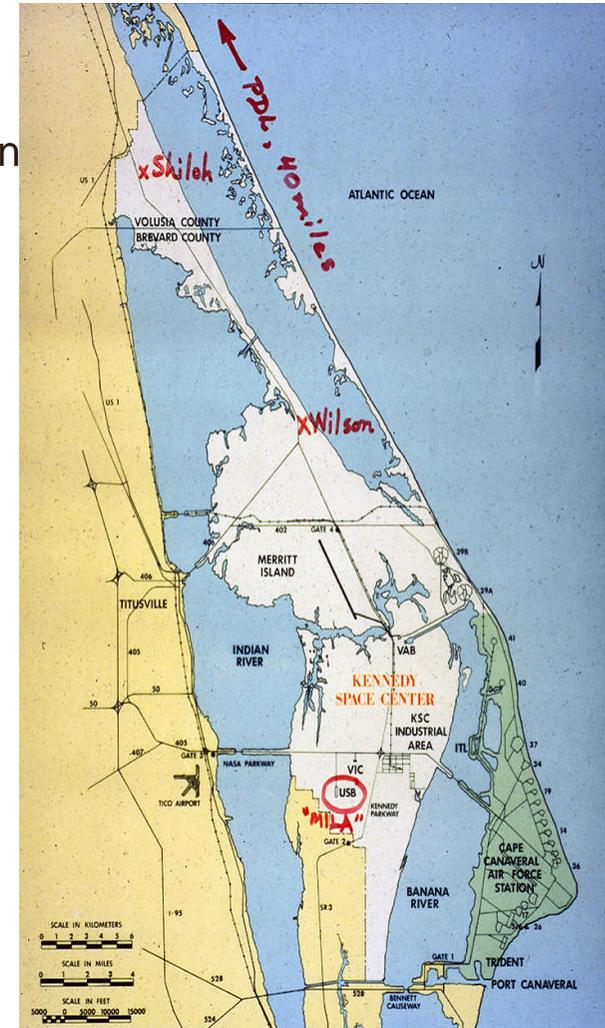
# MILA LOCATION ON KSC



The land area in white is KSC.

Occupying 16 acres with 13 buildings on Kennedy Space Center and located one mile west and south of the Visitors Complex, MILA is a National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Tracking Station located on Kennedy Space Center (KSC) in Merritt Island Florida.

The name "MILA" is an acronym derived from the Merritt Island Launch Annex to Cape Canaveral, which was the previous name of the area that eventually became named Kennedy Space Center.





# MILA OVERVIEW



Occupying 16 acres of land at Kennedy Space Center, Florida, MILA's antennas and equipment provide communications between a space vehicle and its control centers. Antennas at MILA "track" (point directly at and follow) the Radio Frequency signals transmitted from the moving space vehicle. The information (data) transmitted between the space vehicle and MILA includes voice (if astronauts are on board), commands from the control center, and telemetry and television from the space vehicle. A ranging signal is also transmitted to the space vehicle and back again to determine distance by measuring how long the two way trip takes. Antenna pointing and ranging (tracking) data from MILA is sent to the Flight Dynamics Facility to record and analyze the space vehicle's position. MILA provides the communication link for Space Vehicles being tested, launched and landed at Kennedy Space Center, as well as while in orbit. Most of MILA support is for the Space Shuttle but MILA is currently on mission status to support Hubble, LANDSAT, SAMPEX, WIRE, TRACE, SWAS, COBE and TDRS.



# BRIEF HISTORY OF MILA



**1966:** MILA established by NASA's Goddard Space Flight Center contracted to Bendix Field Engineering Corporation as one of the 17 ground stations of the Manned Space Flight Network to provide earth orbital support to the Apollo program. First active mission support was reception of television via S-Band during the Apollo/Saturn-203 mission, launched July 5, 1966 to study the liquid hydrogen fuel performance.

Station equipped with a complete set of remote-site flight controller consoles to train Johnson Space Center engineers during pre-launch testing.

When S-band transmitters were added to NASA's Delta and Atlas/Centaur Expendable Launch Vehicles, MILA began to support those programs as well as continuing support for Apollo/Skylab and Apollo/Soyuz Test Project programs.

**1972:** Fort Myers, Florida Space Tracking and Data Acquisition Network (STADAN) station closed and its Very High Frequency (VHF) systems relocated to MILA to support unmanned scientific satellites which were used until 1980. Manned Spaceflight Network became the Ground Spaceflight Tracking and Data Network (GSTDN)

**1974:** The Jet Propulsion Laboratory (JPL) Deep Space Network Compatibility Station (DSS-71) at Cape Canaveral closed and its systems to checkout planetary and deep spacecraft missions relocated to MILA and renamed MIL-71. First MIL-71 mission support was the Helios-1 sun probe.



