TubeSat and NEPTUNE 30 Orbital Rocket Programs

Personal Satellites Are GO!

Interorbital Systems
www.interorbital.com

Corporation

Founded in 1996 by Randa and Roderick Milliron, incorporated in 2001

Located at the Mojave Spaceport in Mojave, California

98.5% owned by R. and R. Milliron

1.5% owned by Eric Gullichsen

Initial Starting Technology

Pressure-fed liquid rocket engines

Initial Mission

Low-cost orbital and interplanetary launch vehicle development

Facilities

6,000 square-foot research and development facility

Two rocket engine test sites at the Mojave Spaceport

Expert engineering and manufacturing team

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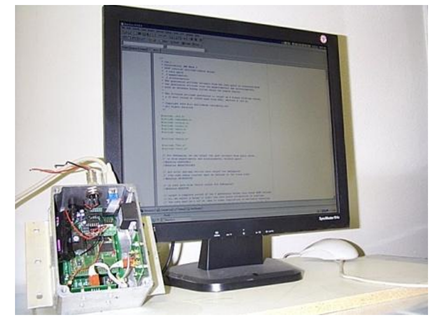
Core Technical Team

Roderick Milliron:	Chief Designer
Lutz Kayser:	Primary Technical Consultant
Eric Gullichsen:	Guidance and Control
Gerard Auvray:	Telecommunications Engineer
Donald P. Bennett:	Mechanical Engineer
David Silsbee:	Electronics Engineer
Joel Kegel:	Manufacturing/Engineering Tech
Jacqueline Wein:	Manufacturing/Engineering Tech
Reinhold Ziegler:	Space-Based Power Systems
E. Mark Shusterman,M.D.	Medical Life Support
Randa Milliron:	High-Temperature Composites

Key Hardware Built In-House

Propellant Tanks: Combining state-of-the-art composite technology with off-the-shelf aluminum liners

Ablative Rocket Engines and Components



Advanced Guidance Hardware and Software

GPRE 0.5KNFA Rocket Engine Test

Manned Space Flight Training Systems

Rocket Injectors, Valves Systems, and Other Metal components

Pressure-Fed Rocket Engines

GPRE 2.5KLMA Liquid Oxygen/Methanol Engine: Thrust = 2,500 lbs.

GPRE 0.5KNFA WFNA/Furfuryl Alcohol (hypergolic): Thrust = 500 lbs.

GPRE 0.5KNHXA WFNA/Turpentine (hypergolic): Thrust = 500 lbs.

GPRE 3.0KNFA WFNA/Furfuryl Alcohol (hypergolic): Thrust = 3,000 lbs.

GPRE 10.0KNHXA WFNA/Turpentine (Hypergolic): Thrust = 10,000 lbs.

Pressure-Fed Sounding Rockets

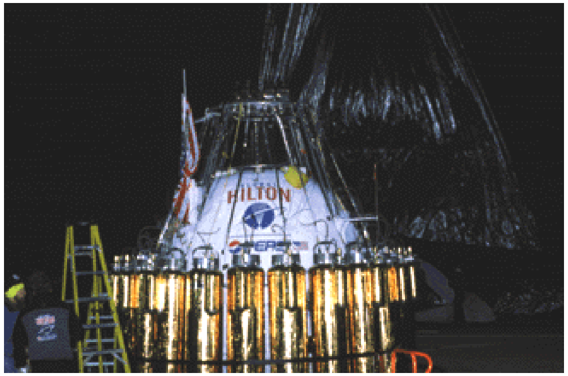
Neutrino: GPRE 0.5NFA Engine

Tachyon: GPRE 3.0KNHXA Engine

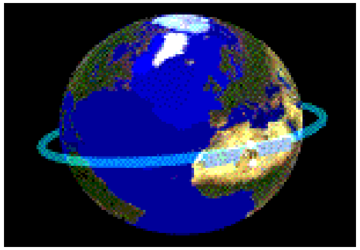
Manned Systems

Dick Rutan’s Global Hilton Project

Helium/Hot Air Balloon System Propane Tanks



Present Mission



NEPTUNE Modular Series Orbital Launch Vehicles

NEPTUNE 30 (30 kg to LEO)
NEPTUNE 1000 (1000 kg to LEO)
NEPTUNE 4000 (4000 kg to LEO)

Orbital Spacecraft

Orbital Expedition Crew Modules (6-person capacity)
Robotic Orbital Supply System (ROSS)

Interplanetary Spacecraft

Google Lunar X PRIZE Lunar Lander
Robotic InterPlanetary Prospector Excavator Retriever (RIPPER)

