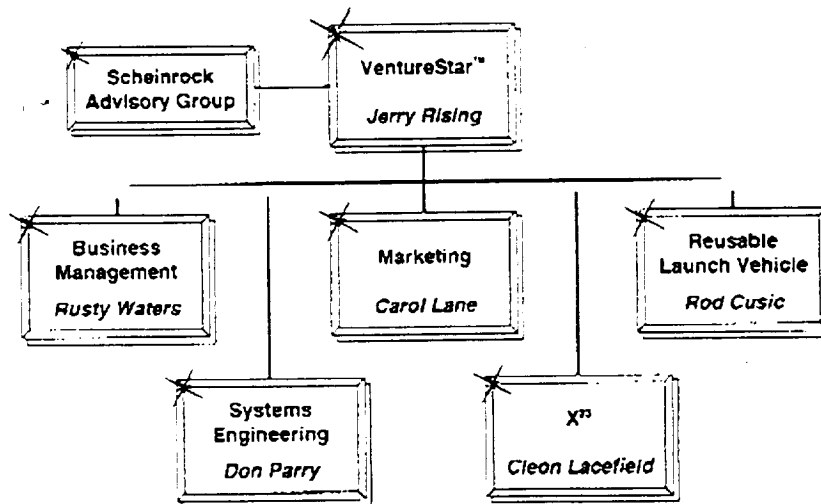IN-16
046 458

The X-33/VentureStar™ Program

Why VentureStar ??

- Expendables cost too much
- Commercial space market is growing
- Meets NASA's goals
- Users want fast ground turnaround
- Users want quick access to space
- "Offline" payload processing saves time
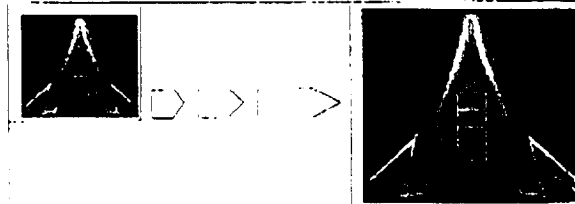- Low cost to space enables new markets
- Because we can!!
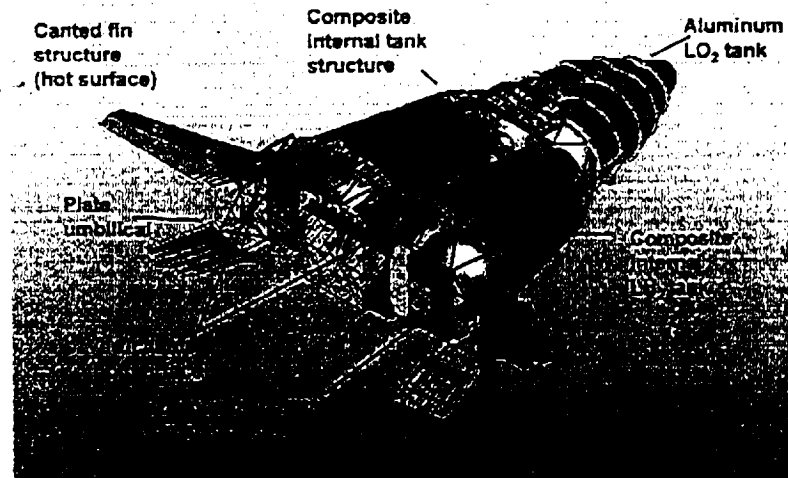
VentureStar™ Organizational Structure

