P78-10139

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 755-8370

(NASA-News-Release-78-132) FIRST IN NEW ENVIRONMENTAL SPACECRAFT SERIES TO BE LAUNCHED (National Aeronautics and Space Administration) 23 p CSCL 22A

N78-30154

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Press Kit

Project TIROS-N

RELEASE NO: 78-132

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Mailed:
September 5, 1978

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Space Administration

Washington, D.C. 20546
AC 202 755-8370

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Immediate

RELEASE NO: 78-132

FIRST IN NEW ENVIRONMENTAL SPACECRAFT SERIES TO BE LAUNCHED

NASA will launch TIROS-N, the first in a series of new operational meterological monitoring satellites -- the TIROS-N series -- from the Western Test Range near Lompoc, Calif. on Sept. 15.

The first of eight in a third generation of polar obriting environmental spacecraft, TIROS-N will carry new environmental monitoring instruments into space that should provide significant technological advances over those on board the current NOAA series spacecraft they will replace.

- more -

The TIROS-N series will be operated by the National Oceanic and Atmospheric Administration's (NOAA), National Environmental Satellite Services (NESS). Support will be provided by a data retrieval and processing system especially designed to help meteorologists, oceanographers, hydrologists, and other scientists maintain -- and perhaps improve -- the quality of life on an increasingly complex Earth.

Potential benefits are: improved weather analysis resulting in more accurate weather forecasts; more specific location of ocean currents and areas of upwelling, important to fishing and shipping interests; and more precise snowcover, snowmelt, and rainfall data, essential to water resource management and flood forecasting.

It will also be possible to give more accurate alerts of high energy solar radiation levels above the atmosphere, of concern to space missions, high altitude commercial aircraft flights, long-range communications, and electrical power distribution networks, For the first time ever, because of its advanced data collection and platform location system, the TIROS-N series spacecraft will provide an operational capability to collect and transmit environmental data from platforms on land, at sea, and airborne, and also determine the geographic locations of those platforms when they are in motion on the sea or land surface or aloft.

The sensors are multi-national in character. Each spacecraft will carry a stratospheric sounding unit from Great Britain and a data collection and platform location system from France, while the other sensors were developed in the United States.

It is the TIROS-N series sensors -- and the systems on the ground that communicate, process, and deliver the final products to the ultimate users -- that are of greatest significance. The scanning radiometer on board, for example, is the most versatile yet to be carried aboard an environmental satellite. It is designated to gather, and store for later playback, visible and infrared measurements and images in four channels.

This will permit more precise evaluation of land, ice, surface water, cloud conditions, and sea surface temperatures, while also transmitting in real time to both Automatic Picture Transmission (APT) and High Resolution Picture Transmission (HRPT) users located in more than 100 countries around the world.

Similarly, the vertical sounder subsystem, consisting of three instruments, should give improved temperatures to within 1 degree C and moisture data from the surface of the Earth up through the stratosphere. Even in the presence of obscuring cloud cover, some data are recovered since one of the three instruments can detect microwave radiation unaffected by most clouds.

The ground support systems are multi-national also. The United States will handle acquisition and processing of most of the data through NOAA Command and Data Acquisition (CDA) stations near Fairbanks, Alaska, and Wallops Island, Va., and a central processing system at Suitland, Md. But the Centre National d'Etudes Spatiales (CNES) of France will be responsible for the processing and distribution associated with the data collection and platform location system.

And, the French meteorological service will operate a special readout station in Lannion, France to gather atmospheric temperature data from the satellite during orbits not visible in the U.S.

The TIROS-N system will be a primary source of data for the First Global Atmospheric Research Program, Global Experiment, an international cooperative project involving some 140 countries, scheduled to begin Dec. 1, 1978. Its instrumentation payload is designed to meet FGGE requirements for quantitative data of the Earth's atmosphere and sea surface essential to the solution of atmospheric numerical models for improved long-range weather forecasts.

The TIROS-N operational system benefits from experience in designing NASA's original TIROS (Television Infrared Observation Satellite) series of 10 research satellites which began with TIROS-1 in 1960.

This series of spacecraft went through a number of evolutionary stages until NOAA was satisfied the spacecraft was ready to go operational and proceeded to fund its own series.

In 1966 its first NOAA Operational Satellite was launched, followed by eight more. The Improved TIROS Operational Satellites (ITOS), with advances in research and development, were funded and launched by NASA in 1970-71 and then five similar NOAA-funded satellites were launched from 1970 to the present.

TIROS-N draw heavily on instrument technology gained from NASA's Nimbus spacecraft program. The TIROS-N bus is a modified U.S. Air Force Block 5D spacecraft/bus, designed to meet mission requirements and still have a growth capability of 25 per cent in payload carrying capability.