Satellite Design and Manufacture

TubeSat

Low-Cost Pico Satellite Kit – The TubeSat

Satellite casing and satellite ejection system are constructed from off-the-shelf aluminum tubing
Manufacturing requires minimal machining
Makes use of the latest developments in off-the-shelf electronics
Makes use of highly efficient solar cells (26% efficiency)
Simple satellite ejection system allows TubeSats to be launched one at a time or in groups of 32
Each TubeSat never comes in contact with other TubeSats in a launch group

Low-Cost Dedicated Launch Vehicle – NEPTUNE 30

All TubeSats have primary payload status

The new IOS TubeSat Personal Satellite Kit is a low-cost alternative to the CubeSat

It has three-quarters of the weight and volume of a CubeSat (weight = 0.75 kg or 1.65 lbs)

Still offers plenty of space for most experiments or applications

The price of the TubeSat Kit ($8,000) includes the price of a launch into Low-Earth-Orbit on an IOS NEPTUNE 30 rocket

Since TubeSats are placed into self-decaying orbits (310 km), they do not contribute to the long-term buildup of orbital debris

After a few weeks of operation, they re-enter the atmosphere and burn-up

Launches are expected to begin in the fourth quarter of 2010

TubeSat Components

General Description
Cylinder shaped
Maximum weight: 0.75 kg
Satellite bus or stand-alone satellite

Power
Batteries: lithium ion 3.6 V
Solar Cells: Spectrolab 2.52 V 31 mA (multiples)
Power management board

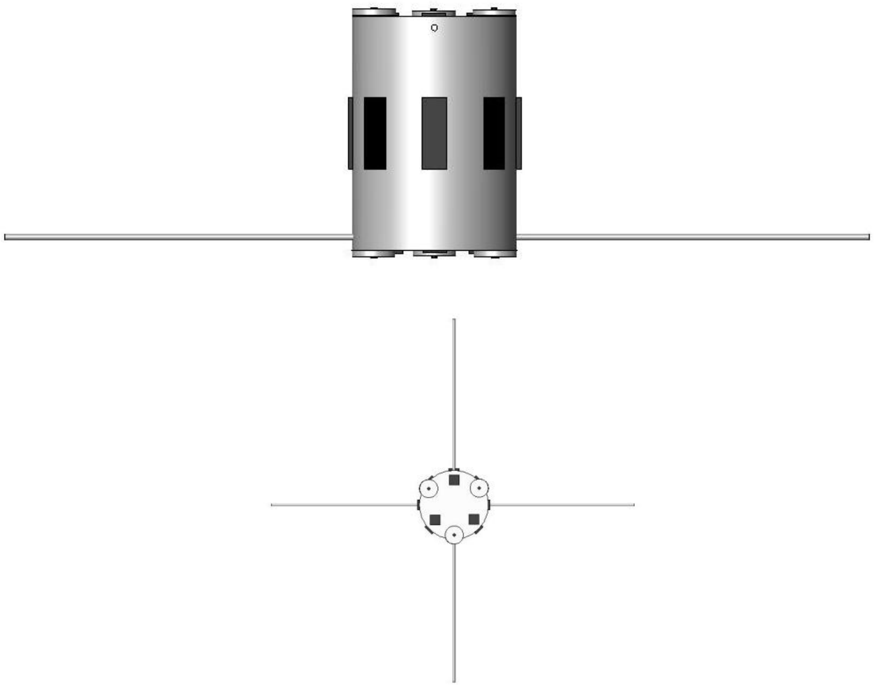
Transceiver Options:
Microhard n425, n920, or n2420
Frequency range: 400 to 450 MHz902 to 928 MHz or 2.4000 to 2.4835 GHz
Voltage: 3.3VDC
Output: 100 mW to 1,000 mW Selectable