# HISTORY OF MILA (Cont.)



- 1978:** To provide data rates of 220 kilobits per second and higher, a Domestic Satellite (DOMSAT) Earth Station was established to relay communications between locations in the U.S. using stationary satellites instead of land lines. (There were three DOMSAT Earth Stations at MILA until they were replaced by fiber optics systems. One Earth Station located at KSC is still in use.)
- 1979:** To provide S-band communications around the Space Shuttle solid rocket booster plume, a "wing site" tracking station was constructed 40 miles north of MILA at New Smyrna Beach's Ponce DeLeon Inlet (PDL). The PDL wing site communicated with the MILA base station via a three-hop microwave system with towers at Shiloh and North Wilson until replaced by T-1 lines in 1998.
- 1980:** The MILA Relay System (MRS) was constructed for KSC users (payloads and satellites) to communicate via the Tracking and Data Relay Satellite (TDRS) in stationary orbit above the Atlantic Ocean. The MRS relays S-band and Ku-band signals for pre-launch verification of the user's compatibility with the space-based TDRS network.
- 1986:** An additional S-band antenna system (the Two-In-Flow Antenna System) was added to support KSC operations simultaneous with other S-band tracking antennas. (This was subsequently displaced by the UHF Quad Helix system.) GSTDN was gradually reduced, because of the growing use of the TDRS system, until only 2 stations remain, MILA/PDL and Wallops (WPS).



# HISTORY OF MILA (Cont.)



- 1990:** A distributive processing Telemetry and Communications Data System (TCDS) replaced the Apollo/Skylab era data equipment. This system contained over thirty microprocessors communicating over four parallel Ethernet links.
- 1993:** Bendix Field Engineering Corporation becomes AlliedSignal Technical Services Corporation. Automated/robotic Kardex Industrier Supply System (KISS) added to ease parts handling. Currently (11/07) nearly 8,800 line items in MILA Logistics.
- 1995:** Fiber Optics replaced Satellite communications between control centers. The three DOMSAT Earth Stations at MILA were removed.
- 1996:** Ultra High Frequency (UHF) voice system Quad-Helix Antenna was added to backup the UHF Teltrac Antenna in case of a Return To Landing Site Abort. This system displaced the Two In Flow S-Band Antenna. MILA/PDL contractor certified in the International Standardization Organization (ISO) 9001 for Quality Management. Natural gas piped into MILA and the boilers converted from burning diesel fuel to natural gas. An episode of the television program "The Cape" entitled "The Burning Fuse" was filmed at MILA.



# HISTORY OF MILA (Cont.)



- 1997:** Digital Recorders using robotics selection of VCR tapes replaced Analog Recorders. MILA was selected as one of five federal facilities to be showcased by the National Institute of Building Sciences for its effective energy conservation practices.
- 1998:** Work Station controlled electronics installed as part of the MILA/Bermuda Reengineering project. (Currently sized at 90k Standard Lines of C Code and 41k Wonder Ware tags, 184 screens). T-1 digital circuits replaced the Microwave analog system between MILA and PDL. Internet Protocol established for data between NASA centers. Natural Gas pumping station was installed.
- 1999:** The Consolidated Space Operations Contract (CSOC) administered by the Space Operations and Management Office (SOMO) in Johnson Space Center replaced the Consolidated Network Mission Operations Support (CNMOS) contract administered by Goddard Space Flight Center.
- 2000:** Projects and upgrades put on hold while commercialization of MILA and PDL attempted by CSOC.



# HISTORY OF MILA (Cont.)



**2001:** Attempt to commercialize MILA/PDL not successful. Funding moved from SOMO in Johnson Space Center to be NASA Headquarters Code Y. Barriers installed in the parking lot for security protection after September 11 terrorist attacks on the World Trade Center and the Pentagon.

**2002:** Projects and upgrades again put on hold for 2nd CSOC attempt to commercialize MILA and PDL. The Department of Energy selects MILA (the only NASA facility) to receive the 2002 Federal Energy and Water Management Award in the Small Group category for MILA Facilities' effective use of low cost/no cost energy reduction initiatives to significantly reduce energy usage without diminishing performance. Additional Television equipment installed to support Shuttle's External Tank Television. NASA decides not to extend the CSOC contract beyond 2003. CSOC commercialization of MILA/PDL halted. GSFC begins work on the Near-Earth Network Support (NENS) contract to include MILA and PDL. Projects and upgrades initiated for three years of operation.

**2007:** GSFC begins work on Space Communications Network Services (SCNS) contract to include MILA and PDL.



# RELATIONSHIP WITH KSC



(Documented in Memorandum Of Agreement (MOA) between GSFC and KSC).

