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NEWS NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
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FOR RELEASE: TUESDAY, A.M.
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PRESS KIT

PROJECT: ESRO II-B

(To be launched no earlier than May 9)

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ESRO II-B SATELLITE

In a cooperative program with the United States the European Space Research Organization (ESRO), will launch a satellite on or after May 9 from the Western Test Range, Calif.

Designated ESRO II-B, the 164-pound satellite was built in Europe under the direction of the 10-nation ESRO. The spacecraft will carry seven scientific experiments to study solar and cosmic radiation. The National Aeronautics and Space Administration will launch it on a Scout rocket, under an agreement signed in 1964.

A previous spacecraft, ESRO II-A, also carrying a solar and cosmic radiation payload, was launched May 29, 1967, from the Western Test Range on a Scout, but did not go into orbit. The launch vehicle failed during third-stage firing when the motor casing burned through and caused the spacecraft to fall in the South Pacific.

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The condition which led to this failure has been eliminated in new Scout motors.

The seven experiments in the ESRO II-B satellite will investigate:

. X-ray radiation emitted by the Sun, to reach a better understanding of the Sun and to correlate X-ray flux changes with heating and ionozation in the ionosphere.

. Corpuscular radiation of the Sun, particles trapped in the magnetic field of the Earth, and cosmic-ray particles.

. Electron component of primary cosmic radiation.

The four-stage Scout will put the satellite into a planned Sun-synchronous, polar orbit with a perigee of 215 statute miles (350 km) and an apogee of 680 miles (1,100 km). Planned orbital period is 98 minutes at an inclination to the Equator of 98 degrees.

The 10 nation members of ESRO are Belgium, Denmark, France, Federal Republic of Germany, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United Kingdom. The headquarters is located in Paris. Professor Hermann Bondi is the Director General.

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The seven scientific experiments carried on the satellite are provided by Imperial College, London (three experiments); University of Leeds, England; University of Leicester and, University College, London; University of Utrecht, the Netherlands; and the Saclay Center for Nuclear Physics, France. Prime contractor for construction of ESRO II-B is Hawker Siddeley Dynamics Ltd. of the United Kingdom.

ESRO and NASA will exchange all scientific information resulting from this cooperative project and will make the results available to the world scientific community.

The agreement between ESRO and NASA set up a two-spacecraft program. The second craft known as ESRO I, will be launched by a Scout into polar orbit to gather information on the ionosphere.

Tracking and data acquisition will be carried out by a special tracking network set up by ESRO. The new network will be fully operational for this launch. The NASA worldwide Space Tracking and Data Acquisition Network (STADAN) will perform backup service.

NASA participation in the ESRO program is directed by the Office of Space Science and Applications, in cooperation with the Office of International Affairs.

NASA's Goddard Space Flight Center, Greenbelt, Md., supervises the project, provides technical assistance, trains ESRO technicians and, for an interim period, tracks and acquires the data from the spacecraft.

Development of the spacecraft and associated test gear is the responsibility of the European Space Technology Centre, Noordwijk, Netherlands.

NASA's Kennedy Space Center, Western Test Range, will provide pre-launch and launch support and NASA's Langley Research Center, Hampton, Va., is responsible for the four-stage Scout launch rocket. The Scout rocket is produced by Ling-Temco-Vought, Inc., Dallas.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS)

MEMORANDUM OF UNDERSTANDING BETWEEN THE EUROPEAN SPACE RESEARCH ORGANIZATION AND THE UNITED STATES NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The European Space Research Organization (ESRO) and the United States National Aeronautics and Space Administration (NASA) affirm a mutual desire to undertake a cooperative program of space research by means of satellites. The objectives are to (a) perform an integrated study of the polar ionosphere with particular emphasis on auroral events and (b) measure solar and cosmic radiation.

It is planned to accomplish this cooperative program through preparation, launching, and use of two satellites which are scheduled tentatively for launching in 1967.

a. The polar ionosphere satellite, to be known as ESRO I, will contain experiments to perform an integrated study of high latitude particles and their effects on the polar ionosphere, including optical, heating, ionization, and large scale dynamic effects involving currents and magnetic perturbations. It will also include a beacon experiment for measurements of the total electron content between the satellite and ground observers. A near-polar eccentric orbit within the capability of the present Scout launch vehicle is planned for ESRO I.

b. The solar astronomy and cosmic ray satellite, to be known as ESRO II, will contain experiments to measure solar and cosmic radiation including X-rays, He II line, Lyman Alpha, trapped radiation, solar and high energy electrons. A near-polar eccentric orbit within the capability of the present Scout launch vehicle is planned for ESRO II.

