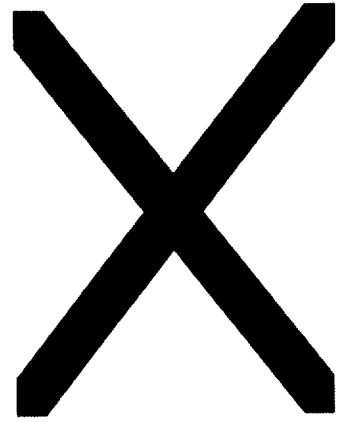
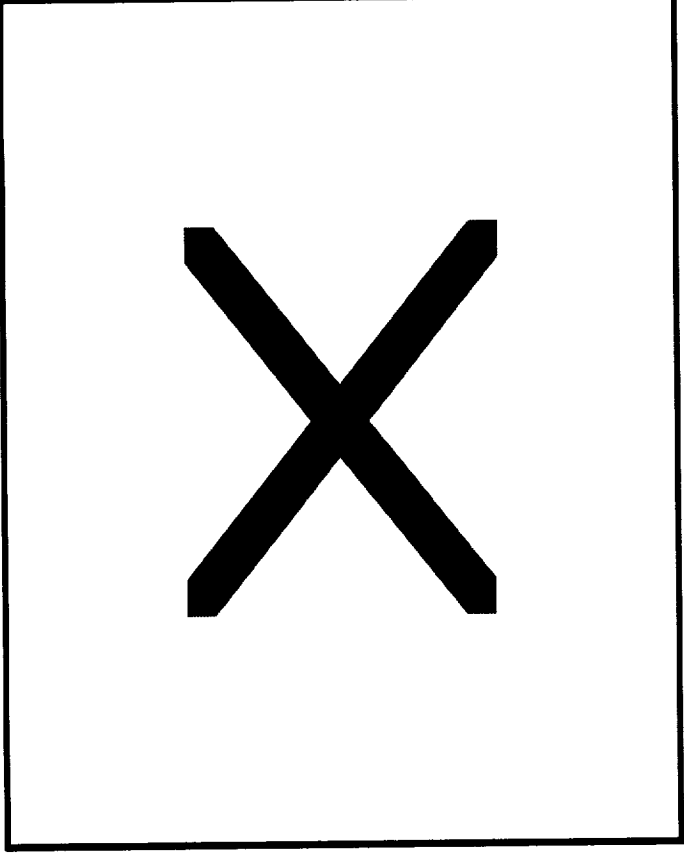


19P

The X-33 Program Update

Charlie Dill, X-33 Assistant Program Manager



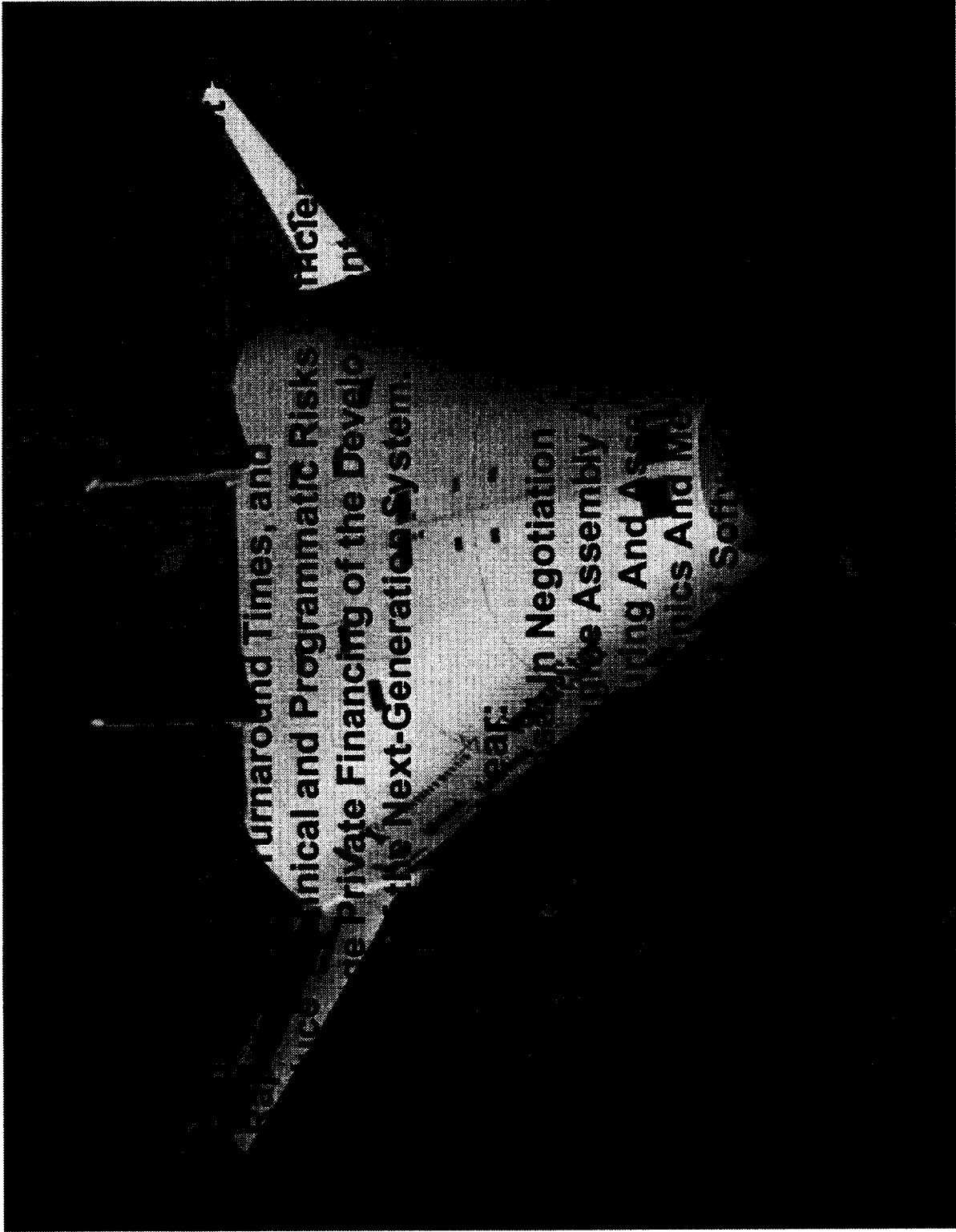
**ST Day 2000:
Risk Reduction
for the
Next Generations**

Oct. 11 - 12, 2000

- ◆ **Program Objectives and Plans**
- ◆ **X-33 Configuration**
- ◆ **Technologies**
- ◆ **X-33 Assembly and Test Status**