Microcomputer Hardware
BasicX-24p
Rogue Robotics uMMC serial Data Module

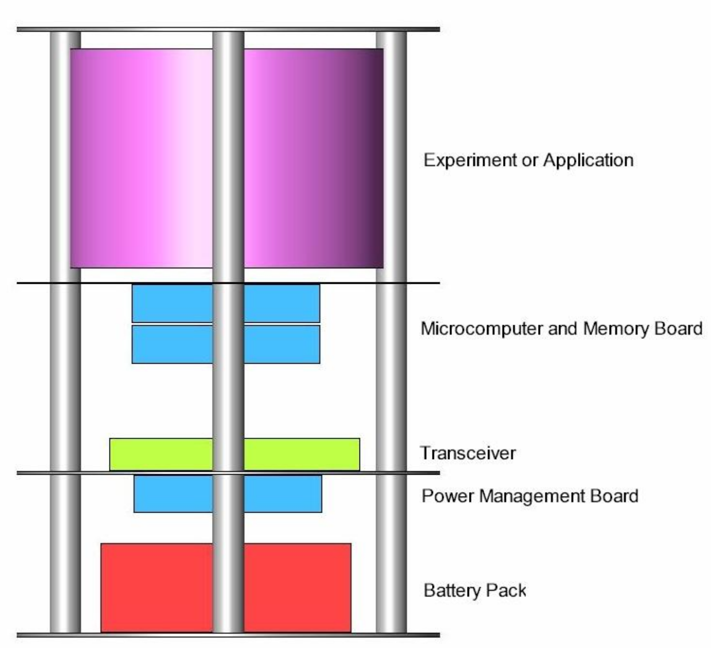
Antennas
Dipole

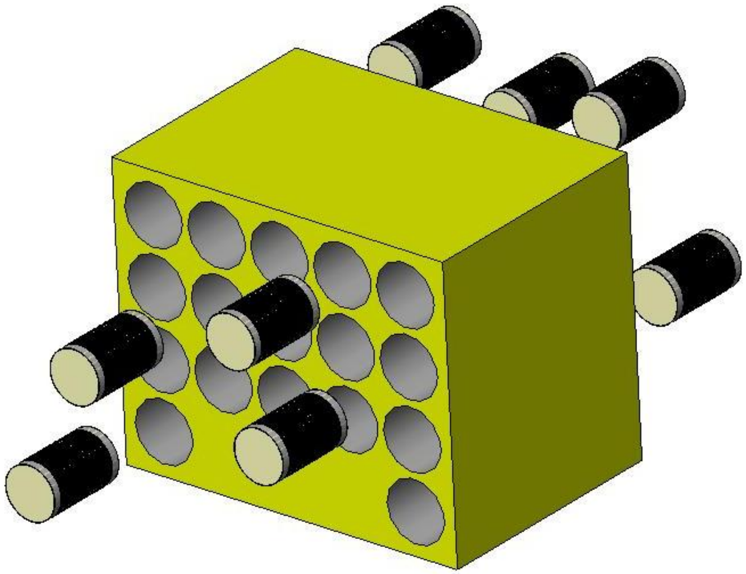
TubeSat Component Layout

Solar Cell and Antenna Placement



TubeSat Component Rack





TubeSat Applications

Earth-from-space video imaging

Earth magnetic field measurement

Satellite orientation detection (horizon sensor, gyros, accelerometers, etc.)

Amateur radio relay

Orbital environment measurements (temperature, pressure, radiation, etc.)

On-orbit hardware and software component testing (microprocessors, etc.)

Tracking migratory animals from orbit

Testing satellite stabilization methods

Biological experimentation

Automatic simple, repeating “message from orbit” transmission

Private e-mail

The builder can add any type of electronics or software application he or she wishes as long as it satisfies the volume and mass restrictions. These restrictions provide a unique intellectual challenge for the application designer.

Customer Support

Call-in or e-mail tech support (Interorbital and/or University partners)

Dedicated support page at **www.tubesat.org** (coming soon)

On-line password-accessed users' forums

Constantly updated FAQs

Quarterly (or more frequent) user's workshops on-ground or on-line

Documentation: NEPTUNE 30 Rocket User's Manual
TubeSat Kit User's Manual


IOS NEPTUNE 30
IOS NEPTUNE 30


SEA STAR

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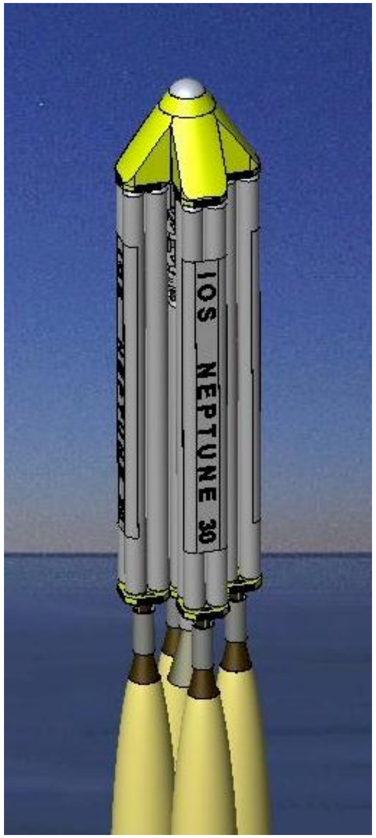
IOS Unique Launch Vehicle Technologies



Environmentally Safe, Storable, High-Density Hypergolic Propellants

White Fuming Nitric Acid (WFNA) and Turpentine/Furfuryl Alcohol

Instantaneous chemical ignition eliminates need for complex ignition system

Low-Cost Propellant Tank Technology

Off-the-shelf aluminum tank liners and tank ends

State-of-the-art composite tank reinforcement technology

Blowdown Propellant Feed

Eliminates the need for turbopumps or a separate pressurant system

Unique Rocket Engine Injector

Automatically maintains propellant jet flow rate in blowdown mode

Maximizes specific impulse over a wide pressure input range

Differential Throttling Rocket Steering Technology

Allows all rocket engines to be fixed

Eliminates complex gimballing or fluid injection steering systems

There are no steering penalties such as jet-vane drag loss

Rockets with throttleable engines don't require hold downs

Modular Rocket System – The Common Propulsion Module (CPM)