Scheinrock Advisory Group

VentureStar™
Jerry Rising

Business Management
Rusty Waters

Marketing
Carol Lane

Reusable Launch Vehicle
Rod Cusic

Systems Engineering
Don Parry

X³³
Cleon Lacefield

X-33 Flight Tests Build Credibility for VentureStar™
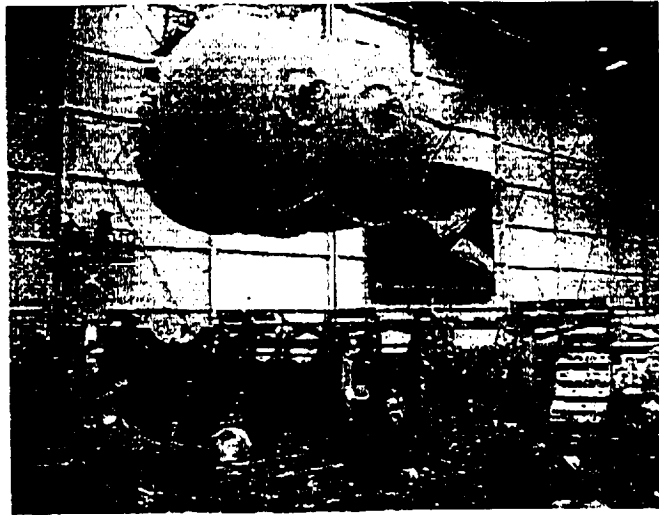
Objectives demonstrate:

- Lifting body/aerospike engine configuration to predict VentureStar™ flight performance
- Prediction of engine thrust vectoring and throttling dynamics
- Thermal performance/structural integrity of the thermal protection system
- Autonomous flight management from launch, entry, approach and landing through rollout and vehicle safing
- Payload environment
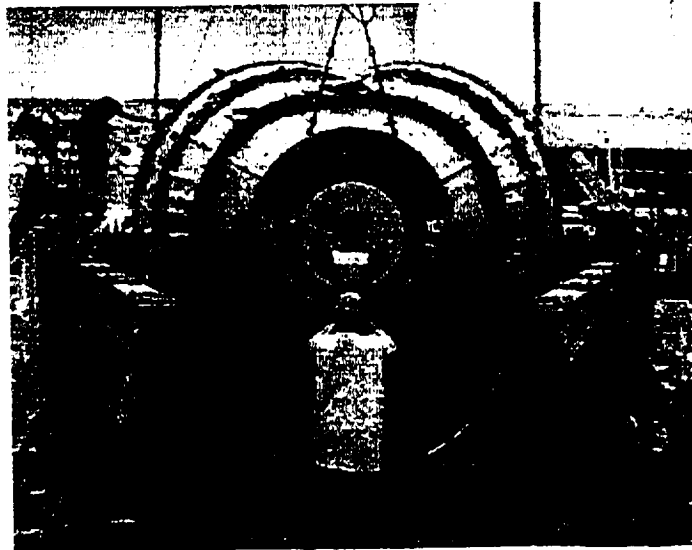- Simplified ground operations

X-33 Isometric Cutaway

Canted fin structure (hot surface)

Composite internal tank structure

Aluminum LO₂ tank

Moving I.O. Tank for Assembly into Vehicle
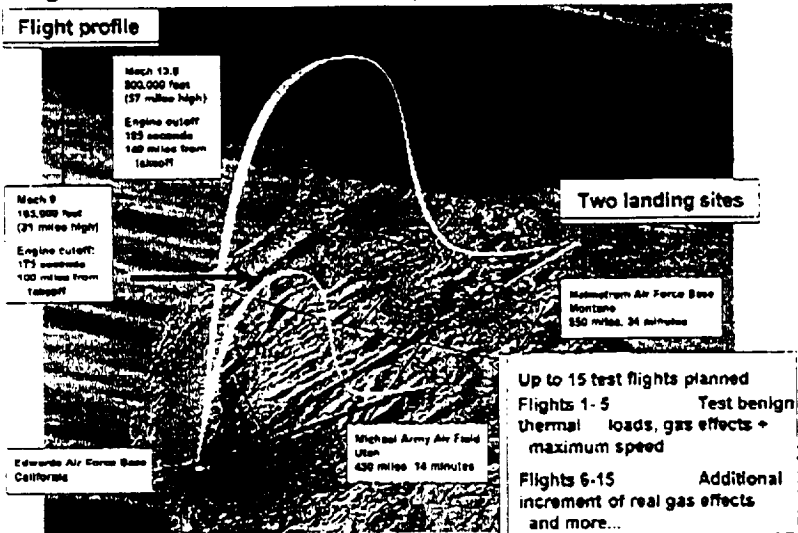

