Section 7

Facilities

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Facilities

An expansion of medical data collection facilities was necessary to implement the Extended Duration Orbiter Medical Project (EDOMP). The primary objective of the EDOMP was to ensure the capability of crew members to reenter the Earth's atmosphere, land, and egress safely following a 16-day flight. Therefore, access to crew members as soon as possible after landing was crucial for most data collection activities. Also, with the advent of EDOMP, the quantity of investigations increased such that the landing day maximum data collection time increased accordingly from two hours to four hours. The preflight and postflight testing facilities at the Johnson Space Center (JSC) required only some additional testing equipment and minor modifications to the existing laboratories in order to fulfill EDOMP requirements. Necessary modifications at the landing sites were much more extensive.

LANDING SITE MEDICAL FACILITIES

Background

Before the full implementation of EDOMP, crew members egressed through a white room with a truck-mounted set of stairs that docked with the Orbiter. Although crew members could de-suit in the white room, space was restricted and the medical care capability was limited. Also, the entire crew was detained until their collective physiological recovery permitted descending the white room stairs. This arrangement limited the capability of immediate medical care and prolonged the duration between wheels stop and medical data collection. Although clinic space at both landing sites was adequate for the landing day physicals, it was not adequate to also accommodate EDOMP investigations.

Edwards Air Force Base (EAFB) was initially the prime landing site for Extended Duration Orbiter (EDO) flights of 13 to 16 days duration. One concern of long duration flights was the crew's ability to perform precision landing maneuvers, especially with a heavy payload such as a Spacelab. Landing at EAFB provided more latitude with multiple runways and expanded landing area compared to the shorter, narrower runway at Kennedy Space Center (KSC). However, the advantage of landing at KSC was an expedited Orbiter processing turnaround, since the need to transport the Orbiter from EAFB to KSC after flight was eliminated.

Edwards Air Force Base (EAFB)

The facilities at the Dryden Flight Research Center (DFRC) of EAFB were expanded prior to those at KSC because of the large number of Shuttle landings there early in the program. Even after EAFB became the contingency landing site, a fully staffed and fully functional data collection facility was necessary to ensure that no data were lost following a flight. Because the clinic at DFRC was not suitable for expansion, a new facility named the Postflight Science Support Facility (PSSF) was built (Figure 7-1). A site was chosen based on proximity to the runway and within the NASA area at EAFB. The design was based on requirements for EDOMP investigations, flight physical examinations, and Spacelab postflight data collection (Figure 7-2).

Kennedy Space Center (KSC)

The facility at KSC, used for the landing day physical examinations, was in the Operations and Checkout

Figure 7-1. PSSF at Dryden.