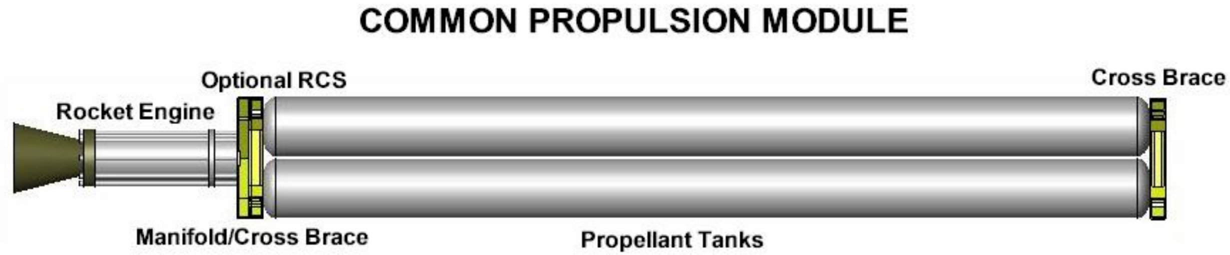
Only small rocket engines have to be developed

Small rocket engines cost less to develop

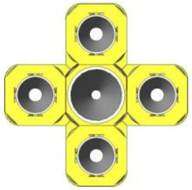
Small diameter tanks don't require slosh baffles

Individual rocket modules can be flight tested at a very low cost

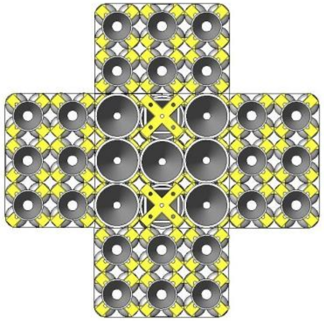
Launch vehicle can be customized for any payload



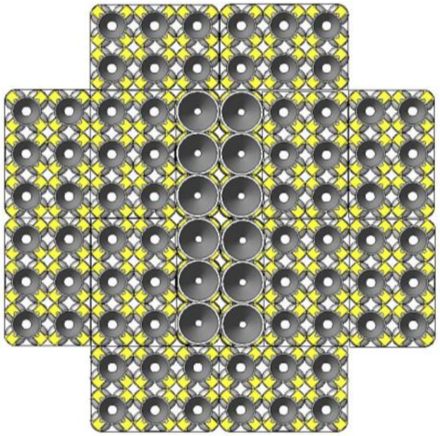
The Common Propulsion Module (CPM) is the Basic Building Block of all Neptune Modular Series Rockets. The CPMs can be clustered together in multiples for both small and large orbital and interplanetary payloads. Clustered engines have been in use since the beginning of the race for space. Below is an aft view of the Russian Soyuz rocket with a cluster of 32 engines. The Soyuz rocket is the most reliable rocket in the world.



NEPTUNE 30

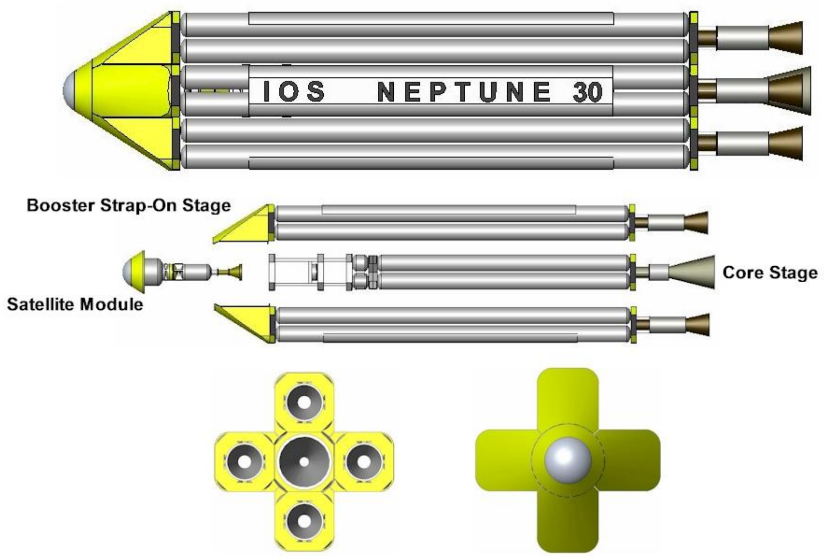


NEPTUNE 1000



NEPTUNE 4000

Neptune 30 Modular System



3 stages

31 feet (9.4 m) in length with a maximum width of 6.2 feet (1.89 m)

The GLOW is 18,700 pounds (8,841 kg)

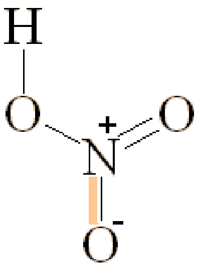
Five (5) Common Propulsion Modules

Satellite Module has a solid kick motor (Thrust = 1,500 lbs.)

