National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

ERR VERSION
April 2000

Human Research Facility Experiment Documents for E085/507 Visuomotor and Orientation Investigations in Long-Duration Astronauts (VOILA)

E085/Human Orientation and Sensory-Motor Coordination in Prolonged Weightlessness

E507/Spatial Orientation and Sensorimotor Coordination in Prolonged Weightlessness

PIs: E085/Charles Oman, Ph.D., E507/Alain Berthoz, Ph.D.

CCB Controlled

LS-20427

PROJECT DOCUMENT APPROVAL SHEET

DOCUMENT NUMBER	DATE	NO. OF PAGES
LS-20427	4/19/00	

TITLE:

Human Research Facility

Experiment Documents
for E085/507
Visuomotor and Orientation Investigations in
Long-Duration Astronauts[VOILA]

E085/Human Orientation and Sensory-Motor
Coordination in Prolonged Weightlessness

E507/Spatial Orientation and Sensorimotor
Coordination in Prolonged Weightlessness

PI – E085/Charles Oman, Ph.D., E507/Alain Berthoz, Ph.D.

APPROVED:	SF4/Angie Lee Experiment System Manager	Signed 1/20/00 - Signature on File
APPROVED:	Charles Oman, Ph.D. Principal Investigator	Signature on File
APPROVED:	Alain Berthoz, Ph.D Principal Investigator	Signature on File.
APPROVED:	SF4/Melvin C. Buderer, Ph.D. Chief, Research and Experiment Management Branch	Signed 1/25/00 - Signature on File

DATE	PREPARED BY	CHANGE APPROVALS	CHANGE NUMBER

DOCUMENT NUMBER LS-20427	**DOCUMENT CHANGE/ REVISION LOG**	PAGE 1 OF 1

CHANGE/ REVISION	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED
Basic	4/19/00	Baseline Issue - ERR Version CCBD: HJED-E085-0001	

Altered pages must be typed and distributed for insertion.

JSC FORM 278 (REV APR 81) NASA-JSC

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AIBS	American Institute of Biological Sciences
AO	Announcement of Opportunity
ASI	Agenzia Spaziale Italiana
ATP	Authorization to Proceed
Avg.	Average
B&W	Black and White
Batt.	Battery
BDC	Baseline Data Collection
BP	Behavior and Performance
BRP	Biological Research Program
C	Controlled
CBT	Computer Based Training
CCB	Configuration Control Board
CCSDS	Consultant Committee for Space Data Systems
CDMS	Command and Data Management System
CDR	Critical Design Review
CD-ROM	Compact Disk – Read Only Memory
CHeCS	Crew Health Care System
cm	centimeter
CNES	Centre National d'Etudes Spatiales
CO	Contracting Officer
COTR	Contracting Officers Technical Representative
CP	Cardiovascular/Pulmonary
CPE	Crew Procedures Engineer
CR	Change Request
Deg.	Degrees
dev.	Developed
DFRC	Dryden Flight Research Center
DFRF	Dryden Flight Research Facility
DRD	Data Requirements Document
DSA	Data Sharing, Archiving, and Distribution Plan
DVIS	Digital Voice Intercommunications System
ECG	Electrocardiogram
ECM	Engineering, Cost, and Management
ED	Experiment Document
EE	Experiment Engineer
EMP	Experiment Management Plan
EPE	Experiment Project Engineer
ERR	Experiment Requirement Review
ESA	European Space Agency
ESM	Experiment Systems Manager
ESS	Experiment Support Scientist
EST	Experiment Support Team
EUE	Experiment Unique Equipment
EUSW	Experiment Unique Software
expts.	Experiments

ACRONYMS AND ABBREVIATIONS (Cont'd)

FD	Flight Day
FD	Flight Day
FDX	Flight Day X
FEPC	Flight Equipment Processing Center
flt.	flight
g	gravity
GASMAP	Gas Analyzer System for Metabolic Analysis Physiology
GDF	Ground Development Facility
GFE	Ground Facility Equipment
GMT	Greenwich Mean Time
GSE	Ground Support Equipment
GSP	Ground Support Personnel
GST	Ground Support Team
H/W	Hardware
HMD	Head Mounted Display
Hr.	Hour
HRF	Human Research Facility
Hz	Hertz
ICDS	Interface Control Documents
IE	Internet Exployer
ISS	International Space Station
Kbps	Kilobits per second
Kg.	Kilogram
L	Length
LBNP	Lower Body Negative Pressure
Limtd	Limited
m	milli
Min.	Minute
mm	millimeter
mntd	mounted
NRT	Non/Near Real Time
Obj.	Objective
P	Postflight
PAO	Public Affairs Office
pdf	portable document format
Powrd	Powered
Pwr	Power
R	Return minus
Req.	Required
reqt.	Requirement
res.	resolution
RT	Real Time

ACRONYMS AND ABBREVIATIONS (Cont'd)

SID	Subject Input Device
sq. ft.	square foot
SRS	Subject Restraint System
Trng.	Training
Vac	Volts alternating current
VR	Virtual Reality
VRUT	Virtual Reality Utility Library

1.0 INTRODUCTION

1.1 PURPOSE

The Experiment Document (ED) serves the following purposes:

a. It provides a vehicle for Principal Investigators (PIs) to formally specify the requirements for performing their experiments.

b. It provides a technical Statement of Work (SOW).

c. It provides experiment investigators and hardware developers with a convenient source of information about NASA's requirements for the implementation of life sciences flight experiment projects.

d. It provides the authoritative source of experiment and experiment equipment information to all NASA organizations that support life sciences flight experiments. Inputs from this document will be placed into a controlled database that will be used to generate other documents.

1.2 SCOPE

This document establishes and controls requirements for: PI activities, selection and training of flight crew members, integration and ground processing of flight experiment equipment, and collection and processing of experiment data.

The PI is responsible for all the requirements defined in this ED. Those sections/tables identified as not to be filled out by the PI will be completed by NASA (if applicable to the experiment).

Different sections of the ED will be approved and placed under configuration control (baselined) at the Experiment Requirements Review (ERR), Preliminary Design Review (PDR), or Critical Design Review (CDR), based on experiment, payload, and mission development requirements. The schedule for phased baselining of the various sections of the ED is presented in Table 1.4-1. The activities associated with the various design reviews can be found in sections 1.3.5.2.3, 1.3.5.3.5 and 1.3.5.3.6, respectively.

After a particular element of the ED has been approved and placed under configuration control (baselined), all proposed changes to that element must be processed through the NASA configuration control board (CCB). To indicate the sections that have been baselined, an asterisk is placed by the section number in the Table of Contents, List of Tables, and List of Figures as well as by each section, table and figure throughout the document.

Experiment No. E085/507
Date: 04/19/00

TABLE 1.1. EXPERIMENT OVERVIEW

Investigation Title:	Human Orientation and Sensory-Motor Coordination in Prolonged Weightlessness						
Experiment ID:	HRF E085/E507		**Ops Name:**	VOILA			
Payload Category:	H	**Sub-Category:**	BP	**Subjects Required:**	6	**Subjects Desired:**	8

	Name	**Address**	**e-mail**	**Fax**	**Telephone**
Principal Investigator: (E085)	Charles M. Oman, Ph.D.	Room 37-219, MIT 77 Massachusetts Ave. Cambridge, MA 02139-4307	cmo@space.mit.edu	617 258-8111	617 253-7508
Principal Investigator: (E507)	Alain Berthoz, Ph.D.	LPPA/CNRS-Collège de France 11 place Marcelin Berthelot 75005 Paris, France	aber@ccr.jussieu.fr	+33 1 44 27 14 25	+33 1 44 27 12 99
Co- I : (E085)	Andrew C. Beall, Ph.D.	Department of Psychology, University of California, Santa Barbara, CA 93160-9660	beall@psych.ucsb.edu	805 893-4303	805 893-5957
Co-I: (E507)	Francesco Lacquaniti	Human Physiology Research Section Scientific Institute Santa Lucia via Ardeatina 306 00179 Rome, Italy	lacquaniti@caspur.it	+39 06 51 50 14 77	+39 06 51 50 14 72
Co-I: (E507)	Joseph McIntyre, Ph.D.	LPPA/CNRS-Collège de France 11 place Marcelin Berthelot 75005 Paris, France	jam@ccr.jussieu.fr	+33 1 44 27 13 82	+33 1 44 27 14 31
Co- I : (E085)	Theodore R. Smith, Ph.D.	Gartner Institute 7157 Shady Oak Rd. Eden Prairie, MN 55344	ted.smith@gartner.com	612 563-2040	612 563-2066
Co- I : (E085) ***(appointment pending)**	Michael Jenkin, Ph.D.*	Department of Computer Science York University 4700 Keele St. North York, Ontario, Canada M3J 1P3	jenkin@cs.yorku.ca	416 736-5872	416 736-5053
Co- I : (E085) ***(appointment pending)**	Laurence Harris, Ph.D.*	Department of Psychology York University 4700 Keele Street North York, Ontario, Canada M3J 1P3	harris@yorku.ca	416 736-5814	416 736-210 X66108
Co- I : (E507) ***(appointment pending)**	Mirka Zago, Ph.D.*	Human Physiology Research Section Scientific Institute Santa Lucia via Ardeatina 306 00179 Rome, Italy	myrka@bioem.ing. uniroma1.it	+39 06 51 50 14 77	+39 06 51 50 14 75
Technical Personnel: (E085)	Andrew M. Liu, PhD (MIT Project Scientist)	Room 37-151, MIT 77 Massachusetts Ave Cambridge, MA 02139-4307	andy@space.mit.edu	617 258-8111	617 253-7758
Technical Personnel: (E085)	James E. Zacher (HPL-CRESTech Project Scientist) Heather Jenkin, PhD (HPL-CRESTech Project Scientist)	Human Performance Laboratory 122 Farquharson Building, 4700 Keele Street, North York, Ontario, Canada M3J 1P3	zacher@hpl.crestech.ca hjenkin@hpl.crestech.ca	416 736-5857	416 736-5659
Technical Personnel: (E507)	Mohamed Zaoui	LPPA/CNRS-Collège de France 11 place Marcelin Berthelot 75005 Paris, France	zaoui@ccr.jussieu.fr	+33 1 44 27 13 82	+33 1 44 27 16 33

TABLE 1.1. EXPERIMENT OVERVIEW (Cont'd)

Investigation Title:	Human Orientation and Sensory-Motor Coordination in Prolonged Weightlessness						
Experiment ID:	HRF E085/E507			**Ops Name:**	VOILA		
Payload Category:	H	**Sub-Category:**	BP	**Subjects Required:**	6	**Subjects Desired:**	8

	Name	Address	e-mail	Fax	Telephone
Technical Personnel: (E507)	Mauro Carrozzo	Human Physiology Research Section Scientific Institute Santa Lucia via Ardeatina 306 00179 Rome, Italy	carrozzo@caspur.it	+39 06 51 50 14 77	+39 06 51 50 14 76

Name and Address of Organization Conducting the Research:
E085: Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307 E507: LPPA, CNRS/Collège de France, 11 place Marcelin Berthelot, 75005 Paris, France Scientific Institute Santa Lucia, via Ardeatina 306, 00179 Rome, Italy
Sponsoring Agency:
NASA, CNES, ASI

Instructions for the table entries are provided below:

Investigation Title - title of experiment on original proposal
Experiment ID - three number ID assigned by NASA
Ops Name - NASA-assigned name, with PI concurrence, for tracking purposes (20 character limit)
Payload Category - A letter designating the science or technology discipline associated with the investigation. For the purposes of the ED, the only categories presently are: H = Human Research Facility and S = Space Medicine Program. If this changes at a later date, NASA will fill in the appropriate code.
Sub-Category - A letter or letters designating the type of functional objective being performed by the investigation. The sub-categories for the Human Research Facility (HRF) are:

BP = Behavior and Performance
MON = Monitoring
CP = Cardiovascular/Pulmonary
MS = Musculoskeletal
HSR = Hygiene, Sanitation, Radiation
NEU = Neurological
IMN = Immunological
NUT = Nutritional
MET = Metabolic

Subjects Required - minimum number of subjects required for generation of statistical significance
Subjects Desired - optimum number of subjects for study
Principal Investigator - the individual who submitted the proposal in response to the AO or NRA
Co-I(s) - Co-Investigators officially recognized by NASA Headquarters
Technical Personnel - individuals who will assist in the conduction of the investigation, e.g., Program Manager, Technical Specialist, etc.
Name and Address of Organization Conducting the Research - usually parent institute of Principal Investigator, or funding organization
Sponsoring Agency - national agency approving conduct of experiment, e.g., NASA, ESA, etc.

1.3 EXPERIMENT MANAGEMENT APPROACH

1.3.1 Background

Numerous medical investigations on human responses to a microgravity environment have been performed beginning early in the Mercury Program. These investigations have served to dispel many physiological concerns regarding the human space explorer; however, many unanswered questions remain. Microgravity-induced physiological changes pose not only interesting research questions but also represent the areas in which medical sciences must develop effective countermeasures if humans are to live and work in space for extended periods of time.

NASA conducts life sciences research by soliciting research proposals from the external and internal scientific communities consistent with the strategic goals of the agency. Selected investigations are assigned to an implementing center under a specific research program. The implementing center is responsible for facilitating the conduct of the experiment by providing the resources necessary to achieve the proposed objectives. In order to effectively execute these investigations in the space environment, it is necessary to combine skills from various organizations, from both NASA and its investigators as well as the PI and the sponsoring institution. These experiment teams jointly define and develop the investigation from selection through to the completion phase.

1.3.2 Human Research Facility

The HRF is a facility class payload that is currently manifested onboard the ISS. It consists of a suite of human life sciences hardware necessary to support a multidisciplinary research program that encompasses basic, applied, and operational research. The HRF provides hardware necessary to study the effects of the space environment on human systems and to develop, where appropriate, methods to counteract these effects to ensure safe and efficient crew operations. The development and use of the HRF is managed within the Space and Life Sciences Directorate (SLSD) at the Johnson Space Center (JSC).

All hardware elements to be used during the conduct of human research on ISS may not necessarily be housed in the HRF racks. The ability to conduct thorough, multidisciplinary investigations will depend on the interaction of the HRF with the Biological Research Program (BRP), the Crew Health Care System (CHeCS) Program, Laboratory Support Equipment (LSE), and other hardware provided by either the investigator or international partners.

The hardware available onboard the ISS for use by science investigations, and a description thereof, will be available through the solicitation process. Investigators are strongly encouraged to use the available hardware and limit the need for unique capabilities. A description of the HRF complement of hardware currently available can be found at http://lslife.jsc.nasa.gov/hardware/front.html

1.3.3 Documents

The documents listed in this section include specifications, models, standards, guidelines, handbooks, and other special publications that are applicable to this document.

1.3.3.1 Applicable Documents

An applicable document is a document that contains additional requirements, beyond the scope of the ED, that must be adhered to by life sciences flight experiment investigators and flight experiment equipment developers. The investigator and/or hardware developer shall regard the exact issue of each of the applicable documents shown in the following listing, to the extent that it is specifically stipulated in this ED, to be a part of this ED and, as such, to constitute a requirement of the experiment to which this ED applies. Whenever there is a conflict between the ED and an applicable document, the ED shall be the governing document.

The applicable documents are listed below, along with the sections of the ED to which they apply.

Document No.	Title	ED section(s)

Document No.	Title	ED section(s)
SM3-WI 012	Payload and Experiment Reviews	1.3.5.3, 1.3.5.4.4, 1.3.5.5.4
LS-71130	Human Research Facility (HRF) Human Computer Interface Design Guide	1.3.5.4.3
JSC-17057	GFE Limited Cycle Time/Age Life Item Requirements	3.2.7.1
LS - 10133-8	Use of Human Subjects in Hardware Development	6.1
NT2-QAS-027	Test Readiness Review	6.1
LS-71042-4	HRF Workstation Interface Definition Document (IDD	8.1
LS-71046-1	Portable Computer IDD	8.1
LS-71062-8	HRF Common Software IDD	8.1
LS-71020	Software Development Plan for the Human Research Facility (HRF)	8.1
LS-40072	Experiment Software Document Guidelines	11.3

1.3.3.2 Reference Documents

Generally speaking, reference documents provide supplemental data and information that give the investigator and/or hardware developer a more complete understanding of requirements that are stated in the ED and its applicable documents. The investigator will find that it is useful to be familiar with the contents of these documents.

The reference documents have been listed below. In a few cases a relevant document is listed even though there is no specific mention of it in the ED text.

Document No.	Title
SSP 52054	Certificate of Flight Readiness
SSP 57000	Pressurized Payloads Interface Requirements Document - International Space Station Program
LS-71072	Baseline Data Collection Requirements Document
SSP50011-03	Concept of Operations and Utilization, Vol. I, II, III
LS-71003	Concept of Operations for the HRF
LS-71025	Hardware Catalog HRF
JSC 20483	JSC Institutional Review Board: Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations
LS-71013	Logistics and Maintenance Support Plan for the HRF
LS-71000	Program Requirements Document for the HRF
HRF-TRG-04	HRF Training Support Guide
LS-71138	Data Requirements Document for the Human Research Facility Core Hardware
LS-71009	Hardware Requirements Document (HRD) Template
SSP 50313	Display and Graphics Commonality Standard
MSFC-PLAN-2885	U.S. PODF Management Plan Annex 5, Payload Display Implementation Plan
MSFC-PLAN-2886	U.S. PODF Management Plan Annex 6, Payload Display Developers Guide

1.3.4 Experiment Support Team Definition

Following the experiment selection process, an Authorization to Proceed (ATP) to the definition phase is issued by NASA HQ. Science implementation support will then be provided to the PI by an Experiment Support Team (EST). The goal of the EST is to satisfy science requirements, meet ISS Program requirements, and deliver the product on time and within budget. Support levels may vary from experiment to experiment depending on the needs of the individual PI and experiment. The EST consists of the following individuals:

- NASA Experiment Systems Manager/Contracting Officer's Technical Representative (ESM/COTR): The ESM is the NASA lead for the EST and is responsible for the overall implementation of the experiment. The ESM is the primary interface with programmatic organizations, such as NASA HQ and the ISS Program Office. The ESM makes recommendations to management regarding the experiment feasibility, mission/increment resources, experiment readiness, etc., and ensures that project milestones are met. For those PIs who are under formal contract, the ESM also serves as the COTR and serves as the point of contact between the PI and the NASA centers concerned with procurement and financial management. The COTR provides technical management of the contract and certifies expenditures.
- Principal Investigator (PI) has the primary responsibility for development and implementation of experiment requirements. The PI defines the experiment objectives and resources, such as crew time, hardware capabilities, and sample collection, necessary to accomplish these objectives. In addition, the PI is responsible for flight objectives, Institutional Review Board (IRB) protocols, experiment procedures, Baseline Data Collection (BDC), Experiment Unique Software (EUSW), and Experiment Unique Equipment (EUE) development. The PI, or his designee, will monitor the in-flight experiment operations and interact, as appropriate, with the flight and ground crews to achieve the experiment objectives.
- Experiment Support Scientist (ESS) serves as the primary scientific liaison between the PI team and various NASA organizations throughout the entire experiment life cycle. The ESS will manage science requirements and familiarize the PI team with Program requirements, mission resources, station interfaces, and station/crew resource limitations. The ESS will support experiment document development, crew training, baseline data collection and inflight operations.
- Experiment Project Engineer (EPE) is responsible for the coordination of experiment resource requirements, experiment reviews, and experiment schedules. The EPE coordinates experiment resource requirements with HRF resource availability and supports conflict resolution. The EPE is responsible for ensuring the EST includes the necessary skills to conduct experiment development, integration, and operations. The EPE is also responsible for the development and provision of NASA-provided experiment unique equipment (EUE) and experiment ground support equipment (GSE). The EPE is also the primary engineering liaison between the PI team and the various NASA organizations with regard to PI-provided or international agency-provided EUE.
- Experiment Engineer (EE) is responsible for experiment development, integration, and operations. The EE is also responsible for the provision of NASA-provided experiment unique equipment (EUE) and experiment ground support equipment (GSE). He also provides and/or functionally tests h/w plus consumables per training session, consumables management, verification, engineering analysis and shipping/logistics support.
- Increment Coordinator (IC) is responsible for the overall implementation of preflight, inflight, and postflight increment requirements. The IC integrates the requirements of all HRF experiments assigned to an increment to ensure science objectives are met with the most efficient use of available resources.
- HLS Increment Scientist (HLS IS) is responsible for promoting the integrated set of all Human Life Sciences investigations on the ISS Flight Increment. The HLS IS works with the ESS, ESM, and PI to represent the requirements of the investigation to the Shuttle and ISS Programs. The HLS IS is responsible for bringing forward all of the requirements and issues of all the HLS investigations to the Increment Research Working Group for resolution within the overall ISS Research Mission Management Team.
- Training Personnel are responsible for the development and implementation of experiment-specific training requirements. They will coordinate training/facility schedules, validate and finalize procedures, and provide and/or assist in training activities. They will review and format experiment procedures to be consistent with the Operations Data File (ODF) standards.

- Operations personnel are responsible for the integration of multiple experiments within an increment. They will assist in the development of ISS Program documentation, experiment timelines, procedures and console tools, and perform logistics and maintenance activities as required to support the experiment.

Other individuals key to experiment development are:

- Hardware Developer (HD) - This term is used in some sections of the ED and refers to the organization that carries out the design, fabrication, and testing of experiment flight equipment. The HD can be the PI, a NASA organization, an international partner and any investigator or investigator designate organization tasked by one of these entities.
- JSC Contracting Officer (CO) - The CO, and only the CO, has the authority to initiate, administer, and/or terminate contracts and make other decisions related to the contract, and is acting on behalf of the U.S. Government.

1.3.5 Experiment Life Cycle

The individual phases of a typical ISS life science experiment are briefly described in the following sections. Selected flight experiments will typically proceed through the experiment definition, design, development, execution, and data distribution phases. Experiments must successfully complete the experiment definition and design phases before proceeding with the development, execution and data distribution phases. The experiment definition phase defines the preliminary science, facility, and resource requirements. The design and development phases define the experiment requirements within the available resources and constraints of the flight platform. Interfaces with the vehicle and crew are also defined and agreed upon. The execution phase includes inflight data collection and data analysis. The experiment concludes with a postflight report of the results.

A general schedule for an experiment life cycle is presented in Figure 1.3.5-1. The actual elapsed time required for each of the phases will vary depending on the nature of the experiment and the flight vehicle (Shuttle or ISS).

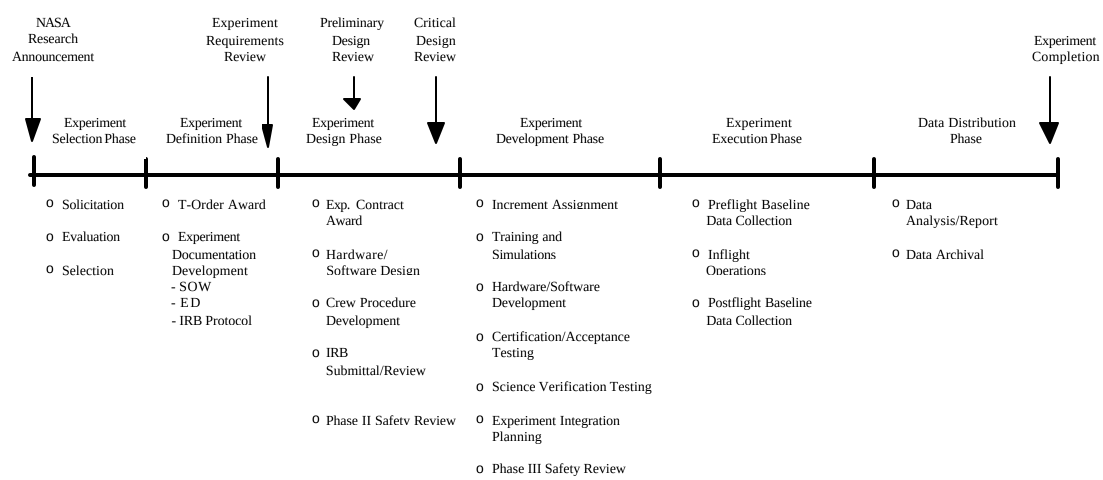


Figure 1.3.5-1 Experiment Life Cycle

1.3.5.1 Experiment Selection

The experiment selection process includes the solicitation, evaluation, and approval of experiments.