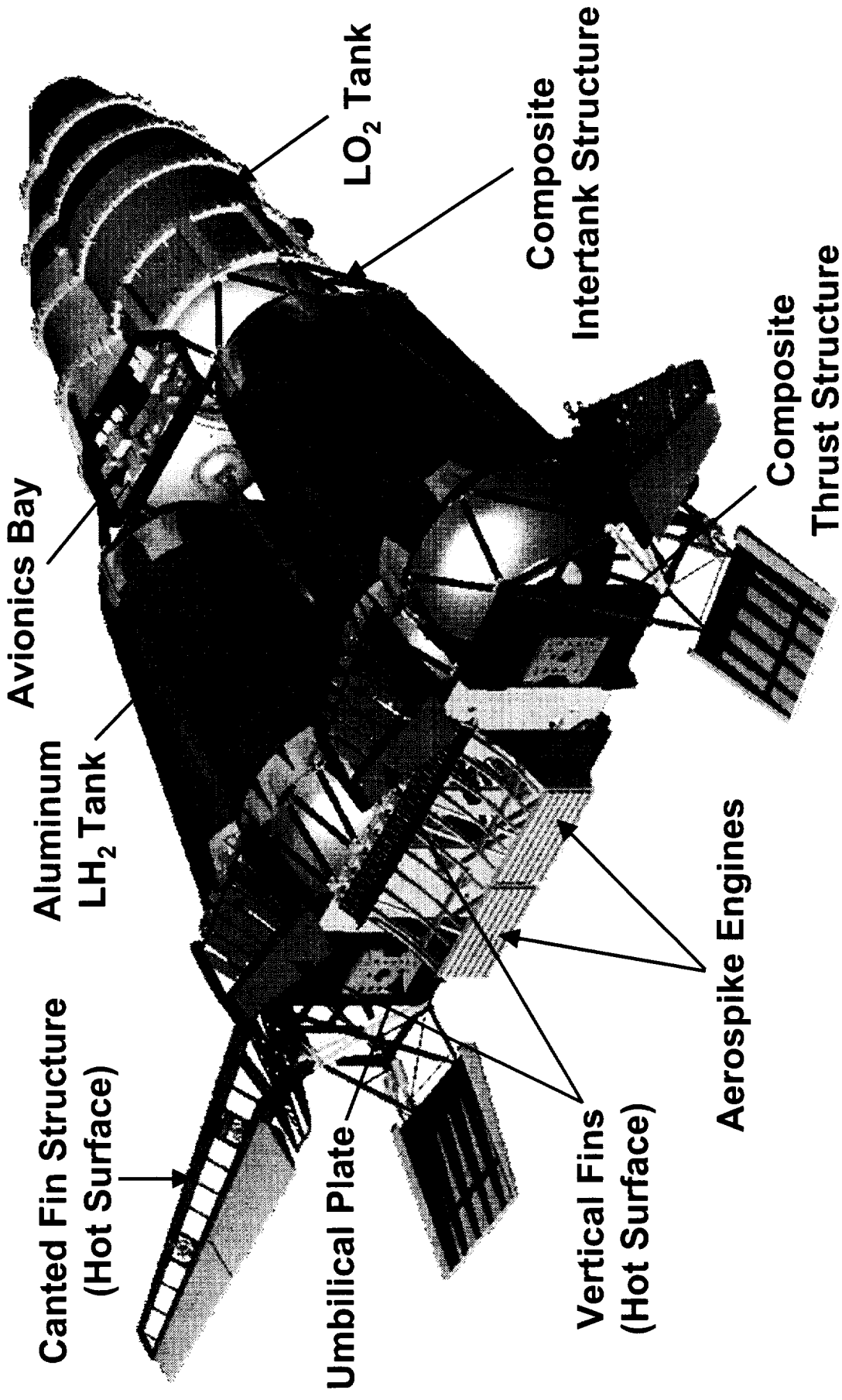
“ST Day 2000: Reducing Risk for the Next Generations” - X33 Update

Outline



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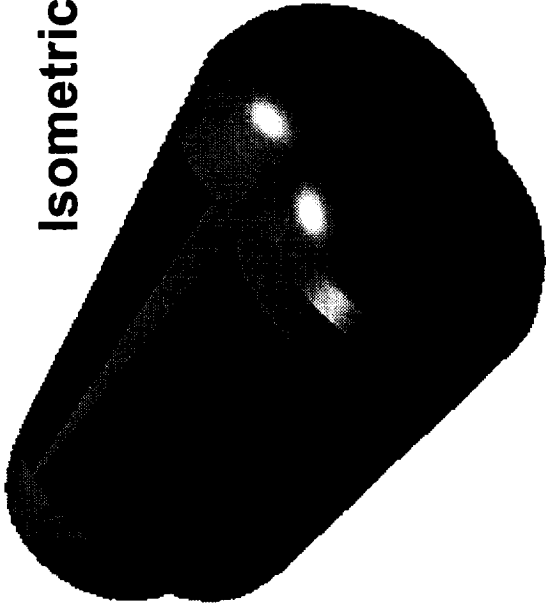
Program Overview



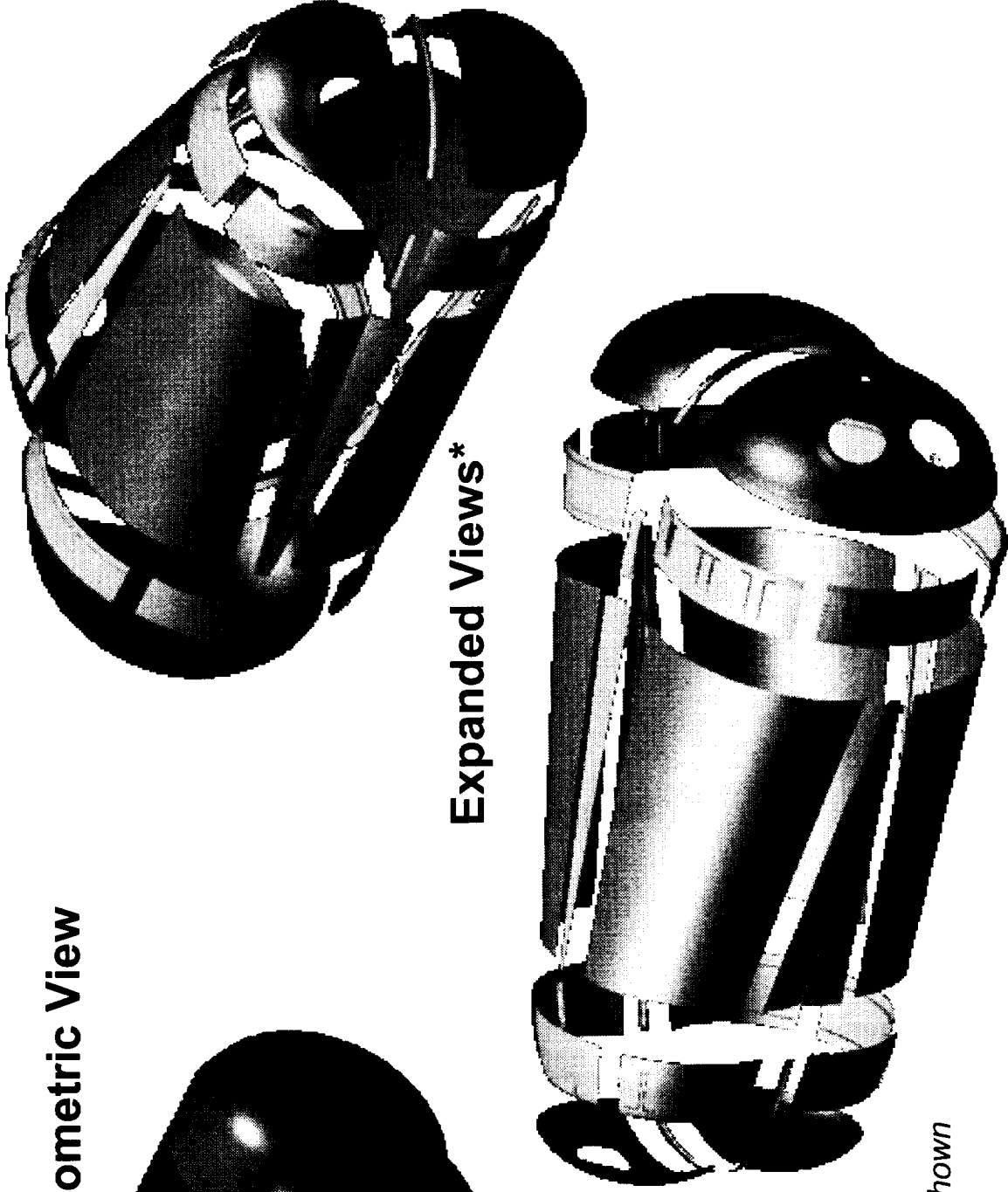
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X-33 Elements