MILA as tenant on KSC adheres to all Kennedy Space Center Directives; KSC Management Instructions (KMIs), KSC Handbooks (KHBs), KSC/NASA Program Directives (KPD's), etc. All numbered buildings (13) are KSC Real Property.

MILA supports KSC's Pre-Test Briefings, Readiness Reviews and Schedules.

KSC provides Utilities; Electricity, Natural Gas, Water, Diesel Fuel and Lubricants, Phones, Solid Waste Processing, Hazardous Waste Pickup/Disposal

KSC provides Services: Roads and Grounds, Heavy Equipment, Fire Detection, Fire Protection, Fire Suppression, Fire Inspection, Occupational Medicine, Environmental Health Services, Training, Mail and Emergency Response (Fire, Medical, Security).

KSC Operates and Maintains their interfaces in 2 rooms at MILA, Wide Band Room and Fiber Optics Room.



# MILA ANTENNA RESOURCES



## Spacecraft Communicating Antennas

Two 9-meter (30-foot) diameter S-Band dish telemetry tracking antennas

Two 3-meter (10-foot) diameter S-Band and Ku-Band dish antennas used primarily to relay data between user projects and the Tracking and Data Relay Satellite (TDRS). One antenna on top of the 140-foot Tower points to a user and is connected by waveguide to the other antenna which points to the TDRS. The antenna on top of the tower is also used for checkout of payloads and during Orbiter landing and tow to the Orbiter Processing Facility.

Two UHF high gain antennas, a Teltrac and a Quad Helix, used for voice communication with the Astronauts in the Space Shuttle Orbiter. These antennas are slaved to one of the 9-Meter antennas to point at the Space Shuttle Orbiter during Ascent, Orbit and Landing.

A 4.3 meter (15 foot) diameter dish S-band antenna used whenever a 9 meter antenna is being refurbished.



