National Aeronautics and
Space Administration

Office of Inspector General
Headquarters
Washington, D.C. 20546-0001

Reply to Attn of: Office of Inspector General

October 6, 2000

The Honorable F. James Sensenbrenner, Jr.
Chairman, Committee on Science
U. S. House of Representatives
Suite 2320, Rayburn House Office Building
Washington, DC 20515-6301

Dear Mr. Chairman:

In response to your March 30, 2000, letter (See Appendix A), my office reviewed (1) NASA's requirements and justification for the utilization of a Boeing 737 for crew medical transport, (2) the nature of the negotiations with the National Space Development Agency (NASDA) and the Government of Japan for the acquisition of the aircraft, and (3) the cost effectiveness of this arrangement and the planned utilization of the aircraft.

We found that negotiations are underway for NASA to acquire a Boeing Business Jet for use as a dedicated crew medical transport for the International Space Station (ISS). NASA plans to receive the aircraft in a barter arrangement involving NASDA, the Government of Japan, and Mitsubishi, Inc. According to NASA, the medical transport aircraft would be used:

- to provide a contingency response capability during launch, landing, and on-orbit operations;
- to enhance post-flight recovery support for astronauts after long-duration missions; and
- to enhance the astronauts' pre-launch health stabilization support.[1]

NASA determined that the acquisition of a dedicated crew medical transport aircraft was the most effective approach to meeting crew medical needs. However, we found NASA's analyses supporting this determination did not consider all reasonable alternatives. We recommend that NASA conduct an independent analysis of the most appropriate approach to providing its astronauts with emergency, pre-launch, and post-mission medical support and reconsider the Agency's current plan to acquire a dedicated crew medical transport through a barter arrangement.

---

[1] Source: Johnson memorandum OA-00-0013, dated March 24, 2000, from the Space Station Manager to the Associate Administrator for Space Flight, Subject: *Crew Medical Transport*.

I. REQUIREMENTS AND JUSTIFICATION FOR THE CREW MEDICAL TRANSPORT

A. Crew Medical Transport Requirements

1. Providing a Contingency Emergency Response Capability During Launch, Landing, and On-orbit Operations

The intent of this requirement is to ensure that emergency medical services are promptly available for ISS crewmembers involved in aborted launches or emergency returns from the ISS. Emergency medical services include the rapid deployment of emergency care, the transport of injured crewmembers to the nearest hospital or U.S. healthcare facilities, and access to astronaut family members.

2. Enhancing the Long-duration Astronaut's Post-Flight Recovery Support (Non-emergency)

Astronauts return from orbit – particularly from long-duration stays in orbit – in a weakened state. The intent of this requirement is to ensure that astronauts returning from long-duration flights on the ISS have rapid access to all necessary equipment and medical attention to enhance their recovery. In addition, post-flight monitoring of astronauts as they recover may enable NASA to acquire better data on the readjustment of the human body after long-duration flights.

3. Enhancing the Astronaut's Pre-launch Health Stabilization Support

The intent of this requirement is to reduce the chance that astronauts will become sick before flight, affecting their scheduled training and launch operations. According to the Johnson Space Center (Johnson) Space and Life Sciences Directorate letter SA-99-284, dated November 1, 1999, commercial travel by astronauts in the week prior to launch significantly increases the probability of their exposure to infectious disease, which could in turn cause a potential slip in the launch date.

4. A Dedicated Crew Medical Transport

In its analyses to determine the best approach to meet crew medical transport needs, the ISS Program established a requirement for a dedicated aircraft available 24 hours a day, 7 days a week (24x7). NASA officials provided conflicting information as to how the requirement for a dedicated crew medical transport originated. For example, the November 1999 Space and Life Sciences Directorate letter proposes the requirement for a crew medical transport based on requirements for emergency, pre-launch, and post-mission medical support. However, an official within the Space and Life Sciences Directorate told us he believed the requirement originated within the Flight Crew Operations Directorate and was given to the Space and Life Sciences Directorate to evaluate. In addition, most individuals we talked to cited the requirement for a contingency medical response as being the main justification for a dedicated aircraft available 24x7, while the November 1999 Space and Life Sciences Directorate letter stressed pre-launch and post-mission medical support as the main requirements.