Isometric View



Expanded Views*

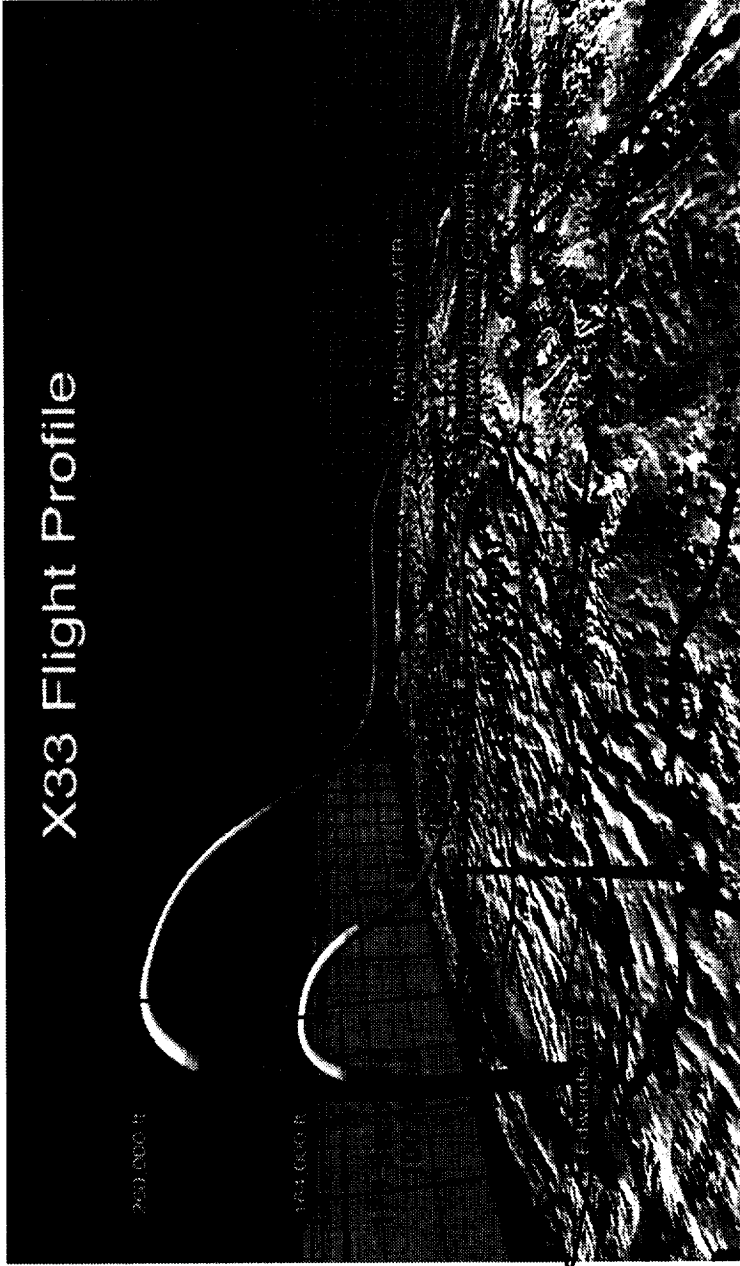


**Internal Septums Not Shown*

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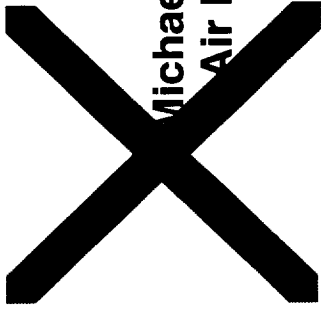
AI LH₂ Tank Design

Aircraft-like Operations: Two Seven-Day Turnarounds and One Two-Day Turnaround During Flight Test Series



X-33 Flight Profile

**Malmstrom
AFB**



**Michael Army
Air Field**

**Edwards
AFB**



- | | | | |
|-----------------|--|---------------------|---|
| Flight 1 | Benign Thermal and Structural Loads | Flight 6 | Additional Increment of Real Gas Effects |
| Flight 2 | Intermediate | Flight 7 | Same Additional Increment |
| Flight 3 | Real Gas Effects | Flights 8-15 | Margin to Repeat Specific Flight Profiles, Data Points |
| Flight 4 | Transition From Laminar to Turbulent Flow | | |
| Flight 5 | Max Speed | | |

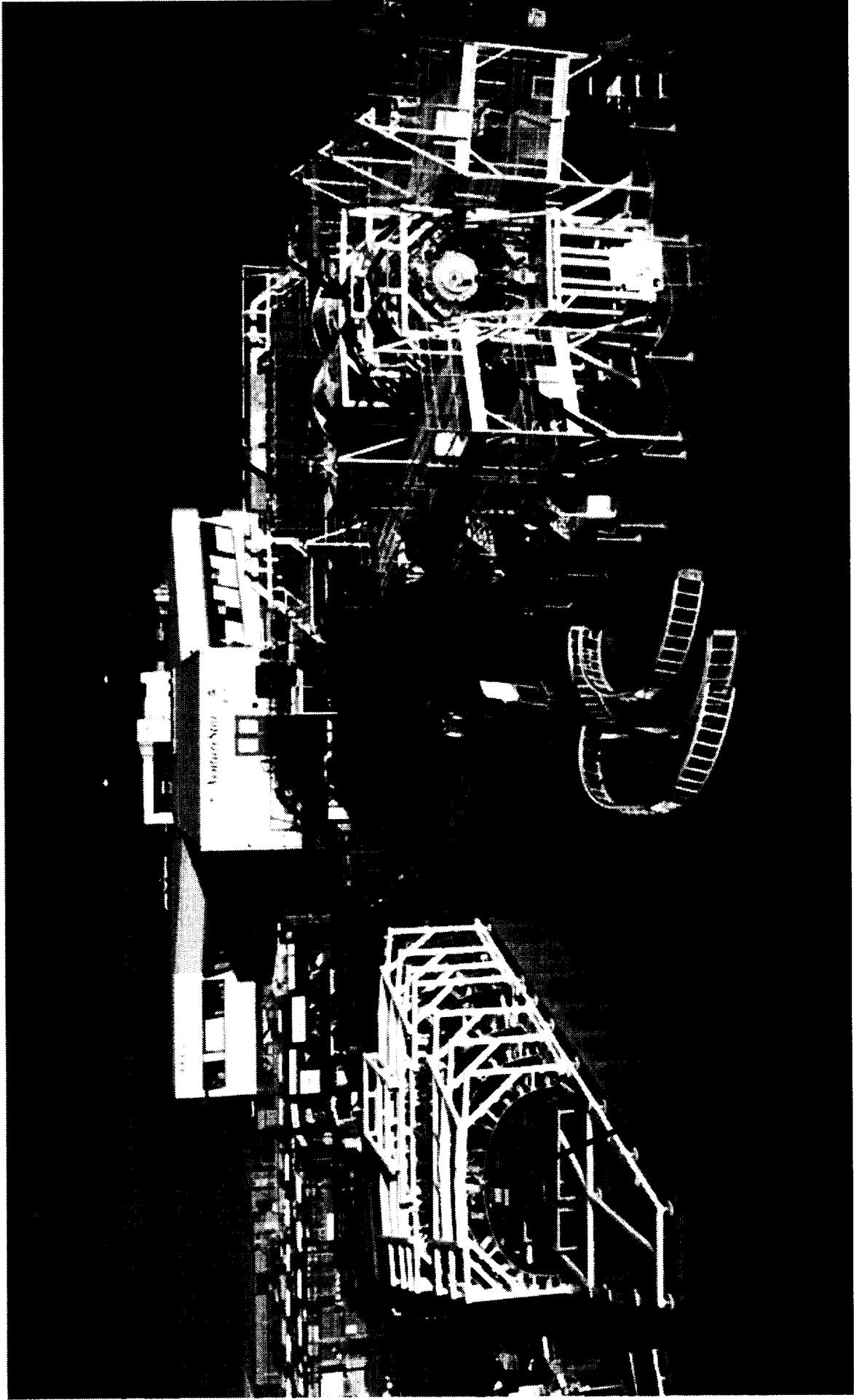
"ST Day 2000: Reducing Risk for the Next Generations" - X-33 Update