# MILA ANTENNA RESOURCES

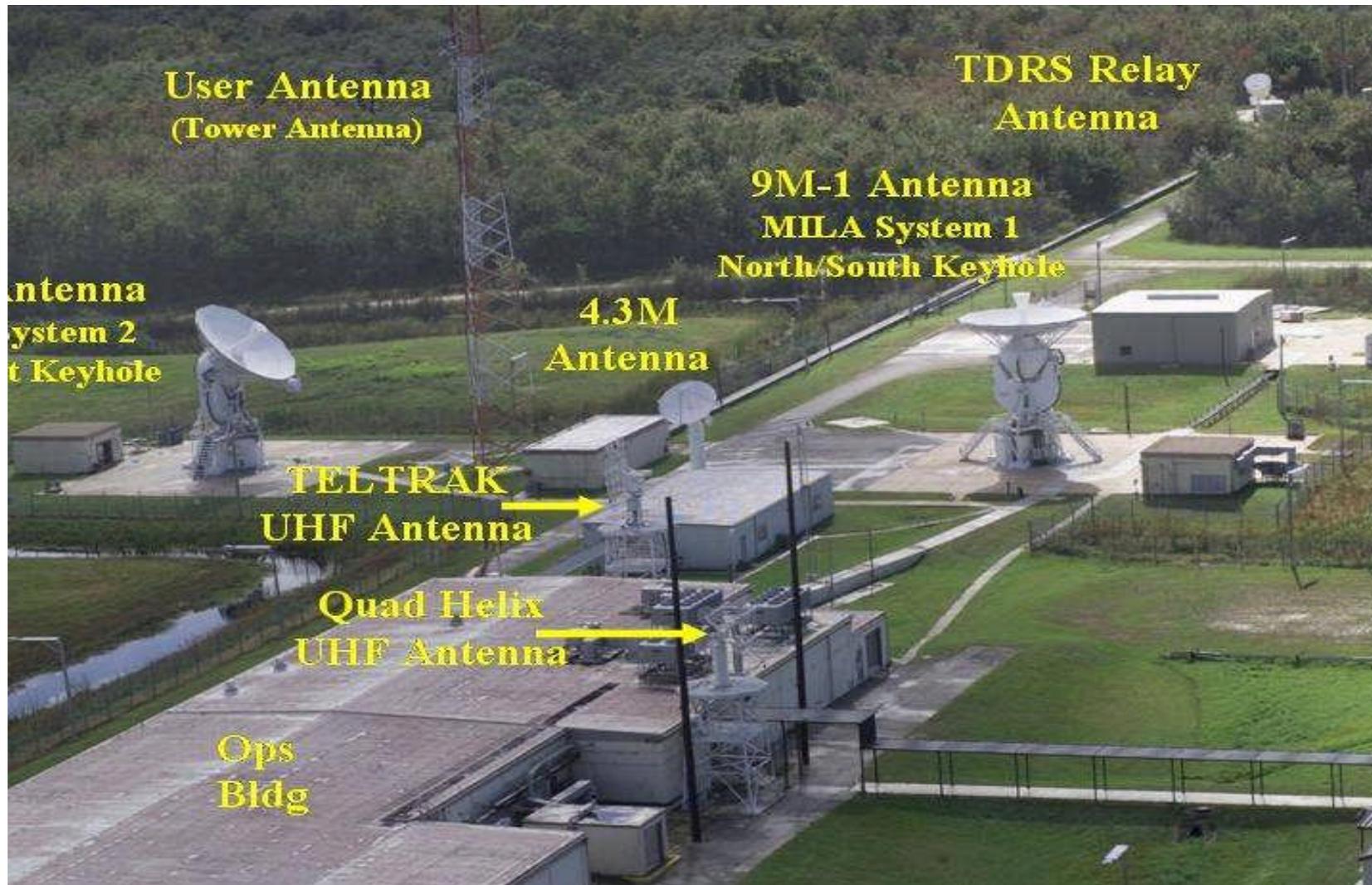


## Support Antennas

Two 1.2-meter (4-foot) S-band and a smaller Ku-band antenna on top of the 140 feet high Collimation Tower located about 3/4 mile north of the station. These antennas are used to calibrate and test the steerable antennas.

Two stationary Discone UHF Antennas used to monitor the moveable UHF high gain antennas.

Two Global Positioning System (GPS) antennas for Timing



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# MILA BUILDINGS



## KSC Real Property

Collimation Tower Equipment Bldg. - Contains Electronics for Collimation Antennas and Portable Spacecraft Simulator (PSS) for testing at MILA.

Security Monitor Bldg - Provides around the clock Access Control

Support Services Bldg – (**CLOSED**) Housed Facilities Personnel and work shop, Training Room, Meeting Room and Offices.

Power Bldg - Contains Switch Gear and Diesel Motor/Generators (3-500 KW, 3-250 KW)

Operations Building - Houses Logistics, Control room, Electronics, Technical Bus UPS, Conference room and Offices.

Backup Generator Building - Contains Backup Generator used during annual Switch Gear Calibration.

Engineering Support Building - Contains Break Room

Hydro-mechanical Bldg - Houses Antenna Maintenance person and equipment.

Transmitter Bldg - Once housed Klystron Power Amplifier Motor/Generators.

MILA Relay System (MRS) Building - Contains MILA Relay System Electronics.

Hazardous Waste Staging Bldg - 45 day Storage for 55 Gallon Drums of Waste

Lift Truck Shelter - Garages 2 High Rangers

TDRS Antenna Site - Contains electronics for the MRS Antenna pointing at TDRS.

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# MILA SYSTEMS FUNCTIONS



Space Shuttle support is the directed primary focus at MILA/PDL. Scientific mission support is a subset of the sites activities and is used to supplement the GSFC mission model and provide proficiency training.

Television- monitors, displays and distributes to KSC Public Affairs for retransmission on NASA TV, TV transmitted from the Shuttle via its S-Band FM Systems on the Orbiter and External Tank-TV.

UHF- transmits, receives, and monitors voice to/from Orbiter and Landing Convoy Vehicle UHF transmitters/receivers, and the Astro Comm System.

Astro Comm- connects KSC and the MCCH voice systems to the Orbiter via MILA's UHF and S-Band Transmitters/Receivers. (Additional portion at KSC connects them to the Orbiter Intercom Umbilical's).

S-Band FM- receives, monitors and distributes to KSC and the Network, data received from the Orbiter FM Transmitter (Main Engine data or TV or Recorder Playback or Payload data) and External Tank TV.

S-Band PM- transmits Forward Link (commands and voice), normally encrypted, to the Orbiter from MCCH via the Network (blocked) or from KSC (commands from the LCC and voice from the Astro Comm System). Receives Return Link (telemetry and voice) from the Orbiter and distributes to KSC and blocked to the Network. During the mission, forwards MCCH Forward and Return Link data to KSC after de-blocking and decrypting (forward link). (These mission functions and the creating of KSC's Forward link are being considered to be performed at KSC to simplify anticipated commercial venture operation).

Range Safety- strips out selected (state vector and engine performance) Orbiter Telemetry data, encrypts and sends to the Range Operations Control Center (ROCC).

Data Recorders- digitally multiplexes and records data streams from selected points onto VCR type tapes and demultiplexes and plays them back employing robotics to cue tapes.