B. Do the Requirements Justify a Dedicated Crew Medical Transport?

1. Providing a Contingency Response Capability During Launch, Landing, and On-orbit Operations

During nearly 100 Space Shuttle missions and seven long-duration astronaut stays on the Russian Space Station Mir, the United States has yet to encounter a situation that would require emergency medical airlift of astronauts. We do not wish to imply that such incidents may not happen in the future – only that such incidents are rare. A dedicated crew medical transport might be able to provide enhanced support in such situations, but it might not.

NASA may have little warning that an emergency landing is about to occur. The Space Shuttle and the Soyuz[2] both typically return to Earth about one hour after they begin the reentry process. In a rapidly developing emergency, the rapid reentries of these vehicles may not provide sufficient time for the crew medical transport to position itself to support the crew. For example, a crew medical transport on the ground in Houston (or ferrying astronauts around the United States in a stabilized environment) would likely arrive at a Soyuz landing site in Russia hours after local first responders reach the scene.

In addition, in many cases, the crew medical transport aircraft may be unable to land near the scene of an emergency Soyuz landing. After reentry, the Soyuz capsule (roughly three meters in diameter, carrying three individuals) parachutes to earth, landing on solid ground. In normal situations, Soyuz capsules returning from the ISS will land in Russia. However, in an emergency return, the Soyuz could land on almost any landmass between roughly 52 degrees North and 52 degrees South. Because the Boeing Business Jet requires an airport runway of approximately 6,000 feet in length for takeoff and landing, it would only be able to land near the site of an unplanned emergency Soyuz landing if the Soyuz lands in the vicinity of an airport.

If an emergency occurs, NASA has already developed plans for contingency rescue of ISS crewmembers – plans that do not require a dedicated crew medical transport.[3] Specifically, the ISS Program Medical Operations Requirements Document states, "The host country for launch/landing shall be responsible for providing emergency medical services, including rescue, recovery, and transport for nominal and contingency events during all mission phases." Following an aborted launch or emergency landing in Russia, an injured ISS crew will initially be treated in the host country within the current Search and Rescue/Military Hospital system and further transport will be provided by Russia to Moscow. The existing International Partner medical management infrastructure then assumes responsibility for medical evacuation to a Western hospital. For a Space Shuttle launch or contingency landing, the NASA Space Shuttle Program continues to be responsible for emergency medical services.

---

[2] The ISS program intends to use the Soyuz as the ISS's principal means of emergency return until the Crew Return Vehicle becomes available in 2005.

[3] Most of these plans are currently in place for the October 30, 2000, launch of the ISS Expedition 1 crew which includes a U.S. astronaut lifting off from Russia.

For the Space Shuttle Program, the Department of Defense (DoD) Manned Space Flight Support Office (DDMS) is responsible for astronaut rescue and recovery, contingency landing site support, payload security, medical support, coordination of airlift/sealift for contingency operations, as well as other support services required in the event of a Space Shuttle emergency. DDMS selects assets best able to provide the required support and coordinates and tasks selected units through appropriate command channels. The ISS Program has designated the DDMS support as a secondary resource if primary medical evacuation support is not available for contingency Soyuz landings. Moreover, when an emergency does occur, the likely scenario is that the United States and ISS partner nations will mobilize every available asset to come to the aid of the downed astronauts.[4]

2. Enhancing the Long-duration Astronaut's Post-Flight Recovery Support

NASA already has plans in place to provide post-flight recovery support to returning ISS crewmembers. When astronauts land in Russia, the Gagarin Cosmonaut Training Center will provide immediate post-landing crew member medical support.[5] The current plan returns the crewmember to the United States via NASA Aircraft Operations or via aircraft chartered by NASA's Space and Life Sciences Directorate. Through April 2003 (the extent of the planned crew rotations), only two Soyuz returns are scheduled involving U.S. crewmembers.[6] For this same period, five Space Shuttle returns are scheduled.

