Affordable Access To Space
Russian Dnepr Launch Vehicle

Export Approval and the Launch Campaign

AIAA/USU Conference
On Small Satellites

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Flight Experience:

On December 20, 2002, SpaceQuest launched two 10 kg microsatellites on a Russian military rocket (Dnepr) from the Baikonur Cosmodrome in Kazakhstan.

Conclusion:

The Kosmotras Dnepr rocket is the most flexible and inexpensive microsatellite launch vehicle in the world, but U.S. customers must first overcome the lengthy, bureaucratic and burdensome launch preparation and approval process.
SpaceQuest, Ltd.

- An industry leader in Microsatellite technology.
- Manufactures satellite components and spacecraft buses.
- Launched first U.S. satellite on a Russian *military rocket*.
Dnepr Launch Vehicle

- Converted Russian SS-18 ICBM
- Offers piggyback “cluster” launch opportunities
- Provides flexible and affordable access to space
- Commercial launches only
- Baikonur Launch Base in Kazakhstan
Silo Launch System

- Dnepr is launched from a silo.
- Launch vehicle is steam-ejected by a black powder gas generator.
- The launch vehicle first stage motor is ignited upon the rocket’s exit from the launch canister.
- Launch is possible under any weather conditions.
Dnepr Launch Vehicle History

3 missions; 12 spacecraft; 6 countries

- 160 SS-18 flights since 1970 - 97% reliability
- 3 Dnepr flights since 1999 - 100% success rate
  1. April 1999 - launch of UoSAT-12 (UK)
  2. September 2000 - 5 spacecraft:
     MegSat-1 (Italy)
     UniSat (Italy)
     SaudiSat-1A and SaudiSat-1B (Saudi Arabia)
     TiungSat-1 (Malaysia).
  3. December 2002 - 6 spacecraft:
     Rubin-2 (Germany)
     SaudiSat-1C (Saudi Arabia)
     LatinSat-A and LatinSat-B (USA)
     UniSat-2 (Italy)
     Structural mockup of TrailBlazer lunar probe.
Dnepr Payload Configuration

Cluster Launch in April 1999

Cluster Launch in Sept. 2000

Cluster Launch in Dec. 2002
# Dnepr Launches and Cost

## Planned Launches

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<th>Dedicated Launches</th>
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## Cost

- **Launch service price:**
  - $10,000 /kg to 64.5° Inclination Orbit
  - $12,500 /kg to Sun-Synchronous Orbit
- Price includes the separation mechanism.
Key Elements in the Export Process

- Technical Assistance Agreement (TAA) with Kosmotras
- Temporary Export License (with Provisos)
- Technology Transfer Control Plan (TTCP)
- Russian Red Tape
  - VISA Processing
  - Baikonur Security Clearance
  - Customs Documents & Payments
  - Transportation & Logistics

Process should begin at least 18 months prior to launch.
Technical Assistance Agreement (TAA)

- Between the launch services provider (ISC Kosmotras) and the U.S. company launching a satellite.
- Allows for U.S. government-approved exchange of technical data to enable ISC Kosmotras to develop a spacecraft-to-launch vehicle interface adapter and integrate spacecraft to the Dnepr launch vehicle.
- Parties agree to abide by all US and international laws and regulations regarding defense services and technical data.
- May not enter into force until approved by U.S. State Department.
- Submitted unsigned to PM/DTC for approval.
Technology Transfer Control Plan (TTCP)

- **A Compliance Manual**
  - Describes how ITAR-controlled data will be monitored.
  - The extent and level of technical data to be released.

- **Processes for control and security of the technical data**
  - Administrative – internal and external procedures
  - Meetings, telecons & other communications
  - Non-Disclosure Agreements
  - Transportation Plan
  - Security Plan
  - Training Plan
  - Joint Operations Plan

- **Procedures for DTSA Compliance Review**

- **On-going monitoring by DoD**

- **Reimbursement of costs to DoD**
Export License Application

Temporary Export of Unclassified Defense Articles

- 9 copies of Form DSP-73
- 7 sets of any descriptive literature
  - Satellites and Test Equipment
- 7 copies of any prior or “Precedent Approvals”
- Original and 6 copies of a Letter of Explanation
- Technical Assistance Agreement (TAA)
- Technology Transfer Control Plan (TTCP)
- Collated & Submitted to:
  - Managing Director
  - Directorate of Defense Trade Controls
Visa Processing and Baikonur Cosmodrome Clearance

- Submit information to Kosmotras on visiting specialists and purpose of visit.

- Kosmotras will obtain official invitation from the Russian Ministry of Foreign Affairs and send it to the Russian Consulate.

- A Multiple Entry Business Visa is required.

- Baikonur Cosmodrome is a Russian Federal Space Center and access is restricted.

- Kosmotras will obtain clearance and issue identification badges for access to Baikonur Cosmodrome.
Kosmotras Responsibilities

• Design and build Launch Separation Mechanism
• Prepare Interface Control Document (ICD)
• Fit Check & Vibration Test of Integrated Platform
• Ground Test Report
• Integrate spacecraft to Space Head Module
• Launch spacecraft into Orbit
• Issue Separation Certificate Document
• Preliminary Orbital Parameters of spacecraft
Documents Required from Customer

- Spacecraft Purpose and Specifications
- Spacecraft Safety Document
- Non-Military Purpose Letter
- Registration of Spacecraft in National Registry of Space Objects
- List of Equipment to be Temporarily Imported
- Spacecraft Operating Frequency Bands and Max Power Level
- Spacecraft Launch Clearance Document
Transport of Spacecraft and Equipment

- Spacecraft constructed at U.S. facility.
- Packed and hand-carried to airport.
- Temporary Export License must be endorsed by U.S. Customs Officer.
- Hand-carried to Moscow via commercial airline and stored on board aircraft.
- Customs clearance by Express Service.
- Remain overnight at Moscow hotel.
- Flight to Baikonur via charter flight with other launch participants.
- Spacecraft and equipment must be under the control of U.S. exporter at all times.
Launch Base Activities

- Arrive at launch base 20 days prior to launch
- Complete spacecraft preparation and mating to Dnepr Space Head 10 days prior to launch
- After integration with Space Head, satellite payloads are encapsulated and sealed, then transported to Space Head processing facility, and then to launch silo for mating with rocket.
- U.S. personnel must accompany the spacecraft during and after integration, and while the spacecraft, attached to the Space Head, are transferred to the launch silo.
Satellite Integration to Space Head

Spacecraft arrives at Baikonur

Delivered to Processing facility

Processing in clean room

Installation on platform

Integration of Encapsulated Payload Module

Integration of Space Head Module

Space Head Module Completed
Integration of MicroSats to Space Head
Space Head Module (SHM) to LV

Loading Space Head

Rotation into horizontal position

Space Head delivery to silo

Space Head to LV mating

Space Head Module in silo

Liftoff

8-12-2003

SpaceQuest, Ltd.
Space Head Loading into Silo
Dnepr Launch from Silo