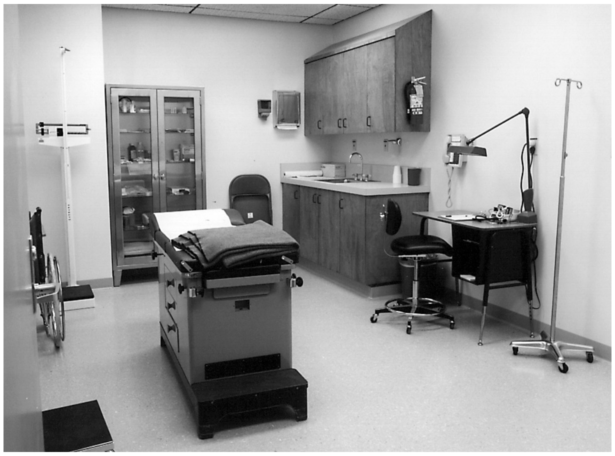


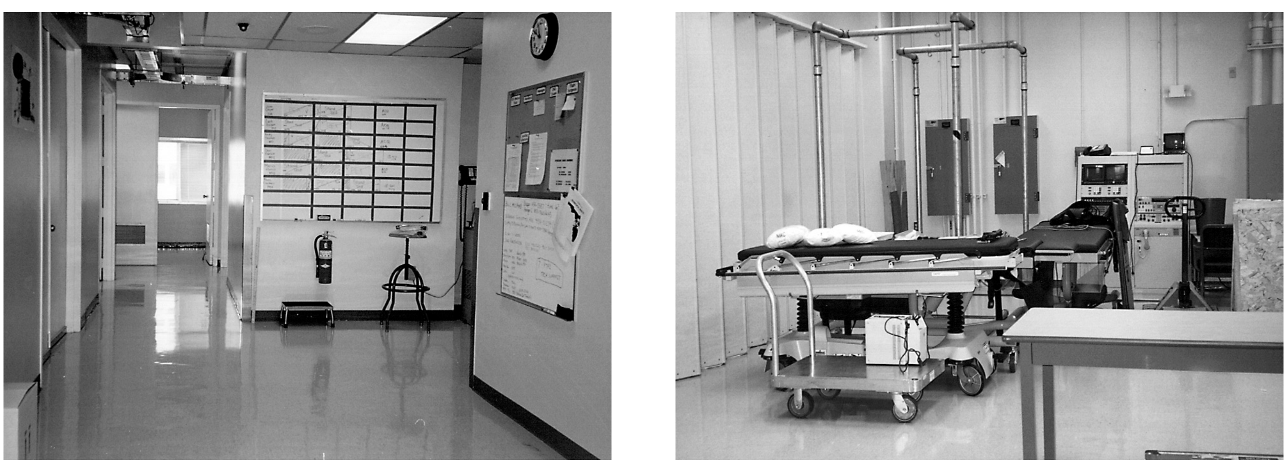
Figure 7-2. Examination room at PSSF.

Building which lent itself to rearrangement of internal space. The driving factors became: (1) to design a layout where the EDOMP data collection did not impede the physical examinations and allowed extra privacy for crew members, and (2) to provide space within the total available area to meet the requirements of the principal investigators. As with the PSSF, the needs for Spacelab data collection were factored into the design. The design also had to provide enough flexibility to accommodate requirements changes from mission to mission based on the total complement of investigations and the number of crew member participants. Space was made available on the second floor, and walls (some removable) were installed to separate the spaces (Figures 7-3a and 7-3b). Some investigations that involved large equipment were always performed in the same location. Other investigations, that used smaller portable equipment and did not require much space, had fewer restrictions on their room location and enhanced the flexibility for each flight.

Experience proved that some testing equipment was too bulky and the electronics too sensitive to endure the rigors of frequent shipping. Additional units of devices such as the Posture Platform (DSO 605), the Underwater Weighing Tank (DSO 608), and the Treadmill were purchased and housed both at KSC and the EAFB PSSF. At KSC, a design change created a docking port for the Crew Transport Vehicle (CTV) (described in the next section) at the second floor of the Baseline Data Collection Facility (BDCF). The CTV docking port enabled crew members to exit directly into the BDCF, thus minimizing crew activity before testing and enhancing the landing day schedule.

Crew Transport Vehicle (CTV)

An important contribution to obtaining crew medical data in a timely manner was the addition of Crew Transport Vehicles at KSC and EAFB (Figures 7-4a and 7-4b). Prior to EDOMP, medical data collection was initiated from 1.25 hours to 2.5 hours after wheels stop. This delay allowed a partial physiological recovery from spaceflight to occur and prevented investigators from gaining data that would provide answers relative to the physiological condition of their subjects at landing. The primary objective of the EDOMP was to ensure that the crew could safely land the Orbiter and perform an emergency egress after a 16-day mission. Some of the considerations that drove the decision on what type of vehicle to purchase and develop for immediate access were: (1) potential medical emergency activities, which were possibly more likely with a 16-day flight than with



a. Entry to the Baseline Data Collection Facility (BDCF) at KSC

b. Examination room at the BDCF

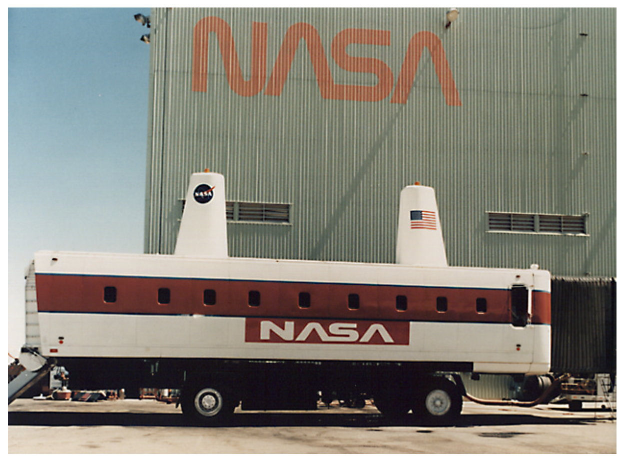
Figure 7-3. Baseline Data Collection Facility (BDCF) at KSC.

the typical 5- to 7-day flight, (2) the number of people required in the CTV at landing, (3) capability and interface with the Orbiter or white room, (4) accommodations for interfacing with the BDCF and PSSF, and (5) accommodations for physiological data collection.