For Space Shuttle landings, immediate post-landing medical support is the responsibility of the Expedition Crew Surgeon and the International Partner Flight Surgeon. As has been the case for the past 20 years, travel from the Space Shuttle landing site (usually Kennedy Space Center) to Johnson will be provided by NASA Aircraft Operations or by Space and Life Sciences Directorate chartered aircraft. The presence of a dedicated crew medical transport arguably might enhance the post-flight recovery support available to long-duration astronauts, but such an aircraft does not appear to be required.

Other alternatives for planned returns to Russia could include the use of NASA or DoD aircraft stationed in Russia or placing astronauts in U.S. military hospitals with access to NASA medical personnel and equipment for post-flight recovery. Other alternatives could also include the use of the Civil Reserve Air Fleet, Aeromedical Evacuation Shipsets available through the Air Mobility Command.

---

[4] For example, in 1996, teams from the U.S. Search and Rescue Team out of Brindisi, Italy as well as teams from Croatia, Britain, France, and Germany searched for Secretary of Treasury Ron Brown and his party from an Air Force Boeing 737 crash. In July 1996, teams from the Coast Guard, the Navy, and the Air Force searched for survivors from TWA Flight 800. In July 1999, extensive teams from the Coast Guard, Civil Air Patrol, the Air Force, the Navy, and the National Oceanic and Atmospheric Administration (NOAA) searched for John F. Kennedy, Jr. and passengers. In October 1999, Dr. Jerri Nielsen, a National Science Foundation researcher and physician was rescued from Antarctica by the Air Force after discovering she had breast cancer and that same month search and rescue teams from the Coast Guard, NOAA, and the Navy responded to the crash of Egypt Air Flight 900. As recently as August 2000, the United States, Britain, and Norway offered to assist Russia in rescue efforts of the sunken Russian submarine, the Kursk, in the Barents Sea.

[5] Source: Space Station Program Joint Medical Operations Implementation Plan.

[6] Source: Space Station Program (SSP) 50110, Multi-Increment Manifest Document, Revision F, August 2000.

3. Enhancing the Astronauts' Pre-launch Health Stabilization Support
NASA has long established procedures to protect the health of its astronauts before their flights. Since the Astronaut Health Stabilization Plan was initiated in the early 1970's to protect astronauts during the week prior to launch, no preflight infectious diseases have been noted in the Apollo, Skylab, or Space Shuttle Programs.[7] NASA was able to protect the health of its astronauts (including those travelling to Russia during the Shuttle-Mir Program) for the last thirty years without a dedicated crew medical transport. Thus, the historical data does not support a strong requirement for such a vehicle now.[8] Moreover, travel other than to Johnson and Kennedy for the timeframe six weeks prior to launch is currently not allowed for ISS Space Shuttle launched crews.[9]

II. NATURE OF THE AGREEMENT WITH NASDA

Because the ISS Program does not have funds allocated to acquire a medical transport aircraft, NASA is pursuing a barter arrangement to acquire such an aircraft. NASA and the Japanese government are currently negotiating the terms and conditions, which will allow NASA to transfer its right to use a Japanese expendable launch vehicle (H-IIA rocket) to a third party, Mitsubishi, Inc. (USA). NASA plans to acquire a Boeing Business Jet fully outfitted with medical equipment specified by NASA from Mitsubishi, Inc. (USA) in exchange for the rights to the H-IIA launch. Mitsubishi, Inc. (USA) will exercise its rights to the H-IIA launch in accordance with all of the terms and conditions specified in the agreement between NASA and the Japanese government. The barter arrangement will be executed via a contractual document in accordance with the Federal Acquisition Regulations.

NASA acquired rights to the H-IIA rocket launch in 1997 as part of a barter arrangement involving the launch of the Japanese Experiment Module (JEM) on the Space Shuttle.[10] The 1997 agreement specifies that between April 2003 and December 2005, NASA will supply a

---

[7] Source: Johnson Space and Life Sciences Directorate letter SA-99-284, November 1, 1999.

[8] One NASA official told us that he was concerned over the health of astronauts travelling on commercial flights to Russia. In particular, he was concerned about the heightened chance of catching tuberculosis on commercial flights carrying Russian passengers (Russia has a higher tuberculosis rate than the U.S.). However, the Centers for Disease Control have reported that there is no reason to suspect that the risk of transmission of tuberculosis is greater on aircraft than in any other confined space. NASA could not provide evidence that any astronauts had developed health problems that significantly delayed training or a launch due to traveling on commercial flights to and from Russia.