I.O. Tank in Position in Nose of Vehicle

Expanding the X-33 Envelope

Higher – Faster – Farther Starting in 1999

Flight profile

Mach 13.8
800,000 feet
(57 miles high)

Engine cutoff
195 seconds
160 miles from
takeoff

Mach 9
163,000 feet
(31 miles high)

Engine cutoff:
175 seconds
100 miles from
takeoff

Two landing sites

Malmstrom Air Force Base
Montana
550 miles, 34 minutes

Edwards Air Force Base
California

Michael Army Air Field
Utah
450 miles, 14 minutes

Up to 15 test flights planned

Flights 1- 5   Test benign
thermal   loads, gas effects +
  maximum speed

Flights 6-15   Additional
increment of real gas effects
  and more...

X-33 Aerial Launch Site View

X-33/VentureStar™ Program

Build investor and customer confidence and technical understanding

X-33
Half-scale suborbital technology demonstrator to verify key technologies to reduce risks and costs of VentureStar™

VentureStar™
Fully operational launch service provides for satellites and payloads to low-Earth orbit and beyond

Phase II

| 1996 | 1997 | 1998 | 1999 | 2000 |
First flight
X-33 Vehicle
Single-stage-to-orbit technology — RLV Technology
• Full-scale design
• Prototype engine
• Composite liquid oxygen tank

Phase III

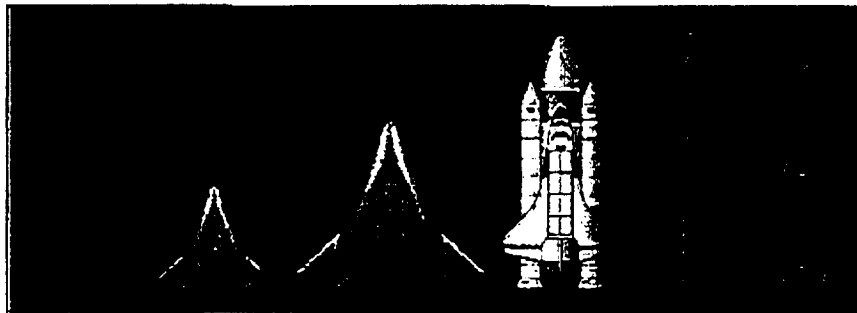| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
Decision to proceed with VentureStar™
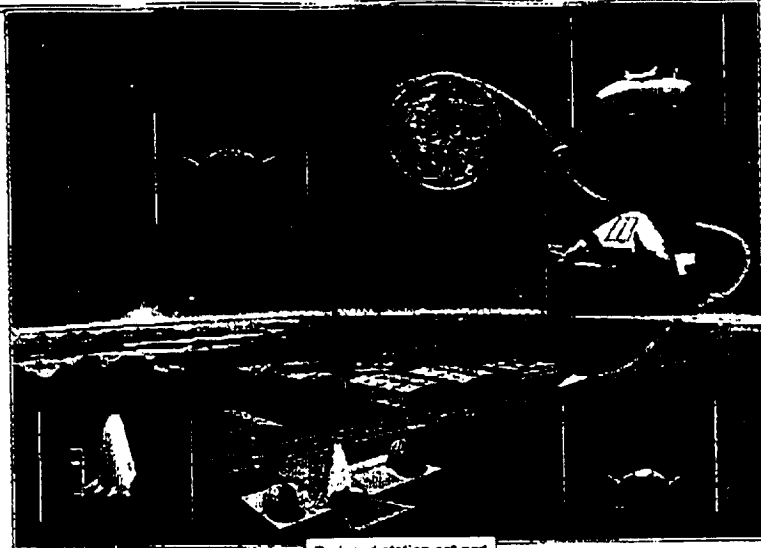Full-scale development
NASA Transportation decision
First flight
Flight test — Revenue service