1.3.5.1.1 Solicitation

The goals and objectives of life science missions onboard the Shuttle and ISS vehicles are established at NASA Headquarters (HQ). Announcements of Opportunity (AO) and NASA Research Announcements (NRAs) are released on a periodic basis by the Office of Life and Microgravity

Sciences and Applications (OLMSA), Washington, DC, to solicit flight and ground-based experiment proposals from the U.S. and international scientific communities. Investigations that are part of a ground-based program will be considered to be flight candidates once the experiments are deemed sufficiently mature and appropriate for flight. Under certain circumstances, unsolicited proposals are also given consideration. Investigators from the international science community will be sponsored by the space agencies of their respective countries and are subject to resource constraints levied by the ISS Program Office.

1.3.5.1.2 Evaluation

Experiment proposals, submitted in response to a AO or NRA, undergo a science peer review process managed by NASA HQ. Evaluation criteria include: scientific merit, the relevance of the investigation to NASA's programmatic goals and objectives, the extent to which the investigation is consistent with the NASA Life Sciences Strategic Plan, and the degree to which the investigation depends upon the space environment for execution.

Experiments deemed acceptable are forwarded to one of the NASA field centers for a detailed Engineering, Cost, and Management (ECM) assessment. The ECM process focuses on the feasibility of implementation of the experiment in terms of available resources such as power, crew time, stowage, volume, up-mass, etc. At the conclusion of the ECM review, NASA personnel at the field centers provide NASA HQ with assessment findings. International proposals are also reviewed by their sponsoring agency.

Proposals that receive passing scores for scientific and technical merit are forwarded to the International Peer Review Panel (IPRP) for flight assignment.

1.3.5.1.3 Selection

Based on the recommendations of the IPRP and the resources available for supporting the development of U.S. investigations, final selection and approval letters announcing the selected experiments are provided by the Director of Life Sciences at NASA HQ.

1.3.5.2 Experiment Definition

1.3.5.2.1 T-Order Award

Minimal funding to initiate the experiment definition and design phases will be awarded to PI team by NASA at this phase. NASA COTRs will monitor funding and ensure deliverables are provided on schedule.

1.3.5.2.2 Document Development

The ESM, along with the Experiment Support Team and in cooperation with the PI, will be responsible for initiating the development of the following documentation as part of the experiment definition phase.

- Statement of Work (SOW): The SOW forms the basis for the contract between NASA and the PI or sponsoring organization and defines the tasks and requirements of experiment contracts. SOWs may be written for specific phases of the experiment life cycle.
- <u>Experiment Document (ED)</u>: The ED will act as a formal agreement between NASA and the PI detailing the technical requirements of the experiment and the resources requested for implementation. The ED provides a detailed description of each experiment to include: objectives, requirements for resources, hardware, and crews, data collection, timelines, ground and mission support, and reporting procedures. Sections of the ED will be baselined at various reviews throughout experiment development. The ED is maintained under configuration control by NASA.

- Preparation of IRB protocols: Life Sciences Research and Training/Baseline Data Collection (BDC) Protocols are documents which provide comprehensive experiment protocols, as well as descriptions, procedures, informed consent documents, and schedules for the conduct of training and BDC activities. This protocol will be prepared for any experiment using humans as subjects, and will be submitted to the JSC Institutional Review Board (IRB) approximately two months prior to the informed consent briefing of the increment to which that experiment has been manifested. Documents should be prepared and submitted in accordance with "JSC Institutional Review Board: Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations" (JSC 20483). Preliminary versions of the protocols will not be submitted. International investigations will be reviewed under their respective IRB guidelines, if present.

1.3.5.2.3 Experiment Requirements Review

The experiment definition phase culminates in an Experiment Requirements Review (ERR). The Experiment Team and NASA review the ED for feasibility of accomplishing the experiment within the HRF and ISS Program capabilities. This review forms the basis for preventive and corrective actions which maintain the quality of the experiment development process. At the conclusion of a successful review, certain tables in the ED are baselined and placed under configuration control.

The intent of the Experiment Requirements Review, if appropriate, is to establish the schedule and requirements for the individual experiment. These reviews will also form the basis for further development and implementation of requirements. At this review, the programmatic and performance requirements for the experiments are presented. The requirements review package shall include, but not be limited to, the following data:

- Science Measurement Specification (SMS) and/or detailed Technical Task Agreement (TTA)
- Mission resources requirements
  - stowage
  - electrical interfaces
  - power
  - thermal
  - Command and Data Management System (CDMS)
  - crew time
  - Baseline Data Collection (BDC)
  - ground operations
  - training
- Preliminary ED Sections (1,2,3, and 5) or equivalent
- Experiment Schedule
- Summary of proposed design reviews to be held for this experiment

1.3.5.3 Experiment Design

The experiment design process will continue with the completion of the Life Sciences Research and Training/BDC Protocols and submittal to the IRB for review. In addition, preliminary experiment crew procedures will be developed by the PI, verified by the EST, and submitted to mission management for review and inclusion in the flight data file procedures. Training materials, timelines, and flight operations information are developed during this time.

As the requirements for implementation of the experiment mature during the development process, assessments are made regarding requested versus available capabilities. In addition, experiments targeted for the same flight period will be analyzed to identify overlaps or conflicts between activities and/or science objectives. Procedures may then be modified in order to maximize science return within identified constraints.

1.3.5.3.1 Experiment Contract Award

Negotiations between NASA and the PI's organization, which began during the Experiment Definition phase, culminate in the awarding of a contract to cover costs necessary to carry the experiment through design phases.

1.3.5.3.2 Hardware/Software Design

Supplemental hardware and/or software to support unique aspects of the experiment, referred to as experiment unique equipment (EUE), will be designed by either the PI, international partner, and/or NASA during this phase. If the development of EUE is the responsibility of NASA, an experiment project engineer (EPE) will be assigned to the EST to develop, build, and certify the EUE in accordance with that piece of equipment's Hardware Requirements Document (HRD). For PI-developed EUE, experiment requirements and conditions will be agreed upon by both the HRF Project and PI and will be documented in the ED and HRD. In general, the PI will provide all required documentation with the EUE.

All screen displays and computer interfaces should also be worked at this time and be designed to ISS and HRF guidelines, section 8.1 of the Human Research Facility (HRF) Human/Computer Interface Design Guide, LS-71130. Human/computer interfaces will be reviewed by Marshall (MSFC) prior to training use.

1.3.5.3.3 Crew Procedure Development

Working with the ESS, the PI team will put together draft crew procedures for operations on Shuttle/ISS.

1.3.5.3.4 IRB Protocol Submittal

Research Protocols are submitted to the JSC Institutional Review Board (IRB) during this period. The board will review the protocol and issue actions or approval as appropriate. All actions must be closed before training may be held with the crew, although an informed consent briefing may be held with provisional approval from the IRB. Following review by the JSC IRB, the protocol will then proceed to the Human Research Multilateral Review Board (HRMRB)—an international panel that will review human-based research protocols for ISS. Actions may also be assigned by the HRMRB.

1.3.5.3.5 Preliminary Design Review

A Preliminary Design Review (PDR), if required by the ESM for the experiment, will be conducted when the basic design of the experiment is from ten to thirty percent complete, to assure acceptability of the implementation approach, and to baseline the design. A PDR shall be conducted after NASA systems and design engineering or the investigator have completed their analysis on the design, and have sufficient details to prove they are meeting the intent of the experiment specification(s). NASA is authorized to produce experiment unique equipment (EUE) if requested and funded.

The product of a PDR is the approval of the design approach and the authorization for the investigator or developer to proceed with further design. Any changes to the basic design approach must be approved by the NASA Experiment Systems Manager or Increment Coordinator, as appropriate, prior to implementation.

The PDR review package shall include the following data, if they apply. The developer shall be ready to explain "missing" items.

1. Experiment Schedule
2. Experiment Overview

3. Experiment Document (ED) or equivalent
4. Summary of mission resources requirements
5. Preliminary layouts
6. Preliminary block diagrams
7. Preliminary power and data interfaces
8. Environmental constraints
9. Preliminary engineering analyses status and schedule (thermal and structural)
10. Waivers or deviations tracking log status
11. Phase 0/I safety report
12. Summary of Ground Operations Requirements
13. Status of Training Plans
14. Status of Baseline Data Collection

1.3.5.3.6 Critical Design Review

The Critical Design Review (CDR) occurs near the end of the experiment design phase. The CDR or equivalent level review, if required by the ESM for the experiment, is a technical review of the detailed design of the experiment to determine the compliance of the completed design with the science and mission requirements. A CDR shall be conducted when the detailed design is approximately ninety percent complete. The product of a CDR is formal (baselined and placed under CCB control) approval of specific experiment documentation which further defines the design of the experiment.

The CDR review package shall include the following data, if they apply.

1. Experiment Schedule
2. Experiment Overview
3. Experiment Document (ED) or equivalent
4. Interface control drawings
5. Environmental constraints
6. Verification plan or Acceptance/certification test plan
7. Engineering analysis (thermal and TVFEM)
8. Waivers or deviations status and tracking log
9. Phase II safety report
10. Limited life list
11. List of open PDR RIDs
    - Summary of mission resource requirements
    - Experiment crew procedures
    - Summary of ground operations requirements
    - Status of training
    - Status of Baseline Data Collection

<u>NOTE</u>: Open RIDs from the previous review will be closed automatically unless renewed at the next level review.

1.3.5.3.7 Phase II Safety Review

Near the time of the experiment CDR, the experiment, as a component of the HLS increment complement, will be taken before the Payload Safety Review Panel (PSRP) for the Phase II Safety

Review. Verification reports for hazards associated with a given experiment will be presented and the proposed actions for closing these reports will be given.

1.3.5.4 Experiment Development

1.3.5.4.1 Experiment Flight Assignment

JSC will make recommendations to NASA HQ for assignment of experiments to increments based on ISS program provided information on flight resources. However, a flight assignment is not necessary to begin experiment development, and as increment requirements mature, assignments may be changed or rescinded.

1.3.5.4.2 Experiment Training

The objective of training is to transfer the knowledge and skills necessary to perform the increment-specific experiment activities in order to facilitate inflight operations. The ESS will oversee and coordinate training activities to ensure that science objectives are being met for all increment operations. The EST in coordination with the PI will conduct training, maintain training records, and certify crew and Ground Support Personnel (GSP) proficiency. Due to the frequency of mission increments, simultaneous training of many crews and GSP will need to be coordinated.

Training will take place primarily at JSC facilities to include the Ground Development Facility (GDF) and the HRF High Fidelity Mockup (HFM). Experiment data flow familiarization, ground support personnel training and simulations support will occur at the JSC Telescience Support Center (TSC) in Building 30. The HFM is accommodated in an ISS element (module) of the Space Station Mockup and Trainer Facility (SSMTF) located in Building 9C. The HFM will accommodate an HRF rack, associated stowage and shared hardware in an environment spatially similar to the ISS element.

1.3.5.4.3 Hardware/Software Development

After successful completion of the Preliminary Design Review and the Experiment Design Phase, JSC authorizes the production of experiment unique equipment (EUE). All requirements for EUE will be documented in an experiment specific Hardware Requirements Document.

1.3.5.4.4 Certification/Acceptance Testing

Hardware contracted by NASA to be built for an experiment will be received at JSC near the end of the development phase. Upon receipt, the EPE will oversee certification and acceptance tests as agreed to in the experiment Hardware Requirements Document.

1.3.5.4.5 Science Verification Testing (SVT)

Science Verification Test (SVT) is an end-to-end test of a complete flight system to verify that the data products produced meet the PI's specifications and scientific objectives. This is one of the last major activities performed with the flight hardware before it is shipped either for integration, or to Flight Equipment Processing Center (FEPC) for stowage. "End-to-end" means testing the flow of the data from all the origins (man-in-the-loop, computers, cameras, etc.) to all the destinations (tapes, hard drives, TSC displays, remote site, etc.).

The SVT should provide a representative data set and so does not require a complete flight protocol for every test. The easiest and most reliable way to produce flight-like data sets is to follow the crew procedures or a subset or a variation of the crew procedures to both set-up the hardware and run the test. The version of the procedures used should be noted in the SVT report and any deviations should be described in detail so that the test can be repeated, if necessary.

After the SVT, the SVT data is sent to the PI team for verification and analysis. Once the PI has reviewed the data, a letter is written to the Experiment Systems Manager certifying that the SVT data is acceptable and that, from the PI's perspective, the experiment is ready to fly. The Experiment System Manager will be responsible for forwarding the letter to the appropriate parties. The PI is usually given sixty days for review and analysis of the data if time permits. If modifications to any aspect of the experiment system are necessary, these should be accomplished either during or immediately after the SVT.

This activity is required as stated in the experiment Statement of Work. For those experiments for which an SOW is not written, an SVT is highly recommended.

1.3.5.4.6 Experiment Integration

An Increment Coordinator (IC) will be assigned from the Human Research Facility (HRF) to oversee the implementation of preflight, inflight, and postflight increment requirements. The EST will participate in development of the following integrated increment operations documents as defined by the HRF and ISS Program.

- HRF Payload Integration Agreement (PIA) Addendum and Increment Data Sets contain the HRF and Payload program agreements for resources and support for an increment.
- Integrated Increment Requirements Document (IIRD) defines the integrated experiment and HRF requirements for the increment. This will be baselined at the SF4 CCB and provide a controlled document of information of HLS experiment requirements.
- Increment Specific Baseline Data Collection (BDC) Plan: defines the requirements for experimental pre and postflight data collection performed for an increment including the duration of each session, the crew members being tested, the hardware requirements, and the collection schedule. Plans for contingencies, such as launch slips, shortened missions, and alternate landing sites will be outlined in this plan. All BDC sessions will be contingent upon the launch date and crew availability. With appropriate assistance from the EST, the PI will conduct the BDC sessions, sample collection and retrieval activities at launch and landing, as required.
- Data Sharing Plan will enumerate human life science data generated by experiments covered under HLS project management per flight. This document will be generated from the measurements listed in each experiment's ED and will be distributed among all HLS investigators on an increment for data sharing purposes. This plan will act as a vehicle for the sharing of data among teams to enhance their own investigations.
- Increment Training Plan defines a unique training plan for each increment based on the knowledge, skill, and ability of the crewmembers as well as the specific inflight experimental activities to be performed.

1.3.5.4.7 Phase III Safety Review

Before experiment execution can begin, the experiment team must show that all hazard reports have been closed with appropriate actions. This occurs at the Phase III Safety Review.

1.3.5.5 Experiment Execution

Experiment execution includes pre- and postflight Baseline Data Collection (BDC) as well as inflight operations.

1.3.5.5.1 Baseline Data Collection (BDC)

HRF and/or the PI will provide the facility and hardware necessary to support the coordination and implementation of BDC activities. Data collection will be performed per the PI's accepted proposal with consideration given to crew availability, schedules and operational considerations. The primary data collection facility for human life sciences will be located in JSC Building 266. Data collection will also be performed at launch and landing sites including Kennedy Space Center (KSC), Dryden Flight Research Facility (DFRF), and in Russia.

1.3.5.5.2 Inflight Operations

It is the investigator's responsibility to monitor his or her own experiment operations. The EST will be available to assist the PI to support real-time operations and data acquisition, as well as timeline replanning, as needed. ISS operations support will take place at the following facilities:

- Marshall Space Flight Center (MSFC) Huntsville Operations Support Center (HOSC) will perform the basic data management functions. It will receive and demultiplex raw data, perform data processing and recording, and distribute data to the appropriate facilities.
- United States Payload Control Center (USPCC) will be located at the MSFC HOSC. The USPCC provides accommodations for users that do not have their own Telescience Support Center (TSC) and that require a place to perform ground-tended payload operations.
- Payload Operations and Integration Center (POIC) will be located at the MSFC HOSC. The POIC will receive data and will be the interface for payload uplink commands.
- Telescience Support Centers (TSC) are located within the U.S. and international communities. Selected facilities will receive real-time and non-real time data and provide capabilities similar to the USPCC at locations more conveniently located to the payload user. Each TSC will interface with the USPCC and POIC via voice and electronic communication.
- The JSC TSC will be located in the Science Center in JSC Building 30, and will be the focal point for all HRF operations and data activities. The JSC TSC will receive and process both HRF science and facility data, and transmit experiment-specific data to remote investigators. The JSC TSC will also provide temporary storage of experiment data for up to six months after the mission. PIs can use the TSC during experiment operations or operate remotely. Because of the continuous nature of ISS missions, there will be simultaneous and continuous operations in the TSC.
- Mission Control Center-Houston (MCC-H) will be used by the TSC for external data, voice, and video communications.
- Remote PI Sites will allow investigators to perform telescience on their investigations without having to travel to the TSC. The TSC will collect, receive, and transmit data to/from these sites. HRF Ground Support Personnel (GSP) will aide the PIs in their interactions with their investigations.

1.3.5.6 Postflight Reporting and Data Archival

The PI shall submit the following post-flight reports to the Experiment Systems Manager at the prescribed dates: an Operational Accomplishments Report shall be submitted 30 days after receipt of experiment data for each ISS Increment; a Preliminary Science Report and a Final Research Report shall be submitted 6 months and 1 year, respectively, after receipt of experiment data from the final ISS Increment on which the experiment is manifested. Details of these reports are described in the Post-Flight Reporting Guide. The experiment life cycle shall formally end with the submittal of the final experiment report.

Data shall be archived by the NASA Life Sciences Data Archive (LSDA) facility at JSC. Working with LSDA personnel, the PI is responsible for furnishing the following data products:

a) An inventory of raw, analyzed and summarized data
b) The actual experiment data sets mentioned in (a) above
c) A written verification of the entire experiment package as it will be archived. The experiment package and verification letter shall be provided by NASA.

Data may also be published in NASA flight reports or in scientific journals at the discretion of the PI.

Approximately one year after each flight, PIs may be required to travel to JSC to brief subjects regarding the data results of the investigation. This briefing will improve subjects' awareness of their data results. Specific details regarding the briefing will be specified by NASA prior to the meeting.

1.3.6 Flight Experiment Deselection

A flight experiment may be deselected immediately after the definition phase, or annually. An annual review of the flight experiments in the definition phase will be conducted by the Life Sciences Division Director to determine whether deselection is appropriate. Recommendations for deselection may also be made by the program managers at the Lead Centers. Those experiments which are deselected may be considered for ground research based on appropriate peer review or may be canceled altogether.

Eight conditions, originating at NASA HQ, have been documented as deselection criteria: violation of one or more of these may warrant deselection.

Experiment No. E085/507
Date: 04/19/00

TABLE 1.4-1 EXPERIMENT DOCUMENT BASELINING SCHEDULE

SECTIONS/TABLES		ERR	PDR	CDR	OTHER
1.0	INTRODUCTION				
1.1	Experiment Overview	P	B		
2.0	SCIENCE OVERVIEW				
2.1	Science Overview	P	B		
2.2	Experiment Design	P	B		
2.3	Experiment Measurement		P	B	
2.4	Supporting Studies	P	B		
3.0	DATA COLLECTION REQUIREMENTS				
3.1.X	Ground Experiment Session Overview	C	P	B	
3.2.X	Inflight Experiment Session Overview	C	P	B	
3.2.1-X	Experiment Block Diagram	C	P	B	
3.2.2.X	Deployed Operational Envelope Sketch	P	P	B	
3.2.3-X	Equipment Location Requirements	P	B		
3.2.4	Summary List of ICDs for the Experiment System		P	B	
3.2.5	Temperature Controlled Stowage	P	P	B	
3.2.6	Trash Stowage		P	B	
3.2.7-1	Limited-Life Items Requirements List (Flight)	P	P	B	
3.2.7-2	Late Load/Early Access Requirements List (Flight)	P	P	B	
3.2.8	Photo/TV Requirements				
4.0	FLIGHT EXPERIMENT EQUIPMENT PERFORMANCE REQUIREMENTS				
4.1	Functional and Performance Requirements Matrix	P	P	B	
5.0	CREW SELECTION AND PROFICIENCY REQUIREMENTS				
5.1	Subject Selection Requirements	B			
5.2	Crew Skill Requirements	P	B		
5.3	Crew Skill Proficiency	P	B		
6.0	TRAINING REQUIREMENTS				

6.2	Training Summary	P	B
6.3-X	Training Session Description	P	B

TABLE 1.4-1 EXPERIMENT DOCUMENT BASELINING SCHEDULE - continued

SECTIONS/TABLES		ERR	PDR	CDR	OTHER
7.0	EXPERIMENT HARDWARE				
7.1.1	Experiment Unique Equipment Stowage List	C	P	B	
7.1.2	Shared Hardware Stowage List	C	P	B	
7.2.1	Power Demand Characteristics for Experiment Unique Equipment	C	P	B	
7.2.2-X	Experiment Power Profile	C	P	B	
7.3.1	Experiment Unique Equipment - Heat Dissipation & MPE Fluid Loop Interfaces	C	P	B	
7.3.2	Venting	C	P	B	
8.0	EXPERIMENT UNIQUE SOFTWARE	8.0	8.0	8.0	8.0
8.1	Experiment Unique Software Requirement	8.1 B	8.1	8.1	8.1
8.2	Experiment Unique Software Module Table	8.2 C	8.2 P	8.2 B	8.2
9.0	JSC, KSC GROUND PROCESSING				
9.1	JSC Ground Processing Requirements	P	B		
9.2	Launch Site Requirements	C	P	B	
10.0	DATA REQUIREMENTS AND MANAGEMENT				
10.2.1	TSC Data Management Requirements	C	P	B	
10.2.2	Remote Site Data management Requirements	C	P	B	
10.3	Downlink/Commanding Data Requirements	C	P	B	
10.4	Archived Data Requirements	C	P	B	
10.5	Miscellaneous Data Requirements	C	P	B	

Legend:
B - Baselined
P - Preliminary Data Required
C - Conceptual Data Required

2.0 SCIENCE OVERVIEW

2.1 SCIENCE OVERVIEW

The Science overview provides information that will be used at the programmatic level.