It is understood that this program is experimental in character and therefore subject to change in accordance with altered technical requirements and opportunities.

<u>ESRO</u> will be responsible for the following:

a. Providing the experiment instrumentation.
b. Designing, constructing, testing, and delivering to the launch site two flight qualified spacecraft for each mission.
c. Supplying spacecraft ground checkout and launch support equipment.
d. Providing such tracking and data acquisition support as may be within the capability of the projected ESRO network.

e. Reducing and analyzing the data.
f. Supporting such trainees as may be assigned pursuant to 5(a) below.

NASA will be responsible for the following:

a. Making available project-related training for periods providing mutual benefits within the limits of resources in facilities.
b. Reviewing the acceptance tests of satellite flight units and the results of these tests. Final determination of the suitability of flight units for launching will be by joint ESRO/NASA decision.
c. Providing the Scout launch vehicles, including heat shields and spacecraft tie-down and separation mechanisms, required for launching the two satellites.
d. Conducting the launch operations, including tracking to the point where an initial orbit is established.
e. Supplying necessary additional tracking and data acquisition support, with reimbursement by ESRO of any incremental costs such as those occasioned by special equipment and data tapes.

ESRO and NASA will each bear the cost of discharging its respective responsibilities including the costs of travel by personnel and transportation charges on all equipment for which it is responsible.

It is intended that this project proceed by mutual agreement between ESRO and NASA. The responsibility for accomplishing this will rest with project managers to be named by ESRO and NASA. Assisted by a Joint Working Group with appropriate membership, the ESRO and NASA project managers will coordinate the agreed functions and responsibilities of each agency with the other.

ESRO and NASA will use their best efforts to arrange for free customs clearance of equipment required in the program.

ESRO and NASA will exchange all scientific information resulting from this cooperative program and make the results freely available to the world scientific community.

(s) Pierre Auger
For the European Space Research Organization

(s) Hugh L. Dryden
For the National Aeronautics and Space Administration

July 8, 1964

ESRO II EXPERIMENTS

Monitor of Energetic-Particle Flux (S-25)

Principal investigators are Professor H. Elliot and Dr. J. J. Quenby, both of Imperial College, London.

The experiment will measure the flux of energetic particles in the vicinity of the Earth with two standard Geiger-Muller counters, types Anton 302 and Anton 112.

The Anton 302 counter is the energetic-particle detector most widely used in satellites to date. One of these counters in the ESRO II satellite will provide data on cosmic-ray and radiation-belt fluxes for comparison with earlier measurements obtained at other times. The Anton 112 counter will study particle fluxes below the main trapping region of the inner belt.

Solar And Van Allen Belt Protons (S-27)

Principal investigators are Professor H. Elliot and Dr. R. J. Hynds, both of Imperial College, London.

The purpose of this experiment is to measure the proton flux outside Earth's atmosphere in the energy range of one to 100 Mev. Protons in this energy range form a part of the galactic cosmic-ray flux; they constitute the major part of the energetic solar-flare particle flux; they also form part of the population of the radiation belt. The detector in this experiment will acquire data on the spectral and intensity variations of these three distinct particle populations, the geomagnetic thresholds at higher latitudes, and the way in which these change in periods of geomagnetic activity.

The detector will measure the flux of alpha particles (mainly of solar origin) in two energy ranges, 5-45 million electron volts, and 45-70 Mev.

Solar and Galactic Alphas and Particles and Protons (S-28)

Principal investigators are Professor H. Elliot and Dr. J. J. Quenby, both of Imperial College, London.

The scientific objective is to measure the time-dependence of the flux ratio of protons and alpha particles of the same magnetic rigidity (0.4 to 0.8 billion electron volts) which are emitted from the Sun in energetic particle events.

These data will help to clarify the modulation mechanism which acts upon cosmic-ray particles in interplanetary space. A further objective is to investigate rigidities of the geomagnetic threshold; the instrument will monitor the flux of relativistic protons and alpha particles.

Primary Cosmic-Ray Electrons (S-29)

Principal investigators are Dr. P. L. Marsden and Professor J. G. Wilson, both of University of Leeds, England.

This experiment will determine the flux and energy distribution of primary cosmic-ray electrons in the Gev range. Such data are relevant to theories of the origin and acceleration of cosmic-ray particles and, when combined with radio noise observations, provide a sound basis for estimating the strength of the galactic magnetic field.

Hard Solar X-Rays (S-36)

Principal investigators are Professor E. H. Stewardson and Dr. K. A. Pound, University of Leicester, England, and Professor R. L. F. Boyd, and J. L. Culhane, both of University College, London.

