Human Factors Engineering Standards at NASA

NASA has begun a new approach to human factors design standards. For years NASA-STD-3000, Manned Systems Integration Standards, has been a source of human factors design guidance for space systems. In order to better meet the needs of the system developers, NASA is revising its human factors standards system. NASA-STD-3000 will be replaced by two documents: set of broad human systems design standards (including both human factors and medical topics) and a human factors design handbook. At the present time the standards document is in final review with some disagreement on several critical issues. The handbook is progressing with November 2008 as the anticipated completion date.

HUMAN FACTORS ENGINEERING STANDARDS AT NASA – PRESENT SYSTEM

For the past 20 years NASA has had a single agency-wide human factors standard, NASA-STD-3000, the Manned Systems Integration Standards. Although NASA-STD-3000 was intended to apply to all human space flight systems, the standard was written primarily to address the needs of the International Space Station (the emerging program at the time).

It became clear that NASA-STD-3000 was not completely fulfilling its goal. Portions were too general to meet the specific needs of the International Space Station. The Space Station program therefore tailored their own program-specific version of NASA-STD-3000. On the other hand, NASA-STD-3000 was too space-station-specific to be the human factors standard for the new Crew Exploration Vehicle (CEV, a vehicle to replace the shuttle and eventually carry humans back to the moon and beyond). Therefore, a CEV program-specific human factors requirements document was prepared.

Also, because NASA-STD-3000 is an agency-wide standard, reviews and procedures required for update make it expensive and time-consuming to revise. In 1995 the standard went through its first and only update since its publication in 1987. It has not kept current with technological changes or lessons learned.

NASA-STD-3000 was the "official" standard, but it was aging and was not applicable to any specific program. The source and implementation of human factors standards at NASA had become unclear.

Also, the relative roles of human factors and space flight medicine were confusing. Both deal with the health, performance, and well-being of the human. NASA-STD-3000 includes medical topics such as requirements for nutrition and medical care. Yet other specific medical requirements exist in individual program specifications as well as in other NASA standards and policy documents.

NEW SYSTEM WITH STANDARDS AND HANDBOOK

To address the problems described above, NASA is creating new standards and a reference handbook. These documents represent a new approach for human factors standards.

NASA has recently completed standards for human space flight systems. The document is called NASA Space Flight Human System Standards (SFHSS). It consists of two-volumes:

> Volume 1- Crew Health
>> This volume covers standards needed to support astronaut health (medical care, nutrition, sleep, exercise, etc.)
> Volume 2 – Habitability and Environmental Health
>> This volume covers the standards for system design that will maintain astronaut performance (environmental factors, design of facilities, layout of workstations, and lighting requirements, for example). It includes classic human factors requirements.

The new standards document is written in general terms so that it is applicable to a broad range of present and future NASA systems. The document states that all new programs prepare system-specific requirements that will meet the general standards. For example, the document does not specify a design should accommodate specific percentiles of a defined population. Rather, Volume 2 states that all programs shall prepare program-specific requirements that define the user population and their size ranges. The design shall then accommodate the full size range of those users.

The accompanying reference handbook, the Human Integration Design Handbook (HIDH), is currently under development. It is based on NASA-STD-3000; the information in NASA-STD-3000 is being updated and the "shall" statements have been removed. HIDH will serve two major purposes:
1. HIDH is the required resource for writing the human factors requirements for specific systems. The Space Flight Human System Standards specify that the handbook must be used.

2. HIDH contains design guidance information to help insure designers create a system which safely and effectively accommodates the capabilities and limitations of space flight crews.

The Space Flight Human System Standards establish human-system standards in broad, general terms. This is a new concept for human factors standards at NASA, but addresses what is actually happening; programs write human factors requirements specific to their systems. However, the program-specific requirements can be incomplete. They were often extracted by non-human factors professionals from an existing set of standards (NASA-STD-3000) What has been added is that the new standard sets the goals and guidelines that program-specific requirements must meet. The SFHSS establishes a comprehensive set of baseline standards that will help insure humans are healthy, safe, and effective.

- The Human Integration Design Handbook will contain human factors design guidelines that can be tailored to specific programs. In addition, the handbook will contain lessons learned, example solutions and research needs.

An advantage of the handbook format is a shortened review cycle for non-critical information. This will permit more frequent update and expansion. The handbook will be on-line and is intended to be an up-to-date resource of information on humans in space.

STATUS OF STANDARDS AND HANDBOOK

Volume 2 of the Space Flight Human System Standards is in final review at NASA. The standard is unique in several ways and has prompted numerous briefings and meetings. On this (hopefully) final review, we have received approximately 300 revision recommendations -- some serious enough to derail the project. At this moment we do not know the final outcome. The standard could be baselined by March 2008. We anticipate that the first issue of the Human Integration Design Handbook will be published and baselined within NASA by the end of 2008.