[9] Source: Station Program Implementation Plan, Volume 7: Training (SSP 50200-7, Revision A), Section 4.5.1.1 C. Exceptions can be made on a case-by-case basis.

[10] The JEM launch offset agreement, executed in September 1997 between NASA and NASDA, contains provisions for NASA to provide standard and non-standard launch services for the module cargo elements as well as accommodations for middeck locker equivalents for NASDA. NASDA in turn is to provide a Centrifuge Accommodation Module, a Centrifuge Motor, Life Sciences Glovebox, and H-IIA launch services, among other items.

payload of its choice, subject to NASDA constraints, for the H-IIA launch. We were told that candidate payloads under consideration at the time the agreement was signed included a Mars probe, a lunar probe, and an Earth orbiting satellite.

NASA officials told us that when they began to consider bartering the H-IIA launch for the crew medical transport, they conducted an internal review to determine whether any NASA programs were interested in using the H-IIA launch. No suitable payloads were identified during this review.[11] Following the review, NASA determined that the launch of the H-IIA rocket was available for barter. However, a NASA official told us that the ISS Program never intended to use the H-IIA launch and always planned to barter the launch rights in exchange for another asset required by the ISS.

Negotiations between NASA and Japan concerning the terms and conditions of the proposed transfer of the H-IIA launch rights commenced in February 2000. Both NASDA and Japan must approve the terms and conditions of such a transfer. Negotiations are currently underway, but the details are not yet finalized.[12]

III. COST-EFFECTIVENESS AND PLANNED UTILIZATION

A. Is the Barter Arrangement a Good Deal?

The H-IIA is a liquid-fueled rocket based on NASDA's H-II rocket, but intended to be less expensive and more reliable. Early models of the H-II are expected to be capable of launching 8,400 kg to the ISS orbit, or 4,100 kg to a geostationary transfer orbit.[13] The first launch of the H-IIA launch vehicle is scheduled for early 2001. NASDA has tentatively identified the price of a launch on a H-IIA launch vehicle to be $75 million.[14] This price does not appear to be inconsistent with the prices of launch vehicles with similar payload capacities, such as the Delta III and the largest Ariane IV rockets.

The Boeing Business Jet is a derivative of the Boeing 737-700. The aircraft has a maximum range of 7,130 statute miles (11,482 kilometers) and cruises at a ground speed of 550 miles per hour. The price for an unfurnished airplane is $37.9 million. Interior completion costs can add $8 million to $12 million, for a total price at delivery of $45.9 million to $49.9

[11] We believe a more diligent search by NASA may yield a candidate payload.

[12] The elements of the discussions between NASA and Japan for use of the H-IIA are considered "negotiation sensitive" by NASA.

[13] With the addition of two liquid rocket boosters, the H-IIA can deliver heavier (by more than 50 percent) payloads to these orbits.

[14] Source: International Reference Guide to Space Launch Systems. S. Isakowitz et al. American Institute of Aeronautics and Astronautics.

million. NASA estimates that the annual operating cost for the aircraft would be approximately $780,000.[15]

NASA proposes a straight swap of the H-IIA launch for a fully outfitted Boeing Business Jet. If only the dollar costs are compared, the barter arrangement does not appear to be advantageous for the United States taxpayer—even if H-IIA prices were cut by twenty percent, a launch on the H-IIA will still cost $10 million more than a fully-outfitted Boeing Business Jet. However, given that the aircraft would be available well before the launch opportunity occurs, and that the price of the H-IIA could potentially drop due to competition or other factors, the deal does not seem patently unreasonable.

B. Is a Dedicated Crew Medical Transport a Cost-Effective Solution?

NASA performed two analyses to determine how best to meet its ISS crew medical transport needs. One focused on determining what aircraft could best meet NASA's requirements for 24x7 medical contingency response. The second compared the costs and benefits of using a dedicated Boeing Business Jet crew medical transport against the costs and benefits of flying astronauts on commercial flights.