TIROS-N was designed and funded by NASA and will be managed during its checkout period (approximately two months) by the Goddard Space Flight Center, Greenbelt, Md., before being turned over to NOAA.

TIROS-N was designed and built by RCA's Astro Electronics Division, Princeton, N. J.

The launch vehicle is a standard reconditioned Atlas E/F, with the second stage a part of the spacecraft. This second stage is a TE-364-15 solid fuel motor which, on command of an onboard system, injects TIROS-N into circular orbit after separation from the Atlas. At separation the spacecraft will weigh 734 kg (1,062 lb.) including the apogee kick motor (AKM) assembly. The AKM contains 664 kg (1,464 lb.) of propellant which burns to depletion, leaving the AKM attached to the spacecraft but weighing only 47.7 kg (105 lb.) in orbit.

The Atlas is made by General Dynamics, San Diego, Calif., and the AKM is manufactured by Thiokol Corporation, Ogden, Utah.

(END OF RELEASE, BACKGROUND INFORMATION FOLLOWS)

TIROS-N MISSION

TIROS-N and NOAA follow-on satellites consist of eight third-generation operational meterological polar orbiting spacecraft. The purpose of these satellites is to make measurements of temperature and humidity in the Earth's atmosphere, surface temperature, surface and cloud cover, water-ice-moisture boundaries, and proton and electron flux near the Earth. They have the capability of receiving, processing, and retransmitting data from free-floating balloons, buoys, and remote automatic stations distributed around the globe and can also track stations which are in motion. In addition, the NOAA-E, -F, and -G spacecraft will carry Search and Rescue instruments (SAR). All launches are planned for the 1978-84 time period.

Project Objectives

TIROS-N objectives include providing an advanced operational prototype satellite and instruments for a third-generation series of operational meteorological satellites for use in the National Operational Environmental Satellite System (NOESS) and to support the Global Atmospheric Research Program (GARP). Specific objectives include providing improved methods of obtaining quantitative environmental data and improved data handling capabilities through:

- Higher resolution, day and night cloud cover observations on a local and global scale;

- High resolution observations of sea surface temperatures;

- Improved observations of vertical temperature and water vapor profiles in the troposphere and lower stratosphere on a global basis;

- Observations of vertical temperature profiles in the middle and upper stratosphere on a global basis;

- Operational flight of a high-capacity data collection/relay and platform location system;

- Observations of electron and proton flux densities and total particle energy densities in the near-Earth space environment.

The general objective of the program will be to improve the capability of the operational environmental satellite system operated by the Department of Commerce/ National Oceanic and Atmospheric Administration (DOC/NOAA).

The TIROS-N series is based on the Block 5D spacecraft bus developed by RCA Astro Electronics Division (RCA/AE) for the Air Force. Differences between the Block 5D and TIROS-N are constrained to those necessary to meet mission requirements or found to be cost effective.

The launch vehicle for the TIROS-N is the Atlas-F. When the series is operational, two satellites will be in orbit at one time with a backup satellite available for launch four months after each spacecraft is placed in orbit.

TIROS-N nominal orbit parameters are:

Orbit altitude:	870 km (518 mi.)
Sun-synchronous inclination:	98.9 degrees
Orbit period:	102.37 minutes

International Participation

International participants are the United Kingdom, Ministry of Defense Meteorological Office (British Met Office);the Republic of France, Centre National d'Etudes Spatiales (CNES); and the Canadian Department of Communications, Communications Research Center (CRC), in the later phases of the series.

INSTRUMENTATION

High Resolution Radiometry

One of the NOAA objectives for the TIROS-N series is to provide timely day and night sea surface temperature, ice, snow, and cloud information to diverse classes of users. The instrument used to obtain this data is the Advanced Very High Resolution Radiometer (AVHRR).

Requirements include:

- Direct readout to ground stations of the Automatic Picture Transmission (APT) class, worldwide, at low resolution of 4 kilometers (2.4 miles) with reduction of panoramic distortion;

- Direct readout to ground stations of the High Resolution Picture Transmission (HRPT) class, worldwide. Resolution will be 1 km (.6 mi.);

- Global Area Coverage (GAC) of on-board recorded data at relatively low resolutions of 4 km (2.4 mi.) for central processing;

- Local Area Coverage (LAC) of on-board storage of data from selected portions of each orbit at high resolution of 1 km (.6 mi.) for central processing.