VentureStar™ Comparison

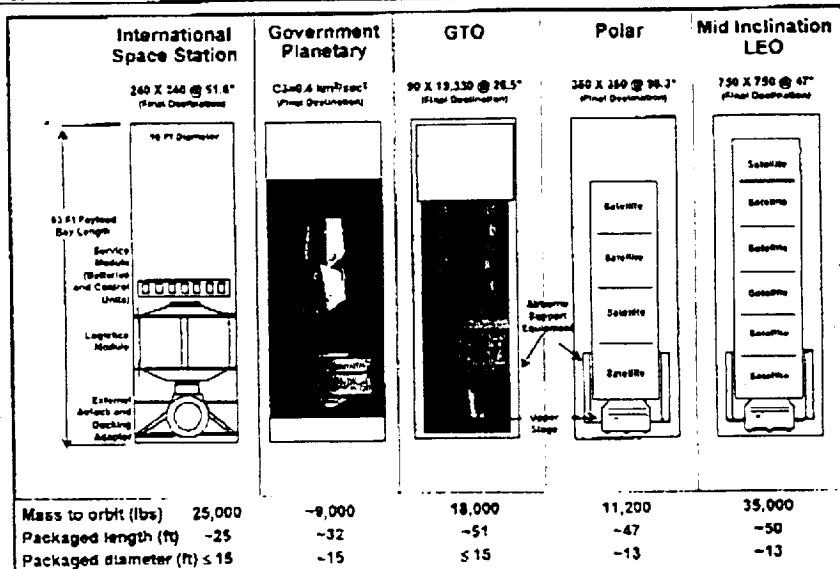|	X-33	VentureStar™	Space Shuttle	Proton D-1e	Ariane V
Weight	273K lb	2.6M lb	4.5M lb	1.6M lb	1.6M lb
Length	69 ft	144 ft	184 ft	188 ft	169 ft
LEO Payload (100 nm/28.58°)	N/A	56,000 lb	51,000 lb	46,000 lb	39,600 lb
Bay size	N/A	15 x 53 ft	15 x 60 ft	13.5 x 48 ft	14.7 x 49.7 ft
Propulsion	2 J-2S aerospikes	7 RS2200 aerospikes	3 SSME bells • 2 solids	6 single-chamber liquids	1 bell • 2 solids

VentureStar™ Mission Concept

Reduced station set ped
Aircraft-like operations

Customer Payload Requirements

	International Space Station	Government Planetary	GTO	Polar	Mid Inclination LEO
Mass to orbit (lbs)	25,000	~9,000	18,000	11,200	35,000
Packaged length (ft)	~25	~32	~51	~47	~50
Packaged diameter (ft)	≤ 15	~15	≤ 15	~13	~13

Lowest Cost to Customers

Lowest
craft-like operations
to

Fewer Parts	Certifiable Vehicle	Easily Maintained
No Staging	No Throwaway Systems	Flexible Customer Service
Increased Reliability	Lower Insurance Rates	Parallel Payload & Vehicle Processing

Vehicle Features

Composite tanks and structure

Linear aerospike engine

Robust metallic thermal protection system

Lifting body

Automated operations
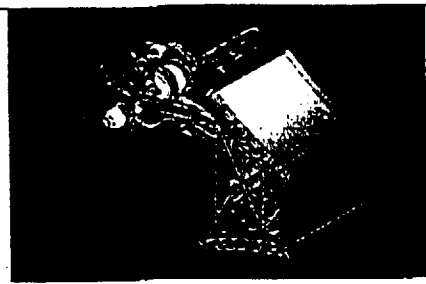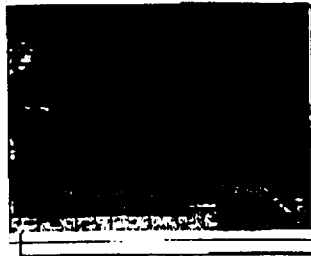
Containerized payload