TABLE 2.1. SCIENCE OVERVIEW

Experiment Description:	**Associated Experiments**
This ISS HRF investigation extends, simplifies, and merges two sensory motor and performance experiments originally developed for the 1998 STS90 Neurolab mission. The two components retain separate numbers (E085/E507) on ISS, but are performed together. The experiments use the HRF Workstation 2 as a “science kiosk” to perform short (typically 30 minute long) tests to study the role of visual, vestibular, and haptic cues on spatial orientation and motor behavior. The experiment utilizes virtual environment generation accessories first developed for the Neurolab as a tool to study these processes during and after long duration (3-6 month) orbital flight. Restrained and free-floating subjects wear a wide field of view, color stereo head mounted display. Tests are based on 1-G paradigms, require little set-up time, and can be selected and performed by an astronaut in an automated fashion using Session Manager software. Three pre-flight, three in-flight, and three post-flight performances of each test are planned on each ISS increment.	
Hypotheses:	
The general hypothesis is that mental processes involved in self-orientation, object perception and motor control will be fundamentally altered in microgravity environments, as evidenced by visual reorientation, inversion, and proprioceptive illusions frequently reported in-orbit by astronauts. Our experiments on self-orientation, linear vection, object perception and motor control will help us characterize the contribution of gravity to the mechanisms underlying these activities.	
Objectives:	
To determine the effects of microgravity on: (1) the influence of scene symmetry, rotation, haptic cues, and expected orientation on static and dynamic self tilt (Virtual Tilting and Tumbling Room Tests); (2) the onset of x-axis illusory linear self-motion without haptic cues (Linear Vection Test); (3) the effect of perceived orientation on visual object recognition and shape recognition (Object Recognition Tests); (4) whether information used in grasping remembered objects is stored in head fixed, body fixed, or exocentric reference frames (Virtual Grasping Test); and (5) how the timing of catching movements depends on anticipation of downward acceleration (Virtual Catching Test).	
New Information Expected:	
Findings will contribute to our understanding of the effects of weightlessness on disorientation, inversion illusions, motion sickness, and human sensorimotor coordination. This information will also guide the development of practical countermeasures, including spacecraft interior layout.	
Relevance to Space and/or Earth-Based Research:	
The vertebrate nervous system evolved in an environment where the stimulus to the body's multiple gravireceptive senses invariably changed whenever the orientation of the body was altered. Experiments conducted in orbital flight allow us to remove static gravireceptor cues to the orientation of the head, body, and limbs. In this way we can better understand the role of gravity in fundamental sensory, motor, and cognitive processes subserving spatial orientation and movement control in daily life on earth. We usually only become aware of these functions when they are compromised by inner ear or central nervous system disease. If this happens, our everyday lives are profoundly affected. More than 90 million Americans suffer from some type of balance disorder. Patients often have difficulty walking at night, cannot see clearly (particularly when moving), cannot safely drive, and suffer injurious falls and sometimes incapacitating bouts of vertigo and nausea. Humans with hippocampal lesions or Alzheimer's disease show impairments on a wide variety of spatial and navigational tasks. Insight into how astronauts adapt to microgravity should provide valuable information into the normal functioning of the human nervous system. Strategies used by human subjects to compensate for the lack of gravity may also suggest how the neural disorders mentioned above might be treated. In addition, there is currently considerable interest in the development of new methods for evaluating a patient's ability to use visual and proprioceptive cues to maintain balance and orientation, and for improving motor control function via rehabilitative training. Portable head mounted displays and head and hand tracking systems, akin to those used in this experiment, may well prove useful for such	

testing and training.	

Instructions for the table entries are provided below:

Experiment Description - provide a one paragraph description of the experiment.
Hypotheses - state the primary hypothesis(es) of the flight experiment.
Objectives - describe the primary objectives of the flight experiment. If there are multiple objectives the investigator shall list them in order of importance and assign each one a number.
New Information Expected - describe the expected findings of the flight experiment.
Relevance to Space and/or Earth-Based Research - describe the relevance to space and/or earth-based research of the flight experiment. Also in a broader sense, describe how the proposed experiment will help mankind.
Associated Experiments - the NASA experiment number and title of any experiments sharing responsibility, conduct and/or products of session.

2.2 EXPERIMENTAL DESIGN

The experiment design table below, Table 2.2, shall provide an overview of the experiment flow, approach and sequence of execution. An absolute timeline is not necessary; however, a listing of sessions and performance timeframes should be sufficiently detailed to clearly summarize the overall design of preflight, inflight and postflight experiment activities.

A session is defined as a separate (unique activity for scheduling), distinguishable, continuous, timelineable event. Therefore, setting up of hardware, conduction of a protocol on numerous subjects and stowing of hardware can be thought of as steps in one session. If the protocol should be treated differently because of objective, hardware involved, protocol length, or data generated, it should be treated as a separate session.

Timeframe designation may be descriptive (i.e., weekly, within the first week of flight, etc.) or in the form of L-X, FDX, etc. Days to crew launch will be designated L-X, whereas days prior to docking with Space Station will be considered L+ or FD days. FDX will designate X days after launch, with launch on FD1. Therefore a session performed on the shuttle prior to docking may be designated in a FDX format. From launch to docking will be approximately 2-3 days. R+X days will all be based on landing, with landing on R+0.

TABLE 2.2. EXPERIMENT DESIGN

<table>
<tr><th>Preflight</th><th>Inflight</th><th>Postflight</th></tr>
<tr><td colspan="3">In each session, based on the amount of crewtime available, the Workstation Session Manager program suggests one or more of 5 different visual perception tests and one or more of 4 different visuomotor tasks. Inflight tests are performed in up to 3 possible conditions: quasi-free floating, lightly restrained and/or with constant-force springs (simulated gravity). Pre - and post-flight tests will be conducted in one of three conditions: erect, supine, or with a tilted seat.
<u>Visual Perception</u>
Test 1: Tilted Room. Subject indicates perceived vertical while viewing a series of tilted scenes.
Test 2: Tumbling Room. Subject indicates vection magnitude and surface identity while viewing rotating scenes.
Test 3: Linear Vection. Subject indicates vection onset and magnitude while viewing a moving corridor scene.
Test 4: Figures. Subject indicates which complex 2D figure seems most familiar.
Test: 5: Shading. Subject indicates which shaded circle seems most convex.
<u>Visuomotor Coordination</u>
Test 6: Grasping. Upright. Subjects align the hand with a object oriented in 3D space.
Test 7: Grasping. Head Tilt. Subjects repeat Test 6 with 30° head tilt.
Test 8: Pointing. Subjects perform rapid point-to-point movements with the dominant hand.
Test 9: Interception. Subjects intercept a flying ball with the dominant hand.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Three preflight performances of each test, separated by about 1 month, approximately L-120, L-90 and L-60. (The L-120 and L-90 performances will take place at JSC; L-60 at either JSC or Russia.)</td><td>Three inflight performances of each test. The first should be during Week 2 (FD8 to FD14), the second during Week 5 (FD29 to FD35), and the third during Week 11 (FD71 to FD77). Depending on crew schedules, it would be highly desirable to schedule one additional performance during Week 1(FD1 to FD7) and another about 3-4 weeks before the end of the increment (R-21 to R-28). If possible, additional performances every six weeks after Week 11 until as late as possible would also be desirable.</td><td>Three postflight repetitions of each test, the first two separated by about 3 days, at approximately R+0 and R+3; the third at approximately R+30.</td></tr>
<tr><td>One preflight performance at L-90 of the following tests:
Test 10: Tilted Bed. Subject aligns the bed to their subjective horizontal in a dark room.
Test 11: Luminous Line. Subjects align a luminous line to their subjective vertical meridian in a dark room.
Test: 12 Tilted grasping. Subjects perform the Virtual Grasping task (Test 9) while seated in a chair inclined by 30° in the frontal plane.</td><td></td><td>One post-flight performance within R+0 and R+3 of Tests 10, 11, and 12. Test descriptions given in preflight column.</td></tr>
<tr><td></td><td></td><td>One post-flight debriefing session to complete a perceptual questionnaire is needed between R+4 and R+6</td></tr>
</table>

2.3 MEASUREMENTS

The accompanying table shall be automatically generated from ground and flight sessions. **NO PI INPUT IS REQUIRED FOR THIS TABLE**. The investigator shall list all parameters to be measured in the tables of sections 3.1 and 3.2. Each measurement shall be associated with an objective (see Table 2.1) and identified on the table by the objective number and a measurement name. Measurements on control and test subjects during preflight, inflight, and postflight phases shall be included on this table. Measurements to be made during each phase will be listed only one time. Units, range of each measurement, the flight phase(s), preflight (B), inflight (I), or postflight (R), and a description of the acquisition method shall be included in this table.

TABLE 2.3. EXPERIMENT MEASUREMENTS

Measurement Name	Session ID(s)	Obj. #	Units	Range	Accuracy	Sample Rate	Phase (B, I, R)	Acquisition Method	Comments

2.4 SUPPORTING STUDIES

Supporting studies are investigative efforts required to supplement the implementation of the proposed experiment. Such studies could possibly be needed to clarify the experimental concept or to develop new procedures for collecting the experimental data. Regardless of their purposes, such studies must be in direct support of the flight experimental investigation. Study results will be presented to NASA and approved before the experiment can proceed to the development phase. Development and testing of state-of-the-art experimental equipment is not regarded as a supporting study.

TABLE 2.4. SUPPORTING STUDIES

Study #	Study Title	# of subjects	Study Site	Study Start Date (months prior to launch)	Study End Date (months prior to launch)	Report Date	Objectives	NASA Facility, Equipment, Services or S/W dev. Required (Y or N)
	(None)							

Instructions for the table entries are provided below:

Study #/Study Title - identify each individual supporting study by number and title and identify the total number of supporting studies. Provide a brief, identifying title that communicates the nature of the study to be performed. (If no supporting studies are required, indicate by N/A as not applicable.)

# of subjects/Study Site - provide the number of subjects required for the study as well as the site at which the study will be accomplished.

Study Start/End Date - define the timeframe for accomplishing each supporting study and indicate how many months before launch each study is to begin and end.

Report Date - date that supporting study results will be submitted to NASA.

Objectives - identify the objective(s) of each supporting study. This should include an explanation of the relationship of each supporting study to the investigation's objectives, and the impact of the study on the flight experiment implementation schedule.

NASA Facility, Equipment, or Services Required - define any government facilities, services or equipment support required as part of a supporting study. Provide a description of the support required (KC-135 flights, etc.). If software development is required for supporting studies, specify who will provide the software.

3.0 DATA COLLECTION REQUIREMENTS

3.1 GROUND DATA COLLECTION SESSIONS

The investigator shall prepare a copy of Table 3.1.X to describe the requirements necessary for properly implementing each preflight and postflight data collection session, as well as each ground control session, if necessary. Ground control sessions refer to any ground-based experiment(s) necessary to provide control data synchronized with the inflight experiment. A launch slip of any significance may necessitate the repeat of a preflight data collection. The criteria for this repeated session may be dictated by the investigator, although it will be reviewed by NASA for implementation feasibility.

TABLE 3.1.1. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-1B	**Type**	B	**Session Title**	HRF E085 Preflight Visual Perception Session A	**Assoc. Exp. Session**	E507 Preflight Science Session
Projected Scheduled Days (L-,FD,R+)	L-120, L-90, and L-60, approximately.	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete a subset of Tests 1-5 lasting 50-60 minutes. The subset of tests will be determined by the Session Manager software as well as the proficiency of the subject at each of the tests The subject will be briefed on the experimental procedure, run the Session Manager to determine the suite of tests, then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be reminded that the remainder of the tests will be completed later in the day.

<u>Session Flow</u> Session Step	**Operators**	**Subjects**	**Projected Time**	**Maximum Time**	**Minimum Time**
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (NOTE: Different test procedures are performed in Sessions A and B, depending on subject and test opportunity)	2 PI team members	1	25	30	25
3. Doff HMD and take break		1	4	5	4
4. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (See note from Step #2)	2 PI team members	1	25	30	25
5. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

Session duration is limited to 60 minutes to limit subject fatigue.

Session should <u>not</u> be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

<u>Hardware Required</u> **Hardware Name**	**Qty**	**Provided by**	**Comments**
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight hardware in function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	

TABLE 3.1.1. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
Emesis basin	2	PI	
Posture platform	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Pointing reticle angle	1	Deg	+/- 180			Subject Input Device (SID)	Computer data file	
Self rotation category	1	Numerical	1-5			SID		
Vection strength	2	TBD				TBD		
Vection onset	2	Binary	0/1			SID trigger		
Object choice	3	Numerical	1-6			SID		
Surveillance video	1,2,3	Video				camera	cassette	
3D Head Orientation	1,2,3	Deg.	0-60	TBD	60 Hz	Head/Body Tracker		
3D Head Position	1,2,3	cm	TBD	TBD	60 Hz	Head/Body Tracker		
Subject Voice notes	1,2,3	Audio				microphone		
Keyboard notes	1,2,3	Text				keyboard		
Postural center of pressure	1,2	In	+/- 10			Force plate		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

Facility Requirements	Timeframe for Facility Access
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List Parameter Name	Units	Monitored or Controlled	Record Description
Room temperature	Deg F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	**days occurs, the L-**	90, 60	**session(s) will need to be repeated.**

Instructions for the table entries are provided below:

Session ID - The session identification (ID) numbers are created by using the last three digits of the assigned experiment number followed by sequential numbers, then by a B for preflight, R for postflight, or C for control (e.g., 001-1B).

Type - Identify session as preflight (B), postflight (R), or ground control (GC)

Session Title - Provide the session name. Following the name, a short one word title should be added in parentheses.

Associated Experiment Session - if session is linked with activities of this or other experiments, indicate that session ID.

Projected Scheduled Days - indicate the day(s) preflight (L-X), inflight (Flight Day - FDX), postflight (R+X) on which the session is to be scheduled.

Session Time/Crewtime Usage - enter the number of minutes required for one performance of the session. Include all time that the crewmember is required to be at the session. Transportation time to other facilities should also be included, and detailed as a step in the session flow. Unattended operations should also be included, with subject and operator numbers at 0. Session Time is the duration of the whole session. Crewtime usage is the time where crew attendance is required. In most cases, assuming single crewmember operations, session time is equal to the sum of crewtime usage and unattended operations time.

Location - indicate the location of the session. For preflight sessions on Shuttle launch missions before L-3 days, or Soyuz launches before L-3 months, this location will be JSC. For Russian based launches after L-3 months (closer to launch), the location will be Russia (either Moscow or Star City). Postflight tests on Shuttle based landings, within the first few days postflight will take place at the landing site (probably KSC), then at JSC. Ground control test may be performed at any of the test sites or at the PI institution. If a session will be performed at a location other than those listed here for any reason, i.e., MRI, list location if known.

Session Scenario - provide a short description of what is to implemented through the performance of the session.

Session Flow - The time, crewmember, and steps involved to complete the session are plotted out in the session flow. This should be concise and at a level consistent to procedure call-out blocks. Provide a session flow listing indicated time annotated activities within the session, including breaks if required.

Session Step - an incremental, timelineable sequence

Operators/Subjects - the number of subjects and operators should be indicated and, when known, Subject(s) and Operator(s) should be identified by crew position. Identify crewmembers to be tested including backups, if applicable.

Projected/Maximum/Minimum Time - estimated time needed to complete the step, with the different times allowing for inefficiencies vs. proficiency.

Scheduling Constraints - provide any scheduling constraints associated with the session (e.g., time of day, post-prandial, must be performed by crewmember X, must be performed before/after session X, etc.). Indicate, where possible, any points in the session where delays or discontinuities could or should be scheduled. If breaks are scheduled, state whether the crewmember may leave or if activities are to be restricted.

Session Constraints - list any resources that would constrain the performance and/or successful implementation of the session. Information that identifies what is required, what is desirable, and what is unacceptable for data quality should be identified here (i.e., "Since procedure X is a housekeeping only activity, if it is not performed, it will not impact the quality of data return"). Provide any other constraints or monitoring needs for the session that do not involve the scheduling of the session (i.e., subject requirements, dietary and exercise constraints)

Session Unique Information - list any information that is unique to the session in this section. If multiple iterations of a session are to be performed with only slight changes (i.e., slight changes in protocol) provide a brief implementation protocol matrix in this section for quick reference by ground support personnel.

Hardware Required - identify the hardware required for each data collection session.

Hardware Name - identify the name of the hardware required for the session. Be consistent with names used in other sections of this document.
Quantity - identify the number of the indicated hardware item needed for the session.
Provided by - identify the supplier of the hardware listed (PI or NASA).
Comments - Any additional information that clarifies the hardware requirements.
Measurement Name - the individual measurements shall each be identified by a short descriptive name. A measurement can be defined as an estimate of a physiological parameter (e.g., ECG, blood pressure, epinephrine concentration, cardiac output, EMG, etc.).
Objective Number - identify the experiment objective(s) (from Table 2.1) which correspond to the listed measurement.
Units - identify the units in which the measurement will be obtained.
Range - identify the range over which the measurement will be made.
Accuracy - specify the accuracy or tolerance required of the measurement acquisition method, if applicable.
Sample Rate - provide the sampling rate of data collected.
Acquisition Method - identify the short title for the method used to obtain the measurement. This may identify the hardware item used to obtain the measurement and should indicate the need for a NASA-provided ground data system.
Storage Media - identify the media in which the measurement will be stored.
Comments - use this for any specific comments about the measurement.
Samples Acquired - identify the biological samples to be obtained during the session. If no samples are collected during this session, the table is N/A.
Sample Name - the individual samples shall be identified by a short name describing the sample to be delivered to the investigator. For biological samples assign sequential numbers to each blood draw beginning with the preflight table and continuing through the inflight, postflight, and ground control experiment tables. The same numbering system should be applied to required samples of urine, saliva, etc. Example: Blood Draw - Baseline
Units - identify the units in which the sample will be obtained.
Volume/Accuracy - specify the volume or amount required for the sample followed by the accuracy.
Comments - use this column for any specific comments about the sample. If the sample requires special handling, state the requirements.
Facility Requirements - provide a description of the facilities required to support this preflight data collection session. Include information on size of room, environmental conditions, power requirements (voltage, number of outlets, etc.) and any special facility characteristics required for the collection of this data (tables, sinks, etc.).
Timeframe for facility access - identify the time prior to the first session that the facility will be needed for hardware setup, checkout, etc.
Environmental parameter list - the investigator shall identify any environmental parameters which must be monitored or controlled during the session.
Parameter Name - list the parameter name that must be controlled or monitored (e.g., ambient temperature, humidity, carbon dioxide levels).
Units - provide the units that are needed to define the parameter (e.g., °C).
Monitored or Controlled - indicate if parameter is to be monitored (M), controlled (C), or both (M/C).
Record Description - indicate the range over which the parameters should be controlled and how the record is to be kept (e.g., +/- 2°C, magnetic tape).
Launch Slip repeat of sessions - the mission launch date may move beyond its original projected date after preflight baseline data collection has started, or completed. If this slip is longer than a certain time (week, month, etc.), one or more of that preflight sessions may be deemed necessary to be repeated. State which sessions will need to be repeated and the slip duration necessary to repeat any of the sessions.

TABLE 3.1.2. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-2B	**Type**	B	**Session Title**	HRF E085 Preflight Visual Perception Session B	**Assoc. Exp. Session**	E507 Preflight Science Session
Projected Scheduled Days (L-,FD,R+)	L-120, L-90, and L-60, approximately	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete Tests 1-5 in a period lasting 50-60 minutes. The subset of tests will be determined by the Session Manager software as well as the proficiency of the subject at each of the tests. At the completion of this session, the subject will have completed all of the trials for Tests 1-5. The subject will be briefed on the experimental procedure, run the Session Manager to determine the suite of tests, then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed.

<u>**Session Flow**</u> **Session Step**	**Operators**	**Subjects**	**Projected Time**	**Maximum Time**	**Minimum Time**
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (NOTE: Different test procedures are performed in Sessions A and B, depending on subject and test opportunity)	2 PI team members	1	25	30	25
3. Doff HMD and take break		1	4	5	4
4. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (See note from Step #2)	2 PI team members	1	25	30	25
5. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

This session should be scheduled within 24 hours of Session 085-1B Visual Perception Session A.

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

085 - 2B should follow 085 – 1B Visual Perception Session A after a separation of at least 3 hours but no more than 24 hours.

Session duration is limited to 60 minutes to limit subject fatigue.

Session should <u>not</u> be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.2. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight hardware in function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	
Emesis basin	2	PI	
Posture platform	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisitio Method	Storage Media	Comments
Pointing reticle angle	1	Deg	+/- 180			Subject Input Device (SID)	Computer data file	
Self rotation category	1	Numerical	1-5			SID		
Vection strength	2	TBD				TBD		
Vection onset	2	Binary	0/1			SID trigger		
Object choice	3	Numerical	1-6			SID		
Surveillance video	1,2,3	Video				camera	cassette	
3D Head Orientation	1,2,3	Deg	0-360	TBD	60 Hz	Head/Body Tracker		
3D Head position	1,2,3	cm	TBD	TBD	60 Hz	Head/Body Tracker		
Subject Voice notes	1,2,3	Audio				microphone		
Keyboard notes	1,2,3	Text				keyboard		
Postural center of pressure	1,2	In	+/- 10			Force plate		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

Facility Requirements	Timeframe for Facility Access
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

TABLE 3.1.2. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Environmental Parameter List Parameter Name	Units	Monitored or Controlled	Record Description
Room temperature	Deg F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	**days occurs, the L-**	90, 60	**session(s) will need to be repeated.**

TABLE 3.1.3. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	507-3B	**Type**	B	**Session Title**	HRF E507 Preflight Visuomotor - Nominal	**Assoc. Exp. Session**	E085 Preflight Science Sessions
Projected Scheduled Days (L-,FD,R+)	L-120, L-90, L-60, approximately	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete a set of interception and grasping tasks lasting 50-60 minutes. At the beginning of each session the subject will be briefed on the experimental procedure then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed.

<u>Session Flow</u> Session Step	**Operators**	**Subjects**	**Projected Time**	**Maximum Time**	**Minimum Time**
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform Grasping protocol standing with head upright (Test 6).	2 PI team members	1	12	15	10
3. Pause		1	1	1	1
4. Continue Grasping protocol with head tilt between stimulus and response (Test 7).	2 PI team members	1	12	15	10
5. Doff HMD and take break		1	4	5	4
6. Don HMD and perform Pointing (Test 8) and Interception (Test 9) tasks in upright (seated) position.	2 PI team members	1	12	15	10
7. Pause		1	1	1	1
8. Continue Pointing and Interception tasks lying on back.	2 PI team members	1	12	15	10
9. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

Session should be separated from other E085/E507 sessions by at least 3 hours but no more than 24 hours.
Session duration is limited to 60 minutes to limit subject fatigue.
Session should <u>not</u> be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.3. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight models in terms of function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
HRF Head/Neck Goniometer	2	NASA	
Hand accelerometer	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	
Emesis basin	2	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenter	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Surveillance video	4, 5	Video				camera	cassette	
3D Head Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Head Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Hand Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Acceleration	5	$cm \cdot s^{-2}$	±100	0.1	500 Hz	EUE/HRF Analog Input OR Head/Body Tracker	Digital	
3D Head/Neck Orientation	4, 5	deg	±45	0.1	60 Hz	PI Goniometer OR Head/Body Tracker	Digital	
Subject Voice notes	4, 5	Audio				microphone		
Keyboard notes	4, 5	Text				keyboard		

TABLE 3.1.3. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Samples Acquired **Sample Name**	**Units**	**Volume/Accuracy**	**Comments**
N/A (no biological samples)			

Facility Requirements	**Timeframe for Facility Access**
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List **Parameter Name**	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	degrees F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	30	**days occurs, the L-**	60	**session(s) will need to be repeated.**

TABLE 3.1.4. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-4B	**Type**	B	**Session Title**	HRF E085 Preflight Subjective Orientation	**Assoc. Exp. Session**	E507 Preflight Science Session
Projected Scheduled Days (L-,FD,R+)	L-90, approximately	**Session Time (min)**	30 min	**Crewtime Usage (min)**	30	**Location**	JSC or Russia

Session Scenario

This session will measure the subject's subjective sense of the horizontal and vertical. Subjects will perform this session in a completely darkened environment such that it does not provide any external frames of reference. For the subjective horizontal test, subjects will lay down on a tilting bed (first with right-shoulder down then left shoulder down) and adjust the angle of the bed until they feel they are lying completely horizontal. The experimenter will then record the bed's tilt. Next the subject will complete the luminous line test by lying on a table and adjusting a self-luminous bar until it is aligned with their subjective vertical. Again, the experimenter will measure the title angle with respect to the gravity vector then debrief the subject on the experiment.