This experiment will measure flux and spectrum of solar X-rays in the wavelength range of one to 20 angstroms. A study of the more energetic part of this radiation, which is closely related to solar flares and exhibits great variation in time, will contribute to the knowledge of solar-flare phenomena and their correlation with the ionosphere.

This experiment will also provide precise information on the absolute intensity, spectral slope, and variability of the "non-flare" Sun mainly in the softer region, about 10 to 20 angstroms.

Soft Solar X-Rays (S-37)

Principal investigators are Professor C. de Jager, Dr. W. de Graaff, and Dr. A. C. Brinkman, all of the University of Utrecht, the Netherlands.

This experiment will monitor the flux of solar X-rays in two wavelength bands between 44 and 70 angstroms to provide data on phenomena occurring during solar disturbances. The intensity of radiation in this range emitted during quiet periods is of great interest for solar and ionospheric studies.

Flux and Energy Spectrum of Solar and Galactic Cosmic-Ray Particles (S-72)

Principal investigator is Dr. J. Labeyrie of Saclay Center for Nuclear Physics, France.

This experiment will measure flux and energy distribution of protons between 35 million and one billion electron volts that either belong to the galactic cosmic rays or have been emitted by the Sun during a flare; the flux and spectrum of alpha particles with energy between 140 and 1200 million electron volts, and flux of relativistic lithium, beryllium, and boron nuclei. The flux and spectrum of trapped protons in the above range may also be measured occasionally.

The results of the investigation will contribute to the understanding of solar flares and particularly of the acceleration of energetic particles on the Sun. The experiment should provide information on the modulation of galactic cosmic rays in interplanetary space, especially in conjunction with other observations.

SPACECRAFT AND SUBSYSTEMS

Figure 10A shows the interior configuration and Figure 10B shows the spacecraft attached to the last stage of a Scout vehicle using the standard E-section adapter and separation system.

The spacecraft is 12-sided, weighs approximately 164 pounds and is 33.5 inches high and 30 inches in diameter. A cylindrical thrust tube provides longitudinal structural integrity. A flange at the tube's lower end attaches directly to the Scout fourth-stage adapter. Each of the 12 sides carries two areas of solar cells, separated by a band around the middle of the satellite, providing 24 areas each carrying 144 solar cells.

The solar cell panels are hinged along one longitudinal edge to allow access to the satellite interior without disconnecting the array wiring. Experiment instrumentation is located at the top, bottom and around the spacecraft mid-band.

Telemetry and Data-Storage System

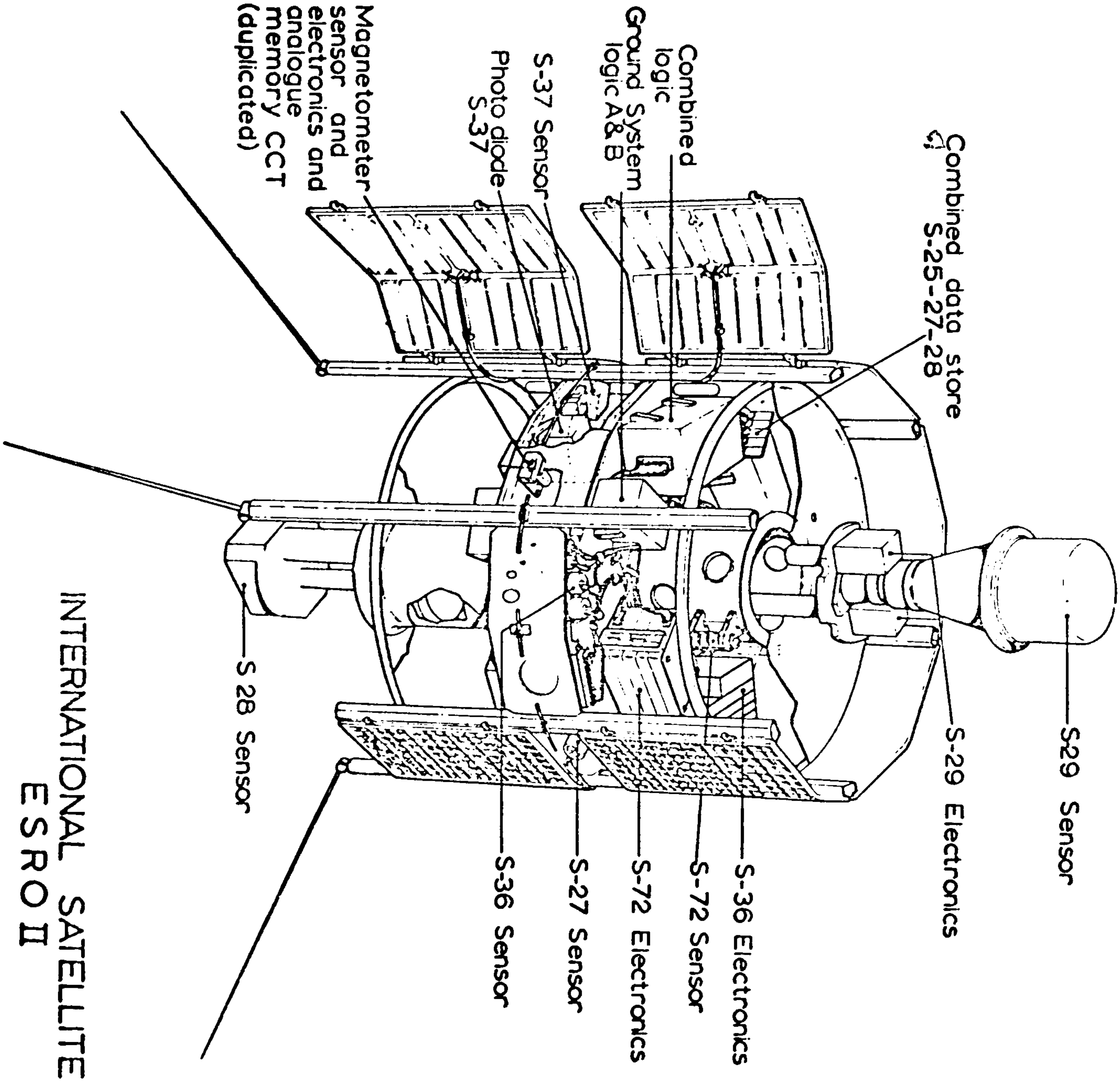
The ESRO II telemetry system provides two data links (real-time and recorded data) which will transmit identical information, consisting of scientific measurements plus "housekeeping" or monitor data for assessing satellite performance and verifying its operating mode.