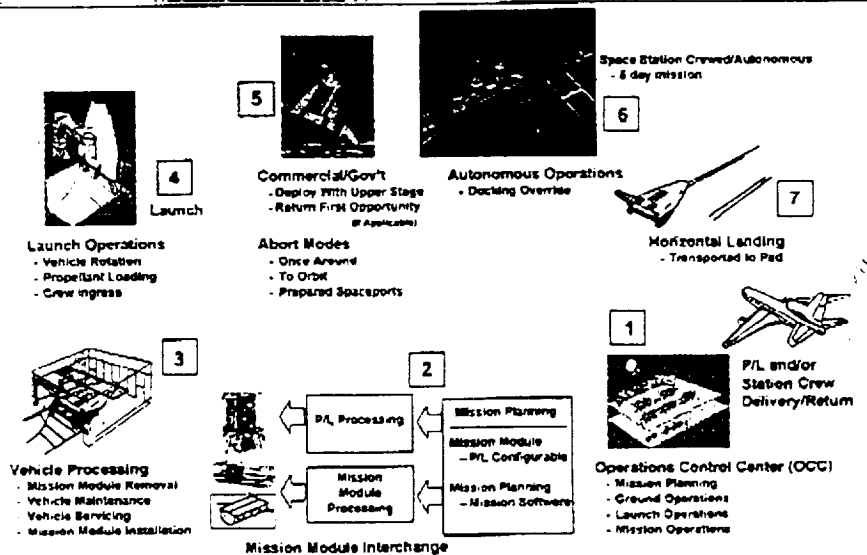Convergence of these maturing technologies enables reliable, low-cost access to space

Linear Aerospike Engine

Extensive testing + performance and integration
advantages = medium risk with high potential payoff

Runway-to-Pad-to-Orbit Operations

5 Commercial/Gov't
- Deploy With Upper Stage
- Return First Opportunity
(if Applicable)

Autonomous Operations
- Docking Override

6 Space Station Crewed/Autonomous
- 5 day mission

4 Launch

Launch Operations
- Vehicle Rotation
- Propellant Loading
- Crew Ingress

Abort Modes
- Once Around
- To Orbit
- Prepared Spaceports

7 Horizontal Landing
- Transported to Pad

3 Vehicle Processing
- Mission Module Removal
- Vehicle Maintenance
- Vehicle Servicing
- Mission Module Installation

2 P/L Processing

Mission Planning

Mission Module
— P/L Configurable

Mission
Module
Processing

Mission Planning
— Mission Software

Mission Module Interchange

1 P/L and/or
Station Crew
Delivery/Return

Operations Control Center (OCC)
- Mission Planning
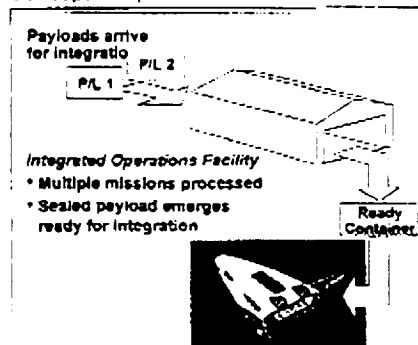- Ground Operations
- Launch Operations
- Mission Operations

VentureStar™ Encapsulated Payload Mission Module

* Payload integration & parallel processing of multiple missions outside RLV
* Includes structure, thermal environment, power, and communications
* Provides flexible mission scheduling & manifesting
* Standard payload interface to RLV

* Encapsulated payload incorporates lessons learned from STS / ELV
* Near term focus: Incorporate ISS & commercial customer requirements

Concept of Operations

Payloads arrive for integratio

P/L 2
P/L 1

Integrated Operations Facility
* Multiple missions processed
* Sealed payload emerges ready for integration

Ready Container

Parallel processing of encapsulated payloads are key to supporting VentureStar increased flight rate

