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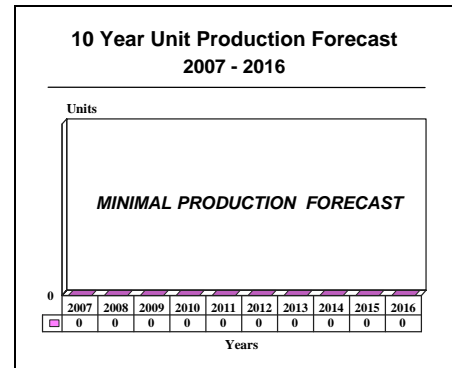
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SPACEHAB - Archived 4/2008

Outlook

- NASA COT not awarded to SPACEHAB; SpaceX and Rocketplan-Kistler selected for \$500 million capability demonstration
- No modules in production; Enterprise and Docking Double Module “de-emphasized”
- SPACEHAB is working with potential Crew Exploration Vehicle contractors to demonstrate potential integration
- Studying feasibility of developing its own launch vehicle



Orientation

Description. SPACEHAB is a habitable experiments payload module for deployment aboard the Space Shuttle. It is the only commercial transport to the ISS on board a Space Shuttle.

Sponsor. NASA’s New Initiatives Office, CMAM (Commercial Middeck Augmentation Module), Project Office, Johnson Space Center, Houston, Texas.

Status. SPACEHAB is operational.

Total Produced. Four units: two modules for science mission operations, one earmarked as a logistics supply carrier, and one commercial module (called Enterprise) that will dock with the Russian portion of the International Space Station (ISS).

Application. SPACEHAB modules provide Space Shuttle and ISS astronauts with additional room in which to conduct experiments in low-Earth orbit.

Price Range. The SPACEHAB Double Research Module cost about \$100 million for the Columbia mission.

SPACEHAB charges \$34,729/kilogram (2004 pricing) for active research experiments mounted internally or externally on its modules. A 2.4 x 4.2 meter unpressurized cargo pallet and related integration for up to 2,725 kilograms of cargo on a Space Shuttle costs \$3.45 million, not including the transportation costs of the Space Shuttle.

Flight support boxes for tools and shuttle or ISS replacement components are also available for \$395,000 per use, including integration of the cargo into the box, but not transportation. Leaving the box on-orbit costs an additional \$75,000 for each additional year.

Contractors

Prime

SPACEHAB Inc	http://www.spacehab.com , 12130 Hwy 3, Bldg 1, Webster, TX 77598-1504 United States, Tel: + 1 (713) 558-5000, Fax: + 1 (713) 558-5960, Email: campbell@spacehab.com , Prime
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Subcontractor

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Astrium Satellites	http://www.space.eads.net , PO Box 801109, Munich, 81663 Germany, Tel: + 49 89 607 0, Fax: + 49 89 607 264 81 (Attachment Hardware)
RSC Energia PLC, RKK Energia	http://www.energia.ru , 4A Lenin St, Korolev, Moscow Area, 141070 Russia, Tel: + 7 095 513 86 55, Fax: + 7 095 513 86 20 (Unpressurized Cargo Pallet)

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. The SPACEHAB Research Single Module (RSM) is a truncated cylinder designed to fit in the forward section of the Space Shuttle's payload bay. Astronauts gain access to the SPACEHAB module through a tunnel connected to the orbiter's mid-deck. Inside the pressurized module is space for experiment lockers similar to those used inside the shuttle's mid-deck area. Two locker arrangements are available.

One features an all-locker configuration with up to 69 mid-deck lockers. The other, the rack and lockers

configuration, calls for one or two Space Station-style racks plus 21 lockers. Either setup provides an extra 21.8 cubic meters of workspace.