Booster Thrust = 4 X 10,000 lbs = 40,000 Lbs SL (177,920 n)

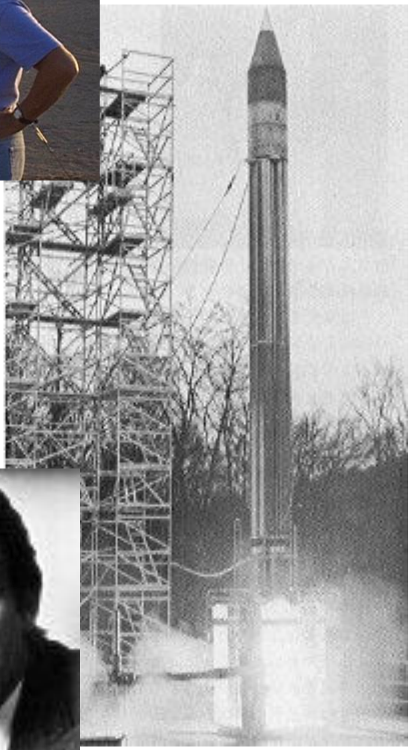
Nitric Acid: Von Braun's Oxidizer of Choice

Wernher von Braun: NASA, OTRAG



Hypergolic

Lutz Kayser: OTRAG and Rod Milliron: Interorbital



Lutz Kayser: OTRAG

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NEPTUNE 30: Pressure-Fed Propellants

Saphir with Emeraude Booster Stage

High-density (1.51) storable oxidizer: White Fuming Nitric Acid (WFNA)

Storable fuels: Turpentine and Furfuryl Alcohol

WFNA is corrosive but non-flammable and non-toxic

Long-term Storage possible in the propellant tanks

Turpentine furfuryl alcohol are are denser than kerosene

Insulated storage tanks not required

Orbital launch vehicle history (Diamant A rocket)

The pressure-fed Diamant A rocket succeeded in placing a satellite into orbit on its first try in November of 1965

Excerpt of a CPM Booster rocket engine test (expansion to ambient) at IOS Alpha Test Site

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NEPTUNE 30 Successes

Rocket engine system components have already been successfully tested

Propellant tank components have been successfully tested

Guidance and Control System has been successfully bench tested

Test infrastructure is already in place (vertical test stand and test site hardware)

Propellant and COTS component suppliers have been identified

Launch site secured on an island in the South Pacific Kingdom of Tonga

Design and manufacturing team is already in place

No existing competition at this price, value, launch frequency, or performance level

Ground Systems

Ground transport system
Launch platform
Rocket lift system
Propellant loading system
Launch control system
Ground communications system

General Launch Procedure

Rocket Hardware

Rocket engine/motor performance in flight
Reaction control system
Rocket engine throttling system
Rocket structural characteristics in flight
Rocket stability in flight
Grid-fin effectiveness criteria in flight
Payload ejection system
Recovery system
Rocket staging system
Spin stabilization

Guidance and Control

Inertial measurement unit
Guidance computer
Guidance software

Rocket Communication Systems

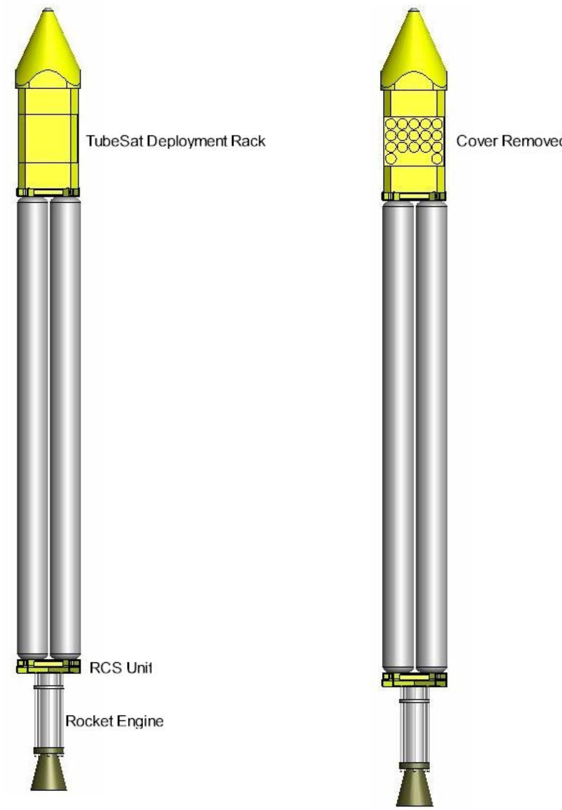
Transceivers
Antennas

Common Propulsion Module (CPM) Flight Tests

Launch 1:
Location: Mojave Test Area
Rocket: Common Propulsion Module
Altitude: 50,000 feet (15.3 km)
Payload: TubeSats and TubeSat deployment system or other
Purpose: Test systems described under Neptune 30 Test Program
Time Frame: Jan/Feb 2010

