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# ELITE Program

## Electric Insertion Transfer Experiment

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# CRDA

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- O 1986 Federal Technology Transfer Act- make US industry more competitive**
  
  - O ELITE CRDA signed by AF & TRW 1991, & ratified by Gen. Rankine, AFSC/XT Jan 92**
  
  - O AF Provides major subsystems**
    - Arcjet, photovoltaic arrays, diagnostics**
    - Launch vehicle, ground segment, s/c & lv integration**
  
  - O TRW provides spacecraft**
    - Spacecraft, systems engineering. & flight support**
    - Flight software, launch & missions operations support**



# Concept

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## **O OBJECTIVE**

- **System level demonstration of Electric Orbit Transfer Vehicle (EOTV) adequate to establish LEO to GEO transfer capability, orbit maneuvers**

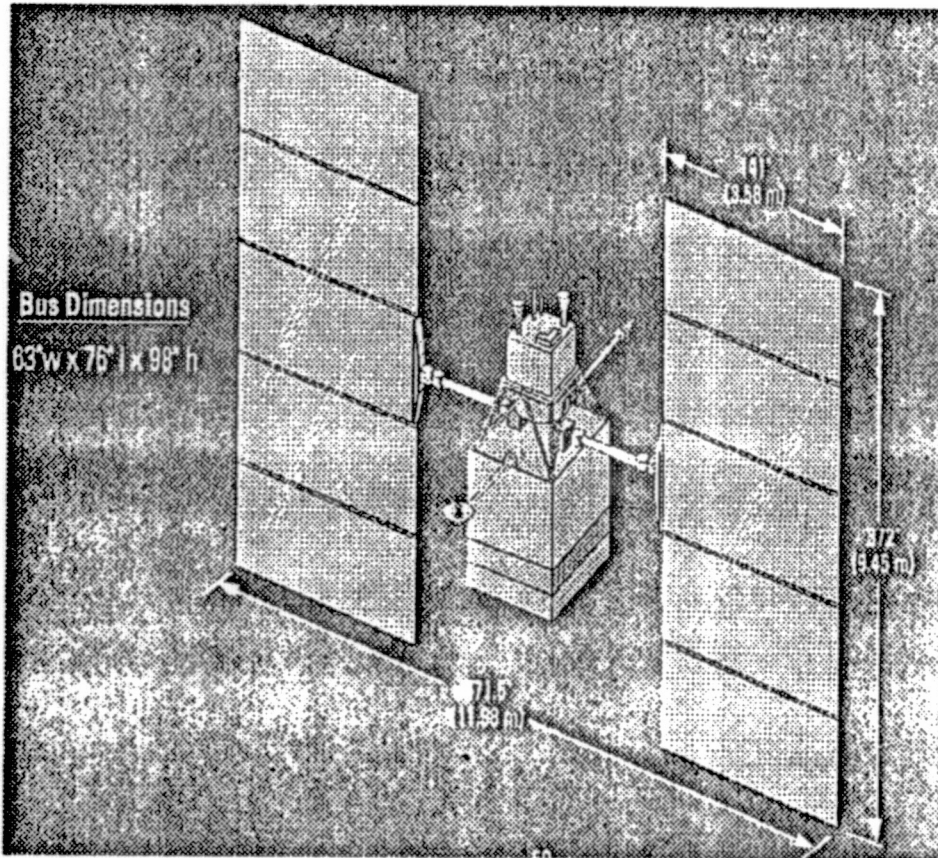
## **O DESCRIPTION**

- **Demonstrate EOTV system**
  - o Autonomous orbit transfer
  - o Orbit repositioning
  - o Survivability in Van Allen belts
- **Demonstrate critical subsystems**
  - o Arcjet
  - o Solar array
  - o Autonomous GN&C



# Electric Insertion Transfer Experiment

## O Electric orbit transfer vehicle (EOTV) and reposition demonstration



**Deployed ELITE Spacecraft**

- Validate LEO-GEO EOTV transfer
- Demonstrate rapid orbit reposition
- High power arcjet and photovoltaic arrays
- Autonomous GN&C

## O Experiment

- 10kW NH<sub>3</sub> arcjet, photovoltaic array
- 200 to 2150 nmi alt.
- 63.5 to 60.5 deg inclination
- 45 day transfer
- Total radiation flux = LEO-GEO transfer
- 100 deg reposition at 2150 nmi, 6 days