<u>Session Flow</u> Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Subject briefing	2 PI team members	1	2	3	2
2. Subjective horizontal test (Right-shoulder down)	2 PI team members	1	8	10	8
3. Subjective horizontal test (Left-shoulder down)	2 PI team members	1	8	10	8
4. Luminous line test (recumbent)	2 PI team members	1	10	15	10
5. Subject Debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Schedule first performance of this session per participating crewmember about (L-90) 3 months prior to flight. Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons.

Session Constraints

Session should <u>not</u> be scheduled immediately after exercise or fatiguing activities or experiments.

Session should be separated from other E085/507 sessions by at least 3 hours but no more than 24 hours.

Session Unique Information

PI team sets up and operates all equipment.

<u>Hardware Required</u> Hardware Name	Qty	Provided by	Comments
Tilting table/luminous line test system	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

TABLE 3.1.4. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Tilted bed angle	1	Deg	+/- 15	+/- 1		Protractor		
Luminous line angle	1	Deg	0-360	+/- 1		Protractor		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

Facility Requirements	Timeframe for Facility Access
Quiet, completely darkenable laboratory room (minimum 120 sq ft.), with 120 Vac power for the luminous line test apparatus. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access to facility at least 30 minutes before planned session.

Environmental Parameter List Parameter Name	Units	Monitored or Controlled	Record Description
Room temperature	Deg	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	days occurs, the L-	90	session(s) will need to be repeated.

Session Scenario

During one session performance, one subject will complete a set of grasping tasks with the body tilted to various angles. The total session lasts 50-60 minutes. At the beginning of each session the subject will be briefed on the experimental procedure then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed

TABLE 3.1.5. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	507-5B	**Type**	B	**Session Title**	HRF E507 Preflight Grasping – Whole Body Tilt	**Assoc. Exp. Session**	E085 Preflight Science Sessions
Projected Scheduled Days (L-,FD,R+)	L-90, approximately	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Flow **Session Step**	**Operators**	**Subjects**	**Projected Time**	**Maximum Time**	**Minimum Time**
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform Grasping protocol seated upright.	2 PI team members	1	12	15	10
3. Pause		1	1	1	1
4. Continue Grasping protocol with 30° left shoulder-down whole body tilt.	2 PI team members	1	12	15	10
5. Doff HMD, return upright and take break		1	4	5	4
6. Don HMD and perform Grasping protocol seated upright.	2 PI team members	1	12	15	10
7. Pause		1	1	1	1
8. Continue Grasping protocol with 30° right shoulder-down whole body tilt.	2 PI team members	1	12	15	10
9. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible..

Session Constraints

Session should be separated from other E085/E507 sessions by at least 3 hours but no more than 24 hours.
Session duration is limited to 60 minutes to limit subject fatigue.
Session should not be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

Hardware Required **Hardware Name**	**Qty**	**Provided by**	**Comments**
HRF Workstation (training, BDC, or development units) equivalent to flight models in terms of function and performance.	1	NASA	
Head Mounted Display (HMD) & microphone	1	PI	
HRF Head & Body Tracker System	1	PI	
Hand accelerometer	1	PI	
Subject Input Device (SID)	1	PI	
Video surveillance camera & tripod	1	NASA	
Emesis basin	1	PI	
Table for computers and equipment	1	NASA	Table should be at least 4x6' in size

TABLE 3.1.5. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required — Hardware Name	Qty	Provided by	Comments
Padded chairs for subject and 2 experimenter	3	NASA	
Shelves or cabinets for equipment	1	NASA	4 ft of shelf space for manuals and equipment
Tilt Chair	1	PI	Capable of ±45 body tilt in frontal plane.

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Surveillance video	4, 5	Video				camera	cassette	
3D Head Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Head Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Hand Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Acceleration	5	$cm \cdot s^{-2}$	±100	0.1	500 Hz	EUE/HRF Analog Input OR Head/Body Tracker	Digital	
3D Head/Neck Orientation	4, 5	deg	±45	0.1	60 Hz	PI Goniometer OR Head/Body Tracker	Digital	
Subject Voice notes	4, 5	Audio				microphone		
Keyboard notes	4, 5	Text				keyboard		

Samples Acquired — Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

Facility Requirements	Timeframe for Facility Access
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List — Parameter Name	Units	Monitored or Controlled	Record Description
Room temperature	degrees F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	30	**days occurs, the L-**	60	**session(s) will need to be repeated.**

TABLE 3.1.6. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-1R	**Type**	R	**Session Title**	HRF E085 Postflight Visual Perception Session A	**Assoc. Exp. Session**	E507 Postflight Science Session
Projected Scheduled Days (L-,FD,R+)	Once between R+0 - R3; Once between R+4 - R+6; And at R+30	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete a subset of Tests 1-5 lasting 50-60 minutes. The subset of tests will be determined by the Session Manager software as well as the proficiency of the subject at each of the tests. The subject will be briefed on the experimental procedure, run the Session Manager to determine the suite of tests, then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be reminded that the remainder of the tests will be completed later in the day.

Session Flow Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (NOTE: Different test procedures are performed in Sessions A and B, depending on subject and test opportunity)	2 PI team members	1	25	30	25
3. Doff HMD and take break		1	4	5	4
4. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (See note from Step #2)	2 PI team members	1	25	30	25
5. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

Session duration is limited to 60 minutes to limit subject fatigue.

Session should not be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.6. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight hardware in function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	
Emesis basin	2	PI	
Posture platform	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Pointing reticle angle	1	Deg	+/- 180			Subject Input Device (SID)	Computer data file	
Self rotation category	1	Numerical	1-5			SID		
Vection strength	2	TBD				TBD		
Vection onset	2	Binary	0/1			SID trigger		
Object choice	3	Numerical	1-6			SID		
Surveillance video	1,2,3	Video				camera	cassette	
3D Head Orientation	1,2,3	Deg	0-360	TBD	60 Hz	Head/Body Tracker		
3D Head position	1,2,3	cm	TBD	TBD	60 Hz	Head/Body Tracker		
Subject Voice notes	1,2,3	Audio				microphone		
Keyboard notes	1,2,3	Text				keyboard		
Postural center of pressure	1,2	In	+/- 10			Force plate		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

TABLE 3.1.6. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Facility Requirements	**Timeframe for Facility Access**
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List **Parameter Name**	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	Deg F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	**days occurs, the L-**	90, 60	**session(s) will need to be repeated.**

TABLE 3.1.7. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-2R	**Type**	R	**Session Title**	HRF E085 Postflight Visual Perception Session B	**Assoc. Exp. Session**	**E507 Postflight Science Session**
Projected Scheduled Days (L-,FD,R+)	Once between R+0 – R+3; Once between R+4 - R+6; And at R+30	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete Tests 1-5 in a period lasting 50-60 minutes. The subset of tests will be determined by the Session Manager software as well as the proficiency of the subject at each of the tests. At the completion of this session, the subject will have completed all of the trials for Tests 1-5. The subject will be briefed on the experimental procedure, run the Session Manager to determine the suite of tests, then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed.

<u>Session Flow</u> Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (NOTE: Different test procedures are performed in Sessions A and B, depending on subject and test opportunity)	2 PI team members	1	25	30	25
3. Doff HMD and take break		1	4	5	4
4. Don HMD and perform tests in sequence determined by Session Manager software. This step will be performed in either erect seated or supine position as directed. (See note from Step #2)	2 PI team members	1	25	30	25
5. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

This session should be scheduled on the same day following Session 085-1R Visual Perception Session A or within 24 hours of 085-1R.

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

E085 2R should follow E085 1R after a separation of at least 3 hours but no more than 24 hours.

Session duration is limited to 60 minutes to limit subject fatigue.

Session should <u>not</u> be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.7. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight hardware in function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	
Emesis basin	2	PI	
Posture platform	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenter	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Pointing reticle angle	1	Deg	+/- 180			Subject Input Device (SID)	Computer data file	
Self rotation category	1	Numerical	1-5			SID		
Vection strength	2	TBD				TBD		
Vection onset	2	Binary	0/1			SID trigger		
Object choice	3	Numerical	1-6			SID		
Surveillance video	1,2,3	Video				camera	cassette	
3D Head Orientation	1,2,3	Deg	0-360	TBD	60 Hz	Head/Body Tracker		
3D Head position	1,2,3	cm	TBD	TBD	60 Hz	Head/Body Tracker		
Subject Voice notes	1,2,3	Audio				microphone		
Keyboard notes	1,2,3	Text				keyboard		
Postural center of pressure	1,2	In	+/- 10			Force plate		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

TABLE 3.1.7. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Facility Requirements	**Timeframe for Facility Access**
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, Xerox and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List **Parameter Name**	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	Deg F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	**days occurs, the L-**	90, 60	**session(s) will need to be repeated.**

TABLE 3.1.8. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	507-3R	**Type**	R	**Session Title**	HRF E507 Post-flight Visuomotor - Nominal	**Assoc. Exp. Session**	E085 Postflight Science Sessions
Projected Scheduled Days (L-,FD,R+)	Once between R+0 – R+3; Once between R+4 - R+6; And at R+30	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete a set of interception and grasping tasks lasting 50-60 minutes. At the beginning of each session the subject will be briefed on the experimental procedure then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed.

<u>Session Flow</u> Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform Grasping protocol standing with head upright (Test 6).	2 PI team members	1	12	15	10
3. Pause		1	1	1	1
4. Continue Grasping protocol with head tilt between stimulus and response (Test 7).	2 PI team members	1	12	15	10
5. Doff HMD and take break		1	4	5	4
6. Don HMD and perform Pointing (Test 8) and Interception (Test 9) tasks in upright (seated) position.	2 PI team members	1	12	15	10
7. Pause		1	1	1	1
8. Continue Pointing and Interception tasks lying on back.	2 PI team members	1	12	15	10
9. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day, if possible.

Session Constraints

Session should be separated from other E085/E507 sessions by at least 3 hours but no more than 24 hours.
Session duration is limited to 60 minutes to limit subject fatigue.
Session should not be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.8. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Hardware Required Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) and monitor. Equivalent to flight models in terms of function and performance.	2	NASA	2 identical BDC set ups desirable to simplify crewmember test scheduling, and/or to provide spares in case of equipment failure.
Head Mounted Display (HMD) & microphone	2	PI	
HRF Head & Body Tracker System	2	PI	
HRF Head/Neck Goniometer	2	NASA	
Hand accelerometer	2	PI	
Subject Input Device (SID)	2	PI	
Video surveillance camera & tripod	2	NASA	
Emesis basin	2	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenter	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Surveillance video	4, 5	Video				camera	cassette	
3D Head Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Head Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Hand Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Acceleration	5	$cm \cdot s^{-2}$	±100	0.1	500 Hz	EUE/HRF Analog Input OR Head/Body Tracker	Digital	
3D Head/Neck Orientation	4, 5	deg	±45	0.1	60 Hz	PI Goniometer OR Head/Body Tracker	Digital	
Subject Voice notes	4, 5	Audio				microphone		
Keyboard notes	4, 5	Text				keyboard		

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

TABLE 3.18. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Facility Requirements			**Timeframe for Facility Access**
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).			Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.
Environmental Parameter List **Parameter Name**	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	degrees F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	30	**days occurs, the L-**	60	**session(s) will need to be repeated.**

TABLE 3.1.9. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-4R	**Type**	R	**Session Title**	HRF E085 Postflight Subjective Orientation	**Assoc. Exp. Session**	E507 Postflight Science Session
Projected Scheduled Days (L-,FD,R+)	Once between R+0 - R+3	**Session Time (min)**	30 min	**Crewtime Usage (min)**	30	**Location**	JSC or Russia

Session Scenario

This session will measure the subject's subjective sense of the horizontal and vertical. Subjects will perform this session in a completely darkened environment such that it does not provide any external frames of reference. For the subjective horizontal test, subjects will lay down on a tilting bed (first with right-shoulder down then left shoulder down) and adjust the angle of the bed until they feel they are lying completely horizontal. The experimenter will then record the bed's tilt. Next the subject will complete the luminous line test by lying on a table and adjusting a self-luminous bar until it is aligned with their subjective vertical. Again, the experimenter will measure the title angle with respect to the gravity vector then debrief the subject on the experiment.

Session Flow Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Subject briefing	2 PI team members	1	2	3	2
2. Subjective horizontal test (Right-shoulder down)	2 PI team members	1	8	10	8
3. Subjective horizontal test (Left-shoulder down)	2 PI team members	1	8	10	8
4. Luminous line test (recumbent)	2 PI team members	1	10	15	10
5. Subject Debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Schedule first performance of this session per participating crewmember about (L-90) 3 months prior to flight. Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons.

Session Constraints

Session should not be scheduled immediately after exercise or fatiguing activities or experiments.
Session should be separated from other E085/E507 sessions by at least 3 hours but no more than 24 hours.

Session Unique Information

PI team sets up and operates all equipment.

Hardware Required Hardware Name	Qty	Provided by	Comments
Tilting table/luminous line test system	1	PI	
Table for computers and equipment	2	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	
Shelves or cabinets for equipment	2	NASA	4 ft of shelf space for manuals and equipment
Padded gurney bed	2	NASA	

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisitio Method	Storage Media	Comments
Tilted bed angle	1	Deg	+/- 15	+/- 1		Protractor		
Luminous line angle	1	Deg	0-360	+/- 1		Protractor		

TABLE 3.1.9. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Samples Acquired **Sample Name**	**Units**	**Volume/Accuracy**	**Comments**
N/A (no biological samples)			

Facility Requirements	**Timeframe for Facility Access**
Quiet, completely darkenable laboratory room (minimum 120 sq ft.), with 120 Vac power for the luminous line test apparatus. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access to facility at least 30 minutes before planned session.

Environmental Parameter List **Parameter Name**	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	Deg	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	180	**days occurs, the L-**	90	**session(s) will need to be repeated.**

TABLE 3.1.10. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	507-5R	**Type**	R	**Session Title**	HRF E507 Post-flight Grasping – Whole Body Tilt	**Assoc. Exp. Session**	E085 Postflight Science Sessions
Projected Scheduled Days (L-,FD,R+)	Once between R+0 - R+3	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC or Russia

Session Scenario

During one session performance, one subject will complete a set of grasping tasks with the body tilted to various angles. The total session lasts 50-60 minutes. At the beginning of each session the subject will be briefed on the experimental procedure then don the HMD and begin the tests. At the end of the session (approximately 1 hour), the subject will remove the HMD and be debriefed

<u>Session Flow</u> Session Step	Operators	Subjects	Projected Time	Maximum Time	Minimum Time
1. Brief subject on experimental procedure	2 PI team members	1	4	5	4
2. Don HMD and perform Grasping protocol seated upright.	2 PI team members	1	12	15	10
3. Pause		1	1	1	1
4. Continue Grasping protocol with 30° left shoulder-down whole body tilt.	2 PI team members	1	12	15	10
5. Doff HMD, return upright and take break		1	4	5	4
6. Don HMD and perform Grasping protocol seated upright.	2 PI team members	1	12	15	10
7. Pause		1	1	1	1
8. Continue Grasping protocol with 30° right shoulder-down whole body tilt.	2 PI team members	1	12	15	10
9. Doff HMD and debrief	2 PI team members	1	2	2	2

Scheduling Constraints

Experiments require alert subject. Subjects can take short breaks (up to 10 minutes) if required to maintain alertness or for personal reasons. Performances of this session should be scheduled at the same time of day.

Session Constraints

Session should be separated from other E085/E507 sessions by at least 3 hours but no more than 24 hours.

Session duration is limited to 60 minutes to limit subject fatigue.

Session should <u>not</u> be scheduled immediately after exercise (sweating in HMD is a problem), or fatiguing activities or experiments.

Session Unique Information

PI team sets up and operates all equipment.

TABLE 3.1.10. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

<u>Hardware Required</u> Hardware Name	Qty	Provided by	Comments
HRF Workstation (training, BDC, or development units) equivalent to flight models in terms of function and performance.	1	NASA	
Head Mounted Display (HMD) & microphone	1	PI	
HRF Head & Body Tracker System	1	PI	
Hand accelerometer	1	PI	
Subject Input Device (SID)	1	PI	
Video surveillance camera & tripod	1	NASA	
Emesis basin	1	PI	
Table for computers and equipment	1	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenter	3	NASA	
Shelves or cabinets for equipment	1	NASA	4 ft of shelf space for manuals and equipment
Tilt Chair	1	PI	Capable of ±45 body tilt in frontal plane.

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Storage Media	Comments
Surveillance video	4, 5	Video				camera	cassette	
3D Head Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Head Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	Digital	
3D Hand Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	Digital	
3D Hand Acceleration	5	$cm \cdot s^{-2}$	±100	0.1	500 Hz	EUE/HRF Analog Input OR Head/Body Tracker	Digital	
3D Head/Neck Orientation	4, 5	deg	±45	0.1	60 Hz	PI Goniometer OR Head/Body Tracker	Digital	
Subject Voice notes	4, 5	Audio				microphone		
Keyboard notes	4, 5	Text				keyboard		

TABLE 3.1.10. GROUND EXPERIMENT SESSION OVERVIEW (Cont'd)

Samples Acquired Sample Name	Units	Volume/Accuracy	Comments
N/A (no biological samples)			

Facility Requirements	Timeframe for Facility Access
Two separate, quiet, completely darkenable laboratory rooms (minimum 120 sq ft.), with 120 Vac power for computer, displays, tracker, and video cameras. Internet access required (for data archiving and software maintenance). Phone, copy machine and FAX. Off-hours access if repairs/troubleshooting are required. Temperature controlled, secure storage for equipment between sessions (prefer to leave laboratory set up).	Access 1 day before session to set up and test. Access to facility at least 2 hours before planned session start through one hour after session completion.

Environmental Parameter List Parameter Name	Units	Monitored or Controlled	Record Description
Room temperature	degrees F	Controlled 68-78°	no record required if within nominal limits
Humidity	%	Controlled	

If a launch slip of	30	**days occurs, the L-**	60	**session(s) will need to be repeated.**

TABLE 3.1.11. GROUND EXPERIMENT SESSION OVERVIEW

Session ID	085-6R 507-6R	**Type**	R	**Session Title**	HRF E085/507 Debrief/Questionnaire	**Assoc. Exp. Session**	E085/507Post-flight Science Session
Projected Scheduled Days (L-,FD,R+)	1 session between R+4 - R+6	**Session Time (min)**	60 min	**Crewtime Usage (min)**	60	**Location**	JSC

Session Scenario
This session will include a debriefing of the subject's subjective experiences in the VR test environment to help interpret the inflight data and review of voice and console notes. Session 085-12R and 507-12R will be held concurrently and conducted once postflight (between R+4 and R+6).

Session Flow **Session Step**	**Operators**	**Subjects**	**Projected Time**	**Maximum Time**	**Minimum Time**
1. Individual Crew member private debriefing	2 PI team members	1	45	50	30
2. Perceptual questionnaire	2 PI team members	1	15	20	10

Scheduling Constraints
Highly desirable for this session to occur within the first week after return to minimize memory loss of E085/507 experiment experiences.
Session Constraints
Session Unique Information
Sessions 085-6R and 507-6R are to be held concurrently.

Hardware Required **Hardware Name**	**Qty**	**Provided by**	**Comments**
Table for computers and equipment	1	NASA	Table should be at least 4x6' in size
Padded chairs for subject and 2 experimenters	6	NASA	

Measurement Name	**Obj. #**	**Units**	**Range**	**Accuracy**	**Sample Rate**	**Acquisition Method**	**Storage Media**	**Comments**
Written responses	1,2,3							

Samples Acquired **Sample Name**	**Units**	**Volume/Accuracy**	**Comments**
N/A (no biological samples)			

Facility Requirements	**Timeframe for Facility Access**
Quiet laboratory room (minimum 120 sq ft.), with 120 Vac. Phone, Xerox and FAX	

Environmental Parameter List Parameter Name	**Units**	**Monitored or Controlled**	**Record Description**
Room temperature	Deg	Monitored	68-78 deg.,

If a launch slip of		**days occurs, the L-**		**session(s) will need to be repeated.**

3.2 INFLIGHT DATA COLLECTION SESSIONS

TABLE 3.2.1. INFLIGHT EXPERIMENT SESSION OVERVIEW

Session ID	085-1I	**Type**	**IN**	**Session Title**	E085 Inflight Visual Perception Session	**Assoc. Exp. Session**	E507 Science Session
Projected Scheduled Days(FD)	**Required** inflight schedule: Within the week of FD8 – FD14: The session must be performed a max of 5X and a min. of 2.5X Within the week of FD29 – FD35: The session must be performed a max of 5X and a min. of 2.5X Within the week of FD 71 – 77: The session must be performed a max of 5X and a min. of 2.5X In addition, these test dates are **highly desirable**: FD1 – FD7: Max 5X, min 2.5X End of mission (as late in the increment as possible): Max 5X, min 2.5X In addition to the above schedule, these dates are **desirable**: Every 6th week after Week 11 (week 17, 23, 29, etc.): Max 5X, min 2.5X						
Session Time (min)	Minimum: 30 min. Maximum recommended: 60 min. (crew fatigue)		**Crewtime Usage (min)**		Same as Session Time	**Location**	HRF Rack 2 Workstation location

Session Scenario

During one inflight session, subjects will have to deploy the experimental hardware (Workstation 2 and EUE), determine the tests to be performed, complete the tests, and restow the equipment. The subset of tests from the E085/507 Test Suite (Tests 1-5) are determined by the time allotted for the session and the Session Manager software which keeps track of previous sessions. The crewmember may take up to five times to complete one block (tests 1- 5) over a given week.

Session Flow Session Step		Operators	Subjects	Projected Time (1g)	Max Time (1g)	Min Time (1g)	Downlink Required? (Y/N)	Ground commanding Required? (Y/N)
1.	Deploy display/keyboard, HMD, tracker, and power up.	1	0	5	10	5		N
2.	Review cue cards and Workstation help files	1	0	1	2	1		N
3.	Configure SRS and tethers, SID	1	0	2	2	2		N
4.	Configure and activate surveillance video	1	0	1	1	1		N
5.	Run Session Manager and verify HMD and Tracker performance	0	1	3	5	3		N
6.	Perform tests as indicated	0	1	30	40	12		N
7.	Transfer test data to downlink network	1	0	1	1	1	Y	N
8.	Power down and stow all equipment	1	0	5	5	5	N	N

TABLE 3.2.1. INFLIGHT EXPERIMENT SESSION OVERVIEW (Cont'd)

Timelining Constraints

Minimum time between sessions 1-2 hours (to prevent cumulative crew fatigue)

Do not schedule other experiments involving vision or motion stimuli expts; arm muscle fatiguing expts, exp ts on rotating chairs or sleds, LB&P expts within 3 hours before E085/507 experiments.

Session Constraints

Subject must not be touched or spoken to by other crewmembers during testing (except in emergency).
Therefore racks immediately adjacent to subject should not be accessed by others during experiment trials (but could be accessed between trials)
Desirable to turn lights down in module (to reduce HMD light leaks. Limit: good video view of subject).
Flash photography should be minimized (due to HMD light leaks)
Loud noises or loud talking by other crewmembers in the same module should be minimized.
Software permits subject to take a break between trials if required to perform other activities or to reduce fatigue. Breaks should be less than 10 minutes long.