A single SPACEHAB locker provides 0.05 cubic meters of volume and comes with 115 watts of electrical power. International Space Station-class racks have 1.27 cubic meters of volume and come with one kW of electrical power. Both the racks and lockers have their own cooling systems.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Module length	3 m	9.8 ft
Module diameter	4 m	13.1 ft
Overall module volume	28.3 cu m	1,000 cu ft
Free workspace volume	21.2 cu m	744 cu ft
Locker volume	0.05 cu m	1.7 cu ft
Rack volume	1.27 cu m	44.6 cu ft
Weights		
Locker weight	27.2 kg	60 lb
Total weight	4,990 kg	11,000 lb
Total payload weight	1,360 kg	3,000 lb
Performance		
Locker power	115 W	
Rack power	1 kW	
SPACEHAB power supply	3.2 kW	

Variants/Upgrades

Logistics Double Module (LDM). The LDM is expected to play a key role in carrying supplies and logistics to the International Space Station. Capable of carrying more than 4,500 kilograms (10,000 lb) of cargo to and from the ISS, the LDM can accommodate bagged, passive supplies, oversized and irregularly shaped hardware, and cargo that requires power during ascent and descent. The LDM permits the crew to access its cargo directly from the shuttle.

Further use of the LDM is unlikely. Beginning in 1998, the Italian Space Agency (ISA) began delivery of the

first of three Multi-purpose Logistics Modules (MPLM) to NASA. The first of the three MPLMs was delivered to the ISS in April 2006 aboard STS-121. Compared to the LMD, the MPLM provides an enhanced cargo carrying and station module capacity. The MPLM, with cargo capacity of 9,070 kg (20,000 lb), has double the space of the LMD.

Research Double Module (RDM). Destroyed aboard Space Shuttle Columbia in February 2003. The RDM had double the space available on the standard module. It could carry nearly 4,100 kilograms of

payload, and included six double rack locations (635 kilograms, 1.27 cubic meters each) and 61 single locker locations (36 kilograms, 0.05 cubic meters each).

Integrated Cargo Carrier (ICC). Depending on the configuration, SPACEHAB's ICC system is designed to carry between 4,000 and 6,000 pounds of external, unpressurized cargo to the International Space Station, to which it can be attached. The ICC is composed of the Unpressurized Cargo Pallet (UCP) and a number of mechanisms, including a shuttle-keel interface structure and tunnel segment that attach the UCP to the shuttle payload bay. The UCP bridges across the shuttle payload bay above the tunnel leading to the SPACEHAB modules.

External Stowage Platform. Known as ESP2, this new platform was launched by the Space Shuttle in August 2005, and with the help of the Space Station's robotic arm, removed from the cargo bay and attached to the air lock of the ISS as a permanent spare-parts stowage facility.

Docking Double Module. In development. A next-generation Logistics module, the DDM will have a docking module in the roof that will permit straight-line access to the Space Station. It will also allow the shuttle to boost the ISS more efficiently. This program's

development has been slowed due to a lack of demonstrable need. SPACEHAB has stated that this could be re-prioritized if there is demand.

Enterprise Commercial Habitat. SPACEHAB and RSC Energia agreed in 1999 to develop a pressurized module, called Enterprise, to attach to the Russian portion of the ISS. First launch was intended for 2003, and now is listed as TBD. Like the DDM, this program's development had been slowed by lack of demonstrable need and funding from the Russian Space Agency (ROSKOSMOS). SPACEHAB has stated that this could be re-prioritized if there is demand.

The demand for the Enterprise may be sufficed by the Multi-purpose Laboratory Module (MLM) built by Khrunichev. Like the proposed Enterprise, MLM will attach to Russian Zvezda module. MLM will provide research laboratory and media transmission technologies analogous to those suggested for Enterprise as well as additional storage space, solar array panels, and crew accommodations. The MLM is scheduled for launch in late 2007.

Program Review

Background. Room on a Space Shuttle orbiter is extremely limited, with total space available inside the flight deck and mid-deck roughly equal to that of a small garage. As many as seven crewmembers live in these cramped quarters for up to a week, sharing the area with space suits, experiment lockers, seats, a toilet, and other gear. The SPACEHAB module alleviates some of this crowding, providing twice the orbiter's habitable volume and quadrupling the space dedicated for experiments.