## MILA SYSTEMS FUNCTIONS (Cont.)



Tracking- Antenna pointing data and Ranging data determine the location of the spacecraft and sent to the GSFC Flight Dynamics Facility for analysis, the Range Operations Control Center to augment their Radar data, and to KSC Camera Site to help point their cameras. MILA receives tracking data from the Flight Dynamics Facility (predicted) and from the ROCC radars (actual) to assist in antenna pointing.

Best Source Select- examines frame sync patterns from up to eight<sup>a</sup> sources and will switch to another source if the current one degrades by a selected amount and another is better. During launch the sources are from MILA's 9 Meter 1 & 2 antennas, User Antenna and TDRS mode equipment, PDL and its backup Jonathan Dickinson Instrumentation (JDI) Facility at Jupiter Inlet, FL, and Wallops. Best Source Select data is sent to the Network.

SLSS- Shuttle Launch Support System communicates with the Orbiter when the Orbiter is in the TDRS mode. Name is a misnomer because the Orbiter has never launched in TDRS mode (always STDN mode). Used to verify Orbiter TDRS mode operation each countdown and during Orbiter/TDRS end-to-end tests when the actual TDRS is not available.

Ranging- inserts tones on the Forward Link and compares to the Return Link to determine distance.

MILA Bermuda Re-engineered (MBR) system- configures and interconnects most of the equipment to achieve the above functions via remote control from Work Stations (7) or equipment rack keyboard, or manually at the equipment. Employs video switches to interconnect equipment. Has remote control capability between MILA, PDL and GSFC but has not been employed for spacecraft support.

MILA Relay System- an RF Bent Pipe which connects a User (orbiter, payload or spacecraft) in the area to the TDRS via S-Band or KU-Band to verify compatibility. Levels can be adjusted to simulate threshold or high signals at the User and TDRS.

Recorders- Digital Voice and analog Video



# MILA SHUTTLE REQUIREMENTS



## Launch Commit Criteria

- S-Band Forward Link (Command/Voice) required functional from T-1 hour 20minutes to 31 seconds. Ground Launch Sequencer will “HOLD” if 3 or more frames of data are lost.
- S-Band Return Link (Telemetry/Voice) required functional from T-5 hours 30 minutes to 31 seconds.
- UHF Voice via High Gain Tracking System required from T-1 hour 20minutes to 31 seconds

## Flight Rules

- 1 Of 2 S-Band 9 Meter Antenna Systems mandatory
- 1 Of 2 UHF High Gain Tracking Antenna Systems mandatory

Metrics- additional metrics supplied each month to Station Director since 1996. Time on each line that data flows through MILA between Spacecraft and Control Center is totaled. Time on each line that data did not flow because of a MILA/PDL problems is totaled.

- Real Spacecraft Data Proficiency = Hours of data flowed/ (Hours of data flowed +Hours of MILA/PDL problems). Expected long term is (CSOC average) 0.99983.
- Critical Launch/Landing Data Proficiency = Hours flowed/(Hours flowed + Hours of MILA/PDL problems). Expected is 1.00000. Critical Launch Data is from T-9 to T+7.5 minutes, Forward & Return Links, UHF and Main Engine Data. Critical Landing Data is from Acquisition (L-13 minutes) to touchdown, Forward & Return Links, UHF .
- SSP Program Requirements Document (PRD) describes function to be performed



# MILA PROCEDURES/STAFFING



Procedures- GSFC describes configurations and capabilities in their Network Operations Support Plan (NOSP) supplemented by Interim Support Instructions (ISI) for each mission.

KSC publishes Operations and Maintenance Instructions (OMI) to describe their tests such as S-0007 Launch Countdown, S-0017 Terminal Countdown Demonstration Test, S-0028 Landing at KSC, and V-1117 Orbiter Comm Testing. Countdown time lines involving MILA also are issued by JSC, GSFC and to Eastern Range.