Session Unique Information

All sessions are identical from a resource point of view. Multiple sessions could be timelined using an identical (e.g. 1 hr long) session template

<u>Hardware Required</u> Hardware Name	Part No.	Qty	Provider	Late/ Early Access (L/E/N)	Limtd Life Item? (Y/N)	Batt. Powrd (Y/N)	Line Powrd (Y/N)	Rack Mntd/St owed (R/S)	Est. Mass (kg)	L (cm)	W (cm)	H (cm)	Total Vol. (cm3)
HRF Workstation 2		1	NASA										
Head Mounted Display (HMD) & microphone		1	PI										
HRF Head & Body Tracker System		1	PI										
Subject Input Device (SID)		1	PI										
Subject Restraint System		1	PI										
Video surveillance camera		1	NASA										

TABLE 3.2.1. INFLIGHT EXPERIMENT SESSION OVERVIEW (Cont'd)

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Comments
Pointing reticle angle	1	Deg	+/- 180			Subject Input Device (SID)	Computer data file
Self rotation category	1	Numerical	1-5			SID	
Vection strength	2	TBD				TBD	
Vection onset	2	Binary	0/1			SID trigger	
Object choice	3	Numerical	1-6			SID	
Surveillance video	1,2,3	Video				camera	cassette
Head Orientation	1,2,3	Deg	0-360			Head/Body Tracker	
Head position	1,2,3	Cm	TBD			Head/Body Tracker	
Subject Voice notes	1,2,3	Audio				microphone	
Keyboard notes	1,2,3	Text				keyboard	
Postural center of pressure	1,2	In	+/- 10			Force plate	

Samples Acquired **Sample Name**	Units	Volume/Accuracy	Temp. Control Required?	Comments
N/A (no biological samples)				

Photo/TV Required?	Yes/Yes	**Documentary 35mm Photo/Video?**	Yes/Yes

Environmental Parameter List **Parameter Name**	Units	Monitored or Controlled	Record Description
Non-condensing humidity/temperature		C	None required unless outside of nominal
Cool shirtsleeve environment (to reduce fogging of HMD)		C	
Low frequency (<1 Hz) vehicle accelerations < 5 milli-g (vestibular threshold) (not expected to be a problem on ISS, except during reboosts)		C	

The investigator shall prepare a copy of Table 3.2.X to describe the requirements necessary for properly implementing each inflight data collection.

<u>Session ID</u> - create a unique session identification (ID) number for each session by using the last three digits of the assigned experiment number followed by a number indicating the sequence of the session, then an I for inflight (e.g., 001-1I).
<u>Type</u> - Identify session as inflight (IN)
<u>Session Title</u> - provide the session name. Following the name, a short one word title should be added in parentheses.

Associated Experiment Session - if the session is linked with activities of this or other experiments, indicate that session ID.

Projected Scheduled Days - indicate the timeframe (e.g., FD), number of iterations, and starting date that the inflight session is to be scheduled.

Session Time/Crewtime Usage - enter the number of minutes required for one performance of the session. Include all time that the crewmember is required to be at the session. Unattended operations should also be included, with subject and operator numbers at 0. Session Time is the duration of the whole session. Crewtime usage is the time where crew attendance is required. In most cases, assuming single crewmember operations, session time is equal to the sum of crewtime usage and unattended operations time.

Location - indicate where the session should be performed (i.e., Shuttle middeck, Space Station (specific module if required or known)).

Session Scenario - provide a short description of what is to implemented through the performance of the session.

Session Flow - The time, crewmember, and steps involved to complete the session are plotted out in the session flow. This should be concise and at a level consistent to procedure call-out blocks. In the Session Flow table, provide a session flow listing indicated time annotated activities within the session, including breaks if required.

Session Step - an incremental, timelineable sequence

Operators/Subjects - the number of subjects and operators should be indicated and, when known, Subject(s) and Operator(s) should be identified by crew position

Projected/Maximum/Minimum Time - estimated time needed to complete the step, with the different times allowing for inefficiencies vs. proficiency. Times should be terrestrial (1-g) estimates, and not an estimate of extended step durations incurred by performing in a microgravity (0-g) environment.

Downlink /Ground Commanding Required - When Downlink or ground commanding is required, or desired, for that step in the session flow, then it should be designated with a Y or N. If a Y is indicated then the associated information should be provided in tables in section X.

Timelining Constraints - provide any scheduling constraints associated with the session (e.g., time of day, post-prandial, must be performed by crewmember X, must be performed before/after session X). Indicate, where possible, any points in the session where delays or discontinuities could or should be scheduled. If breaks are scheduled, state whether the crewmember may leave or if activities are to be restricted.

Session Constraints - list any resources that would constrain the performance and/or successful implementation of the session. Information that identifies what is required, what is desirable, and what is unacceptable for data quality should identified here (i.e., "As procedure X is a housekeeping only activity, if it is not performed, it will not impact the quality of data return"). Provide any other constraints or monitoring needs for the session that do not involve the scheduling of the session (i.e., subject requirements, dietary or exercise constraints)

Session Unique Information - list any information that is unique to the session in this section. If multiple iterations of a session are to be performed with only slight changes (e.g., placement locations of dosimeters) provide a brief implementation protocol matrix in this section for quick reference by ground personnel.

Hardware Required - In the Table, list all items for the experiment (includes Hardware Developer- and NASA-provided equipment). Include equipment ID and name, total quantity for flight, supplier of the hardware, the mode by which power is supplied, stowage or rack mounting of hardware, and estimated stowage mass and dimensions. For NASA-supplied hardware, additional hardware information will be obtained from the applicable Hardware Requirements Document, or the NASA point of contact. Additional information on investigator-provided hardware will be detailed in the investigator-provided Experiment Unique Equipment (EUE) Hardware Requirements Document (HRD). Hardware stowed in a refrigerated or frozen state for launch, or generated inflight and returned in a refrigerated or frozen state will be identified here and listed in a table to follow.

Definitions applicable to stowed hardware are as follows:

Kit - A collection of items inside a container, which permits the assemblage to be handled, carried, or stowed as a unit. The items in a kit usually have a common or complementing relationship when in use.

Stowage Set - A collection of items intended to be stowed together in one location (e.g., locker, drawer, or tray). A set includes the packing material and stowage restraints (usually a custom-made foam cushion), which make the set a complete, stowable unit. A set may also include a locker, drawer, or tray, if it is supplied by the same party who supplies the rest of the set.
A kit can be part of a set, but a set cannot be part of a kit.

Hardware Name - identify the equipment name that will be used throughout this document and the life of the program.
Part Number - should be provided by the investigator for investigator-provided hardware, but will be provided by NASA for all other hardware.
Qty - the quantity of each item to be flown shall be listed.
Provided By - identify provider of all hardware required inflight (PI, NASA, or international partner). If hardware is provided by NASA, distinguish between Laboratory Support Equipment (LSE) and Station Support Equipment (SSE).
Late Load/Early Access Req't? - identify if hardware item has a requirement to be loaded within two and a half months of launch (L), or retrieved within a week of landing (E). Further details will be listed in Table 3.2.7.2. If no late or early access requirements exist, enter N.
Limited Life Item? - identify if the hardware item will have shelf life less than one year. Further details will be listed in Table 3.2.7.1.
Battery Powered - identify if the equipment listed has a battery power source. If item is not battery powered enter N. Battery details will be described in Table 7.2.1.
Line Powered - identify if the equipment listed has a shuttle or station based power source. If item is not line powered enter N. Power details will be described in Table 7.2.1.
Rack Mounted/Stowed - identify if item is rack mounted (R) or stowed (S) hardware.
Estimated Mass - provide information about the weight of each hardware item in kg. This information will be used to assign a suitable location within the International Space Station or in the Orbiter. Enter dimensions in centimeters.
Estimated Dimensions - provide information about the size of each hardware item. This information will be used to assign a suitable location within the International Space Station or in the Orbiter. Enter dimensions in centimeters.
Total Volume - provide the volume of the total quantity of the hardware item in cubic centimeters.
Measurement Name - the individual measurements shall each be identified by a short descriptive name. A measurement can be defined as an estimate of a physiological parameter (e.g., ECG, blood pressure, epinephrine concentration, cardiac output, EMG, etc.).
Objective Number - identify the experiment objectives (from Table 2.1) which correspond to the listed measurement.
Units - identify the units in which the measurement will be obtained.
Range - identify the range over which the measurement will be made.
Accuracy - specify the accuracy or tolerance required of the measurement acquisition method, if applicable.
Sample Rate - provide the sampling rate of data collected
Storage Media - identify the media to be used to archive the data inflight.
Acquisition Method - identify the short title for the method used to obtain the measurement. This may identify the hardware item used to obtain the measurement and should indicate the need for a NASA-provided ground data system.
Comments - use this for any specific comments about the measurement.
Samples Acquired: identify the biological samples to be obtained during the inflight session. If no samples are collected, the table is N/A.
Sample Name - the individual samples shall be identified by a short name describing the sample to be delivered to the investigator. For biological samples assign sequential numbers to each blood draw beginning with the preflight table and continuing through the inflight, postflight, and ground control experiment tables. The same numbering system should be applied to required samples of urine, saliva, etc. Example: Blood Draw – Baseline.
Units - identify the units in which the sample will be obtained.

Volume/Accuracy - specify the volume or amount required for the sample followed by the accuracy.

Temp Control Required - specify if special temperature control is required of the sample. Otherwise, sample will be stowed at ambient conditions

Comments - use this column for any specific comments about the sample. If the sample requires special handling, state the requirements.

Photo/TV Required/Documentary 35 mm/Video - identify if photographs or video are required for the experiment as a data product or for experiment documentation purposes. Also, identify if photographic or video documentation of the experiment is requested. Further details will be documented in Table 3.2.8.

Environmental parameter list - the investigator shall identify any Shuttle or International Space Station environmental parameters which must be monitored or controlled during the session.

Parameter Name - list the parameter name that must be controlled or monitored (e.g., ambient temperature, humidity, carbon dioxide levels).

Units - provide the units that are needed to define the parameter (e.g., °C).

Monitored or Controlled - indicate if parameter is to be monitored (M), controlled (C), or both (M/C).

Record Description - indicate the range over which the parameters should be controlled and how the record is to be kept (e.g., +/- 2°C, mag. tape).

TABLE 3.2.2. INFLIGHT EXPERIMENT SESSION OVERVIEW

Session ID	507-2I	**Type**	IN	**Session Title**	E507 Inflight Visuomotor Session	**Assoc. Exp. Session**	E085 Science Session
Projected Scheduled Days(FD)	**Required** inflight schedule: Within the week of FD8 – FD14: This session must be performed a max of 3X and a min. of 1.5X Within the week of FD29 – FD35: This session must be performed a max of 3X and a min. of 1.5X Within the week of FD71 – FD77: This session must be performed a max of 3X and a min. of 1.5X In addition, these test dates are **highly desirable**: FD1 – FD7: Max 3X, min. 1.5X End of mission (as late in the increment as possible): Max 3X, min. 1.5 In addition to the above schedule, these dates are **desirable**: Every 6th week after Week 11 (week 17, 23, 29, etc.): Max 3X, min. 1.5X						
Session Time (min)	Minimum: 30 Maximum recommended: 60 (crew fatigue)	**Crewtime Usage (min)**	Same as Session Time	**Location**	HRF Rack 2 Workstation location		

Session Scenario

During one inflight session, subjects will have to deploy the experimental hardware (Workstation 2 and EUE), determine the tests to be performed, complete the tests, and restow the equipment. The subset of tests from the E507 Test Suite (Tests 6 – 9)are determined by the time allotted for the session and the Session Manager software which keeps track of previous sessions. The crewmember may take up to five times to complete one block (tests 6- 9) over a given week.

Session Flow Session Step		Operators	Subjects	Projected Time (1g)	Max Time (1g)	Min Time (1g)	Downlink Required? (Y/N)	Ground commanding Required? (Y/N)
1.	Deploy display/keyboard, HMD, tracker, and power up.	1	0	5	10	5		N
2.	Review cue cards and Workstation help files	1	0	1	2	1		N
3.	Configure SRS and tethers, SID	1	0	2	2	2		N
4.	Configure and activate surveillance video	1	0	1	1	1		N
5.	Run Session Manager and verify HMD and Tracker performance	0	1	3	5	3		N
6.	Perform tests as indicated	0	1	30	40	12		N
7.	Transfer test data to downlink network	1	0	1	1	1	Y	N
8.	Power down and stow all equipment	1	0	5	5	5	N	N

TABLE 3.2.2. INFLIGHT EXPERIMENT SESSION OVERVIEW (Cont'd)

Session Constraints

Subject must not be touched or spoken to by other crewmembers during testing (except in emergency).
Therefore racks immediately adjacent to subject should not be accessed by others during experiment trials (but could be accessed between trials)
Desirable to turn lights down in module (to reduce HMD light leaks. Limit: good video view of subject).
Flash photography should be minimized (due to HMD light leaks)
Loud noises or loud talking by other crewmembers in the same module should be minimized.
Software permits subject to take a break between trials if required to perform other activities or to reduce fatigue. Breaks should be less than 10 minutes long.

Session Unique Information

All sessions are identical from a resource point of view. Multiple sessions could be timelined using an identical (e.g. 1 hr long) session template

Hardware Required Hardware Name	Part No.	Qty	Provider	Late/ Early Access (L/E/N)	Limtd Life Item? (Y/N)	Batt. Powrd (Y/N)	Line Powrd (Y/N)	Rack Mntd/ Stowed (R/S)	Est. Mass (kg)	L (cm)	W (cm)	H (cm)	Total Vol. (cm3)
HRF Workstation 2		1	NASA										
Head Mounted Display (HMD) & microphone		1	PI										
HRF Head & Body Tracker System		1	PI										
HRF Head/Neck Goniometer		1	PI										
Hand Accelerometer		1	PI										
Subject Input Device (SID)		1	PI										
Subject Restraint System		1	PI										
Constant Force Springs		1	PI										
Video surveillance camera		1	NASA										

TABLE 3.2.2. INFLIGHT EXPERIMENT SESSION OVERVIEW (Cont'd)

Measurement Name	Obj. #	Units	Range	Accuracy	Sample Rate	Acquisition Method	Comments
Surveillance video	4,5	Video				camera	cassette
3D Head Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	
3D Head Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	
3D Hand Orientation	4, 5	deg	0-360	0.15	60 Hz	Head/Body Tracker	
3D Hand Position	4, 5	cm	±100	0.2	60 Hz	Head/Body Tracker	
3D Hand Acceleration	5	$cm \cdot s^{-2}$	±100	0.1	500 Hz	EUE/HRF Analog Input OR Head/Body Tracker	
3D Head/Neck Orientation	4, 5	deg	±45	0.1	60 Hz	PI GoniometerOR Head/Body Tracker	
Subject Voice notes	1,2,3	Audio				microphone	
Keyboard notes	1,2,3	Text				keyboard	

Samples Acquired **Sample Name**	Units	Volume/Accuracy	Temp. Control Required?	Comments
N/A (no biological samples)				

Photo/TV Required?	Yes/Yes	**Documentary 35mm Photo/Video?**	Yes/Yes

Environmental Parameter List **Parameter Name**	Units	Monitored or Controlled	Record Description
Non-condensing humidity/temperature		C	None required unless outside of nominal
Cool shirtsleeve environment (to reduce fogging of HMD)		C	
Low frequency (<1 Hz) vehicle accelerations < 5 milli-g (vestibular threshold) (not expected to be a problem on ISS, except during reboosts)		C	

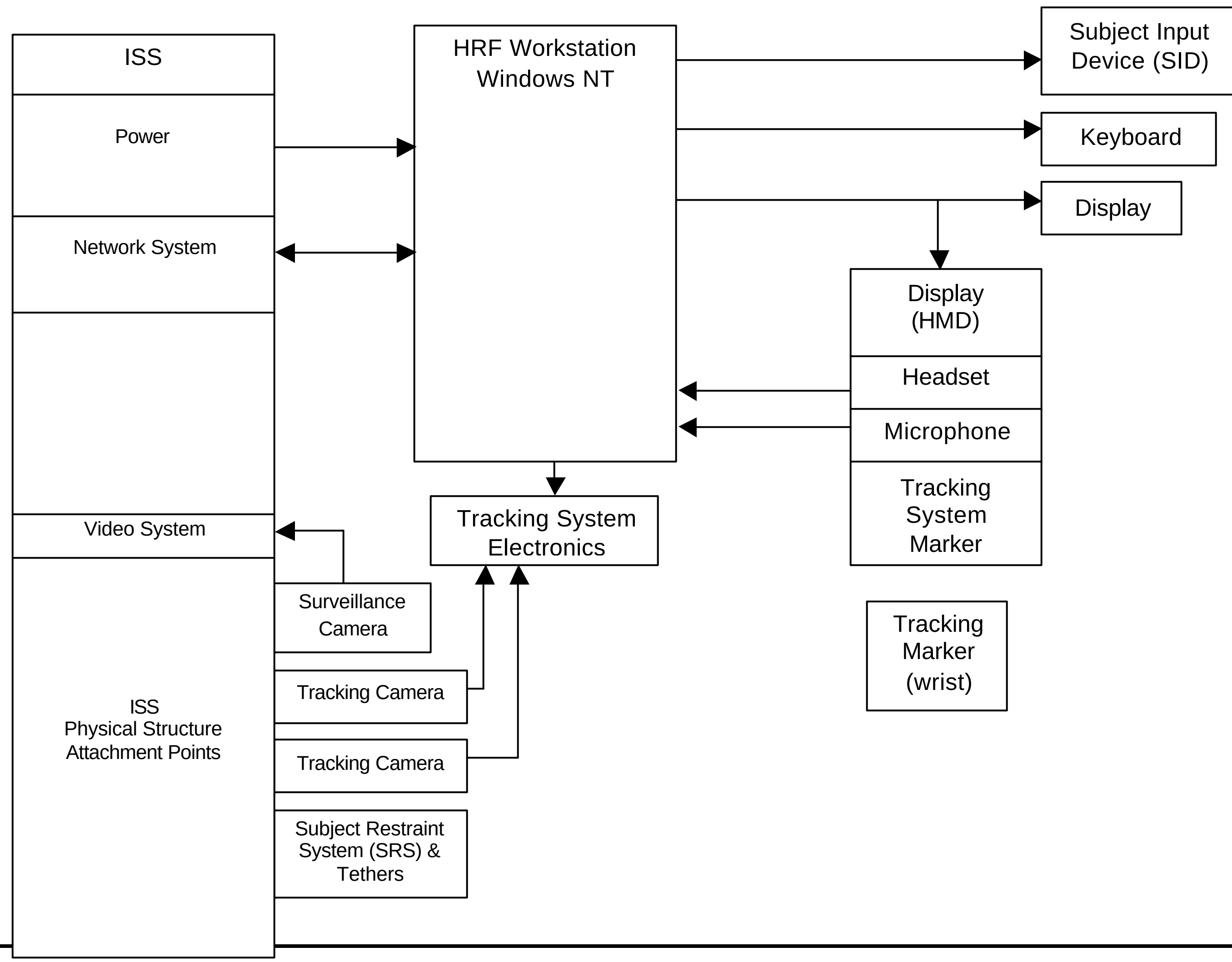
3.2.1 Experiment Block Diagram

For each mode of inflight experiment operation, the investigator shall provide a block diagram of the equipment configuration using the form in the Figure below. The diagram should include all investigator-provided, International Partner-provided and NASA-provided equipment, and show all interconnections between active experiment elements. The diagram should include applicable Shuttle or Station power and/or data system and mechanical interfaces (including fluid or vacuum lines). The diagram elements should be labeled with the appropriate equipment item name. If more than one diagram is provided, indicate session ID, as identified in previous tables, the diagram number and total number of diagrams (i.e., 1 of 10). These diagrams are for information purposes only, and the controlling drawing is the ICD.
Diagrams should be in jpeg or bitmap (.bmp) format, if possible.

Experiment No. E085/507
Date: 04/19/00

Figure 3.2.1-1. EXPERIMENT BLOCK DIAGRAM

Session ID(s)	085-xI, 507-xI	**Diagram**	1	**of**	1	



3.2.2 Deployed Operational Envelope

Provide a dimensioned illustration of the operational envelope for each session that deploys outside of the rack or protrudes from the rack face during operation (protrusions due solely to handles, knobs, switches, etc., are to be excluded). For session-level operational envelopes, include all investigator-provided, International Partner-provided and NASA-provided equipment. Dimensions should be provided for as many components as possible. These illustrations shall be numbered Figure 3.2.2-A, B, C, etc.

Additionally, if hardware is nominally stowed outside of a stowage locker or drawer, i.e., in a bag, etc., provide a dimensioned drawing package in its stowed configuration. Include structural attachment interfaces and any cable routing and hardware protrusions as defined in SSP 57000 paragraph 3.12.4.

Illustrations should be in jpeg or bitmap (.bmp) format, if possible. Photographs of all major individual pieces of hardware should be included, if possible.

These illustrations are for information purposes only. The controlling drawing will be the ICD.

Figure 3.2.2-A. DEPLOYED OPERATIONAL ENVELOPE ILLUSTRATION

Session ID	085-xI, 507-xI	**Hardware/System Name**		**Part No.**	
TBD Approximately cubic volume 3m per side Highly desirable to leave tracker camera bars, and workstation keyboard and display deployed in position between experiment sessions to reduce set up time.					

3.2.3 Equipment Location Requirements

In the accompanying table the investigator shall provide the following information:

Indicate by yes or no (Y/N) if there are any constraints/limitations to be considered when determining the layout and location of the experiment. If there are constraints, describe them. Use illustrations, if necessary. Example constraints include: location requirements related to the proximity of subjects and operator, equipment co-location requirements (proximity to rack-mounted equipment, etc.), or to equipment limitations on cable length or signal path. All equipment hardware involved (investigator-, NASA-, or IP-provided) should be included.

TABLE 3.2.3-1. EQUIPMENT LOCATION REQUIREMENTS

Any Constraints to Experiment Location (Y/N)?	Y
Equipment Name and Identification:	HRF Workstation + Virtual Reality Components
Constraints to Experiment Location - Description:	
Need large enough volume such that subjects can free float with upper body in a 2m x 2m x 2m volume, i.e, one end of the space station laboratory module Need a suitable place on deck to attach subject restraint system (approximately 3’ x 2’ area). Need suitable mounting locations for tracker camera bars (As high as possible). (Number TBD, but perhaps up to 4 locations) Physically adjacent to the HRF Workstation 2 Stowage must be immediately adjacent to experiment area to facilitate speedy deployment and re-stow. Desirable to have no loud noise sources nearby.	

3.2.4 Interface Control Drawings

For equipment installed either on the Shuttle or International Space Station, the details of physical and functional interfaces between the investigator-provided equipment and the vehicle systems are documented in an ICD to be provided by NASA during experiment development. **NO PI INPUT IS REQUIRED FOR THIS TABLE**. The ICD will provide a level of detail necessary to ensure the physical and functional compatibility of rack-mounted equipment and allow joint control of interfaces between the investigator and NASA.

TABLE 3.2.4. SUMMARY LIST OF ICDS FOR THE EXPERIMENT SYSTEM

ICD Number	ICD Title	Hardware Involved (From)	Hardware Involved (To)

3.2.5 Special Stowage (Refrigerator, Freezer)

Table 3.2.5 is to be used when hardware or samples require temperature controlled transportation in an incubated or chilled state, cold storage once generated on board, return from space in a temperature controlled (incubated, refrigerated or frozen) state, or when more than one party may require the use of a refrigerator or freezer. In these tables the investigator shall identify those items which are planned to be stowed (even temporarily) in the refrigerator or freezer. Knowledge of the contents of a refrigerator or freezer will help with resource and contingency planning. Do not indicate removal and restowage of an item if it occurs within a single session.

Mission total cold stowage volume in cm^3 for the ascent and descent phases, as well as the maximum cold stowage volume in cm^3 required for the experiment, will be calculated by NASA based on the requirements presented in these forms.

Launch capabilities, although not presently set for any mission, may be limited to a liquid nitrogen dewar, and/or a middeck refrigerator/freezer unit with the range of ambient down to -25 degrees Celsius. Liquid nitrogen dewars have a useful life of two weeks. On orbit cold stowage capability will be provided by the Minus Eighty Laboratory Freezer for ISS (MELFI), which will be composed of four (4) dewars configurable to any temperature down to -80 degrees Celsius. Dewars can be removed for return to Earth. The total cold volume of each unit is provided by four identical Dewars that can be controlled by modulating the cold gas supply.