## O Operational System

- 30kW H<sub>2</sub> arcjet, photovoltaic array
- 200 to 20,000 nmi alt.
- 28.5 to 0 deg inclination
- 6 month transfer
- Total radiation flux = LEO-GEO transfer
- Orbit reposition at GEO



## **EOTV**

### **New Space Business**

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- **Faster or more on-orbit maneuvers**
- **Increase MLV capability to HLV range**
- **Expand HLV capability to NLS domain**
- **Fast crisis response GEO satellites**
  - **Launch-On-Schedule & on-orbit spares**
- **2x the payload & 1/2 trip time of ballistic asteroid, comet missions**
- **High power platform for space tests**



# Program Milestones

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- Program start, *Jan 91*
- Go/No Go, **Dec 91**
- Systems Requirements Review, **Sep 92**
- Go/No Go, **Dec 92**
- Preliminary Design Review, **Jul 93**
- Critical Design Review, **Jun 94**
- Flight Qualification Review, **Mar 96**
- Launch, *Sep 96*
- Flight Op.s end, **Jun 97**



# Subsystem Status

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- **Ammonia arcjet**
  - RFP release end Nov 92
  - 1460 continuous hours demonstrated, 50% x needed
  - 707 on/off cycles demonstrated, 30% x needed
  - At 10 kW,  $I_{sp} > 620$  s, efficiency  $> 33\%$
- **Photovoltaic array**
  - RFP release end Nov 92
  - BOL= 10.2 kW, EOL $\geq$  6.8 kW
  - Sp power  $\geq 40$ W/kg
- **Diagnostics**
  - Prioritized
  - Health & status, engineering & scientific data





# Subsystem Status

Cont.'d

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- **High Power Testbed**
  - Objective: Simulate ELITE power distribution system with arcjet load
  - Approach: Solar array simulator, peak pwr tracking, pwr distribution system, arcjet
  - Rationale: Eliminate risks of end-to-end system
  - Testing: Nov 92 at PL/Edwards AFB
- **Spacecraft Bus (TRW UTB)**
  - Modular, improved performance, reduced weight, reduced cost
  - ELITE adaptations include structure, thermal control, avionics



# Partners

- Other government & industry partners likely

| Organization     | B u s | Propul | P/W | Diag | GN&C | Experiment              | Cost |
|------------------|-------|--------|-----|------|------|-------------------------|------|
| TRW              | X     |        |     |      | X    |                         |      |
| Air Force        |       | X      | X   | X    |      |                         |      |
| NASA Code B      |       |        | X   |      |      | Xe Ion, hydrogen arcjet |      |
| NASA Code S      |       |        |     |      |      |                         | X    |
| AFSPACE COM      |       |        |     |      |      |                         | X    |
| General Dynamics |       |        | X   |      |      | Cryo H2 storage         |      |



# Payloads

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- **Global Surv Sat Tech Demo, Eagle Dancer (PL)**
  - New, 5-10kW, maneuvering?, #1 AFSPACECOM
- **High Temperature Superconductivity Space Experiment (NRL)**
  - Needs bus, operate in Van Allen belts, #2 Tri Service SERB
- **High power ELITE spacecraft bus (JPL)**
  - Candidate for Discovery program
  - The body for EP planetary spacecraft
  - 2x payload mass in 1/2 time to comets, asteroids
- **High power ion engine experiment (JPL/LeRC)**
  - Qualify engine for VESTA/CLIPPER
- **Radiation Hardened S/C Microelectronics (NRL & PL)**
  - Van Allen belt exposure? #6 AFSPACECOM
- **Space Surveillance Initiative (PL)**
  - New, maneuvering need? #9 AFSPACECOM
- **Hydrogen arcjet and cryo storage (Gen Dynamics, LeRC)**
  - Experiment or primary propulsion



# Summary

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- **ELITE system demo traceable to operational solar electric vehicle**
- **CRDA assures transfer of advanced technology to industry**
- **Orbit transfer, maneuvering, planetary vehicles greatly reduce the cost of future missions**
- **ELITE & CRDA offers opportunity benefiting DOD, NASA and industry interests**