Launch 2:
Location: Mojave Test Area
Rocket: Common Propulsion Module
Altitude: 50,000 feet (15.3 km)
Payload: TubeSats and TubeSat deployment system or other
Purpose: Test systems described under Neptune 30Test Program with modifications if required
Time Frame: April/May 2010

Launch 3:
Location: Mojave Test Area
Rocket: Satellite Module with solid rocket motor
Altitude: 20,000 feet (6.1 km)
Payload: TubeSats and TubeSat deployment system or other
Purpose: Test spin stabilization system
Time Frame: June 2010



NEPTUNE 30 Flight Tests

Launch 1:

Location:	Mojave Test Area or Delamar Dry Lake
Rocket:	NEPTUNE 30 with dummy core stage and Satellite Module
Altitude:	50,000 feet (15.3 km)
Payload:	TubeSats and TubeSat deployment system or other
Purpose:	Test systems described under Neptune 30 Test Program
	Test Satellite Module spin-up and deployment system (with recover
	Test differential thrust steering system
	Test rocket stability at Mach 1 and at maximum dynamic pressure
	Test staging system
Time Frame:	August/September 2010

Launch 2:

Location:	Tonga Spaceport
Rocket:	NEPTUNE 30
Altitude:	312 km (193.3 mi)
Payload:	32 TubeSats and TubeSat deployment system or other
Purpose:	First orbital satellite launch
Time Frame:	November/December 2010

Flight Test Payload Options

Common Propulsion Module, Satellite Module, or Staging Test

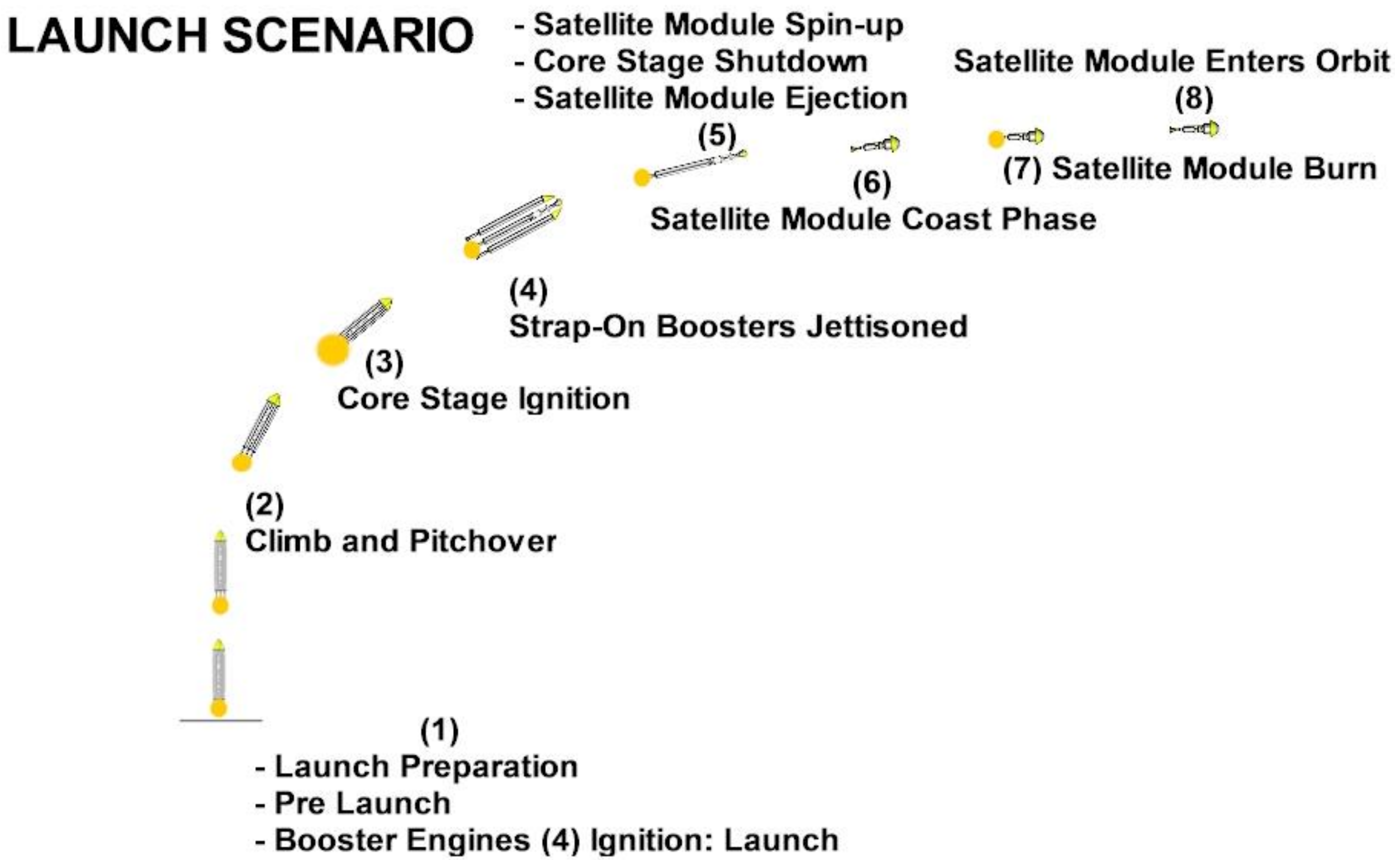
Maximum Payload:	30 kg
Payload Type:	Up to 32 TubeSats
	Up to 15 CubeSats
	Single Payload