Customers can use SPACEHAB to perform commercial space research and development, and life sciences or materials sciences research. The module's highly flexible interior can accommodate a number of customer configurations. Security for proprietary payloads is also included. Advanced shuttle systems and procedures development can be carried out inside the module, which can also be used to test equipment earmarked for the Space Station. SPACEHAB can also be used as a habitat for crews of extended orbiter missions.

One of the advantages of a SPACEHAB module is that it uses only one-fifth of the shuttle's payload bay, freeing the remaining space for other payloads. Sharing

the payload bay with the first SPACEHAB module, for instance, were a Getaway Special (GAS) bridge and a Super Fluid Helium Orbit Transfer (SHOOT) demonstration experiment.

SPACEHAB Inc and NASA agreed in 1988 to allow the company six shuttle flights for the SPACEHAB module. Under the terms of the agreement, SPACEHAB pays NASA \$28.2 million for each flight, in 1988 dollars adjusted for inflation.

Selling SPACEHAB Space

In early 1990, SPACEHAB was set to develop the pressurized module. The firm was confident that it could sell at least half the space available on SPACEHAB's first mission. By June 1990, SPACEHAB had received enough bookings from customers to fill 82 percent of available space on the six flights. Topping the list was NASA, which reserved 200 of the 300 lockers available.

NASA awarded SPACEHAB a five-year, \$185 million contract for the Commercial Mid-Deck Augmentation Module in December 1990. In the contract, SPACEHAB provided for the physical and operational integration of the module and the experiments, power,

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cooling, data management, and crew training, spread over six flights.

The space agency awarded SPACEHAB a \$54 million contract in 1995 to use the SPACEHAB module as a cargo carrier for four Space Shuttle flights to Russia's Mir space station. The module transported food, water, and parts for the Mir platform. The agency selected SPACEHAB in 1996 for three additional flights.

Another contract was issued in 1997 for the use of modules on three Space Shuttle missions. The aggregate value of the contract was \$42.8 million, with approximately \$19 million of additional revenue derived from three of NASA's major International Space Station partners: the European Space Agency, the National Space Development Agency of Japan, and the Canadian Space Agency.

The first mission, STS-95, took place in 1998 and carried the SPACEHAB Research Single Module. STS-96, in 1999, used the SPACEHAB Logistics Double Module and carried about 4,550 kilograms of food, crew clothing, and other vital supplies in support of the International Space Station. Simultaneously, the integrated cargo carrier ferried the Russian-built Strela crane and certain tools to be used in construction of the Space Station.

The third mission, STS-101, was launched in May 2000 and involved the first flight of the SPACEHAB Logistics Double Module. The seven-member crew transferred almost two tons of equipment and supplies from the module to the ISS.

NASA sent a third resupply mission to the ISS, STS-106, in September 2000. This involved the Logistics Double Module, ICC, and SPACEHAB Oceaneering Space Systems (SHOSS) box. American and Russian cargo aboard the SPACEHAB carriers included fire extinguishers, smoke detectors, and gas masks for each of the three Expedition 1 crew members who boarded in the fall; food and water supplies and personal hygiene items; trash bags; tools for intravehicular and extravehicular use; cameras; exercise equipment; TV/data and radio telemetry cables; assorted critical spare parts; and office supplies.

SPACEHAB received a \$4.2 million award from NASA in 1999 for the launch of the ICC and two SHOSS boxes on ISS assembly flight 7A.1, launched in August 2001. This mission marked the third flight of the Integrated Cargo Carrier (ICC). With the award, NASA exercised the first of six options added to the Research and Logistics Mission Support (REALMS) contract with SPACEHAB the previous October.

SPACEHAB Signs Deal with DASA and RSC Energia. In 1997, SPACEHAB awarded contracts to Daimler-Benz Aerospace (now part of Astrium) and RSC Energia for design and production of the Integrated Cargo Carrier system. RSC Energia developed and produced the Unpressurized Cargo Pallet, while Daimler-Benz Aerospace provided the attachment hardware for the UCP and integrated the ICC system to the Space Shuttle.