TABLE 3.2.5. TEMPERATURE CONTROLLED STOWAGE

Hardware Name	Part No.	Qty.	Mass	Dimensions L	W	H	D	Session/Time Stowed	Session/Time Removed	Pref. Temp./ Tolerance	Sec. Temp or Range	Comments
N/A												

Definitions applicable to stowage hardware are as follows:

Hardware Name/Part No. - Identify the equipment that requires temperature control, e.g., 7 ml blood tubes
Quantity - either a finite number or subject dependent, e.g., 3/subject
Mass/Dimensions - the stowage kit mass and outside dimensions should be identified. Mass should be identified in Kg. Dimensions (length, width and height, or height and diameter) should be expressed in centimeters
Session/Time Stowed/Removed - for an item that is stored in a temperature controlled environment on-orbit, enter session no. and/or timeframe when stowed and/or when removed, if applicable.
Preferred Temperature/Tolerance - optimal temperature at which sample should be stored
Secondary Temperature or Range - temperature at which sample can be stored without measurable science loss
Comments - provide any additional information which may serve to further define temperature controlled storage requirements, e.g., investigator-provided incubator.

3.2.6 Trash Stowage

In Table 3.2.6, the investigator shall identify the total volume of wet, dry, radioactive and/or toxic chemical trash (cm^3) that is generated by the experiment and needs to be stowed in the Space Station and/or Space Shuttle.

It is recognized that the trash volume is often difficult to estimate early in experiment development. Nevertheless it is important for planning, and NASA will provide assistance for early estimates when required. Improved estimates of the trash volume will be determined during ground testing or training.

TABLE 3.2.6. TRASH STOWAGE

Approximate Volume of Trash generated by experiment:						
Trash Element	**Dry Volume (cm^3)**	**Wet Volume (cm^3)**	**Biohazard Volume (cm^3)**	**Radioactive Volume (cm^3)**	**Toxic Volume (cm^3)**	**Desire Return?**
N/A						
TOTAL (cm^3)						

Definitions applicable to trash stowage hardware are as follows:

Trash Element. - Identify the trash component that will not be returned to its stowage locker or be consumed.

Dry Volume - identify the volume of trash that is predominantly composed of dry products or does not fall under any of the following special groups, e.g., wrappers, papers, etc.

Wet Volume - identify the volume of trash that may have moist component, i.e., alcohol wipes, electrode gel, etc.

Biohazard Volume - identify the volume of trash that may have blood, saliva, or urine components

Radioactive Volume - identify the volume of trash that may have radioactive component. If component is wet, dry, or biohazardous and is also radioactive, include the volume in this column.

Toxic Volume - identify the volume of trash that may have toxic components.

Desire return - identify if the trash element should be returned to PI. If not identified, trash will be disposed of at landing site.

3.2.7 Limited-Life and Late Load/Early Access Items Lists

3.2.7.1 Limited Life Items

The limited-life items list for the experiment flight items is shown on Table 3.2.7.1. The limited-life list shall identify and document time/cycle restricted items, age-controlled items, and related requirements for the purpose of inspection, maintenance, and replacement of these items. Requirements for limited-life items can be found in GFE Limited Cycle Time/Age Life Item Requirements, JSC-17057.

TABLE 3.2.7.1. LIMITED-LIFE ITEMS REQUIREMENTS LIST

Hardware Name	Part No.	Qty.	Shelf Life	When Used Inflight	Comments
N/A					

Definitions applicable to stowage hardware are as follows:
Hardware Name/Part No. - identify the equipment that has a limited life.
Qty - identify the quantity of any listed item that is affected by a limited life.
Shelf Life - identify the component in the hardware item that will limit the life of that item, and the expected life of that component.
When Used Inflight - identify when the hardware item is anticipated to be used inflight
Comments - any additional clarifying remarks.

3.2.7.2 Late Load/Early Access Items

Certain items may require loading on the launch vehicle within two and a half weeks of launch or may need removal from the landing vehicle within twenty-four hours of landing. The late load/early access list shall identify and document these items in Table 3.2.7.2.

TABLE 3.2.7.2. LATE LOAD/EARLY ACCESS REQUIREMENTS LIST

Hardware Name	Part No.	Qty.	Access Concern	Required Vehicle Access Time	Comments
N/A					

Definitions applicable to stowage hardware are as follows:
Hardware Name/Part No. - identify the equipment that requires late load or early access.
Qty - identify the quantity of any listed item that is affected by these requirements.
Access Concern - identify the component in the hardware item that will limit the life of that item and the expected life of that component.
Required Vehicle Access Time . - identify when the launch or landing vehicle will need to be accessed to install/retrieve hardware item

Comments - any additional clarifying remarks.

3.2.8 Photo/Video Requirements

The following section provides a synopsis of imagery requirements for the experiment's inflight sessions.

TABLE 3.2.8. PHOTO/ TV REQUIREMENTS

35mm Still Camera	Description of Field of View/Views	Number of Exposures		Number of Sessions	Special Handling
E085-xB	B&W and color photos suitable for journal article methods section use showing subject and experiment equipment in erect and supine configurations	6		1	
E085-xI	Color photos suitable for journal article methods section use showing typical subject and experiment equipment in free floating and restrained configurations	6		1	
E085-xR	B&W and color photos suitable for journal article methods section use showing subject and experiment equipment in erect and supine configurations	6		1	
Electronic Still Camera	**Description of Field of View/Views**	**Number of Exposures**		**Number of Sessions**	**Downlink RT/NRT/P**
E085-xI	Color hi res E--photos suitable for PAO, briefings, or journal article methods section use showing typical subject and experiment equipment in free floating and restrained configurations	6		1	NR
Video	**Description of Field of View/Views**	**Audio Y/N?**	**Video Length (min.)**	**Number of Sessions**	**Downlink RT/NRT/P**
E085-xI	Wide angle lens view of Workstation, tracker and subject's entire body in nominal position. Tape entire session, not just trials. Important: leave camera mike active for time synch of video and experiment audio)	Yes	Up to 60 min	all	NR (to verify whether subject doing experiment correctly),

Definitions for the table entries are provided below:

<u>35 mm Still Camera; Electronic Still Camera; Video</u> - select one or more imagery formats by listing session ID where this format is required.
<u>Description of Field of View/Views</u> - describe the image(s) required; also, under Video, indicate the need (Y/N) for audio.
<u>Number of Exposures</u> - identify the number of photo exposures requested.
<u>Length in Minutes</u> - identify the video minutes requested.
<u>Number of Sessions</u> - indicate the number of imagery collection sessions.
<u>Special Handling</u> - describe any requirements for special post-mission processing of imagery.
<u>Downlink RT/NRT/P</u> - identify downlink requirements such as real time (RT), near real-time (NRT), or postflight (P).

Experiment No. E085/507
Date: 04/19/00

Experiment No. E085/507
Date: 04/19/00

4.0 FLIGHT EXPERIMENT EQUIPMENT PERFORMANCE REQUIREMENTS

Each experiment measurement will be made by a component of the equipment complement of that experiment. To compare the measurements required, and therefore the requirements of the hardware items, to the capabilities of those pieces of hardware, the following table shall be filled out by the NASA team members. **NO PI INPUT IS REQUIRED FOR THIS TABLE.** An entry will be made in this table for each functional requirement (measurement) proposed in Table 3.2.X and related to the performance characteristic of the applicable Hardware Requirements Document (HRD) or equivalent document. If a requirement is not met by a piece of hardware, the characteristic number will be listed and a note added that the required characteristic was not met. Any additional remarks may be made under the comments section.

TABLE 4.1. FUNCTIONAL AND PERFORMANCE REQUIREMENTS MATRIX

Measurement Name	Range	Accuracy	Assoc. Hardware Item	Part No.	Hardware Doc. No.	Spec. Performance Characteristic No.	Performance Req. Maturity

Hardware Document No.	Document Title	Comments

Experiment No. E085/507
Date: 04/19/00

5.0 CREW SELECTION AND PROFICIENCY REQUIREMENTS

In this section, the investigator shall define the payload crew selection, skill and proficiency requirements for the experiment. In the following section, individual experiment training requirements will be identified. The NASA Training Coordinator will use this data to create an integrated training program.

5.1 SUBJECT SELECTION

Using Table 5.1, provide the following information to define the subject selection requirements:

***TABLE 5.1. SUBJECT SELECTION REQUIREMENTS**

Human Subjects Required? (Y/N)	Y	**No. of Subjects Required**	6		
Gender Requirements? (Y/N)	N*	**No. of Males**	3 desired	**No. of Females**	3 desired
Scientific Rationale for Gender Req.	*Approximately equal representation of male and female subjects is desirable.				
Physical Selection Requirement? (Y/N)	Y				
Selection Requirement for Physical Req.	Corrected near visual acuity 20/20. Normal binocular color stereoptic vision, visual fields (<15 deg. contraction), accommodation, normal equilibrium (Normal Equitest dynamic posturography or Normal ANSI S3.45-1999 Basic Vestibular Function caloric and positional tests). NASA Astronaut physical exam waivers for: abnormal oculomotor, vestibular, or visual function or positive history of clinical vertigo or abnormal vestibular function possibly disqualifying; review with PI.				
Scientific Rationale for Physical Req.	Impaired visual function prevents performance of experiment; impaired oculomotor or vestibular function compromises scientific interpretation. It is possible to wear spectacles with HMD.				

Definitions to be used in completing Table 5.1 are as follows:
Human Subjects Required - indicate if human subjects are required (Y/N)
No. of Subjects Required - indicate the number of subjects required for generation of statistical significance
Gender requirements, No. of Males/Females - indicate if a gender requirement is present (Y/N), or if a Gender type (M/F) breakdown is required of the study subjects
Scientific Rationale - if a gender requirement or gender breakdown exists, state the rationale for requirement

Physical Selection Requirements - indicate whether there are any mandatory physical requirements for selection (Y/N). These should include any health or habit constraints (e.g., smoking history, pre-menopausal, etc.) and are described in detail under Selection Requirements.
Scientific Rationale - provide the scientific rationale for the physical requirements

5.2 CREW SKILL REQUIREMENTS

In Table 5.2, the investigator shall define the crew skill requirements.

If the experiment can be performed by any crewmember regardless of background, indicate yes (Y) on Table 5.2. If not, indicate no (N), describe the background requirements, and give the rationale for the requirements.

TABLE 5.2. CREW SKILL REQUIREMENTS

Can experiment be performed by any crewmember, regardless of background, if trained adequately? (Y/N)	Y
If experiment must be performed by a crewmember with a specific disciplinary background, what is the background and the rationale for this requirement?	
N/A	

5.3 CREW SKILL PROFICIENCY

Table 5.3 defines the requirements for assessing crew proficiency. This Table will describe the criteria which will be used by the investigator to determine that a satisfactory proficiency level has been reached by each trained crewmember.

TABLE 5.3. CREW SKILL PROFICIENCY

Objective:	**Proficiency Criteria:**
1. Understand experiment goals and vocabulary and give informed consent	Attend science and informed consent briefings.
2. Be able to deploy and stow equipment.	5 minute set up in ISS simulator. Demonstrate familiarity with equipment and stowage.
3. Be able to operate experiment unassisted (nominal procedures).	TBD. (Our goal is to embed experiment science overview, procedures reviews and help functions, and cue cards in the E085/E507 session manager and experiment manager software which will minimize training requirements. In many procedures, Subject's response consistency is measured and must meet criterion in order to proceed.)

Definitions to be used in completing Table 5.3 are as follows:

Objective - identify all measurable skills on which crewmember will be judged; e.g., dissection of certain animal part, etc.

Proficiency Criteria - identify the aspects of the respective skill that will be criteria for assessing proficiency; e.g., dissection within a certain time limit, etc.

6.0 TRAINING REQUIREMENTS

In this section, the Principal Investigator shall define the training requirements for the experiment. Crew time, whether preflight, inflight, or postflight, is a limited resource, and it must be managed efficiently to achieve effective results. Therefore, the Training Coordinator will combine individual experiment and hardware training requirements to create an integrated HRF training program. The HRF requirements, along with International Partner, shuttle, systems and assembly requirements, will be integrated by NASA into the overall ISS crew training program. Training for an ISS assembly flight is projected to be 2.5 years. Experiment training is anticipated to begin 18 months prior to flight.

For ISS experiment training, see the HRF Training Support Guide (HRF-TRG-04) for additional information about the training process, lesson plan and courseware development, material translation and interpreters, instructor and ground support personnel training, standards for computer-based training tools, hardware, process for bringing training hardware to JSC, and procedures development.

6.1 PI PARTICIPATION

The Principal Investigator is expected to be the primary trainer for the experiment. Each PI Team, together with the HRF training team and in coordination with the Experiment Support Scientist (ESS), is responsible for preparing crewmembers to perform scientific research aboard ISS and to return usable data. In order to efficiently and effectively utilize this resource, training sessions must be well planned and prepared. Successful completion of a dry run of each crew training session will be required to be executed and reviewed prior to training with the actual crew. PI participation is necessary in the following areas:

Training Development

- Provide all training requirements for crew and ground support personnel.
- Develop training hardware and software of sufficient fidelity and quantity to effectively train crews.
- Hardware must meet all quality and safety prerequisites and have accompanying documentation prior to start of training session dry runs.
- For ISS, software must interface with HRF Common Software. A ‘Usability” test will be conducted with mission management prior to training.
- Identify all support or interfacing hardware and software, including power sources and/or converters, cables, and stowed items necessary to conduct training.
- Submit appropriate human use protocols via the ESM and Increment Scientist to the Institutional Review Board (IRB) and receive approval to proceed with training.
  NOTE: Training sessions involving humans as subjects cannot be scheduled without IRB approval. This is mandatory (see section 11.2.1).
- Provide procedures or procedural inputs 90 days prior to the first training session. See HRF Training Support Guide for details.

Courseware Development (For ISS, see the HRF Training Support Guide for further details)

- Develop individual session lesson plans based on a provided format.
- Prepare presentation material for crew and ground support personnel.
- Support the development of additional courseware.

- Support the development of computer-based training (CBT) tools.
- Provide timely review of courseware, including procedures to maintain accuracy of information.

Training Implementation

- Work with the experiment support and training teams to resolve logistical, scheduling, session content, or other issues that may arise during training preparation or implementation.
- Provide support to Training/Test Readiness Reviews (TRRs).
- Provide certified instructors to train crews and ground support personnel as required.
- Provide experiment unique equipment (EUE) training hardware/software.
- Provide training feedback on crew proficiency.
- Certify crewmember's readiness for inflight operations (see section 11.2.7).

NOTE: A Test Readiness Review must be performed before any "human-in-the-loop" activity may occur. For NASA-sponsored experiments, this requirement is levied on the PI for any testing that occurs, whether at JSC or another site. For information on requirements for a TRR, see Use of Human Subjects in Hardware Development (LS-10133-8) and Test Readiness Review (NT2-QAS-027).

6.2 TRAINING REQUIREMENTS SUMMARY

The training required for this experiment shall be summarized in Table 6.2. In this table, a session is defined to be a more-or-less continuous time period during which one or more crewmembers is involved in training.

Table 6.2 assumes that there could be more than one different kind of training session. It is assumed that training will be required for any experiment with crew involvement.

TABLE 6.2. TRAINING SUMMARY

Training Session ID:	Session Type	Session Title	Timeframe	Session Duration	Repetitions Required
085-1	Science	Science & Hardware Overview/ Informed Consent briefing	L-18 months	2 hours	1
085-2	CBT	Intro to Experiment Procedures Laptop CBT	L-18	1 hour	1
085-3	Nominal/Hardware	Stow/Unstow/Tracker Calibration Training	Complete before L-120 BDC	1 hour	1
085-4	Nominal	Experiment Nominal Procedures Training Visual Perception	Complete before L-120 BDC	2 hours	1
507-5	Nominal	Experiment Nominal Procedures Training Visuomotor Coordination	Complete before L-120 BDC	2 hours	1
085-6	Nominal	Nominal Procedures Practice Inflight Sessions A & B	Complete before L-120 BDC	3 hours	1 or more if launch delay
507-7	Nominal	Visuomotor Procedures Practice	Complete before L-120 BDC	2 hours	1 or more if launch delay
085-8	CBT/Proficiency	Experiment Procedures Review Laptop CBT	L-1 month	1 hour	1 or more if launch delay

Using Table 6.2, the investigator shall summarize the training required for this experiment.

Training Session ID - provide session identifier numbers by using the last three digits of the assigned experiment number followed by sequential numbers of each of the different training sessions. Number the sessions consecutively (1,2,3,...) if more than one session.
Session Type - select session type from the list below.
Timeframe - provide the timeframe when training should start.
Session Title - Provide a descriptive title for each session. Indicate number of separately scheduled repetitions for each session.
Session Duration - provide the length of each session in hours.
Repetitions Required - provide the number of sessions needed, from the first training session through launch, to be proficient at this session's objectives.

Training Session Types

- Science, Hardware, Operations Overview - Generally the first payload or experiment training session with crewmembers. This session familiarizes the crew with the payload or experiment scenario from beginning to end. It covers science objectives, hardware and hardware operations, sample or data collection taken preflight, inflight and postflight, inflight crew operations, science or session constraints, and examples of previous flight results. Hardware operations may be demonstrated, but the crewmember is not expected to perform any operations.

- Nominal Training - The crewmember is taught specific skills or hardware/software operations required to perform the experiment. Training focuses on a crewmember's "hands-on" interaction with hardware/software. The crewmember has obtained proficiency when he/she can gather the requested data samples. Nominal training includes experiment set-up, take-down, data gathering, and planned inflight maintenance.
- Off-nominal Training - Only those malfunctions which have a high likelihood of occurring are trained.
- Proficiency Training - Training for crewmembers who have already achieved competency in a task but require some ongoing training to maintain that competency. Proficiency training may have currency requirements which require additional training at prescribed intervals to maintain current skill or knowledge.
- CBT - computer-based training
- Other - Describe any training which does not fit into one of the categories above.

6.3 REQUIREMENTS DEFINITION

Using Table 6.3-X, provide the information and identify requirements for this experiment's training sessions. Complete a copy of Table 6.3-1 for each separate training session identified in Table 6.2.

TABLE 6.3-1. TRAINING SESSION DESCRIPTION

Session ID:	085-1	**Session Type**	Science				
Session Title	Science & Hardware Overview/ Informed Consent briefing						
PI Training Point-of-Contact:	**CM Oman,** Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu **J McIntyre,** LPPA/CNRS – College de France, 11 place Marcelin Berthelot, 75005 Paris, France, Tel: +33 1 44 27 14 31, Fax: +33 1 44 27 13 82, jam@ccr.jussieu.fr						
Trainee							
Subject	X	**Operator**		**GSP**			
Surrogate Subjects required							
Session Timeline:							
	Location:	JSC					
	Currency requirement:	Three years					
Length of Session and Timeframe:							
L-18 to L-12 months (hours of training)	**L-12 to L-6 months (hours of training)**	**L-6 to L-3 months (hours of training)**	**On-orbit Training (hours)**				
2							
Prerequisites:	None						
Session Synopsis	Introduction to experiment science and demo of hardware and procedures. Informed consent briefing. Tabletop environment.						
Session Objectives	Science & Hardware Overview/ Informed Consent briefing						
Courseware:							
E085/507 CBT furnished by PI to take home after session.							
Photo/Video Requirements							
None							
Training Hardware Requirements							
Hardware Name	**Part No.**	**H/W Provider**	**Qty**	**Avg. Pwr (W)**	**Peak Pwr (W)**	**Power Source**	**Fidelity**
HRF Workstation 2							
085 training or protoflight EUE (HMD, tracker, SID, SRS, etc.)							
Support Equipment Requirements							
Overhead Projector	Y	**Slide Projector**	N				
Videocassette Player	Y	**TV**	Y				
Other	Crew laptops for CBT						

Instructions for the table entries are provided below:

Session ID - provide session identifier numbers by using the last three digits of the assigned experiment number followed by sequential numbers of each of the different training sessions.

Session Type - identify the type of training session from the list following Table 6.2

Session Title - provide each training session a descriptive title such as "Ultrasound Imaging" or "Blood Draws and Processing"

PI Training Point-of-Contact - provide the name of the PI's training point-of-contact, telephone number, fax number, mailing address, and e-mail address.

Trainee - identify the number of subject(s) and/or operator(s) required for this session. Use "0" if not applicable. Indicate with Y or N in the GSP box if this session is intended for ground support personnel.

Surrogate subjects required - if surrogates are required to serve as subjects, identify the number need; otherwise, indicate N/A.

Location - the location of training should be assumed to be in the U.S. at a JSC facility or, possibly, at an investigator site.

Currency Requirements - frequency of sessions to obtain and/or maintain proficiency. Define the maximum time span between training sessions or between training and operations; e.g., if the maximum time span for a crewmember to maintain currency or be competent on a skill is 5 months, then this crewmember should receive proficiency training every 5 months and within 5 months of its projected performance inflight.

Length of Session and Timeframe - it should be assumed that crew training will only take place in the U.S. Generally, all payload training must be started by L-12 months, with the L-12 to L-6 months timeframe being used for refresher and proficiency training. Fill in the number of sessions to be provided to the crew during each timeframe with the session length; e.g., four 2 hour sessions.

Prerequisites - identify any training the trainee should have completed prior to this session; e.g., HRF rack activation, 35 mm camera operations, web-based lesson review.

Session Synopsis - define in a paragraph, outline, or bullet format the events that will take place during this session. Be specific; do not summarize.

Session Objective - define the objectives of the training sessions in terms of tasks or skills the crewmember must be capable of accomplishing by completion of the session. An example of an objective is, "the crewmember will be able to power the GASMAP and verify that power-up has been successfully accomplished." or, "the crewmember will be able to perform vacuum and tank pressure checks."

Courseware - identify any courseware to be used such as videos, viewgraphs, etc.

Photo/Video Requirements - if photo or video is to be an integral part of the experiment, e.g., as a data product or of a required documentary value, identify any photo/video requirements including the type of camera and the scene objective.

Training Hardware Requirements (HRF and ISS-Provided) - identify any training hardware, with part number and quantities if available, that will either be provided by the PI or must be provided by either the HRF training facility or the ISS Program. Identify all hardware down to the level of cables, power supplies, tubes, culture dishes, bags, gloves, etc. A list of HRF-provided hardware can be found at http://lslife.jsc.nasa.gov/hardware/front.html. Further help on HRF and ISS hardware can be obtained through experiment support team members. Provide power details where applicable.

Power Source - identify power supplies of the rack are required or AC power will need to be made available.

Fidelity - define the fidelity of the hardware as commercial off-the-shelf (COTS), prototype, ground unit, qual unit, or flight unit (see definitions below).

- COTS is commercial off-the-shelf equipment.
- Prototype is the first unit of a particular hardware item to be built.
- Ground unit is the version used to verify the design of the hardware.

- Qual unit is a flight unit used for testing and verifying the equipment's functionality; once used for this purpose, it is normally not used for flight.
- Flight unit is the equipment which is certified for flight.