Expanding The X-33 Envelope

- ◆ **Demonstrate Aircraft-like Reusability, Maintenance and Scheduling**
 - Flying One (1) Two-day Turnaround Flight.
 - Flying Two (2) Consecutive Seven-day Turnaround Flights.
- ◆ **Robust Metallic TPS System**
 - Achieve Thermal Protection System Multi-use Operating Limits.
 - Panel Seal Designs
 - Attachment System/Replaceability
- ◆ **Composite Liquid Hydrogen Tank Mfg Processes/Assembly Techniques**
- ◆ **Linear Aerospike Engine**
 - Performance
 - Plume/Vehicle Flowfield Interaction
- ◆ **Vehicle Health Monitoring System**
 - Fiber Optic Strain & Temperature Sensors
 - Fiber Optic Hydrogen Leak Detection Sensors
- ◆ **Aerothermal Environment Prediction Verification**
 - Measure Surface Catalysis Caused by Atomic Oxygen
 - Measure Boundary Layer Transition

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Technologies Demonstrated

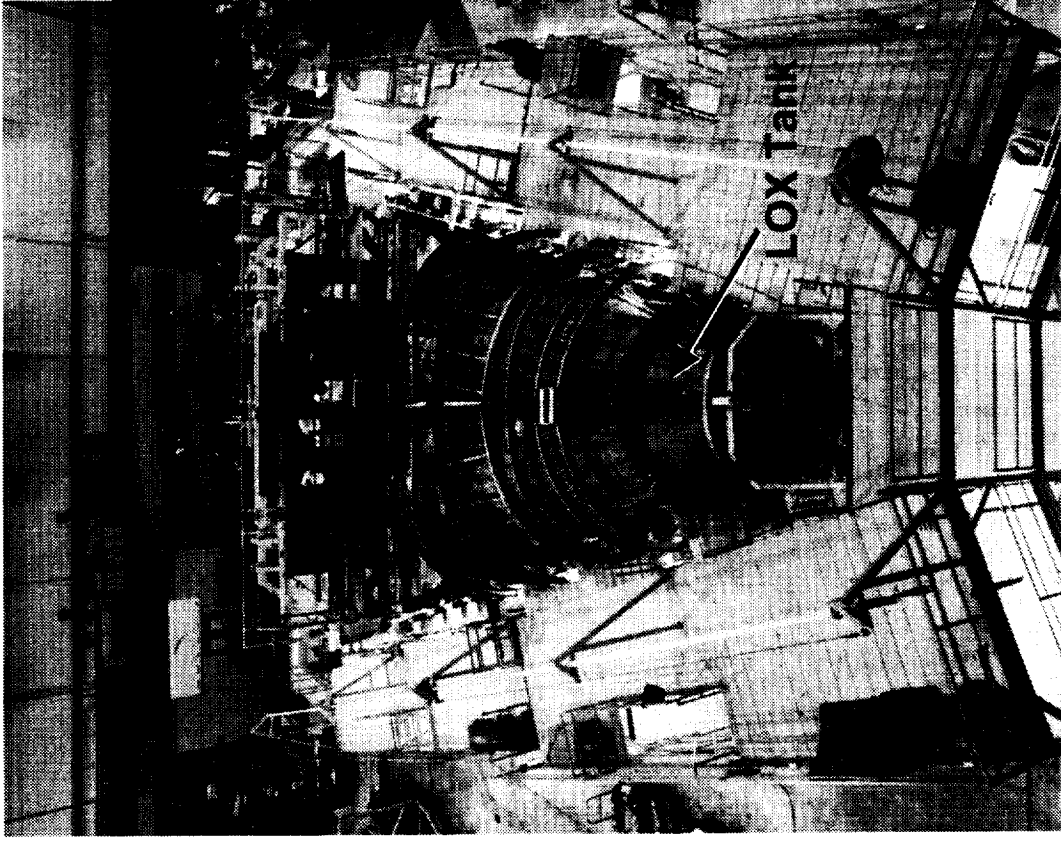
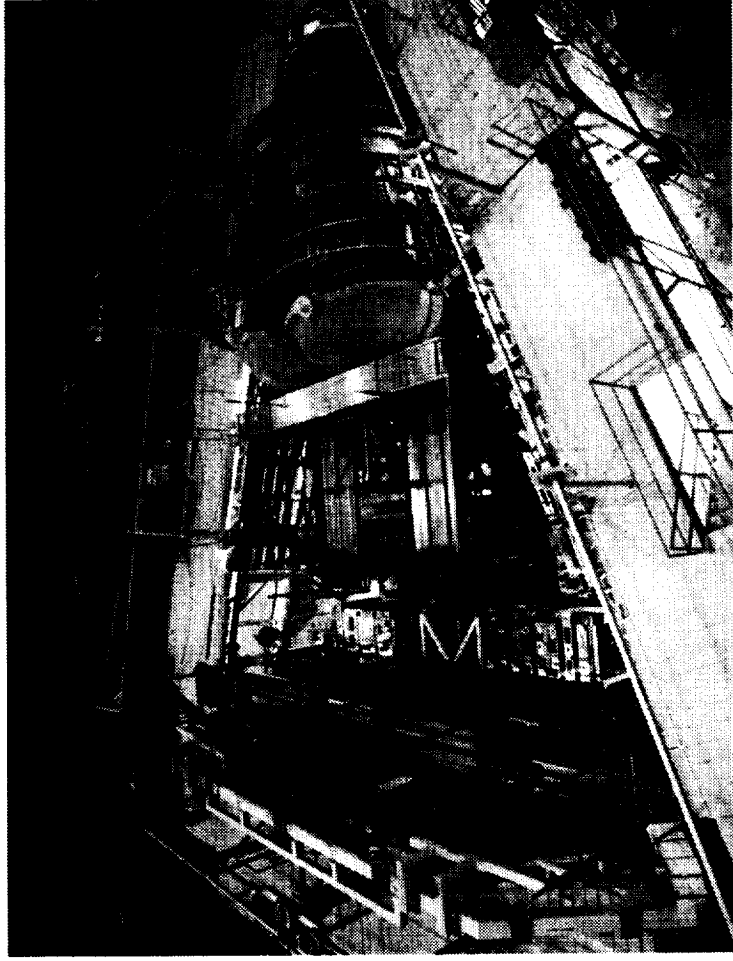


Overall Assembly 75% Complete

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Vehicle Assembly in Palmdale