German Government Contract

In 1998, SPACEHAB reached an agreement with the German Aerospace Center, DLR, to provide space-based research services aboard a 2001 Space Shuttle research flight. Under the \$1.1 million agreement, DLR (Deutsches Zentrum für Luft- und Raumfahrt) will purchase one locker aboard the SPACEHAB Double Research Module on Space Shuttle Mission STS-107. The direct contract with DLR marked the first time the German government has been an independent customer of SPACEHAB Inc. Previous Shuttle-based research services involving German researchers have been arranged through NASA or the European Space Agency.

Contract with ESA. SPACEHAB landed a \$5.15 million contract with the European Space Agency in 1998 for flight of the Advanced Respiratory Monitoring System aboard its Research Double Module on a Space Shuttle mission. The contract included associated payload integration and operations to provide commercial space-based research services.

New Ventures Formed

SPACEHAB and RSC Energia in October 2000 formed Space Station Enterprise (SSE) LLC, under which the two companies will build and own the Enterprise commercial space station habitat. Simultaneously, the Space Infrastructure Division of Astrium made a strategic investment in SPACEHAB's Space Media subsidiary. In August 2000, Space Media formed a partnership with RSC-Energia, called Enermedia LLC, to develop and market space-based multimedia content for television broadcast and Internet distribution first from the Russian service module Zvezda and later from Enterprise, also using materials from Russian space program archives.

In 2001, Astrium signed a sale-leaseback agreement for the ICC worth \$15.4 million. Under the agreement, SPACEHAB and Astrium agreed to expand the ICC program to offer new versions of the unpressurized payload carrier. New variations of ICC services will include deployable and vertical cargo carriers. Future enhancements may also include an Express carrier, a propulsion pallet, and a cryogenic carrier.

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Contract Modification. NASA awarded SPACEHAB a \$42.4 million contract modification in March 2002. Terms include supply of a pressurized Logistics Single Module (LSM) and an unpressurized Integrated Cargo Carrier (ICC) for ISS Missions STS-116 and STS-118.

Enterprise Lands SPMM Contract. Space Station Enterprise LLC (SSE) finalized a contract agreement in June 2002 to accommodate the Florida Space Research Institute's Scanning Probe Microscope for Microgravity (SPMM) research facility on board the Enterprise module. Inside Enterprise, SPMM scientists will work on advanced materials, nanostructures, biotechnology, and other microgravity experiments on-orbit at the International Space Station.

However, the Enterprise facility will be allowed to launch to the space station only *after* NASA achieves U.S. Core Complete ISS assembly status. Core Complete was planned for February 2004, but has suffered serious delays in light of the Columbia accident.

Doomed Debut of RDM. The SPACEHAB Research Double Module finally made it into orbit in mid-January 2003, aboard Mission STS-107 on the Shuttle Columbia. The pressurized aluminum RDM carried about 7,500 pounds of research payloads for NASA, other space agencies, the U.S. Air Force, and commercial customers. The seven-person crew successfully carried out more than 100 experiments stowed on board the RDM before attempting their scheduled return to Earth. A devastating turn of events ended the mission prematurely, and the entire mission and its crew were lost when Columbia broke up over Texas just 15 minutes before landing. The RDM was partially insured by NASA and a commercial insurance provider, but SPACEHAB has confirmed that it will not build a replacement.

NASA Cancels Contract

Shortly after the Columbia tragedy, NASA terminated its SPACEHAB contract for astronaut training at the Johnson Space Center's Neutral Buoyancy Lab, and awarded it to Raytheon. SPACEHAB has long provided the space station mockups and ISS-related spacewalk preparation at Johnson Space Center's indoor NBL swimming pool. The loss of the astronaut training contracts, which were carried out by SPACEHAB's Johnson Engineering subsidiary, will result in a 250-person layoff at the Johnson division.

SPACEHAB Closes Washington DC Office. SPACEHAB has implemented a transition plan as part of a continuing effort to reduce operating expenses and increase profitability. As a result, SPACEHAB closed its corporate office in Washington, DC, and will

consolidate these operations into its Houston, Texas, headquarters. No jobs were lost as a result of this consolidation.