CPM test vehicle is recoverable

Orbital Launch

Maximum Payload:	30 kg
Payload Type:	Up to 32 TubeSats
	Up to 15 CubeSats with 5 P-Pods
	Single satellite with deployment system

NEPTUNE 30: Launch Scenario

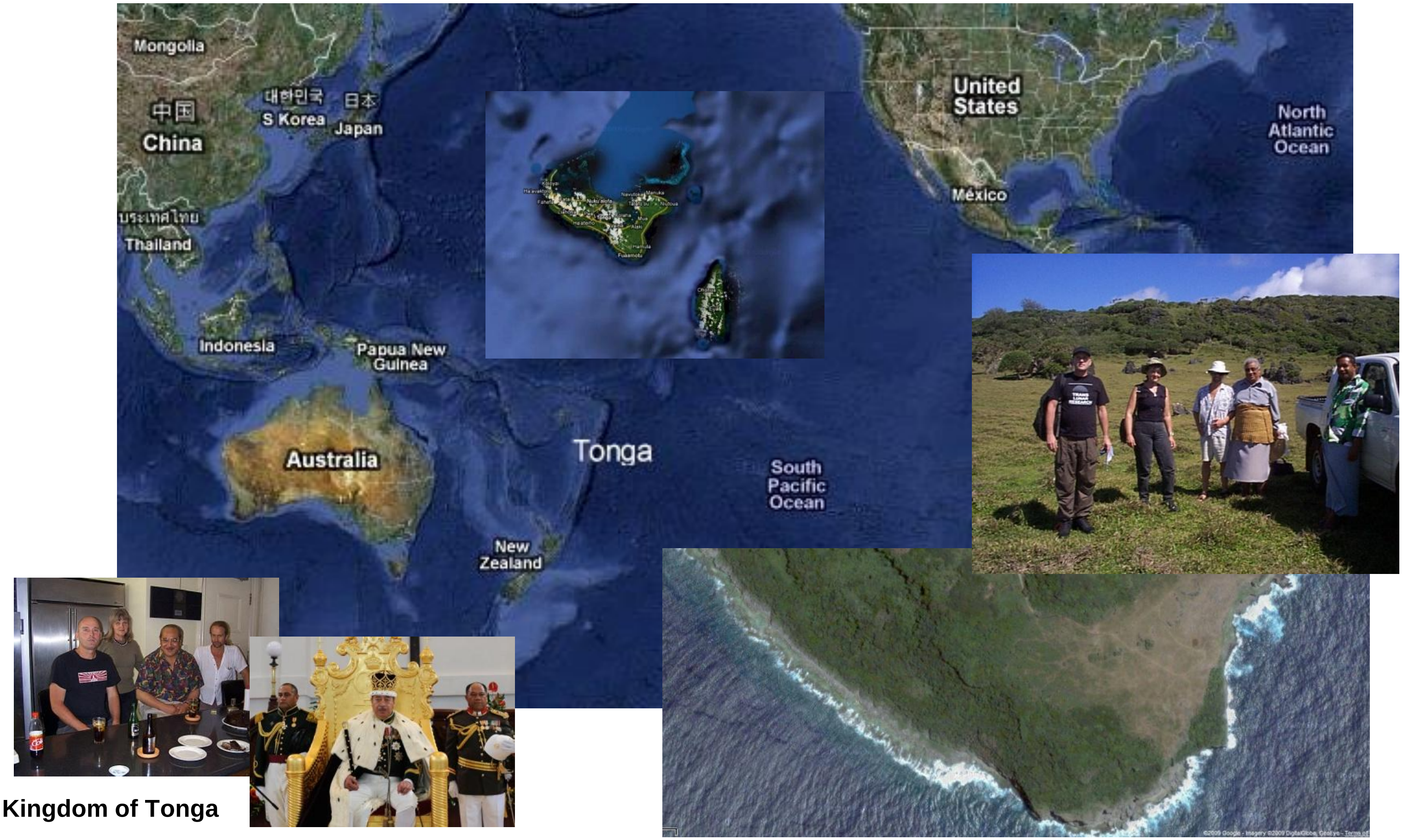


Launch Licenses & Permits

FAA/AST launch license for orbital launches: in process

IOS held one of the first Commercial Space Transportation Launch Licenses (LLS 00-054, October, 2000) for Tachyon sounding rocket