Overall Assembly 75% Complete

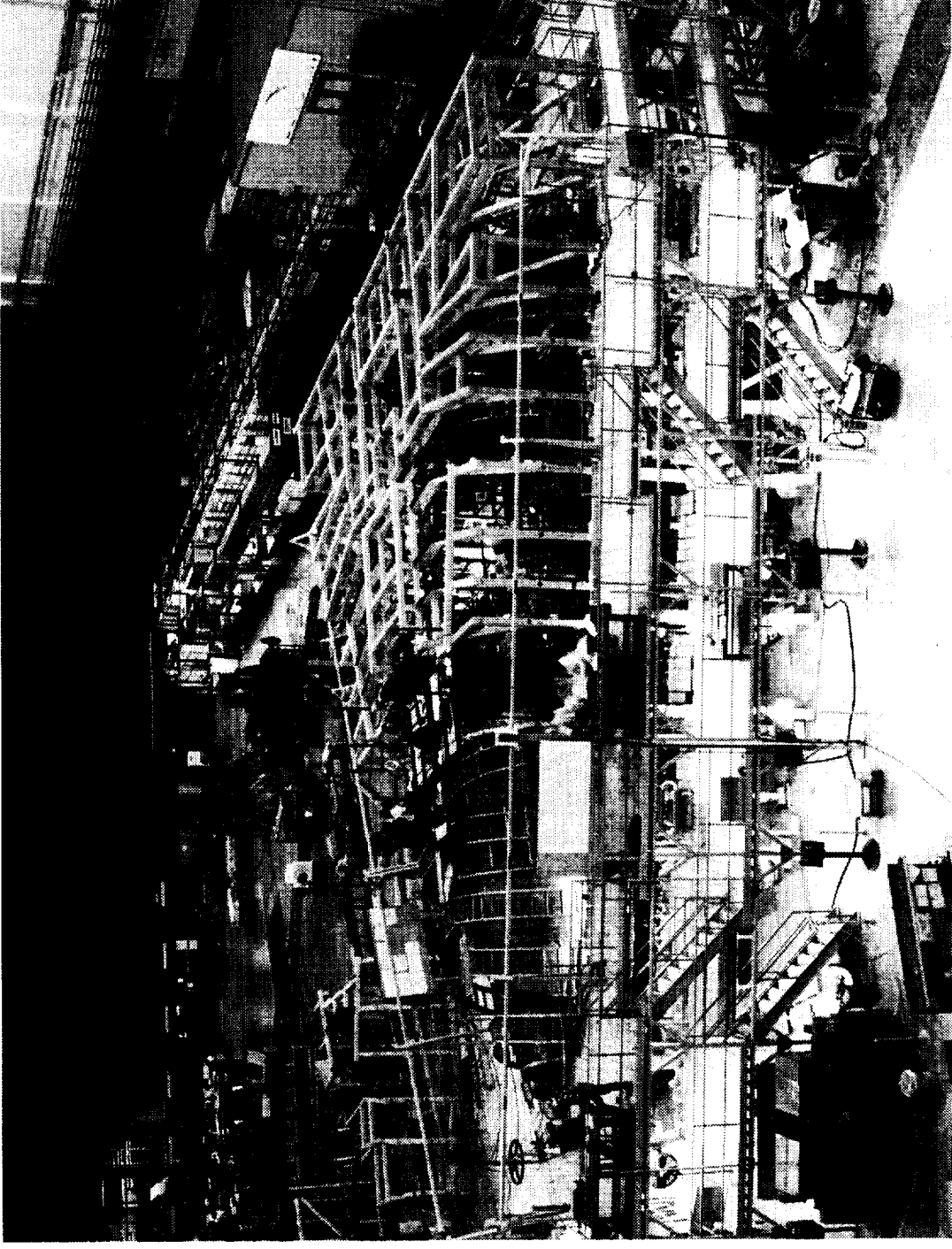


**Websites On X-33: www.x33.msfc.nasa.gov
www.venturestar.com**

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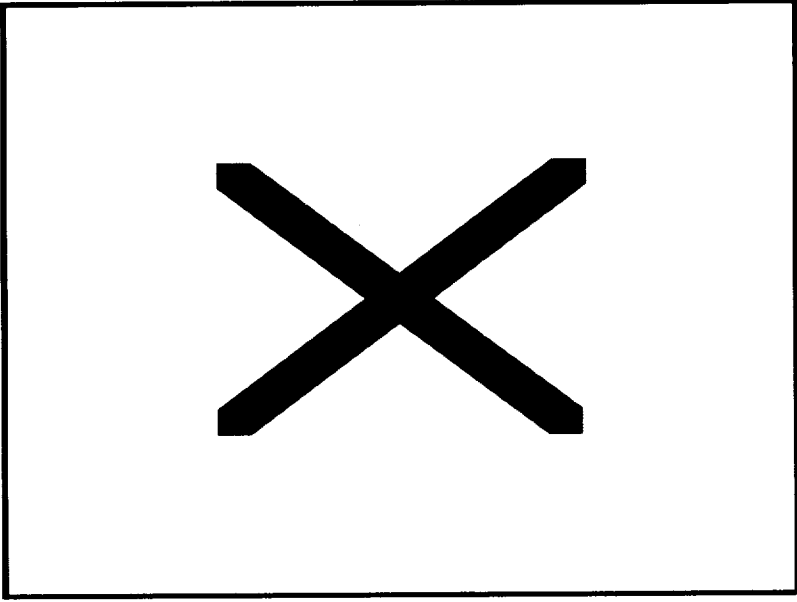
X-33 Assembly Floor

Crews Wiring X-33's Avionics Bay Within Primary Assembly Structure

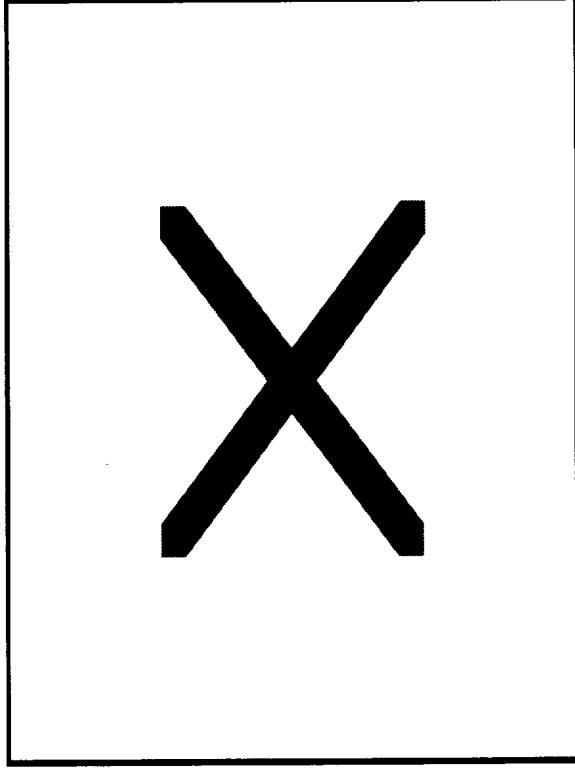


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X-33 Assembly Floor



View Looking Aft

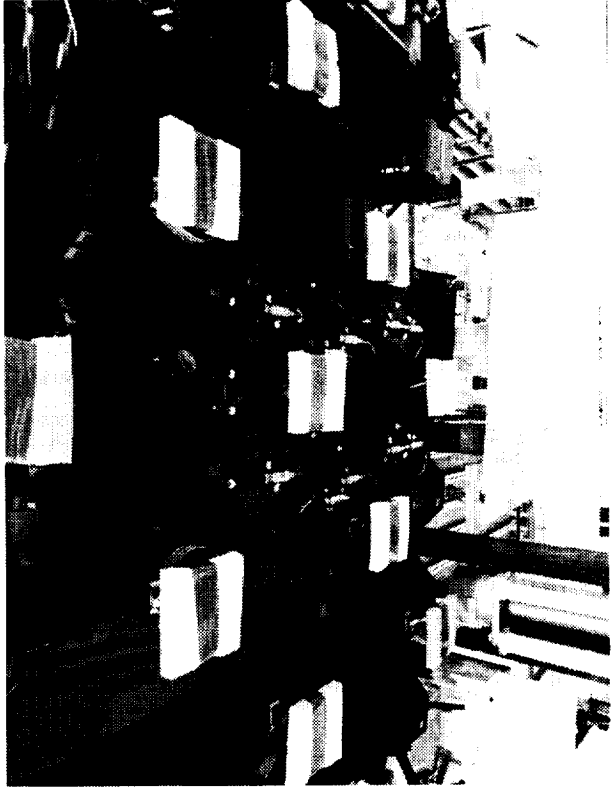


View Left to Right

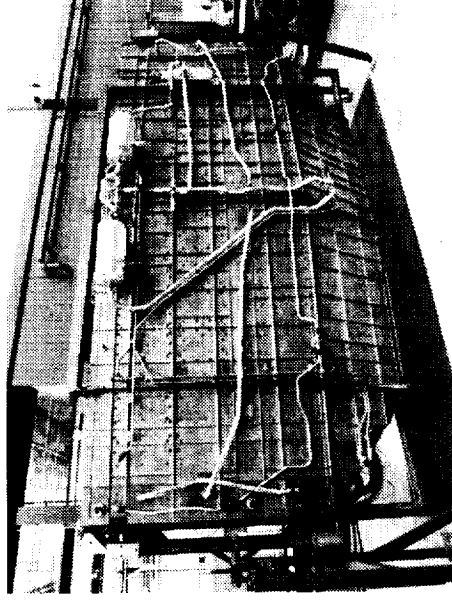
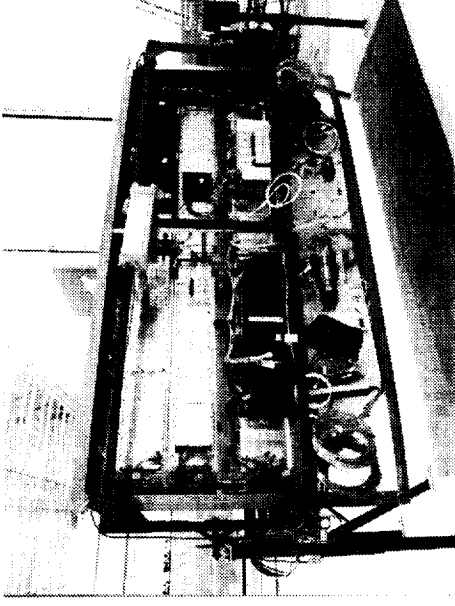
Modified F-15E Strut / F-16 Tire/Wheel