SPACEHAB Awarded ISS Cargo Contract. In November 2003, SPACEHAB was awarded a new mission under its Research and Logistics Mission Support (ReALMS) contract with NASA for cargo services to the ISS. A modification to the ReALMS contract added SPACEHAB's ICC to the STS-121 mission. Additionally, the contract directs Lockheed Martin, the winner of the ISS Cargo Mission contract, to establish a contract with SPACEHAB for continued ICC and logistics module support, which began in January 2004. The value of the contract provided approximately \$24 million in revenue to SPACEHAB.

SPACEHAB Awarded NASA Exploration Contract. In September 2004, SPACEHAB was awarded \$1 million for a NASA study contract to support new exploration initiatives.

NASA Offers Cash for Loss of RDM

In October 2004, NASA informed SPACEHAB that it would pay \$8 million for the loss of the company's Research Double Module (RDM.) This amounts to approximately 10 percent of the \$87.7 million claim filed by SPACEHAB to cover its losses associated with the RDM.

SPACEHAB then decided in November 2004 to file a formal claim against NASA under the Federal Tort Claims Act. SPACEHAB is seeking restitution in excess of \$79.7 million. NASA has stated that its liability is limited to \$8 million under the terms of the ReALMS contract. The tort claim filed by SPACEHAB is separate and in addition to the claim previously filed under SPACEHAB's RDM contract.

SPACEHAB is claiming that the Columbia accident and the resultant loss of the RDM were a product of NASA's "negligence." The status of this claim is ongoing.

Lloyd's Joins Suit against NASA. Recently, Lloyd's of London, who insured the RDM, joined SPACEHAB in its suit against NASA. Lloyd's was previously seeking a restitution of the \$17.7 million it paid SPACEHAB after the accident. Under the new agreement, Lloyd's will receive \$500,000 if SPACEHAB wins.

Renewed STS Launch Activity

Following the recommendations of the Columbia Accident Investigation Board (CAIB), NASA resumed shuttle launches in 2005. As SPACEHAB is dependent upon the shuttle launch vehicle, resumption of shuttle

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flights ended a two-year delay in SPACEHAB business. Since this time, two SPACEHAB payload shuttle missions to the ISS have launched with a third launch planned for June 2007. Launched in August 2005, STS-114 delivered the ESP-2 storage module. In December 2006, STS-116 carried the Logistics Single Module (LSM) to resupply the ISS. STS-118, scheduled for launch in June, will supply the ISS using the ICC module.

A New Path. As of July 12, 2005, SPACEHAB will seek to develop a space launch vehicle called the Apex. Program manager, Jim Baker, has stated that the company no longer wants to depend on outside sources to launch its modules. The problems with the shuttle flights no doubt are the key factor in the company's

decision to develop an organic launch vehicle. The Apex will take advantage of existing technology and launch on existing rockets, such as Boeing's Delta and Lockheed's Atlas.

The plan is to create a flexible vehicle that could be used for both one-way missions as well as missions that require a return to the earth. Apex will come in three planned configurations. The 100 will carry about 380 kg to space on a Falcon 1, Minotaur, or Taurus rocket. The 300 will carry about 4,000 kg on top of a Delta 2 rocket. The final configuration, the 400, will carry 12,000 kg to space under the power of an Atlas 5 or Delta IV rocket. Each will have a smaller cargo capacity on return missions.