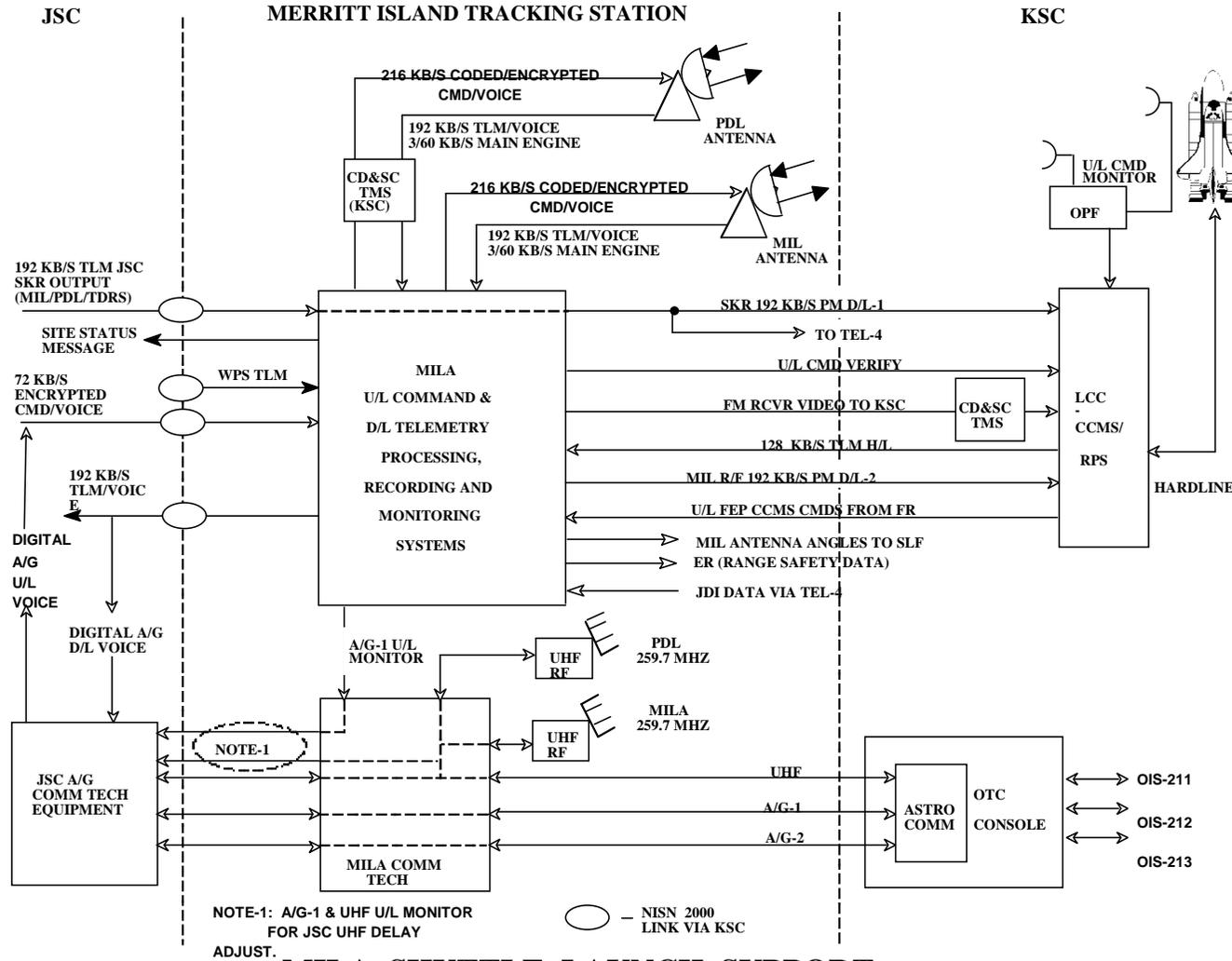
MILA incorporates all their functions in the MILA Support Procedure (MSP) produced for each mission and distributed to each system.

Scheduling- MILA and PDL are scheduled by e-mail notification from White Sands.

Staffing- Based on Launch Countdown operations with around the clock coverage starting about two days before launch. When not covering Launch or other scheduled operations, MILA covers operations Monday - Friday, 2 shifts a day. PDL supports 1 shift a day. Security Monitors cover around the clock. Same personnel perform maintenance when not operating. Bargaining Unit (International Brotherhood of Electrical Workers) represents MILA personnel.



# MILA/PDL LAUNCH DRAWING



## MILA SHUTTLE LAUNCH SUPPORT

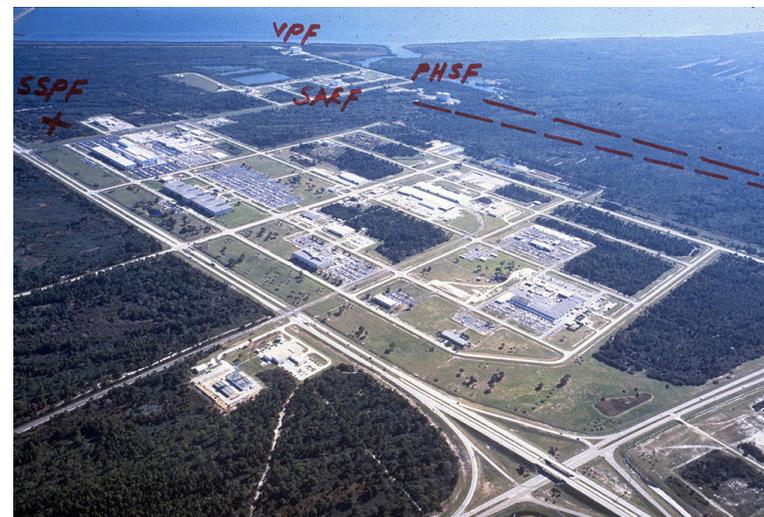
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# MILA: AERIAL VIEWS