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Nose Landing Gear



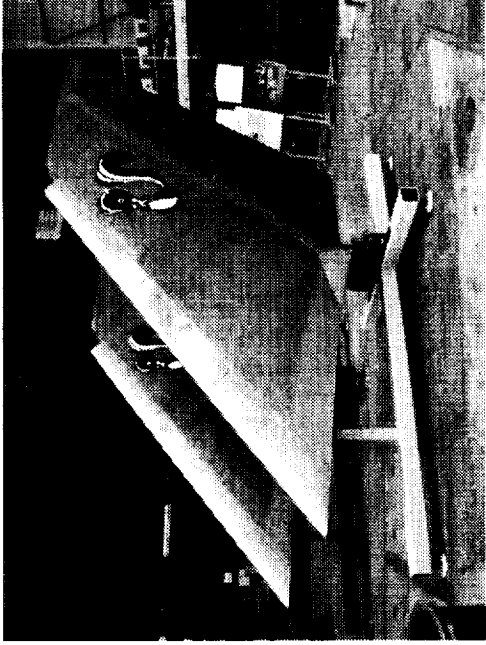
**RCS Auxiliary Propellant Tank and
Control Valve Pallets**



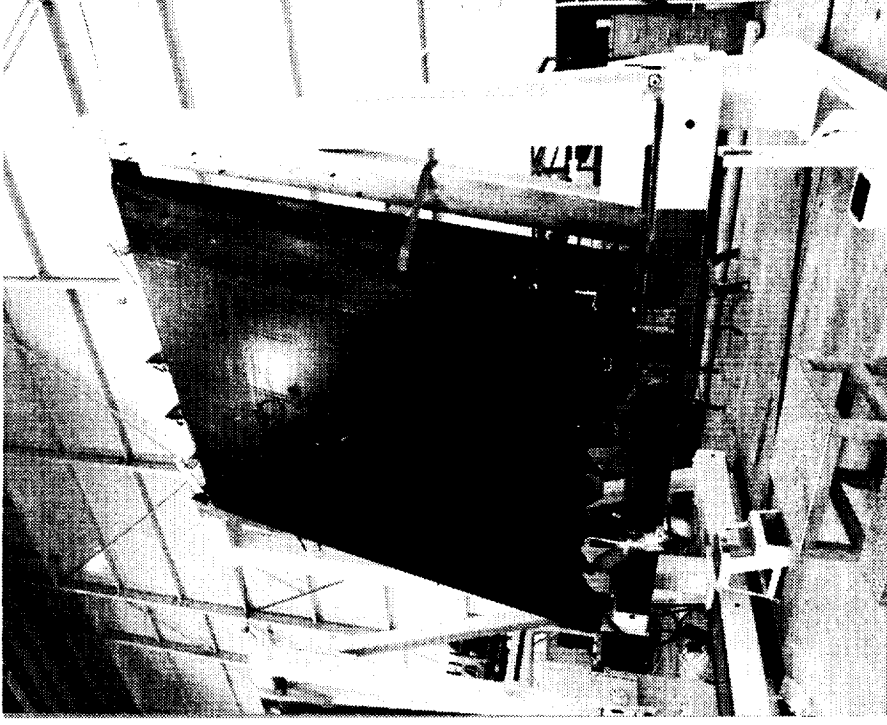
Avionics Bay

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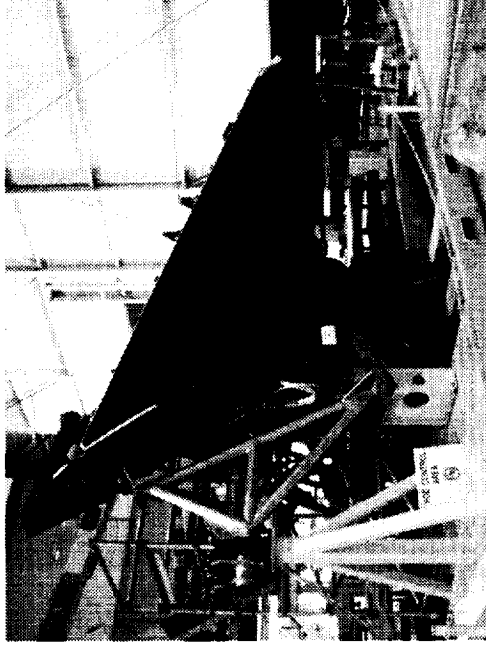
Systems Installations