Sea surface temperatures will be derived primarily from the window channel measurements. It is NOAA's objective to provide sea surface temperatures to an accuracy of 1.5 degrees C, absolute and 0.5 degrees C, relative (2.7 degrees F and 0.9 degrees F) on a 10 km (6.2 mi.) grid, at least once per day, but hopefully twice, and to an accuracy of 1 degree C absolute on a 100 km (62 mi.) grid at least once per day. Visible and near-IR spectral coverage is necessary to meet NOAA requirements for observation of land coverage, delineation of water, of snow and ice, and of melting snow and ice.

Data Collection System (DCS)

A data collection and platform location subsystem is required to meet NOAA goals including support to GARP. This subsystem will provide for the receipt, processing, and storage of data (temperature, pressure, altitude etc.) from fixed and moving platforms (e.g., free-floating balloons and buoys) and for the location of the moving platforms for later transmission to a central processing facility.

Platform location is for the purpose of determing the velocity of the fluid medium in which the platform is immersed (i.e., wind velocity in the case of balloons and ocean current at a depth of the drogue in the case of buoys). The accuracy achieved is primarily a function of the position location accuracy for each fix, the time interval between fixes and the representativeness or responsiveness of the "tracer" (e.g., balloon, drogue motion). The First GARP Global Experiment (FGGE) -- stated accuracy requirement for wind determination at mid and high latitudes is plus or minus 3 mi. per second preferably averaged over two to three hours. The TIROS-N system will provide measurements which are commensurate with this end requirement, and will be capable of acquiring data from up to 2,000 platforms per day.

DCS components are:

- Free-floating balloon platforms
- Free-floating buoy platform
- Fixed platforms located predominately in polar regions
- The satellite data collection subsystem
- The ground station data retrieval subsystem
- Centralized data reduction and processing

As an operational spacecraft TIROS-N satellite would receive low-duty cycle transmissions, uncoordinated in time or frequency, from the platforms in a random access manner using a one-way RF link. The received transmission is processed onboard the satellite in order to recover the platform data message and, for the free-floating platforms, to measure the transmission received frequency so that additional ground processing can determine the locations from the doppler induced frequency shift. The recovered data message and frequency measurements (along with time code) are stored onboard the satellite for ground station data retrieval at periodic intervals.

Atmospheric Sounding

The sounder system data will be used to determine the vertical temperature profile of the atmosphere from the Earth's surface to near the top of the atmosphere (1 mb) and moisture vapor content profile from the surface to the tropopause. It is a goal to compute these profiles globally to an accuracy of 1 degree C (temperature) and 20 per cent moisture vapor content (10 per cent desired) on a grid spacing at the Earth's surface of 400 km (248 mi.) or less, even in the presence of clouds. An ozone measurement is necessary for correcting the determinations of the profiles.

The NOAA requirements for atmospheric soundings are consistent with the objectives of the GARP. The sounding instruments used to obtain the measurements from which the temperature and moisture profiles will be computed will consist of a High Resolution Infrared Sounder (HIRS/2) which will measure incident radiation in 20 spectral regions of the IR spectrum, including longwave (15-) and shortwave (4.3-) regions.

Space Environment Monitor (SEM)

The SEM will provide continuous measurement of proton alpha and electron flux activity near the Earth. This instrument is an extension of the present solar portion monitor (SPM) now flying on ITOS satellites. The new monitor package additionally provides for measurement of alpha and electron flux, spectrum and total energy disposition into the Earth's upper atmosphere.

Data Transmission

The sounder system data along with radiometry data will be telemetered through the TIROS-N Information Processor (TIP) telemetry system. Data will be transmitted at full resolution in the following modes:

- Direct TIP transmission, worldwide;
- Direct TIP multiplexed with HRPT, worldwide;
- TIP multiplexed with Global Area Coverage AVHRR data, stored and played-back;
- TIP multiplexed with Local Area Coverage, full resolution AVHRR data, stored and played-back;
- TIP only data, stored and played-back during blind orbits.

Tracking and Data Acquisition

Tracking and orbit determination support will be provided by the USAF. Goddard will be responsible for providing the orbital information to NOAA to satisfy TIROS-N activation and evaluation requirements. All data acquisition will be performed through NOAA Command and Data Acquisition stations and data links.

Data Management

Data collected by NASA will support the activation and evaluation of the satellite, trend data and performance monitoring and anomaly investigation.

Operational data obtained by NOAA is sent to the Environmental Data Center's National Climatic Center at Asheville, N.C., for indexing and filing.

NOAA CDA Stations

The primary Command and Data Acquisition (CDA) stations are located at Fairbanks, Alaska, and Wallops Station, Va. In addition, there will be a reduced capability (no command capability) station, located at Lannion, France, to receive tape recorded TIP data from the satellite.