KSC Industrial Area with MILA  
Lines of Site shown to the  
Payload Processing Facilities:  
Vertical Processing Facility  
Space Station Processing Facility  
Spacecraft Acceptance &  
Encapsulation Facility  
And the Payload Hazardous  
Spacecraft Facility



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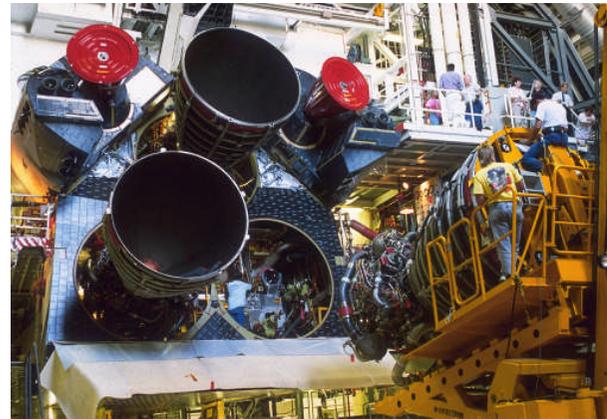


# MILA: PROCESSING VIEWS



Views of Space-Lab Processing in the O&C, Main Engine Replacement in the OPF.

Hat couplers on the Orbiter in the OPF and Re-Radiating Antennas on top of the VPF, used by MILA to communicate with the Orbiter or Payloads in the Processing Facilities.



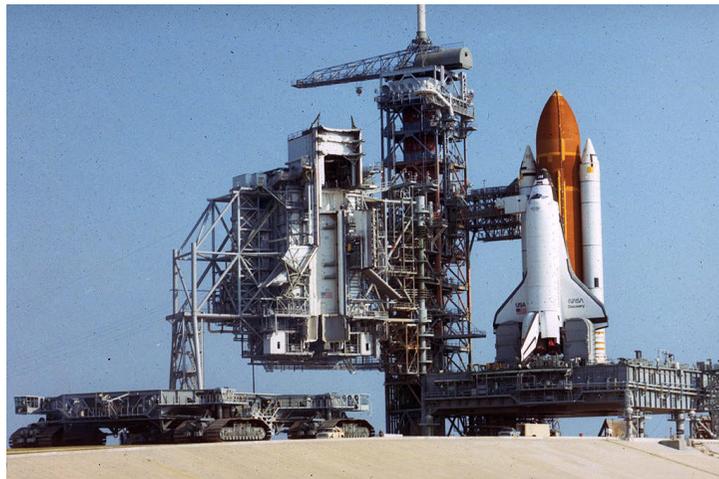
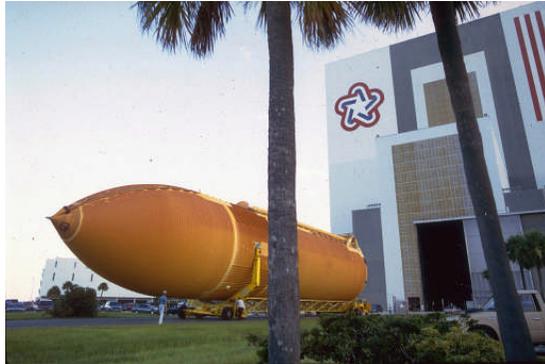
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# MILA: SHUTTLE PROCESSING



Views of Shuttle construction with the External Tank going to the VAB and the Tank, SRBs and Orbiter being connected in the VAB. Lower picture shows the Shuttle after it has been carried to the Pad by the Crawler. MILA communicates with Orbiter's upper-left antenna (beside the windows) while the RSS is as pictured. When the RSS rotates to the Shuttle, the Re-Radiating System is used.



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# MILA: LAUNCH VIEWS



Views of Shuttle launching. Main Engine Plume (Steam) is shown deflected toward MILA while the SRB plume (containing aluminum Perchlorate which attenuates the signal) is deflected away from MILA.

View from behind 9 Meter Antenna #2.

View of Plume developing.