Support Equipment Requirements - check the appropriate box for support equipment and/or identify other equipment needed; e.g., overhead projector, slide projector, videocassette player, TV, other (please specify)

Experiment No. E085/507
Date: 04/19/00

TABLE 6.3-2. TRAINING SESSION DESCRIPTION

<table>
<tr><td colspan="2">Session ID:</td><td colspan="2">085-2</td><td>Session Type</td><td colspan="3">Science</td></tr>
<tr><td>Session Title</td><td colspan="7">Intro to Experiment Procedures Laptop CBT</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="2">PI Training Point-of-Contact:</td><td colspan="6">CM Oman, Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu</td></tr>
<tr><td colspan="8">Trainee</td></tr>
<tr><td>Subject</td><td>X</td><td>Operator</td><td></td><td>GSP</td><td colspan="3"></td></tr>
<tr><td colspan="2">Surrogate Subjects required</td><td colspan="6"></td></tr>
<tr><td colspan="8">Session Timeline:</td></tr>
<tr><td></td><td colspan="2">Location:</td><td colspan="5">On their own</td></tr>
<tr><td></td><td colspan="2">Currency requirement:</td><td colspan="5">Three years</td></tr>
<tr><td colspan="8">Length of Session and Timeframe:</td></tr>
<tr><td colspan="2">L-18 to L-12 months
(hours of training)</td><td colspan="2">L-12 to L-6 months
(hours of training)</td><td colspan="2">L-6 to L-3 months
(hours of training)</td><td colspan="2">On-orbit Training
(hours)</td></tr>
<tr><td colspan="2">1</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="2">Prerequisites:</td><td colspan="6">085-1</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="2">Session Synopsis</td><td colspan="6">CBT introduction to experiment science and demo of hardware and procedures. Nominal and malf flight procedures in .pdf electronic format</td></tr>
<tr><td colspan="2">Session Objectives</td><td colspan="6">Science & Hardware Overview</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Courseware:</td></tr>
<tr><td colspan="8">E085/507 CBT furnished by PI to take home after session.</td></tr>
<tr><td colspan="8">Photo/Video Requirements</td></tr>
<tr><td colspan="8">None</td></tr>
<tr><td colspan="8">Training Hardware Requirements</td></tr>
<tr><td>Hardware Name</td><td>Part No.</td><td>H/W Provider</td><td>Qty</td><td>Avg. Pwr (W)</td><td>Peak Pwr (W)</td><td>Power Source</td><td>Fidelity</td></tr>
<tr><td>Crew Wintel Laptop (Pentium/W98 or equivalent) with CD ROM drive</td><td></td><td>PI</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Support Equipment Requirements</td></tr>
<tr><td>Overhead Projector</td><td></td><td colspan="2">Slide Projector</td><td colspan="4"></td></tr>
<tr><td>Videocassette Player</td><td></td><td colspan="2">TV</td><td colspan="4"></td></tr>
<tr><td>Other</td><td></td><td colspan="2"></td><td colspan="4"></td></tr>
</table>

TABLE 6.3-3. TRAINING SESSION DESCRIPTION

Session ID:	085-3	**Session Type**	Nominal Hardware				
Session Title	Stow/Unstow/Tracker Calibration Training						
PI Training Point-of-Contact:	**CM Oman,** Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu						
Trainee							
Subject	X	**Operator**		**GSP**			
Surrogate Subjects required							
Session Timeline:							
	Location:	JSC					
	Currency requirement:	Three years					
Length of Session and Timeframe:							
L-18 to L-12 months (hours of training)	**L-12 to L-6 months (hours of training)**	**L-6 to L-3 months (hours of training)**	**On-orbit Training (hours)**				
	1 hour						
Prerequisites:	085-1 to 2, Workstation/Commo n SW training						
Session Synopsis	Conducted in ISS module trainer with HRF Workstation, EUE, and stowage. Practice rapidly deploying experiment, configuring and testing tracker, SRS and tethers, and stowing the experiment.						
Session Objectives	Demonstrate proficiency						
Courseware:							
Photo/Video Requirements							
Video of each crewmember successfully performing procedure in nominal time (for PI and for crew for procedures review)							
Training Hardware Requirements							
Hardware Name	**Part No.**	**H/W Provider**	**Qty**	**Avg. Pwr (W)**	**Peak Pwr (W)**	**Power Source**	**Fidelity**
HRF Workstation 2							
E085/507 EUE							
E085/507 stowage							
Support Equipment Requirements							
Overhead Projector	TBD	**Slide Projector**	TBD				
Videocassette Player	TBD	**TV**	TBD				
Other							

TABLE 6.3-4. TRAINING SESSION DESCRIPTION

Session ID:	**085-4**	**Session Type**	**Nominal**
Session Title	Experiment Nominal Procedures Training – Visual Perception		
PI Training Point-of-Contact:	**CM Oman,** Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu		
Trainee			
Subject X	**Operator**	**GSP**	
Surrogate Subjects required			
Session Timeline:			
Location:	JSC		
Currency requirement:	Three years		
Length of Session and Timeframe:			
L-18 to L-12 months (hours of training)	**L-12 to L-6 months (hours of training)**	**L-6 to L-3 months (hours of training)**	**On-orbit Training (hours)**
	2 hours		
Prerequisites:	085-1 to 3, Workstation/Common SW training		
Session Synopsis	Conducted in ISS module trainer with HRF Workstation, EUE, and stowage. Practice with Common Software, Session and Experiment Managers; starting and ending each procedure. OK to skip over repetitive multiple trials. Practice voice and keyboard annotation and downlink.		
Session Objectives	Demonstrate proficiency		
Courseware:			
Photo/Video Requirements			
Simlulate SRS tether use and free floating operations.			

TABLE 6.3-4. TRAINING SESSION DESCRIPTION

Training Hardware Requirements							
Hardware Name	**Part No.**	**H/W Provider**	**Qty**	**Avg. Pwr (W)**	**Peak Pwr (W)**	**Power Source**	**Fidelity**
HRF Workstation 2							
E085/507 EUE							
E085/507 stowage							

Support Equipment Requirements			
Overhead Projector	TBD	**Slide Projector**	TBD
Videocassette Player	TBD	**TV**	TBD
Other			

Experiment No. E085/507
Date: 04/19/00

TABLE 6.3-5. TRAINING SESSION DESCRIPTION

Session ID:	**507-5**	**Session Type**	**Nominal**
Session Title	Experiment Nominal Procedures Training – Visuomotor Coordination		
PI Training Point-of-Contact:	**J McIntyre,** LPPA/CNRS – College de France, 11 place Marcelin Berthelot, 75005 Paris, France, Tel: +33 1 44 27 14 31, Fax: +33 1 44 27 13 82, jam@ccr.jussieu.fr		

Trainee					
Subject	X	**Operator**		**GSP**	
Surrogate Subjects required					

Session Timeline:	
Location:	JSC
Currency requirement:	Three years

Length of Session and Timeframe:

L-18 to L-12 months (hours of training)	L-12 to L-6 months (hours of training)	L-6 to L-3 months (hours of training)	On-orbit Training (hours)
	2 hours		

Prerequisites:	085-1 to 3, Workstation/Common SW training
Session Synopsis	Conducted in ISS module trainer with HRF Workstation, EUE, and stowage. Practice with Common Software, Session and Experiment Managers; starting and ending each procedure. OK to skip over repetitive multiple trials. Practice voice and keyboard annotation and downlink.
Session Objectives	Demonstrate proficiency
Courseware:	
Photo/Video Requirements	
Simlulate SRS tether use and free floating operations.	

Training Hardware Requirements

Hardware Name	Part No.	H/W Provider	Qty	Avg. Pwr (W)	Peak Pwr (W)	Power Source	Fidelity
HRF Workstation 2							
E085/507 EUE							
E085/507 stowage							

Support Equipment Requirements

Overhead Projector	TBD	**Slide Projector**	TBD
Videocassette Player	TBD	**TV**	TBD
Other			

TABLE 6.3-6. TRAINING SESSION DESCRIPTION

<table>
<tr><td>Session ID:</td><td colspan="2">085-6</td><td>Session Type</td><td colspan="4">Nominal</td></tr>
<tr><td>Session Title</td><td colspan="7">Nominal Procedures Practice Inflight Sessions A & B</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>PI Training Point-of-Contact:</td><td colspan="7">CM Oman, Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu</td></tr>
<tr><td colspan="8">Trainee</td></tr>
<tr><td>Subject</td><td>X</td><td>Operator</td><td></td><td>GSP</td><td colspan="3"></td></tr>
<tr><td>Surrogate Subjects required</td><td colspan="7"></td></tr>
<tr><td colspan="8">Session Timeline:</td></tr>
<tr><td colspan="2">Location:</td><td colspan="6">JSC</td></tr>
<tr><td colspan="2">Currency requirement:</td><td colspan="6">Three years</td></tr>
<tr><td colspan="8">Length of Session and Timeframe:</td></tr>
<tr><td colspan="2">L-18 to L-12 months (hours of training)</td><td colspan="2">L-12 to L-6 months (hours of training)</td><td colspan="2">L-6 to L-3 months (hours of training)</td><td colspan="2">On-orbit Training (hours)</td></tr>
<tr><td colspan="2"></td><td colspan="2">3 hours</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Prerequisites:</td><td colspan="7">085-1 to 4, Workstation/Common SW training</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Session Synopsis</td><td colspan="7">Conducted in ISS module trainer with HRF Workstation, EUE, and stowage. Practice performing the full experiment with all trials. Data collected, practice voice and keyboard annotation and downlink.</td></tr>
<tr><td>Session Objectives</td><td colspan="7">Demonstrate proficiency</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Courseware:</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Photo/Video Requirements</td></tr>
<tr><td colspan="8">Surveillance video of each crewmember successfully performing procedure in nominal time (for PI and for crew for procedures review). Simulate SRS tether use and free floating operations.</td></tr>
<tr><td colspan="8">Training Hardware Requirements</td></tr>
<tr><td>Hardware Name</td><td>Part No.</td><td>H/W Provider</td><td>Qty</td><td>Avg. Pwr (W)</td><td>Peak Pwr (W)</td><td>Power Source</td><td>Fidelity</td></tr>
<tr><td>HRF Workstation 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>E085/507 EUE</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>E085/507 stowage</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Support Equipment Requirements</td></tr>
<tr><td colspan="2">Overhead Projector</td><td colspan="2">TBD</td><td colspan="2">Slide Projector</td><td colspan="2">TBD</td></tr>
<tr><td colspan="2">Videocassette Player</td><td colspan="2">TBD</td><td colspan="2">TV</td><td colspan="2">TBD</td></tr>
<tr><td colspan="2">Other</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

TABLE 6.3-7. TRAINING SESSION DESCRIPTION

Session ID:	**507-7**		**Session Type**	**Nominal**			
Session Title	Nominal Procedures Practice Inflight - Visuomotor Coordination						
PI Training Point-of-Contact:	**J McIntyre,** LPPA/CNRS – College de France, 11 place Marcelin Berthelot, 75005 Paris, France, Tel: +33 1 44 27 14 31, Fax: +33 1 44 27 13 82, jam@ccr.jussieu.fr						
Trainee							
Subject	X	**Operator**		**GSP**			
Surrogate Subjects required							
Session Timeline:							
Location:	JSC						
Currency requirement:	Three years						
Length of Session and Timeframe:							
L-18 to L-12 months (hours of training)	**L-12 to L-6 months (hours of training)**	**L-6 to L-3 months (hours of training)**	**On-orbit Training (hours)**				
	2 hours						
Prerequisites:	085-1 to 3; 507-5; Workstation/Common SW training						
Session Synopsis	Conducted in ISS module trainer with HRF Workstation, EUE, and stowage. Practice performing the full experiment with all trials. Data collected, practice voice and keyboard annotation and downlink.						
Session Objectives	Demonstrate proficiency						
Courseware:							
Photo/Video Requirements							
Surveillance video of each crewmember successfully performing procedure in nominal time (for PI and for crew for procedures review). Simulate SRS tether use and free floating operations.							
Training Hardware Requirements							
Hardware Name	**Part No.**	**H/W Provider**	**Qty**	**Avg. Pwr (W)**	**Peak Pwr (W)**	**Power Source**	**Fidelity**
HRF Workstation 2							
E085/507 EUE							
E085/507 stowage							
Support Equipment Requirements							
Overhead Projector	TBD	**Slide Projector**	TBD				
Videocassette Player	TBD	**TV**	TBD				
Other							

Experiment No. E085/507
Date: 04/19/00

TABLE 6.3-8. TRAINING SESSION DESCRIPTION

Session ID:	085-8	**Session Type**	Proficiency				
Session Title	Experiment Procedures Review Laptop CBT						
PI Training Point-of-Contact:	**CM Oman,** Room 37-219, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307, Tel: 617-253-7508, Fax: 617-258-8111, cmo@space.mit.edu						
Trainee							
Subject	X	**Operator**		**GSP**			
Surrogate Subjects required							
Session Timeline:							
Location:	JSC						
Currency requirement:	1 month						
Length of Session and Timeframe:							
L-18 to L-12 months (hours of training)	**L-12 to L-6 months (hours of training)**	**L-6 to L-3 months (hours of training)**	**On-orbit Training (hours)**				
	1 hour						
Prerequisites:	All E085/507 training sessions						
Session Synopsis	PI provided CBT for crew laptop covering experiment procedures and troubleshooting review. For use by crew in final months in US and Russia						
Session Objectives							
Courseware:							
PI provided CBT							
Photo/Video Requirements							
Training Hardware Requirements							
Hardware Name	**Part No.**	**H/W Provider**	**Qty**	**Avg. Pwr (W)**	**Peak Pwr (W)**	**Power Source**	**Fidelity**
HRF Workstation 2							
E085/507 EUE							
E085/507 stowage							
Support Equipment Requirements							
Overhead Projector		**Slide Projector**					
Videocassette Player		**TV**					
Other	Crew Pentium Laptop with CD ROM						

7.0 EXPERIMENT HARDWARE

7.1 STOWAGE LIST

7.1.1 Experiment Unique Equipment

In Table 7.1.1, the PI shall list all Experiment Unique Equipment (EUE) that will be used at any time during the inflight portion of the experiment.

TABLE 7.1.1. EXPERIMENT UNIQUE EQUIPMENT STOWAGE LIST

Hardware Name	Part No.	Qty	Dimensions (cm) L	W	H	D	Volume Each (cm3)	Volume Total (cm3)	Stowed/Rack Mounted	# Trng. Units	# Flt. Units	Provider
HMD		1										
Tracker System & targets		1										
SID		1										
SRS & Tethers		1										
Videotapes for camcorder												

Definitions to be used in completing Table 7.1.1 are as follows:
- Hardware Name - shall be provided by the investigator, and should be the same as that listed in Table 3.2.X
- Part No. - should be provided by the investigator for Investigator-provided hardware, but will be provided by NASA for all other hardware.
- Qty - the quantity of each hardware item required inflight.
- Dimensions - provide dimensions of item using either length by width by height or height by diameter
- Volume Each - product of dimensions
- Total Volume - volume of total quantity of listed item
- Rack Mounted/Stowed - identify if item is rack mounted or stowed hardware.
- # Training Units - the quantity of training units of this item to be built
- # Flight Units - the quantity of flight units of this item to be built
- Provided By - identify provider of listed hardware item (PI, NASA, or international partner). If hardware is provided by NASA, distinguish between LSE (Laboratory Support Equipment) and SSE (Station Support Equipment).

7.1.2 Shared Hardware

In Table 7.1.2 the PI shall list all non-experiment unique hardware that will be used at any time during the inflight portion of the experiment.

TABLE 7.1.2. SHARED HARDWARE STOWAGE LIST

Hardware Name	Part No.	Qty	Dimensions (cm) L	W	H	D	Volume Each (cm3)	Volume Total (cm3)	Stowed/Rack Mounted	# Training Units	# Flight Units	Provider
HRF Workstation 2												
Workstation Monitor												
Workstation Keyboard												
Video Camera												
Bogen brackets for camera, keyboard, and monitor												

Definitions to be used in completing Table 7.1.2 are as follows:

Hardware Name - shall be provided by the investigator, should be the same as that listed in Table 3.2.X.
Part No. - should be provided by the investigator for Investigator-provided hardware, but will be provided by NASA for all other hardware.
Qty - the quantity of each hardware item required inflight.
Dimensions - provide dimensions of item using either length by width by height or height by diameter.
Volume Each - product of dimensions.
Total Volume - volume of total quantity of listed item.
Rack Mounted/Stowed - identify if item is rack mounted or stowed hardware.
Training Units - the quantity of training units of this item to be built.
Flight Units - the quantity of flight units of this item to be built.
Provided By - identify provider of listed hardware item (PI, NASA, or international partner).

7.2 ELECTRICAL

Experiment Unique Equipment Electrical Power

In Table 7.2.1 the investigator shall provide the electrical power requirements for investigator-provided equipment. For ISS, indicate the type of power required; either battery, 120 or 28 VDC. No AC power is available on the International Space Station. For Shuttle operations, 400 Hz AC power is available. Indicate the number of phases to be used; either 1 phase (1Ø) or 3 phase (3Ø).

TABLE 7.2.1. POWER DEMAND CHARACTERISTICS FOR EXPERIMENT UNIQUE EQUIPMENT

Hardware Name	Part No.	Power Type	Mode Name	Peak Power (W)	Avg. Op Power (W)	Cyclic Power Duration Peak Power (DD:HH:MM)	Non-Session Power	
							Power On Time (DD:HH:MM)	Power Off Time (DD:HH:MM)
HRF Workstation								
Tracker Electronics								

Definitions to be used in completing Table 7.2.1 are as follows:
Hardware Name - should be the same as that listed in Table 3.2.X.
Part No. - should be provided by the investigator for Investigator-provided hardware, but will be provided by NASA for all other hardware.
Power Type - indicate the type of power required from the available types listed above.
Mode Name - If an equipment item is operated in multiple ways such that power demand on the vehicle varies between the operational modes by more than 10% (but not less than 10 watts), then it has multiple power modes. The power demand for each of these modes needs to be identified separately. Equipment items whose power demand varies in the same manner each time it is operated would have only a single mode. As an example, if power levels for an equipment item are lower during a standby period than power required for operation by more than 10%, then "standby" is one mode and "operate" is at least one mode. Indicate mode as Essential if vehicle power on a separate bus must be used to insure that power is continuously available to equipment in applications where power loss could create a safety hazard or affect overall mission success.
Peak Power - The maximum power demand on the vehicle from an equipment item. The peak power is used to size circuit protection; therefore, it represents power demand present for a significant time interval (30 seconds or greater), not short duration transients having no effective circuit protection design.
Avg. Op Power - Average Operating Power - A power demand value that represents the average load presented to the vehicle over the time interval being described. An average operating power should be specified for each mode.
Cyclic Power Duration Peak Power - Power demand which increases and decreases in a regular, periodic manner. Time spent at peak power demand. If not applicable, indicate N/A.
Non-Session Power - the investigator shall provide the power requirements for investigator-provided equipment if used outside an experiment session. When reporting non-session power-on times, indicate any modes of operation (i.e., warm-up, operating, standby, etc.) which generate different power levels. If not applicable, indicate N/A.

Experiment power profiles during startup and operation shall be included for illustration purposes using Figure 7.2.2-X. Show any significant transient features not indicated in Table 7.2.1. Provide a power profile for each different session identified in section 3.2 (if there are significant differences). Number the figures 7.2.2-1A, B, C, etc., where X mimics that used in Table 3.2.X.

Figure 7.2.2-1. Experiment Power Profile

Figure Number:	
Session ID(s):	
TBD	

Add notes for major changes in values. All hardware directly involved with the experiment session should be included; however, certain items that may be in use by other teams during session operations, such as rack power, can be ignored.

7.3 VENTING/THERMAL/ FLUIDS

In Table 7.3.1 and 7.3.2, the investigator shall, respectively, define the heat dissipation and venting requirements for investigator-provided equipment.

For each item listed which draws power from the vehicle, indicate the avenue of heat rejection (i.e., rack avionics air, cabin air, or fluid loop) for each power mode of the instrument.

TABLE 7.3.1. EXPERIMENT UNIQUE EQUIPMENT - HEAT DISSIPATION & MPE FLUID LOOP INTERFACES

			Vacuum	Heat Removal (% of Total)				Fluid Loop Interfaces			
Hardware Name	Part No.	Mode Name	Venting Req?	Rack Air	Cabin Air	Fluid Loop	Other	Cooling Load (W)	Flow rate (Kg/Hr)	Pressure (N/m^2)	Max/Min Inlet Temp (^oC)

Definitions applicable to hardware heat dissipation and fluid loop interfaces are as follows:

Hardware Name - shall be provided by the investigator, and will be acquired from Table 3.2.X.
Part No. - should be provided by the investigator for Investigator-provided hardware, but will be provided by NASA for all other hardware.
Mode Name - identify each unique operating mode.
Vacuum Venting Required? - Y/N, if required please complete Table 7.3.2.
Heat Removal - indicate the fraction of heat rejected to each avenue as a percentage of the heat production (under steady state conditions).
Fluid Loop Interfaces - specify the Cooling Load, in watts dissipated by the fluid loop for each power mode. Specify Flow Rate requirements of the fluid loop, in Kg/Hr, to meet the equipment cooling loads. Specify the required Pressure Drop in N/m^2, across the fluid loop, as well as maximum and minimum inlet temperatures in degrees centigrade, to the equipment item under column headed Max/Min Inlet Temp.

TABLE 7.3.2. VENTING

Hardware Name	Part No.	Chamber Volume (L)	Min. Pressure (N/m^2)	Vacuum Vent Rate (TorrLiter/Min.)	Cycle Frequency	Composition

Definitions applicable to hardware venting are as follows:

Hardware Name - shall be provided by the investigator, as listed in Table 3.2.X.
Part No. - should be provided by the investigator for Investigator-provided hardware, but will be provided by NASA for all other hardware.
Chamber Volume - indicate the volume to be evacuated, in liters.
Min. Pressure - indicate the minimum pressure to be maintained on the chamber.
Vacuum Vent Rate - the steady state vacuum vent rate in torr-liter/minute.
Cycle Frequency - number of evacuations required during a given time period.
Composition - the composition of the products to be evacuated and discharged overboard.

8.0 EXPERIMENT UNIQUE SOFTWARE (EUSW)

The purpose of this section is the determine the need for unique software for the inflight portion of the experiment. If such software is required, then certain top-level information is required to be documented. This section will provide guidance and direction to the software developer. The software developer may be the PI, NASA and/or its support contractors, or an International Partner.

***TABLE 8.1. EXPERIMENT UNIQUE SOFTWARE REQUIREMENT**

Inflight EUSW Needed? (Y/N)	Y					
EUSW Developed by?	X	**PI**		**NASA**		**International Partner**

8.1 DEVELOPMENT GUIDELINES AND REQUIREMENTS

For experiments being performed on ISS, HRF has two computer systems available for individual experiment use: the HRF Workstation and the HRF Portable Computer. Both are capable of supporting a variety of operating systems, such as DOS/Windows, UNIX/X-windows, OS/2, and Windows NT. Although the systems can run these operating systems, the HRF baseline operating system is Windows NT only, and the other operating systems may not work with the HRF common software. Both computers will support general experiment use and are capable of accepting EUSW or standard off-the-shelf applications for specific experiment needs; i.e., LabView. Information on these computers, their design, capabilities, specifications, and system upgrades, may be found in the HRF Workstation Interface Definition Document (IDD) (LS-71042-4) and the Portable Computer IDD (LS-71046-1).

The nominal experiment design and inflight operations will most likely favor the installation and operation of the EUSW on one of these computers over the other. However, it is strongly recommended that the software developer, where feasible, allow for interchangeability between the workstation and the portable computer to account for inflight anomalies and work-arounds and to provide maximum operational flexibility.

A software package, known as HRF Common Software, will be loaded on each HRF Workstation and Portable Computer. HRF Common Software serves two major purposes:
1) it provides a common user interface from which the crew can launch individual experiment and equipment software programs; and 2) it allows for data transfer from the workstation/portable computer to the Rack Interface Controller (RIC), which provides the interface to the ISS data downlink capabilities. All EUSW loaded on the HRF Workstation or Portable Computer will interface to some extent with the HRF Common Software. Software developers should refer to the HRF Common Software IDD (LS-71062-8) for further information.