The CDA stations transmit command programs to the satellite, acquire and record environmental and engineering data from the satellite. All data will be transmitted between CDA and Suitland via commercial communications links. Commands will be transmitted between NOAA's Satellite Operations Control Center (SOCC), and CDA via commercial communications links.

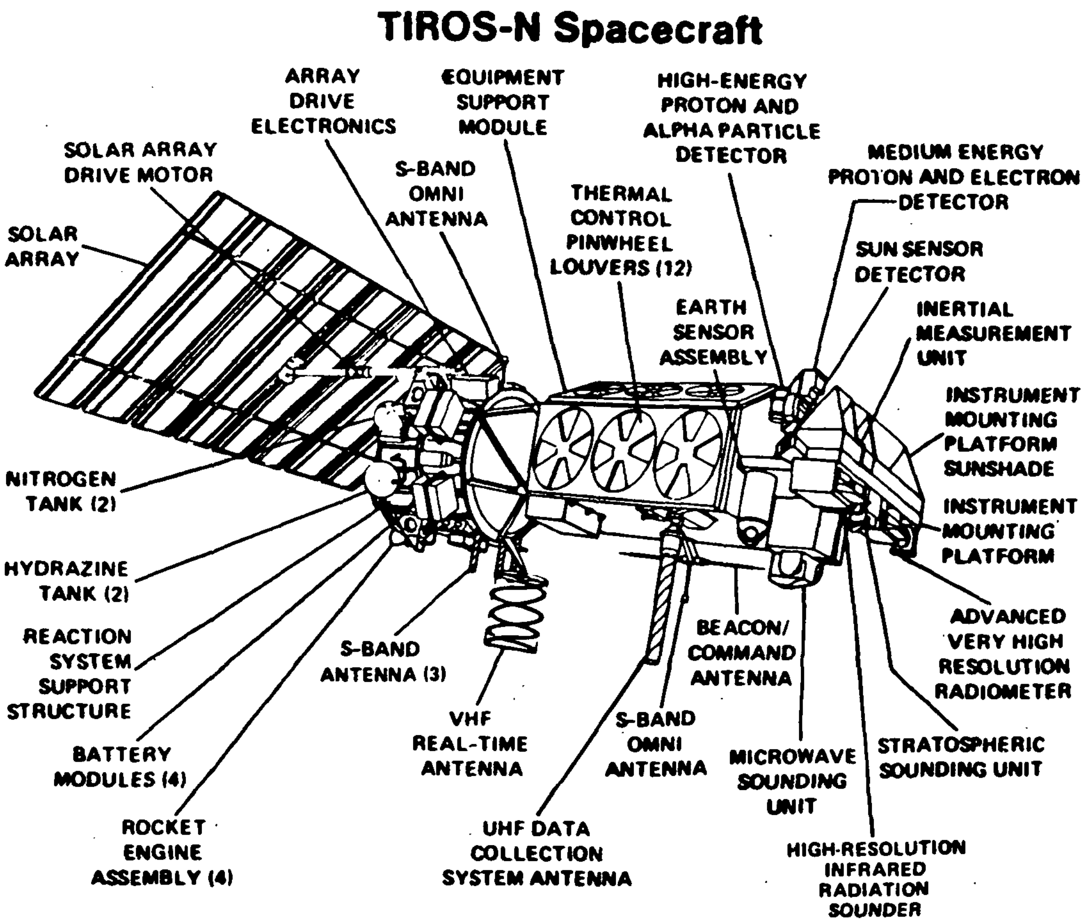
Ground Communications

The ground communication links for TIROS-N are provided by RCA Satcom and Goddard's NASA Communications (NASCOM) link. NASCOM will provide any launch unique communications links for the TIROS-N launch. RCA Satcom under contract to NOAA, will provide all voice and data links between the SOCC and the CDA stations after launch. Satcom is provided and operated by NOAA NESS.

During launch and early orbit, Goddard will provide special Spacecraft Tracking and Data Network (STDN) support for telemetry reception. After launch, the NOAA CDA stations will handle all telemetry reception. There is no requirement for STDN to command the spacecraft. The USAF will provide "skin-track" tracking and orbit determination support during the mission. GSFC will provide VHF interferometer tracking for the TIROS-N launch and checkout only, with stations available at that time.

SPACECRAFT DESCRIPTION

The TIROS-N satellite is an integrated spacecraft system designed to provide for, and control injection into, the required orbit after separation from the Atlas-F launch vehicle.