Tails



Body Flaps

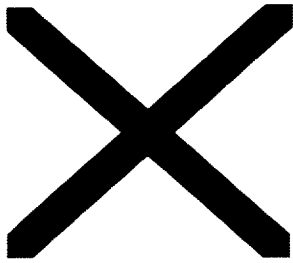


Canted Fins

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Canted Fins and Tails

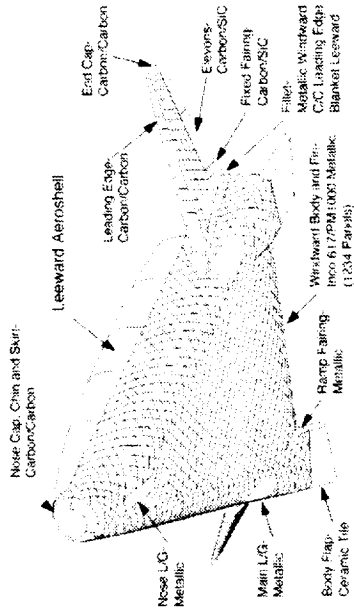
Upper Surface TPS AFRSI/FRSI Blankets



Metallic TPS Fit Test

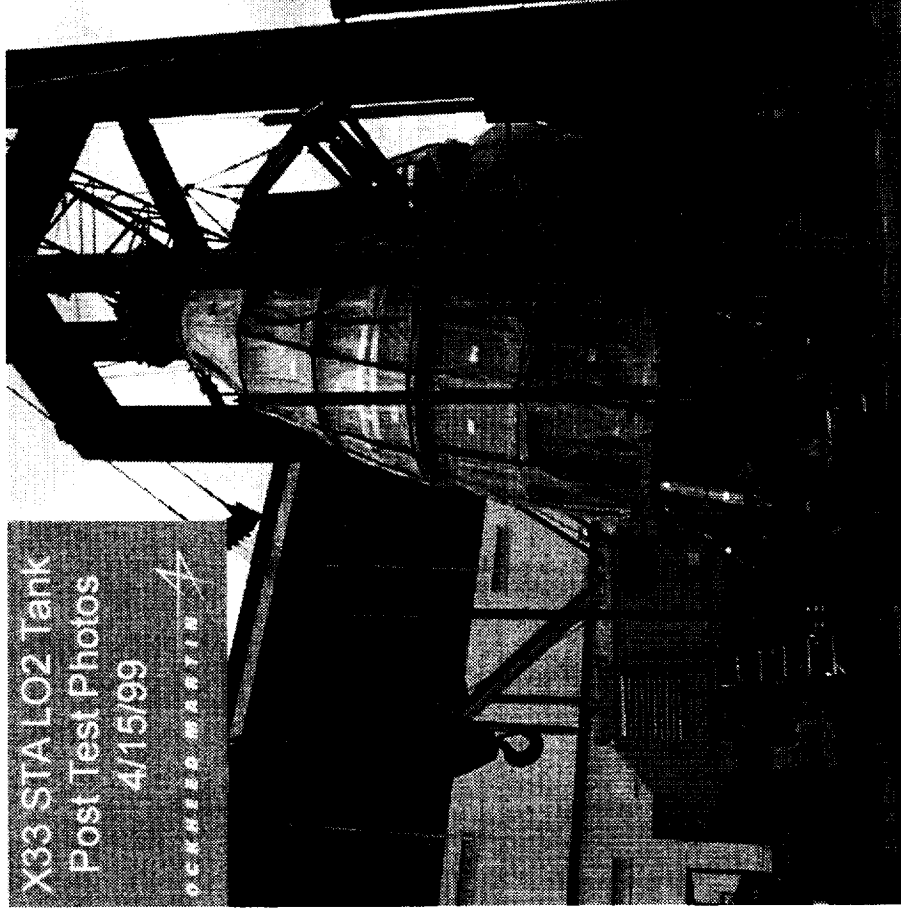


Metallic TPS Panel Layout



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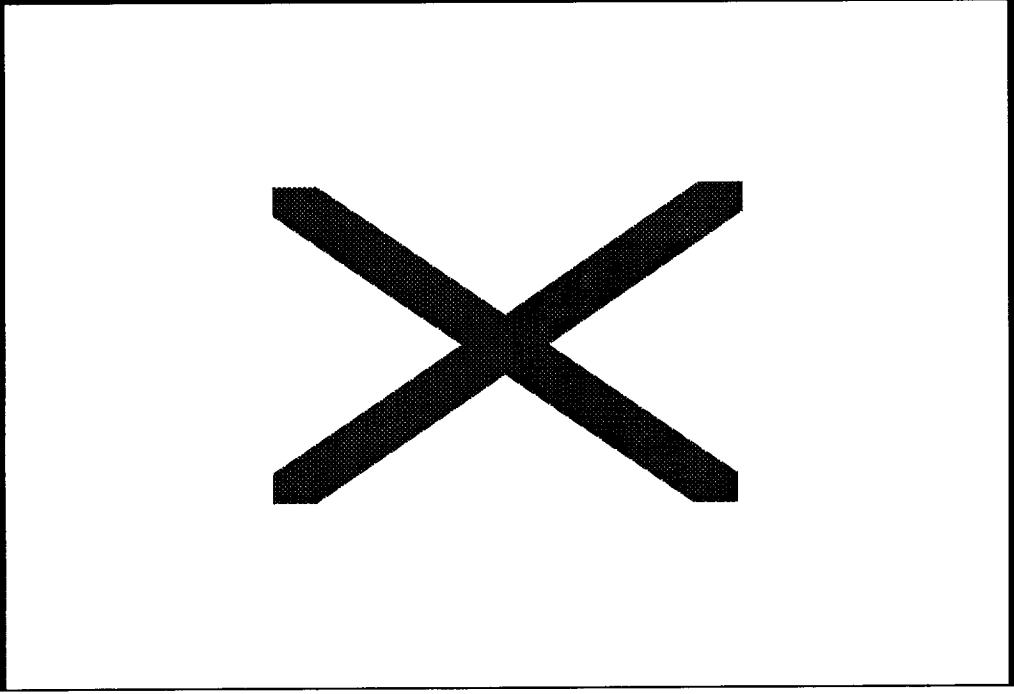
Thermal Protection System



- ◆ Test Conducted on Structural Test Article (STA) - Identical to X-33 Flight Tank
- ◆ Successfully Completed LO₂ Flight Tank Structural Verification
- ◆ STA Tank currently at Glenn Research Center for Propellant Densification Tests

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LO₂ Tank Testing at MSFC



◆ **Technology**

- **Graphite/epoxy Composite Material**
- **Primary Load Structure**
- **Complex Lifting Body Geometry**
- **Unique Stand-off Structure Thermal Shield Internally Cooled**

◆ **Status**

- **First Test Tank Suffered Lobe Skin Delamination Following Simulated Launch Loads With Full Load of LH₂**
- **Subscale Testing Was Successful**
- **Joint NASA/Lockheed Martin Team Conducted Complete Failure Investigation**
- **Further Development Required for Large Scale Cryogenic Tanks Serving As Primary Structure**

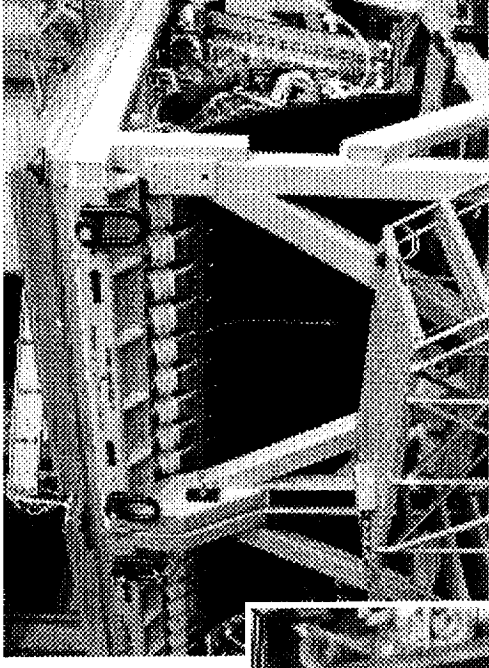
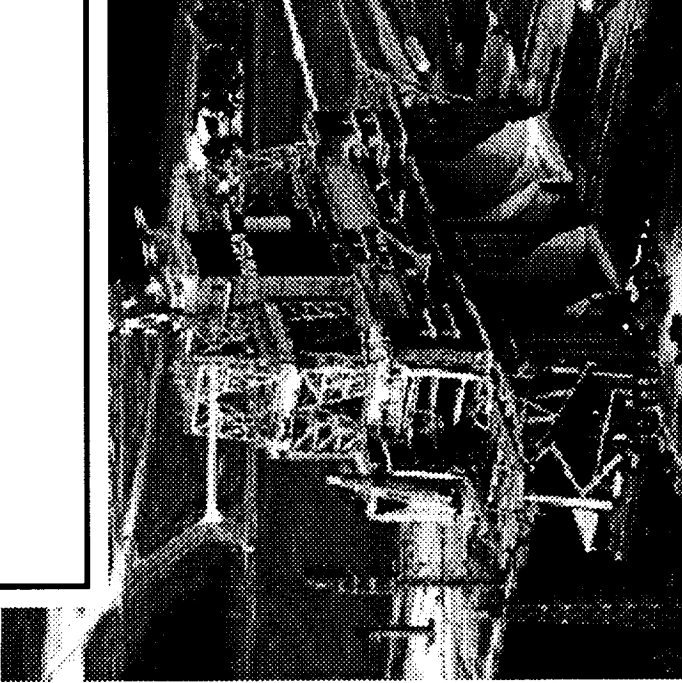
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LH2 Composite Tank Test at MSFC