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VentureStar™ Operations - 7 Day Turnaround

* Designed for operability
* Robust vehicle design and operational concept enables repeatable, simplified, and automated turnaround processing
* Single Stage, horizontal processing with front-end RM&S + lessons learned incorporated
* Circa 2000 + fault detection / reconfiguration / prognostics
* Off line encapsulated payload module integration
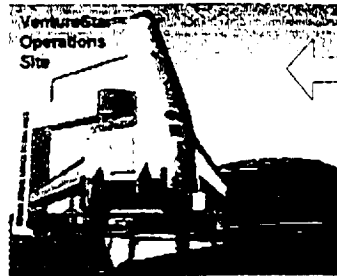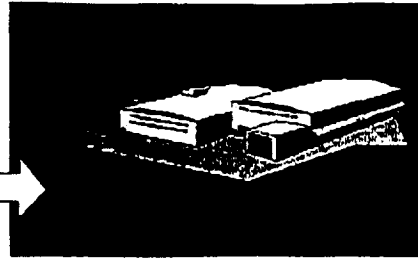* "Lock & Load" payload module to vehicle integration
* Automated mission planning

7 Day Turnaround

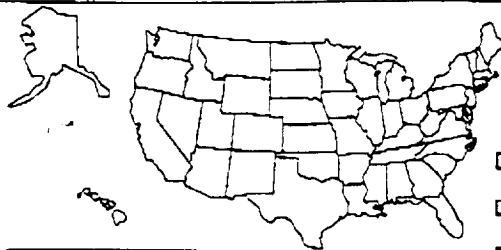| Activity	1	2	3	4	5	6	7
Wheels Stop	▽						
Runway Operations							
Pad Operations		⎯					
Safing Operations							
Maintenance							
Payload Integration							
Prelaunch Prep							
Propellant Load / Launch Operations							
Launch Flight							∨

Complex system designed to enable simple operations

VentureStar™ Operations Concepts
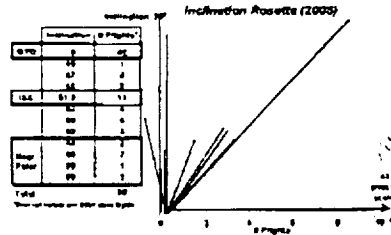
Payload arrives

Spaceport Selection Activity

Financing Contribution

- Spaceport Facilities
- Business Incentives
- Equity
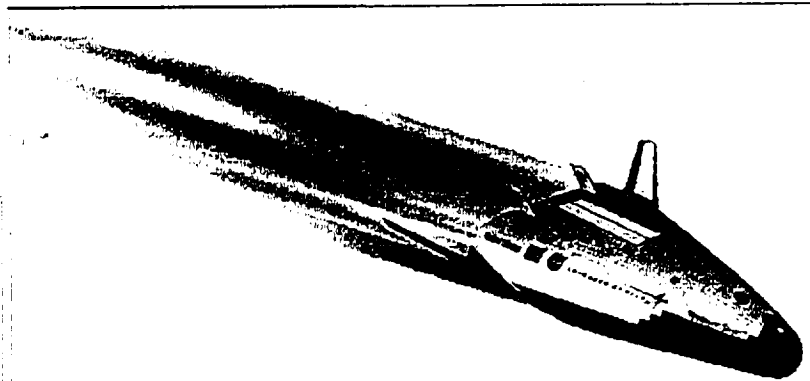- Market Share/ Investors
- Other

- **Interest Expressed by Groups from Eighteen States**
- **1st Site selection scheduled for end of 1999**
- **15 states submitted proposals**

In Closing .....

- **•Flight rate** - up to 40 flights per year
  7 day standard turnaround, 2 day quick turnaround
- **• Reliability** - .9998 vehicle safe recovery
- **• Orbits** - LEO, MEO, GEO, ISS
- **•Payload return capability**
- **• First flight in 2004**

Price, Flexibility, and Reliability!

For more information, visit our web site at
www.venturestar.com