TIROS-N Spacecraft
ARRAY DRIVE ELECTRONICS
EQUIPMENT SUPPORT MODULE
HIGH-ENERGY PROTON AND ALPHA PARTICLE DETECTOR
SOLAR ARRAY DRIVE MOTOR
MEDIUM ENERGY PROTON AND ELECTRON DETECTOR
S-BAND OMNI ANTENNA
THERMAL CONTROL PINWHEEL LOUVERS (12)
SOLAR ARRAY
SUN SENSOR DETECTOR
EARTH SENSOR ASSEMBLY
INERTIAL MEASUREMENT UNIT
INSTRUMENT MOUNTING PLATFORM SUNSHADE
NITROGEN TANK (2)
INSTRUMENT MOUNTING PLATFORM
HYDRAZINE TANK (2)
ADVANCED VERY HIGH RESOLUTION RADIOMETER
REACTION SYSTEM SUPPORT STRUCTURE
S-BAND ANTENNA (3)
BEACON/ COMMAND ANTENNA
VHF REAL-TIME ANTENNA
S-BAND OMNI ANTENNA
BATTERY MODULES (4)
MICROWAVE SOUNDING UNIT
STRATOSPHERIC SOUNDING UNIT
ROCKET ENGINE ASSEMBLY (4)
UHF DATA COLLECTION SYSTEM ANTENNA
HIGH-RESOLUTION INFRARED RADIATION SOUNDER

The spacecraft, including the apogee kick motor (AKM), in the launch configuration is 371 cm (148 in.) high and 188 cm (75 in.) in diameter and weighs nominally 1,405 kg (3,095 lb.). On-orbit, with the AKM and reaction-control equipment expendables consumed, the satellite has a nominal weight of 723 kg (1,590 lb.). Figure 1 identifies the major external features of the TIROS-N configuration.

The spacecraft bus consists of the following subsystems: structure-thermal, power, attitude determination and control and communications and data handling.

Structure-Thermal

The structure consists of a Block 5D integrated structure modified as required for the NOAA mission. An integrated Block 5D structure consists of a solar array, an injection motor structure, and an equipment support module and instrument mounting platform. The satellite thermal control is achieved for all Sun angles between 0 degrees to 68 degrees, internal maximum and minimum power dissipation and for end-of-mission-life conditions. Active and passive thermal control similar to that used on Block 5D will confine the temperature of the Internal Satellite-Equipment Interface to a range of 5 degrees C to 30 degrees C (41 degrees F to 85 degrees F) and the instruments to a range of 10 degrees C to 30 degrees C (50 degrees F to 86 degrees F).

Power Subsystem

The Block 5D basic power subsystem will be used with the addition of a second 26.5 amperes per hour battery, and a pulse load regulator. The subsystem is a direct energy transfer type and will provide 420 watts average power.

Attitude Determination and Control Subsystem (ADACS)

The Block 5D ADACS consists of an inertial measurement unit, a Sun sensor unit and Earth sensor assembly, reaction wheels, and torque coils. Additional features include a three-axis magnetic moment compensation assembly, to trim out external and internal disturbances, and jet wheel unloading capability as a backup mode.

Communications and Data Handling Subsystem (CDHS)

Because of the unique instrument data formats required by the TIROS-N mission a new communications and data handling subsystem (CDHS) has been developed.

Low data rate sensor data will be formatted into a serial data stream along with bi-level and digitized analog, housekeeping by the TIP. The TIP will operate in two modes. A 16.6 kilobits per second (kbs) format will be both recorded and transmitted real time during the launch phase.