Obtained: Two active 365-day FAA waivers for pre-orbital flight tests to 50,000 ft. at Mojave Test Area, California, and at Delamar Dry Lake, Nevada



Kingdom of Tonga

Latitude: 21.45 degrees S

Longitude: 174.90 degrees W

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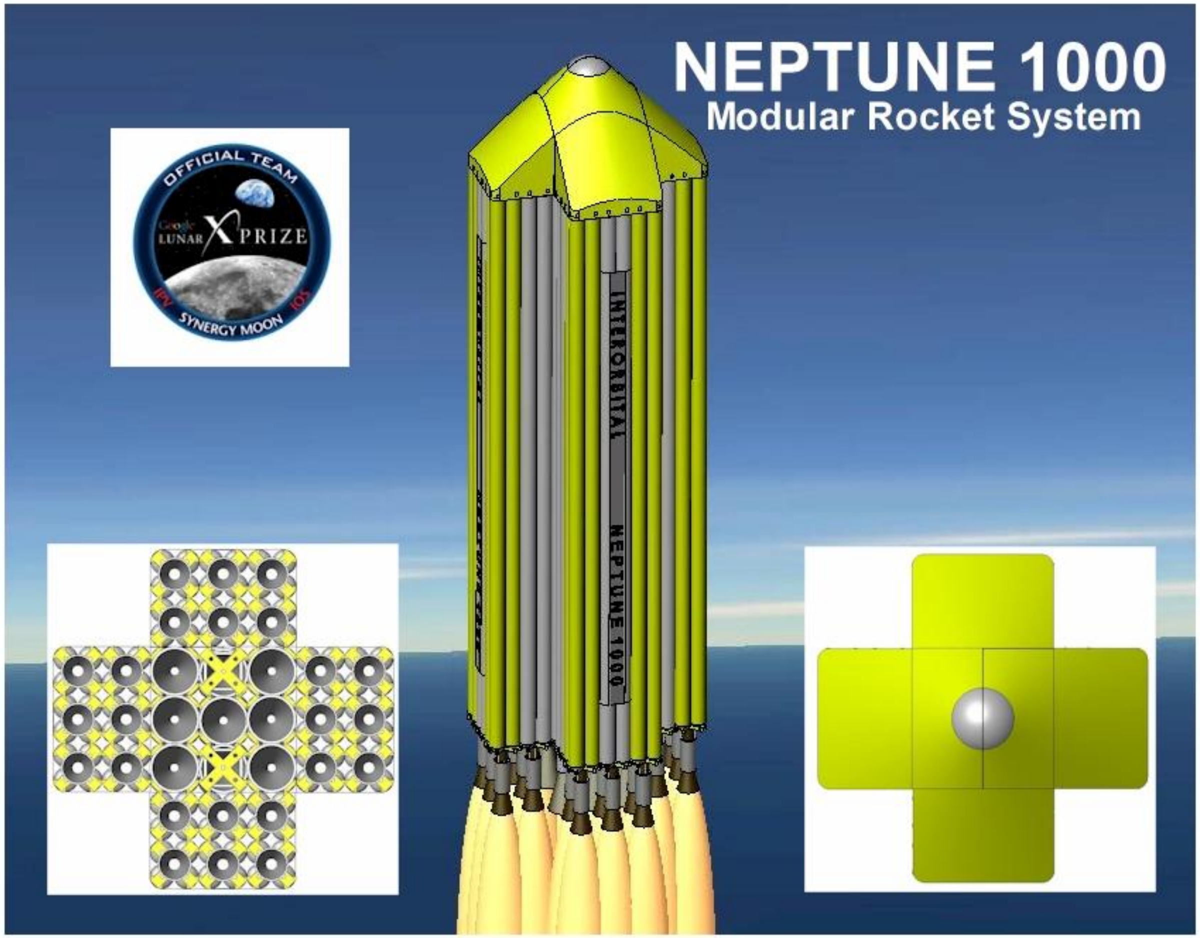
NEPTUNE 1000: Moon Rocket



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