Real-Time Telemetry

The real-time link will operate continuously to transmit data as produced by the scientific or the housekeeping systems. Any suitably equipped station can receive transmissions, which are compatible with conventional STADAN receiving equipment. Signals from the real-time transmitter will also aid in pointing the telemetry station antennas for tracking purposes.

Tape Recorder

In addition to real-time transmission, an on-board endless-tape magnetic tape recorder will store information generated while reception of real-time transmission is not possible. Maximum storage capacity is 110 minutes, slightly more than one orbit period. The ratio of record-to-playback speeds is 1 to 32. Stored data from one orbit will be replayed in approximately 3.5 minutes and transmitted by the high-power stored data transmitter.



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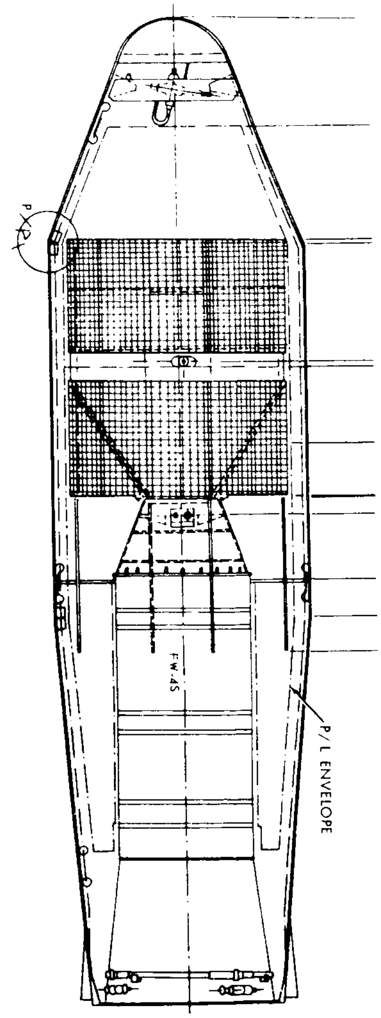
ESRO II



-ESRO II Spacecraft in Launch Configuration

Stored Data Telemetry

This telemetry link will operate during tape-recorder playback initiated by ground command. Transmitted bit rate (4096 bits per second) is approximately 32 times the real-time bit rate.

Transmitter characteristics are:

Carrier frequency	136.05 MC
Modulation	PCM/PM
Subcarrier	None
Transmitter power	1.6 watts on command
Duration of transmission	3.5 minutes per orbit
Information bandwidth	30 kc

Antennas

Both telemetry transmitters (along with the telecommand receiver) are coupled through a duplexer and hybrid ring to a four-element turnstile antenna whose elements, about 20.3 inches (52.1 cm) long, are attached to the lower end of the solar cell longerons and deployed parallel to the satellite's longitudinal axis.