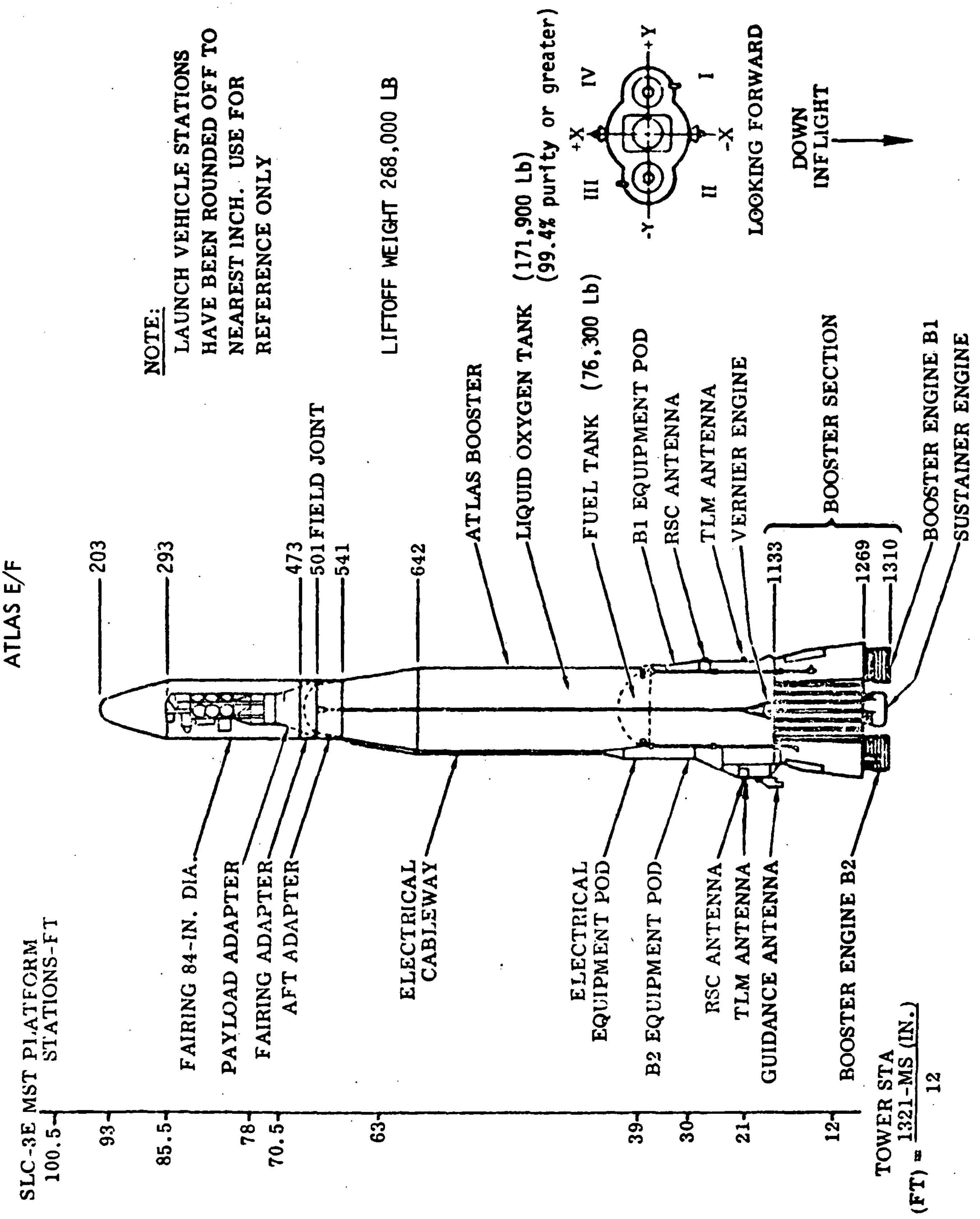
A 8.32 kbs mode will be used for normal orbit operations. Tape recording of all orbital TIP data including blind orbits will be provided as well as a real time VHF transmission link.

Tape recorders will be capable of recording and playing back four orbits of continuous global coverage and 10 minutes per orbit of local area data. The recorder units will be identical to provide flexibility and redundancy at minimum cost.

Three S-band transmitter antenna units are incorporated. The capability to operate all three units simultaneously is provided so that blind orbit data can be dumped at the same time as real time HRPTA data are transmitted. In addition, VHF antennas for command, telemetry, and APT data are provided.

LAUNCH VEHICLE

TIROS-N will be launched from the Western Test Range (WTR) by an Atlas-E/F launch vehicle. The second stage will be a TE-364-15 solid motor and will be used as an injection motor. Length of the overall launch vehicle, including fairing, is 293 m (96 ft.) and the maximum body diameter is 3 m (10 ft.). NASA/Goddard will have overall system responsibility for the launch vehicle system. The standard Atlas launch vehicle, mission peculiar hardware, launch support, and gantry modifications will be procured by Goddard from the USAF. The TE-364-15 motor was procured through the Goddard Delta Project Office for the systems integration contractor, RCA.


ATLAS E/F
SLC-3E MST PLATFORM
STATIONS-FT
100.5
93
85.5
78
70.5
63
39
30
21
12
TOWER STA
(FT) = 1321-MS (IN.) / 12
203
293
473
501 FIELD JOINT
541
642
1133
1269
1310
FAIRING 84-IN. DIA.
PAYLOAD ADAPTER
FAIRING ADAPTER
AFT ADAPTER
ELECTRICAL
CABLEWAY
ELECTRICAL
EQUIPMENT POD
B2 EQUIPMENT POD
RSC ANTENNA
TLM ANTENNA
GUIDANCE ANTENNA
BOOSTER ENGINE B2
ATLAS BOOSTER
LIQUID OXYGEN TANK (171,900 Lb)
(99.4% purity or greater)
FUEL TANK (76,300 Lb)
B1 EQUIPMENT POD
RSC ANTENNA
TLM ANTENNA
VERNIER ENGINE
BOOSTER SECTION
BOOSTER ENGINE B1
SUSTAINER ENGINE
NOTE:
LAUNCH VEHICLE STATIONS
HAVE BEEN ROUNDED OFF TO
NEAREST INCH. USE FOR
REFERENCE ONLY
LIFTOFF WEIGHT 268,000 LB
III
IV
II
I
+X
-X
-Y
+Y
LOOKING FORWARD
DOWN
INFLIGHT