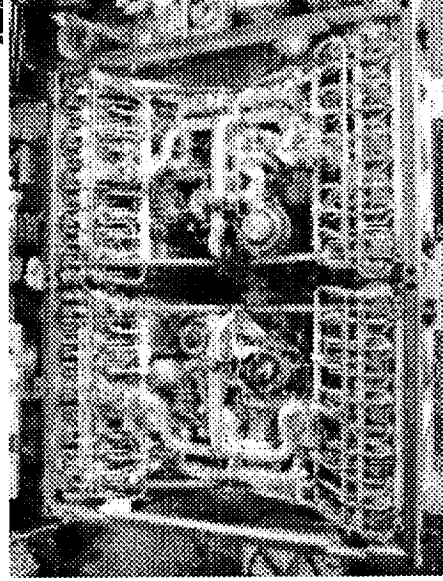
Single Engine

Replace with
~~Quick Time~~
Movie

- ◆ Unprecedented Success With Extensive Test Program
 - Single Thruster: 13 Tests, 985 Seconds
 - Multi Cell: 10 Tests, 49 Seconds
 - Powerpack: 17 Tests, 1506 Seconds
 - Single Engine: 14 Tests, 1563 Seconds
- ◆ No Test Cutoffs Due to Hardware Malfunction
- ◆ Achieved Full Power Level on 6th Test
- ◆ Dual Engine Testing to Begin in October(Flt. Engines)



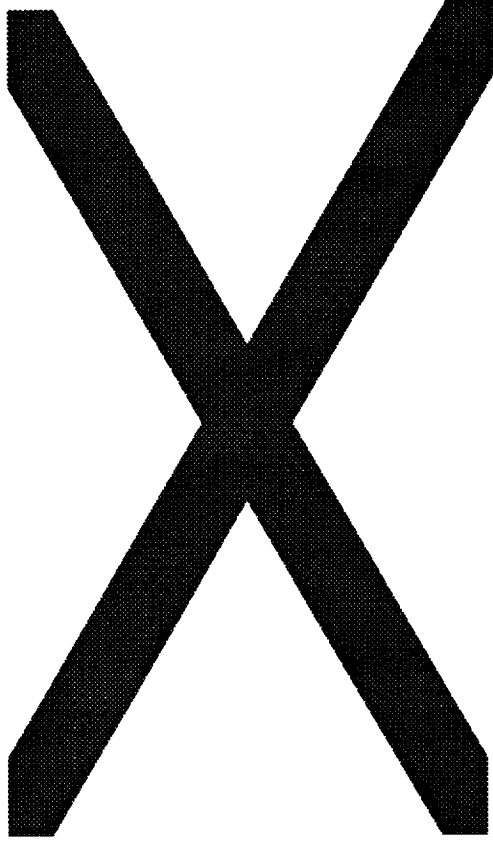
Dual Engine Assembly



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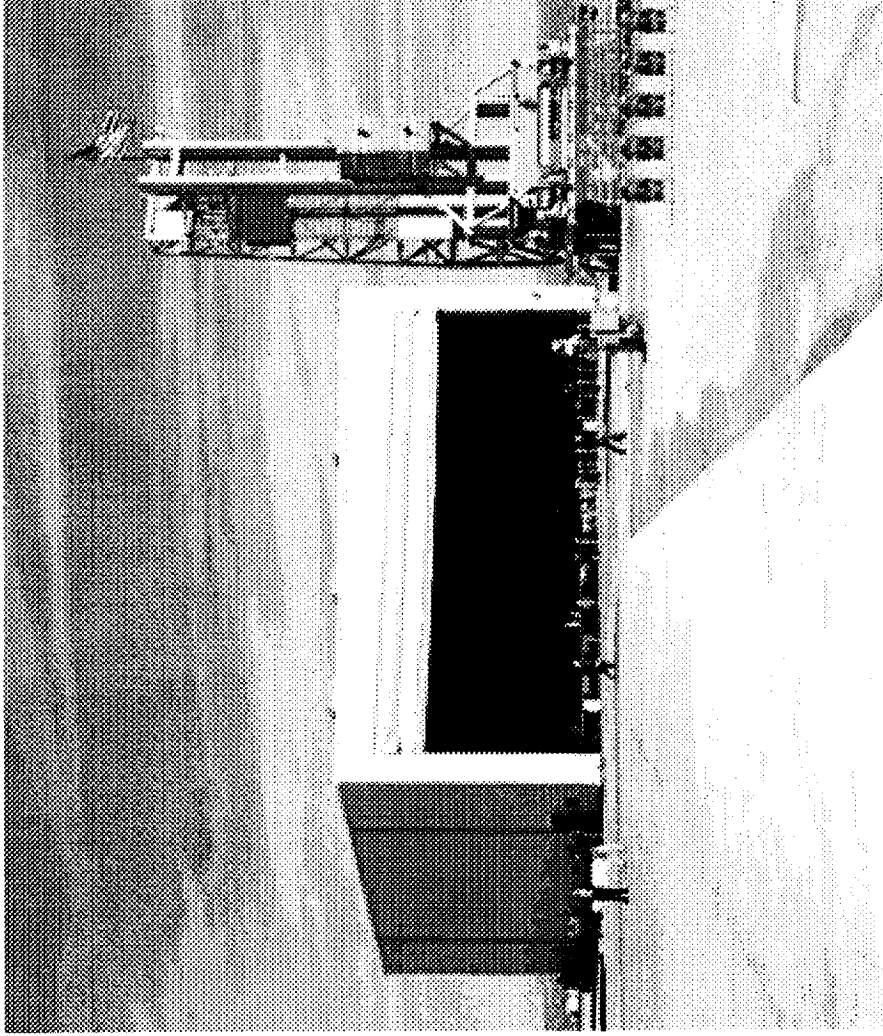
Aerospike Engine, XRS-2200

Completed 25 - Acre, \$32 Million X-33 Flight Operations Center on Edwards Air Force Base, Calif.

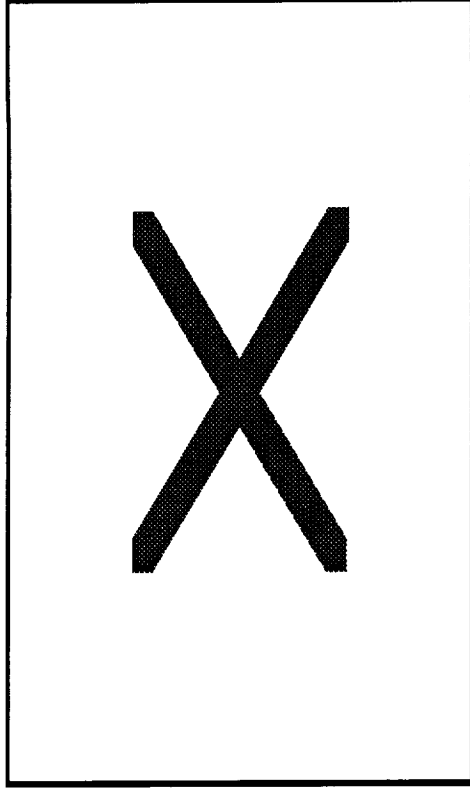


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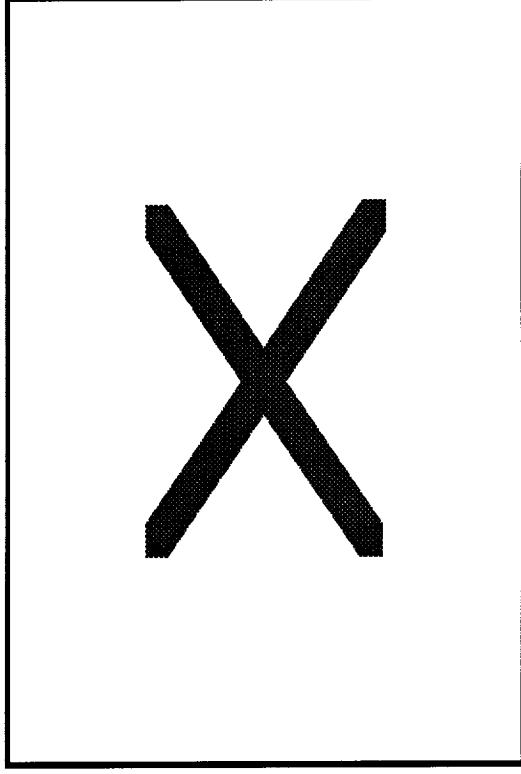
Flight Operations Center



**Translating Shelter and Strong Back with
Weight Simulator**



Eight-Person Control Room



Strong Back with Weight Simulator

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Flight Operations Center