Command System

The ESRO II satellite will be controlled in flight by 36 commands, using a tone-digital command system compatible with Goddard Space Flight Center standards. The on-board receiver shares antennas with the telemetry transmitters and operates on an RF frequency of 148.25 megacycles.

Power System

Solar energy converted to electrical energy in 3456 n-on-p 2-cm solar cells supplies power for the satellite. A nickel-cadmium battery supplements this supply during shadow periods. Although the nominal orbit places the satellite in full sunlight for most of its one-year lifetime, the power system design allows a continuous full satellite operation with 37 per cent orbit time in shadow.

Solar Array

The solar cells mounted on the 12 faces of the satellite body are connected to form a single solar array whose working point is defined by the battery normally floated across the array.

The array provides power into the battery and into the load. A shunt regulator is an essential part of the battery charge control, maintaining a maximum of 23.4 volts on the array.

Battery

A nickel-cadmium battery of 16 hermetically sealed, 3-ampere-hour cells connected in series will provide sufficient power to operate the satellite during eclipse periods. The battery pack is in two eight-cell sections side by side. The cells of each section are arranged with alternate polarities to minimize the net magnetic moment.

An under-voltage detector is provided to protect the power system by reducing the loads if the battery power falls below 16.8 volts.

Attitude Control System

The satellite will be spin-stabilized about its longitudinal axis. Nominal orbital injection will orient this axis approximately normal to the Earth-Sun line, insuring adequate viewing for the solar experiments. An attitude control system is provided to maintain this orientation within plus or minus 10 degrees.

The control torques will result from the interaction between the geomagnetic field and a field generated in the satellite by passing a suitably polarized current through a coil. Solar-aspect information obtained by sensors is fed to an on-board logic system, which generates the appropriate current polarities and switch-on times. This automatic on-board system is subject to ground command override. Attitude information is obtained, in this case, from the on-board magnetometer and an analog Sun sensor measuring the pointing-error angle.

De-Spin System

The spin rate at satellite separation from the fourth-stage motor will be between 160 and 180 rpm. This will be reduced to the required operational spin rate of 30 to 40 rpm by a yo-yo system, consisting of two equal weights attached to the satellite by tapes. A simple pyrotechnic latch mechanism will release the weights. The assembly will be mounted around the satellite body close to the center of gravity.

Spin-up System

A cold-gas spin-up system will operate on command, with a capability of three spin-ups to maintain the rate between 30 and 40 rpm.

Nutation Damping System

A ball-in-tube nutation damper will be used to reduce or eliminate the spacecraft coning angle. The dampers will have a time constant of about 20 minutes and a small threshold coning angle.

Housekeeping System

Seven voltage, three current, and 10 temperature sensors will monitor the operation of the satellite throughout its life. A sensor will measure the spin rate of the satellite with an accuracy of one percent. The ESRO II system includes telemetry channels allocated to provide information on telemetry and tape recorder performance, as well as monitors to permit verification of command execution.

Thermal Control System

ESRO II is thermally controlled by strictly passive means. The internal spacecraft equipment is thermally coupled to the solar cell panels, whose radiation properties are reasonably well known. Because the spacecraft's attitude control system maintains the spin axis nearly normal to the sunlight, the area exposed to sunlight remains constant. The end covers, which receive no direct solar input, are coated with substances which act to adjust the mean spacecraft temperature to the level desired.

LAUNCH VEHICLE

Scout is a four-stage solid fuel rocket system. Scout S-161 and the ESRO II spacecraft will be set on an initial launch azimuth of 191.949 degrees to obtain a retrograde orbit. The Scout program is managed by NASA's Langley Research Center, Hampton, Va.

The four Scout motors, Algol, Castor, Antares, and FW-4S are interlocked with transition sections that contain guidance, control, ignition, instrumentation system, separation mechanics, and the spin motors needed to stabilize the fourth stage.

Guidance for Scout is provided by an autopilot and control achieved by a combination of aerodynamic surfaces, jet vanes and hydrogen peroxide jets. The launch vehicle is approximately 73 feet long and weighs about 40,000 pounds at liftoff.

Flight Sequence

Event	Time (seconds)
Liftoff	-
First stage burnout	76.1
Second stage ignition	77.9
Second stage burnout	116.8
Third stage ignition	176.8
Third stage burnout	212.7
Spin-up	402.3
Third stage separation	403.8
Fourth stage ignition	408.3
Fourth stage burnout & orbital injection	439.8
Spacecraft separation	739.8

ESRO PROGRAM PARTICIPANTS

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