First Stage

The first stage will be a reconditioned Atlas-E/F supplied by the Air Force. The booster is powered by an engine using liquid oxygen (LOX) and liquid hydrocarbon propellants. The main engine is gimbal mounted to provide pitch and yaw control from liftoff to main engine cutoff (MECO). Two liquid propellant vernier engines provide roll control throughout first-stage operation and pitch and yaw control from MECO to first-stage separation.

Second Stage

The second stage is a TE-M-364-15 solid rocket motor manufactured by Thiokol Corp. This motor is part of the Block 5D spacecraft. It contains 664 kg (1,464 lb) of propellant which burns to depletion leaving the motor assembly case, weighing 47.7 kg (105 lb.), in orbit with the satellite. Three axis stabilization of the satellite during burning is by nitrogen and hydrazine thrusters.

Attach Fitting

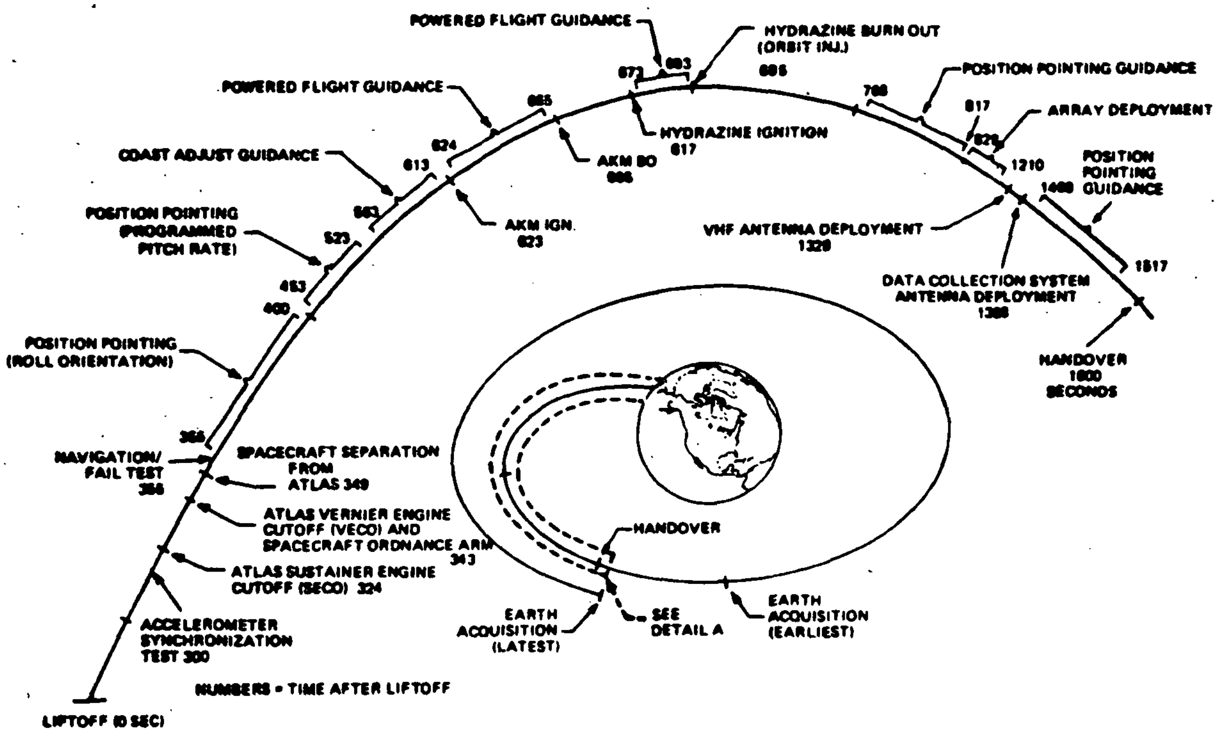
The TIROS-N satellite is attached to the launch vehicle by means of a 0.97-m (38 in.) diameter cylindrical attach fitting, which in turn is secured to the adapter assembly mounted to the first stage.