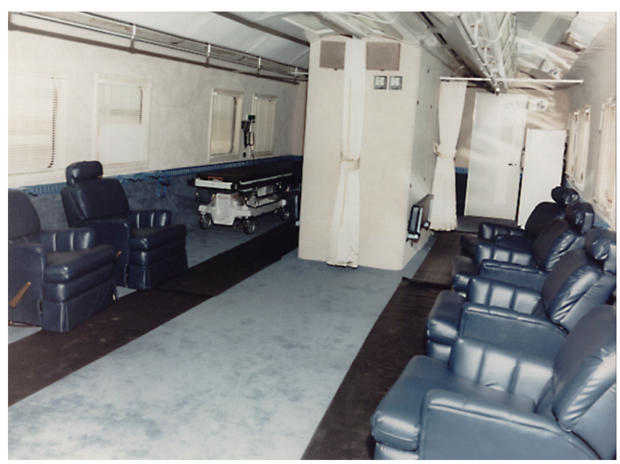
Several variations of available vehicles were considered. These included the airport passenger transporter (APT) with 568 square feet, and the aircraft service vehicle (ASV) with 360 square feet of available space. The ASV was determined to be insufficient primarily because of its size. The APT was selected and modified to meet the unique requirements. Both CTVs (KSC and EAFB) were fully self-contained, single operator, self-propelled units with internal environmental control systems. Each CTV could be raised by as much as 11 feet via a self-contained lift system to dock with the Orbiter hatch or the BDCF (Figure 7-4a). A telescoping gangway was provided for docking ingress and egress, and a stairway in the rear of the vehicle provided an alternate exit. The passenger seats were removed and provisions for large recliner-type chairs, a refrigerator, restroom, emergency medical equipment, and other improvements were added (Figure 7-4c).

Although the two CTVs were originally different models of a Plane Mate APT, after modification they provided similar capabilities. The CTVs have been used since June 1991 (STS-40) and have proven to be very effective. Use of the CTVs contributed to enhanced emergency medical capability, improved crew comfort, enhanced medical data collection capability, and reduced time from wheels stop to data collection.

a. CTV docked to the BDCF at KSC



b. CTV at Dryden



c. Interior of CTV

Figure 7-4. Crew Transport Vehicles (CTVs).

JOHNSON SPACE CENTER (JSC)

Throughout the Space Program, JSC has been the focal point for pre- and postflight medical testing, with a significant amount of crew training and hardware development and testing also being performed there. Therefore, implementation of the EDOMP at JSC primarily involved modification and relocation of existing facilities, such as adding test and analysis equipment and utilizing any unused or under-used space to better accommodate the laboratories. EDOMP support required a wide range of activities. The activities performed at JSC were ground-based testing, flight protocol development, flight hardware development and testing, crew training, baseline data collection (pre- and postflight), planning and directing medical activities to be performed at landing sites, and analysis and archiving of data.

Because flight opportunities are relatively few, as are the number of crew members available for a particular investigation, ground-based testing of non-astronaut populations was critical to gaining as much knowledge as possible before implementation of a flight investigation. With the science knowledge gained from ground-based testing, flight protocols could be developed that would provide maximal data and also take into account flight constraints such as limited stowage, power, and crew time.

Development of hardware to support these flight protocols was essential to the success of each investigation. In many cases commercial off-the-shelf items were modified and certified for flight, but often hardware had to be designed specifically for the unique investigation in the environment of space. All hardware was developed, certified, and processed at JSC.

Crew training was performed at JSC, mostly in the disciplines' laboratories. Numerous training sessions were held in the Shuttle Crew Compartment Trainer (CCT) and the Full Fuselage Trainer (FFT). Access to these trainers was advantageous when precision was required in flight or where positioning of equipment and crew members was critical.

Preflight as well as postflight baseline data collection sessions were performed at JSC, typically in the disciplines' laboratories. Strict adherence to the standards for clinical testing was observed.

The success of landing day activities depended primarily on the planning and oversight of medical activities performed at the landing sites; this was performed by JSC personnel. Preparation of and adherence to a landing day schedule were required so that all crew members received their designated testing within the guidelines of numerous constraints. The constraints of each investigation had to be considered with respect to all other investigation constraints. For example, exercise would perturb results of a neurological or cardiovascular test, or drinking or eating certain foods would nullify an exercise test. This, combined with adhering to other landing day constraints, required a well-planned schedule which was ultimately approved by the crew, the flight surgeon, and each of the investigators.

All data and samples from flight and landing day were transported to JSC where they were analyzed and stored. Each laboratory was equipped with instruments and hardware to perform appropriate analyses, as well as personnel trained in these methods. After analysis, the refined data were incorporated into the EDOMP data archive.