NASA considered numerous options for meeting the Agency's requirement for 24-hour dedicated support. These included utilization of existing NASA aircraft, utilization of excess aircraft from NASA or the Air Force, utilization of charter aircraft, aircraft lease, fractional ownership of aircraft, and utilization of support aircraft from the Air Force. However, the study focused on only one of the three crew medical transport requirements – provision of a contingency response capability – and based many of its decisions on the derived requirement that the crew medical transport be available 24x7. Because NASA did not retain detailed backup for the study, the Agency was only able to provide us the study's scope and results, so we had no way of verifying the study's conclusions.

NASA was able to provide us with more information about the study that compared the cost of operating the Boeing Business Jet against the costs of flying astronauts on commercial flights. However, we found the study was limited because of NASA's lack of any consistent plan for post-flight recovery and pre-launch stabilization usage.[16] In addition, the study did not examine any alternative aircraft or procurement approaches. Neither of the analyses compared the costs of obtaining and maintaining a medical transport aircraft with the cost of

[15] Source: Crew Medical Transport. Mission Support. Johnson Flight Crew Operations Directorate Presentation, February 29, 2000.

[16] For example, one NASA official said the medical transport would be used exclusively for contingency recovery and pre and post-flight support of long-duration crewmembers. Other officials said that the transport would additionally support crew training requirements (thereby providing a stabilized environment during transport) and would make numerous flights each year between the U.S., Russia, or wherever the crew might require training (transporting more than 700 travelers over a 5 year period).

using existing medical transport solutions or considered sharing the crew medical transport costs with other Government agencies and/or International Partners.[17]

IV. CONCLUSION

We found that NASA already has in place contingency plans and partnership agreements to meet current crew medical transport requirements. Although the Agency contends that a thorough analysis of all alternatives was completed, we found that NASA's justification for acquiring a dedicated crew medical transport available 24x7 is based on incomplete analyses and a requirement that cannot clearly be traced back to overall crew medical requirements.

We believe that NASA should base its decisions on a thorough analysis of the costs and benefits of all alternatives to meeting crew medical transport needs. Such an analysis would include a determination of the adequacy of existing policies and procedures and an independent assessment of potential low-cost alternatives for crew medical transport.

In light of the above, we recommend to the Agency as follows:

Recommendation 1: NASA should conduct an independent analysis of the most appropriate approach to providing its astronauts emergency and post-mission medical support. In this analysis, the use of a dedicated aircraft available 24x7 should only be considered one possible approach, and not a requirement.

Recommendation 2: NASA should consider alternatives to the proposed barter arrangement to procure a crew medical transport, including cost sharing from International Partners.

Sincerely,

Original Signed By
Roberta L. Gross
Inspector General

Enclosure
Appendix A: Letter from Chairman Sensenbrenner

[17] NASA did ask the DDMS whether the DoD could provide dedicated contingency response capabilities on a 24x7 basis. The DDMS responded that the requirement for a dedicated aircraft available 24x7 cannot be met and that this capability is only available to the President of the United States.

Appendix A

Letter from Chairman Sensenbrenner

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE

SUITE 2320 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6301
(202) 225–6371
TTY: (202) 226–4410
http://www.house.gov/science/welcome.htm

March 30, 2000

Ms. Roberta L. Gross
Inspector General
National Aeronautics and Space Administration
Washington, DC 20546

Dear Ms. Gross:

It has come to my attention that NASA is currently in the process of negotiating an arrangement with the National Space Development Agency (NASDA) of Japan for the use of a Boeing 737 aircraft for International Space Station (ISS) crew medical transport requirements. It is also my understanding that the negotiations include NASDA's use of the Shuttle in support of ISS. Given past Congressional concerns regarding the nature of aircraft obtained by NASA for use in Russia, I believe this arrangement must be reviewed and that the facts be clearly established. Furthermore, I do not believe it is appropriate to go forward with any deals for aircraft until such time as the facts have been established and Congress has had the opportunity to review these findings.

Specifically, I would like your office to review: (1) the requirements and justification for this aircraft; (2) the nature of the agreement with NASDA; and (3) the cost effectiveness of the arrangement with NASDA including planned utilization of the aircraft. Please provide the House Science Committee with the results of your review as soon as you have completed your work.

Sincerely,

F. JAMES SENSENBRENNER, JR.
Chairman

FJS/wba