Guidance and Control

The Atlas-E/F satellite ascent trajectory is a direct ascent, ballistic type trajectory for a 192.8 degree azimuth from Pad SLC-3E. At satellite separation, 349.5 seconds after liftoff, it will be at an apogee altitude of 896 km (560 mi.). At 626.9 sec. the apogee kick motor (AKM) is fired to circularize the orbit.

The AKM burns for 43.5 sec. and at 675.4 sec. after liftoff, the orbit is trimmed, the satellite is oriented and handover to satellite control is accomplished.

ATLAS-F/SATELLITE ASCENT TRAJECTORY



FLIGHT SEQUENCE OF EVENTS
(seconds)

Liftoff	0
Booster Engine Cutoff	121.0
Jettison Booster Engines	124.1
Jettison Fairing	144.0
Sustainer Engine Cutoff	324.5
Vernier Engine Cutoff	343.5
Spacecraft Separation	349.5
Obtain Ignition Attitude	456.9
TE-M-364-15 Ignition	626.9
AKM Burnout	670.4
ΔVelocity Trim	675.4
End ΔV Trim	698.2
90 Deg Yaw	703.2
Start Roll Rate	758.2
Deploy Solar Array	827.7
Fine Point	1467.7
Handover	1600.0

Ascent guidance and control during the boost phase is accomplished by the Atlas-F autopilot program which is augmented by a ground based radio guidance system (GERTS) to account for any off-nominal booster dynamics. After booster shutdown, the satellite is separated and begins closed loop inertial guidance of the coast phase and AKM circulating maneuver. Satellite guidance and control is accomplished by an onboard inertial measuring unit (IMU) and a guidance computer. The IMU provides vehicle accelerations and rotational motion inputs to the guidance computer which then navigates, predicts errors and determines corrective guidance changes to produce the desired orbit circularity and Sun-synchronism. The expended Atlas continues on its ballistic trajectory and impacts approximately 7,770 km (4,800 mi.) down range in the South Pacific.

Fairing

The fairing, which protects the satellite from aerodynamic heating during the boost flight, is jettisoned as soon as the vehicle leaves the atmosphere.

Procurement

Procurement of the Atlas Launch Vehicle from the Air Force is coordinated with Space and Missiles System Organization (SAMSO) directly from Goddard. The launch vehicle activities are technically monitored and reviewed by Goddard prior to and during launch operations. The launch is the responsibility of the U.S. Air Force Space and Missile Test Center, Vandenberg AFB, Calif.

TIROS-N PROJECT COSTS

The funding of the TIROS-N Project (including spacecraft, sensors, and ground support) is provided in the following table.

(Millions of Dollars)

	FY 77	FY 78	FY 79	TOTAL
Spacecraft	26.9	4.0	0	30.9
Instruments	13.1	.1	0	13.2
Ground Operations	.4	.3	0	.7
IMS	1.0	.2	0	1.2
TOTALS (OSTA)	41.4	4.6	0	46.0
Atlas Launch Vehicle (OSTS)	4.6	4.3	0	8.9

MISSION MANAGEMENT RESPONSIBILITY

NASA Headquarters

Associate Administrator for Space & Terrestrial Applications	Dr. Anthony J. Calio
Deputy Associate Administrator for Space & Terrestrial Applications	Samuel W. Keller
Director, Environmental Observations Division, Office of Space & Terrestrial Applications	Dr. Lawrence R. Greenwood
Manager, Operational Meteorological Satellite Program	M. L. Garbacz
Associate Administrator for Space Transportation Systems	John F. Yardley
Director, Expendable Launch Vehicles Program	J. B. Mahon
Manager, Atlas-F	J. A. Salmanson

Goddard Space Flight Center

Director	Dr. Robert Cooper
Director, Project Management Directorate	Robert Lindley
Project Manager	Gil Branchflower
Deputy Project Manager, Technical	G. L. Burdett
Deputy Project Manager, Resources	R. J. Flick
Spacecraft Manager	W. M. Peacock
Instrument Manager	C. E. Thienel
Launch Vehicle Manager	J. F. Corrigan
Mission Operations Manager	W. A. Hembree

CONTRACTORS

RCA Astro Electronics Div. Princeton, N.J.	Spacecraft
ITT-Aerospace/Optical Div. Ft. Wayne, Ind.	Advance Very High Resolution Radiometer, High Resolution Infrared Radiometer Sounder/2 (HIRS/2)
Jet Propulsion Laboratory Pasadena, Calif.	Microwave Sounding Unit
Ford Aerospace Communications Corp., Palo Alto, Calif.	Space Environment Monitor
General Dynamics Corp. San Diego, Calif.	Atlas-E/F Launch Vehicle
Thiokol Corp. Huntsville, Ala.	Apogee Kick Motor

-end-