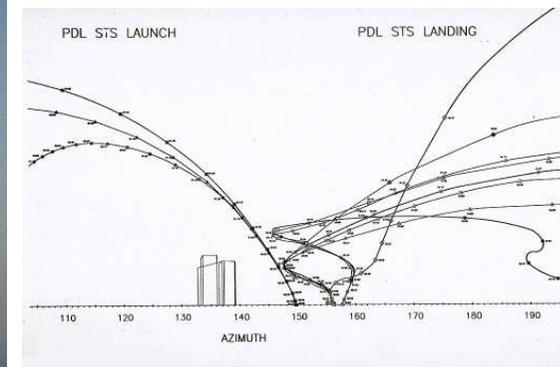
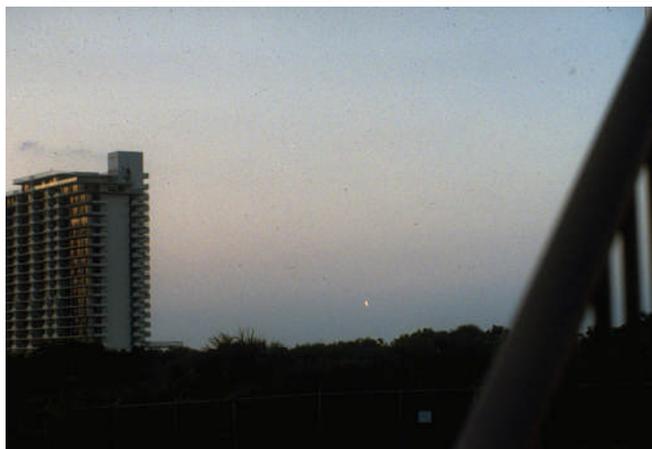


# MILA: PDL VIEWS



PDL at New Smyrna Beach and a close-up of the Station.(The tower has been removed).

Below shows launch from PDL. Middle picture shows about L +1 minute when PDL uplinks. Right shows launch and landing trajectory profiles from PDL's antenna. Landing no longer supported.



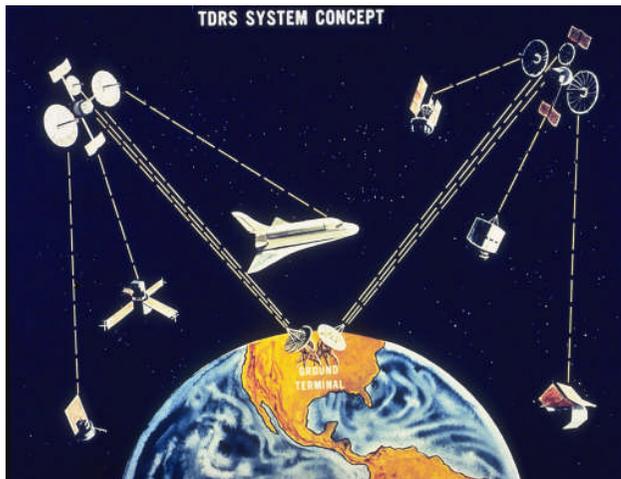
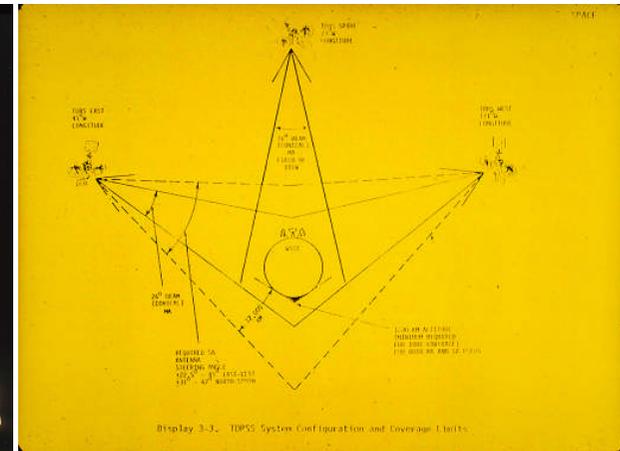
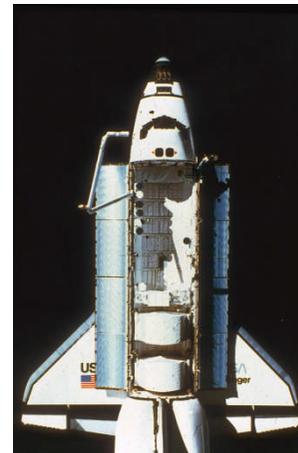
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# MILA: ASCENT & ORBIT



After SRB separation, Forward Link is handed over from PDL to MILA. On orbit view of Florida and the Orbiter with Payload Bay Doors open and KU-Band Antenna deployed for communication via TDRS as shown in the remaining pictures. Diagram shows Zone-Of-Exclusion.



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# MILA: LANDING



Views of Orbiter Decent and Landing at KSC. Below shows MILA relation to the Shuttle Landing Facility.



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