Significant News

Loss of NASA COTS Contract – In August 2006, NASA announced SpaceX and Rocketplane-Kistler as winners of its Phase I Commercial Orbital Transportation Services (COTS) contract. This initial capability demonstration contract is the precursor to NASA's Phase II selection of a firm to provide crew and cargo delivery services to the ISS. The COTS program is viewed as a major step in NASA's plan to commercialize low-Earth orbit payload delivery and supply. The loss of this contract will directly affect the SPACEHAB's Flight Services business group, which has been the primary revenue source for the firm over the last several years. (NASA, 8/06)

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Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1983	SPACEHAB established
Aug	1988	NASA and SPACEHAB sign agreement for six space flights
Jun	1993	First SPACEHAB mission
Oct	1998	SPACEHAB mission on STS-95
May	1999	SPACEHAB mission on STS-96
May	2000	SPACEHAB mission on STS-101
Sep	2000	SPACEHAB mission on STS-106
Mar	2001	SPACEHAB mission on STS-102
Aug	2001	SPACEHAB mission on STS-105
Feb	2003	SPACEHAB RDM lost on failed Space Shuttle Columbia mission STS-107
Jul	2005	SPACEHAB ESP2 on STS-114
Dec.	2006	SPACEHAB LSM on STS-116
Jul.	2007	Planned SPACEHAB ICC on STS-118

Forecast Rationale

SPACEHAB is facing increasing competition in the payload processing and delivery services market. NASA's purchase of the ISA MPLM and planned funding of the Khrunichev MLM illustrate a changing market dynamic that was dominated by SPACEHAB only five years ago. This increased competition and the resulting decline of SPACEHAB modules to a single

module per year since 2005 has impacted SPACEHAB's bottom line. In FY06, SPACEHAB posted \$3.9 million in profits compared to a \$5.2 million profit in FY05. Revenues in FY06 were \$53.6 million, down from \$59.4 million in FY05.

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With the majority of its business tightly bound to the Space Shuttle program, SPACEHAB has a rough road ahead as the shuttle is scheduled for retirement between 2010 and 2012 once U.S. core components are installed on the ISS. One positive outlook for SPACEHAB is the possibility of a new NASA vehicle in the future. Be it the Orion Crew Exploration Vehicle (CEV) or otherwise, SPACEHAB wants to be involved. When Forecast International spoke with SPACEHAB in 2006, Kimberly Campbell made it clear that the company was establishing its business base in support of the CEV program.

This, along with the development of the Apex launch vehicle, is the bright light on which SPACEHAB will focus, and with good cause. For the long term, we firmly expect to see a considerable increase in NASA funding for development of the CEV. In addition, the desire on NASA's part to use commercial space vehicles to resupply the International Space Station will open new opportunities for privately developed vehicles such as the Apex.

In addition to the modules previously mentioned, SPACEHAB offers a Logistics Double Module and an External Stowage Platform for shuttle mission needs. Campbell did comment on the status of the two modules in development and the Docking Double Module (see **Variants**, above), and said that these programs have slowed considerably due to the uncertain future of the shuttle fleet.

Forecast International does not expect production of further modules in their current configuration, as NASA will begin to concentrate efforts on a replacement for the shuttle. SPACEHAB will undoubtedly work to integrate a future module into whatever RLV is designed, although production of these future modules is too speculative to forecast at this point.

In the near term, SPACEHAB will realign its business strategy to reflect the loss of the NASA COTS contract. The loss of this contract for the Flight Services business unit of SPACEHAB will impact operations as Flight Services accounted for 60 percent of consolidated earnings according to the 2006 SPACEHAB Annual Report. With the option to provide commercial supply services under a NASA contract no longer an option, SPACEHAB will seek to diversify its business. One possible option to compensate is the expansion of its Astrotech business unit. Astrotech, which specializes in payload processing, was awarded a \$9.5 million contract to provide payload processing services to NASA's Kennedy Space Center in May 2006 and received a \$20 million fixed-price award to design and construct a payload processing facility for the U.S. Office of Space Launch at Vandenberg Air Force Base. In January 2007, SPACEHAB named James Royston, previous senior vice president of the Astrotech subsidiary, as executive vice president of SPACEHAB.

Ten-Year Outlook

Production of one commercial module for the International Space Station and development of a Docking Double Module were under way, but have now slowed due to uncertainties in human spaceflight and shuttle operations. The loss of future LEO supply contracts further complicates the short-term position of SPACEHAB. The development of the CEV and SPACEHAB's own launch vehicle could possibly be the key to the company's future success.

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