All software developed for use on ISS is intended to possess unified display characteristics or a “common look and feel”. This consistency in display and user interface design is meant to simplify operations for the flight crew. The ISS design approach is documented in the ISS Display and Graphics Commonality Standard (SSP 50313), and the Payload Operations Data File (PODF) Management Plan, Annex 5 (MSFC-PLAN-2885, U.S. PODF Management Plan Annex 5, Payload Display Implementation Plan), and Annex 6 (MSFC-PLAN-2886, U.S. PODF Management Plan Annex 6, Payload Display Developers Guide). The guidelines for the HRF design approach can be found in document LS-71130, Human Research Facility (HRF) Human-Computer Interface (HCI) Design Guide. It is recommended that the EUSW developer become familiar with all of these documents.

All software is required to be reviewed and approved by the Payload Display Review Panel (PDRP) for the display and user interface design and compliance with the documents mentioned above. The PDRP is composed of astronaut office, payload management and human factors representatives; its processes are further explained in the PODF Management Plan Annexes 5 and 6. Experiment development team personnel will work with the EUSW developers early in the software development process to interpret the documents and ensure adherence to them so that any comments or changes the PDRP may impose on the EUSW developer at the formal review will cause minimal impact. It is recommended that the EUSW developer provide hard-copy print-outs of the user interfaces and screen displays to the experiment team as early in the design process as possible for review and comparison against the ISS and HCI design standards. Software must be reviewed and approved by the PDRP before crew training can be scheduled and conducted.

The following documentation must be provided for all EUSW:

- Software Requirements Document (only if NASA is developing the EUSW for the PI)
- Experiment Software Document
- Software Operational and Acceptance Test Plans and Procedures
- Software Operational and Acceptance Test Reports
- Version Description Document
- Interface Control Document
- Operator and User's Guide

Templates, or versions, of these documents will be provided to the PI team by the EST.

In addition, the software developer must provide a full demonstration of the EUSW to a designated government representative prior to delivery of each version of the software.

Finally, if the software developer needs additional guidance on software design approaches, documentation, or configuration control mechanisms, whether for an HRF/ISS on Shuttle experiment, they may refer to document LS-71020, Software Development Plan for the Human Research Facility (HRF). The content requirements for a Software Requirements Document are also provided in this document.

8.2 DEFINITION OF REQUIRED FLIGHT EXPERIMENT UNIQUE SOFTWARE

The purpose of this section is to define the EUSW required for inflight activities. This table should be repeated as necessary to encompass each EUSW module. Each table should be uniquely numbered and related to a session identifier from the tables in section 3.2.

TABLE 8.2-1. EXPERIMENT UNIQUE SOFTWARE MODULE TABLE

EUSW Module Name:		E085 CBT on CD-ROM		**Module No.**	
Related Session ID:		Training sessions 085-2, -8			
Installed on:	**Laptop**	x	**Workstation**		
EUSW Module Description:					
Used in Training Sessions 085-2, -8					
Major Hardware Items Controlled/Operated by EUSW:					
Hardware Name			**Part No.**		
COTS software required		TBD, probably Windows98 + Quicktime 4 + Acrobat Reader 4.0 + Web Browser (IE or Navigator)			

EUSW Module Name:		Session Manager		**Module No.**	
Related Session ID:		All inflight and most preflight			
Installed on:	**Laptop**		**Workstation**	x	
EUSW Module Description:					
Called from common software. Schedules tasks in this session, based on subject ID and session info. Calls Experiment Manager. Context sensitive help and troubleshooting functions available.					
Major Hardware Items Controlled/Operated by EUSW:					

TABLE 8.2-1. EXPERIMENT UNIQUE SOFTWARE MODULE TABLE (Cont'd)

Hardware Name	**Part No.**
HRF Workstation 2	
COTS software required	TBD, probably Windows NT

EUSW Module Name:	E085/507 Experiment Manager		**Module No.**		
Related Session ID:	All inflight and most preflight				
Installed on:	**Laptop**		**Workstation**	x	
EUSW Module Description:					
Runs individual VR experiment protocols using parameters provided by Session Manager. Pipes data to Data Manager for storage. Written in VRUT/Python/C++/OpenGL					
Major Hardware Items Controlled/Operated by EUSW:					
Hardware Name	**Part No.**				
HRF Workstation 2					
COTS software required	Python				

EUSW Module Name:	E085/507 Data Manager		**Module No.**		
Related Session ID:	All inflight and most preflight				
Installed on:	**Laptop**		**Workstation**	x	
EUSW Module Description:					
Stores data during experiment and schedules downlink by common software.					
Major Hardware Items Controlled/Operated by EUSW:					
Hardware Name	**Part No.**				
HRF Workstation 2					
COTS software required					

Definitions applicable to software modules are as follows:

EUSW Module Name - A software module refers to a separate and unique software protocol/category/etc. As an exa mple, Autonomic Early Mission Protocol, Autonomic Mid Mission Protocol, etc.

Related Session ID - the session identifier used in Table 3.2.X.

EUSW Module Description - This should be a short description of the purpose, function, etc. of the module.

Hardware Name/Part No. - Identify the equipment that requires a software interface or operation.

COTS software required - identify the manufacturer, name and version for the commercial off the shelf software required for EUSW operation.

9.0 JSC, KSC GROUND PROCESSING

This section defines the normal series of tests, activities, and supporting facilities that: (1) assure that the experiment hardware performs properly and meets its science objectives as part of an integrated payload, (2) integrate the experiment hardware into the launch configuration at KSC, and (3) provide for the removal of the hardware and any experiment samples after the landing of the Orbiter spacecraft.

The investigator and Experiment Support Team shall: (1) support NASA and HRF personnel in the preparation of the test procedures that are required during the JSC and KSC ground processing of the experiment; (2) provide science and technical personnel to support the Science Verification Tests at JSC; (3) provide science and technical personnel to support any testing at KSC; (4) support the pre-closeout inspection of the experiment at KSC; (5) provide personnel if required to perform preflight experiment servicing; and (6) support experiment trouble-shooting at JSC or KSC as required.

After reviewing this section, the contractor has the option of requesting special equipment, facilities, tests, or procedures that are necessary during the ground processing operations to assure that the experiment is successful.

9.1 JSC GROUND PROCESSING

This section identifies the types of tests and the general sequence of testing that are performed at JSC to verify that the experiment systems, including the contractor-provided and NASA-provided hardware, perform satisfactorily to accomplish the experiment objectives. The investigator and Experiment Support Team shall review the sequence of events at JSC that are described in the following paragraphs prior to the PDR and make their best effort at identifying the applicable requirements on Table 9.1. At the experiment PDR, the applicable requirements are baselined and at the experiment CDR, the requirements are finalized.

It is assumed that the certification testing of the experiment hardware has been completed prior to delivery to JSC, except possibly for EMI and offgas testing. The Hardware Developer (HD) normally performs a bench level checkout and operation demonstration of the experiment hardware after delivery to JSC as well as providing some degree of training to the JSC operators. Once the experiment hardware has been delivered and accepted at JSC, the ESM is the coordination focal point for the HD or the contractor to schedule test equipment support, technical support, or the use of facility space. Standard electronic-type laboratory areas are available for the HD to use at JSC. Technical support is available, but any unplanned support is provided on a time-available basis. If the HD needs test equipment other than the standard GSE that is described later in this section, then these needs should be identified in Table 9.1. The HD should also be aware that all testing of flight hardware that has been accepted by NASA with full documentation and Quality Control inspection of most of the activities. The ESM provides the interface with the JSC-SF4/EA5 Quality organization personnel.

After the experiment systems have been accepted and bench testing completed by the HD, the ESM and the JSC Verification Test Manager are responsible for coordination of the completion of the JSC portion of the verification tests as described the associated Hardware Requirements Document (HRD). Some of these tests are performed on the bench prior to integration into the mockup Space Station racks although many of them are completed after integration.

9.1.1 JSC Ground Processing Support Facilities

During the ground processing activities at JSC, the experiment hardware is maintained and operated within Building 241 and/or 9 at JSC for the majority of the testing. Any testing requirements not accommodated in either of these buildings will be supported in the Building 36 work areas. The following descriptions of the facilities provide the experiment contractor and the HD with a concept of the support they can expect to find available.

9.1.1.1 Standard Facility Power

120 and 28 VDC power will be available either at a bench setting or from a flight-like station or HRF rack. For battery powered items, the battery recharger will be made available. Although no AC power will be available on the International Space Station, the following types of 60 HZ facility power is available:

120 VAC	1 phase	20 amps
208 VAC	3 phase	30 amps
480 VAC	1 phase	30 amps

9.1.1.2 Facility Water and Air

Most Building 36 work areas have facility air available at approximately 80 psig and standard water and drains. It should be noted that the facility air is not cleanliness-controlled. Bottled deionized water is available, if required. All water and air requirements shall be documented in Table 9.1.

9.1.1.3 JSC Ground Support Equipment

The JSC SM3/EA5 offices have developed an extensive set of specialized test equipment to support the flight experiment level testing and the integrated level testing in the mockup racks. The items that the experiment contractor or the HD work with directly are the Rack Power System (RPS), the mockup racks, and the weight and balance system.

9.1.1.4 Flight Hardware Shipping

At a point in the schedule approximately 6 to 9 months prior to launch, the flight hardware that is not a late load or middeck stowed item, is prepared for shipment to KSC by cleaning the items to a visibly clean level using a Freon TF (trichlorotrifluoroethane, technical), and then wrapped in static-free plastic. Shipment is provided by air ride, van, or air freight. If special cleaning or shipping is required, the contractor shall provide the guidelines in Table 9.1.

TABLE 9.1. JSC GROUND PROCESSING REQUIREMENTS

		Yes/No	If YES, any additional comments or requirements may be documented below
9.1.1	**Additional floor space required?**		
9.1.2	**Special power required?**		
9.1.3	**Special water and air requirements?**		

9.1.4	**Special flight hardware shipping and cleaning required?**		

9.2 KSC PROCESSING

The KSC ground processing for life sciences experiments consists of the integration, checkout, launch, and deintegration of the experiments within the Multi-Purpose Logistics Module (MPLM) and/or the Orbiter middeck. Most of the testing and integration activities at KSC must be executed and coordinated with and through the KSC management system. This is especially true after hardware has been released to KSC for integration.

The HRF Payload Project team has prime responsibility for hardware/science payload assembly, test, and servicing while processing through KSC. Payload and Orbiter integrated activities and KSC-provided services identified herein will be the responsibility of KSC.

KSC is delegated by the ISS Payloads Office to provide the institutional capability at KSC for processing payloads. Processing includes offline support; physical integration and deintegration; and checkout of payload interfaces to high-fidelity ISS and Orbiter simulated interfaces, as well as actual Orbiter interfaces. Payload processing activities extend from simulation(s), through preflight, inflight, and postflight, to prelaunch and post-landing phases, including supporting late access to the MPLM and to the Orbiter middeck and payload bay, as well as early access to the MPLM and to the Orbiter middeck. Further details of these activities shall be obtained through the Experiment Support Team.

The Principal Investigator and Experiment Support Teams shall review the sequence of activities at KSC prior to the PDR and make their best effort at identifying the applicable requirements on Table 9.2. At the experiment PDR, the applicable requirements are baselined and at the experiment CDR, the requirements are finalized and details of the requirements are added to Table 9.2.

9.2.1 Support Requirements

In Table 9.2 the description of experiment launch site processing operations and support activities will be documented. Information for this table will fall into one of the sixteen categories listed below. Further information can be obtained from the Experiment Support Team.

- Offline Processing Area and Electrical Power Requirements - if there is a need for an offline processing area with any electrical power requirements, place OFF in the category column. This category will include such areas as photo dark rooms, cold rooms, surgery rooms, animal housing, the Orbital environmental simulator, and experiment test areas, etc. Information should include specifics such as: floor area, minimum door dimensions and ceiling heights, sinks, facility air/vacuum, network connections, crane requirements, and hook heights. Any experiment unique or unusual facility environmental requirements should be specified, such as: cleanliness levels, temperatures, humidity, lighting, and unique and/or critical electrical power configurations/requirements.
- On Line Processing Area and Electrical Power Requirements - if there is a need for a processing area after turnover to KSC with any electrical power requirements, place ONL in the category column. Requirements and specifications for this category should include information at a level comparable to that above, and may be related to post test refurbishment, healthchecks, etc.
- User Room Area and Electrical Power Support - if there is a need for User Room area and Electrical Power Requirements, place USP in the category column of and items provided by either KSC or the HRF Payload Project team for which User Room area and/or electrical power is required.
- Flight Hardware, GSE and Container Storage - if there is a need for Flight Hardware, Ground Support Equipment (GSE), or Container storage support, place STO in the category column and the detailed technical information necessary to fully describe the requested support should be supplied. Examples: State the physical dimensions and quantity of items to be stored; advise whether the items can be stacked with other items

for purposes of storage; describe how frequently access to the item will be required (i.e., daily/weekly/monthly), and at which points during the ground processing phase; stipulate if long term storage will be required, and for how long; describe any temperature or humidity parameters which must not be exceeded for safe storage of the item; specify minimum cleanliness level required for safe storage of the item

- <u>KSC Administrative Support</u> - if there is a need for Administrative Support, place ADM in the category column. These requirements include transient office areas and furniture, telephone for voice, fax and modem and computer network access, etc.. Examples: Furniture and office equipment (area required in square feet, number of people, quantity of desks, chairs, tables, etc.); number of telephone handsets, fax lines, voice lines, etc..
- <u>KSC GSE and Special Test Equipment</u> - if there is a need for KSC Ground Support Equipment (GSE) and Special Test Equipment support, place STE in the category column. If there is a preferred outside vendor for the GSE/Test Equipment, please identify them, along with the equipment's part number. Examples: Forklifts, cranes, dollies, carts, hydra sets, Leak detectors, workbenches, power supplies, MultiMate's, vacuum GSE, OIS-D Headsets, accelerometers, temperature and humidity recorders, toxic vapor detectors, He detectors, particle counters, plant growth chambers, exhaust hoods, laminar flow benches, etc. Additionally, indicate if there are times when GSE/Test Equipment will not be actively utilized, during which time others may use the hardware. If such times do exist, please indicate the critical time period(s) during which the PD will be actively using the equipment (i.e., the times during which it can not be shared).
- <u>Reusable and Expendable Supplies</u> - if there is a need for Special Laboratory Areas and Capabilities support, place EXP in the category column. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. If there is a preferred outside vendor for the GSE/Test Equipment, please identify them, along with the equipment's part number. Also indicate if equivalent substitutes are acceptable.
- <u>Fluid Resources</u> - if there is a need for Fluid resources, place FLU in the category column. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. Examples: GN2, He, Alcohol, Air, etc. Specify minimum, nominal, and maximum pressures and flow rates for each fluid, as well as the quantity of each required. Refer to SSP 30573, Space Station Program Fluid Procurement and Use Control Specification, for additional information concerning fluid specifications.
- <u>Chemicals</u> - if there is a need for Chemicals Support, place CHE in the category column. Include all chemical supplies to be used at KSC; those requested from KSC, chemicals shipped to KSC, and chemicals produced by processes during processing operations. MSDS and PWQs must be submitted prior to first use for all chemicals to be used at KSC. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. If there is a preferred outside vendor for the GSE/Test Equipment, identify them, along with the equipment's part number. Also indicate if equivalent substitutes are acceptable.
- <u>Payload Data Transmission and Recording</u> - if there is a need for Payload Data Transmission and Recording support, place DAT in the category column. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. Examples: List the type of data which is to be transmitted/recorded (such as OIS-D, Data, TV/Video signals, etc.). If recording is required, specify the desired recording medium (120 min VHS Video Tape, 1.44 Meg 3 ½ floppy discs, C-60 audio tape, etc.). Specify the facilities or locations from which the signals will originate and to which they will be transmitted;
- <u>Transportation / Shipping</u> - if there is a need for Transportation support, place T/S in the category column of Table 9.2 and requirements. Include ground transportation of HRF Payload Project team experiment samples and equipment between payload facilities at the launch site and at the SLF and DFRC landing facilities. Describe the type of experiment samples or equipment for which transportation assistance is required. Describe all services and/or considerations which are pertinent to the transportation of the Item. HRF will be responsible for coordinating and providing inputs per all special, sensitive, or unique transportation/shipping activities with KSC support personnel. For a

particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. Examples: transportation assistance required (crane, forklifts, transport dolly, etc.); special handling constraints/techniques; environmental considerations (temperature, cleanliness, humidity, etc.). Indicate if the requirement involves shipping of animals, plants, or other perishable cargo. List the facilities that the item should be transported from and to.

- Technical Support Services - if there is a need for Technical Support Services, place TSS in the category column. Specify the type of technical service required, such as: technician support (electrical, mechanical, quality inspection); special services (precision cleaning, decontamination, foam cutting, specimen preparation, sample analysis, leak detection, electromagnetic measurements, machining, optical lab services, long term hardware maintenance, etc.); animal/vertebrate; science; or unique environmental support, such as high cleanliness or low humidity.
- Photographic and Video Support - if there is a need for Photographic and Video Support, place PHO in the category column. Describe the nature of the operation/event to be photographed/recorded (such as major lift, plant growth, etc.). Describe in detail the type and specifications of desired recording medium (such as 35 mm print, Hi-Quality videotape, 800 x 600 dpi digital photos, etc.), and the estimated quantity of each type of photo/video support requested (such as number of prints, contact sheets, duplicate negatives, etc.).
- Communications - if there is a need for Communications Support, place COM in the category column. Examples: Estimate the quantity of headsets, etc., required.
- Personnel Access and Training Requirements - if there is a need for Personnel Access and Training support, place ACC in the category column and list the name of each person requiring access to KSC facilities, Company or organization affiliation, national citizenship, area of access requested (e.g., KSC Industrial Area, SSPF Clean Work Area, OPF, Pad, Animal Care Section, etc.). If unescorted access into controlled work areas is required, such as the SSPF Clean Work Area, a current certification in the NASA Personal Responsibility Program (PRP) is required.
- Hazardous Disposal, Storage, and Handling - if there is a need for hazardous disposal, storage, or handling, place HAZ in the category column and identify information necessary to accommodate hazardous products handling, storage and disposal by the HRF Payload Project team during KSC processing or a KSC activity in support of the HRF Payload Project team. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied. Where possible, estimate the quantity of each requirement for which disposal, storage, or handling is needed.
- Other - if there is a need for a type of support not previously identified in any of the previous tables, detail requirements in the free from table below:

TABLE 9.2. LAUNCH SITE REQUIREMENTS

Cat.	Requirement	Specifications	Phase	Comments

Definitions to be used in completing Table 9.2 are as follows:

Category - from the descriptions above, and the Acronyms below, assign a category to the launch site requirement:
OFF Offline Processing Area and Electrical Power Requirements
ONL On Line Processing Area and Electrical Power Requirements

USP User Room Area and Electrical Power Support
STO Flight Hardware, Ground Support Equipment (GSE) and Container Storage
ADM KSC Administrative Support
STE KSC Ground Support Equipment (GSE) and Special Test Equipment
EXP Reusable and Expendable Supplies
FLU Fluid Resources
CHE Chemicals
DAT Payload Data Transmission and Recording
T/S Transportation/Shipping
TSS Technical Support Services
PHO Photographic and Video Support
COM Communications
ACC Personnel Access and Training Requirements
HAZ Hazardous Disposal, Storage, and Handling

Requirement – identify the type of requirement needed, such as floor space, a laboratory, expendable supplies, special test equipment, etc.
Specifications – indicate, in a short description, the actual support requirement. For a particular requirement, the detailed technical information necessary to fully describe the requested support should be supplied, i.e., temperature, relative humidity, and cleanliness parameters required for safe storage or transportation of a payload; floor area needed; crane requirements (i.e., 10-ton Monorail); facility physical dimensions; electrical power requirements (120Vac 3-phase, 15-A, 60 Hz).
Phase L-/R+ – indicate the time(s) during the payload processing flow when a particular support is required, from beginning to end of the support, measured in days. Indicate the duration for each requirement. Ex: Preflight (Launch – X to Launch – Y); Inflight (L+X to L+Y); Postflight (Return +/-X to Return +Y).
Comments – indicate any information of importance that is not called out in any of the other requested fields.

10.0 DATA REQUIREMENTS AND MANAGEMENT

This section shall describe the data products required to support the experiment. This section provides tables for the investigator to specify which products and services are required by the experiment. A separate document that lists the data products and services that are available for the intended increments will be delivered to the investigator prior to filling out this section. Inputs to these tables will provide agenda items for meetings with NASA personnel to obtain detailed information for mission and integrated payload data requirements documents. If an experiment requires Telescience Support Center (TSC) or remote site support, the detailed requirements will be compiled in a Data Requirements Document prepared by NASA.

10.1 TELESCIENCE SUPPORT CENTER DATA MANAGEMENT GENERAL REQUIREMENTS

The focal point for all Human Research Facility operations and in-flight data activities will be the JSC TSC. The TSC will receive and process both HRF science and facility data, and transmit experiment specific data to remote investigators. Principle Investigators (PIs) can use the TSC during experiment operations or choose to operate remotely from their home site(s), interfacing with the TSC as required to support each function. Because of the long duration of ISS missions, operations for multiple missions may occur simultaneously in the TSC (in-flight operations for one increment, simulations for future increments).

HRF operations are based on centralized science management and operations support functions at the JSC TSC with distributed experiment support, using investigator capabilities at remote sites. TSC operators are responsible for administrative support as defined in this Operations Plan, storage of all data transmitted to the TSC, and local playback of recorded data during Station support. Dedicated HLS TSC console positions include: Operations Lead, Operations Support, Payload Systems Engineer (PSE), Planning, Data/Commanding, Crew Procedures Engineer (CPE), and Increment Scientist. PIs and Experiment Support Teams will vary by increment.

The JSC TSC also provides operations management, administrative support, data and communications systems support, and remote user interfaces. JSC TSC Support positions for TSC Users: TSC Manager, Operations Manager, Operations Support, Data Systems Support, and Operations Administration Support.

Preflight and postflight mission support is coordinated through the JSC/Space and Life Sciences Directorate, using directorate facilities and laboratories as mandated by individual experiment requirements.

Experiment Principal Investigator (PI) teams may elect to use the JSC TSC to perform/support operations. Increment assigned multi-purpose workstations shall be used to support this function. The multi-purpose consoles accommodate up to three personnel each. Consoles may be shared due to experiment activities and TSC console availability constraints.

The operator and investigator consoles shall be co-located. Each console function shall have simultaneous access to actual Shuttle/ISS data and simulated Shuttle/ISS data. The following capabilities/equipment shall be provided:

1. Copiers, tables, chairs, headsets, bookcases, printers, Facsimile machines, phones, NASA video, power/data lines, e-mail, and clerical support.
2. Sustaining engineering/on-line maintenance for JSC TSC/user equipment/interfaces.

3. Access to appropriate ground support documentation and the Operations Data File/Payload Operations Data File.

4. Training on use of the JSC TSC facility and equipment.
5. Data, voice and video interfaces shall be provided between the JSC TSC and other facilities used for hardware verification, crew training, and simulation activities. These facilities include but are not limited to JSC Buildings 5, 9, 241, 30, and 36.

Operational interfaces including existing and future data, voice, and video lines (JSC-to-MSFC and JSC-to-KSC) shall be provided and used as follows:

JSC-MSFC:

1. Control and command
2. Payload integrated operations (voice, operational data transfer)
3. Software test and verification
4. Consultative Committee for Space Data Standards (CCSDS) packetized data routing

JSC-KSC:

1. Pre-ISS delivery testing

A controlled access gateway to the Internet shall be provided for distributing HRF science data to remote users. Electronic mail and planning system communications interfaces shall be provided between the JSC TSC and HRF remote users.

Interfaces with international PIs shall be provided via commercial Internet or NASA dedicated networks as available. Interfaces with other partner control centers shall be provided when HRF hardware is being operated and/or accommodated in their segments as required and approved.

The JSC TSC shall provide HRF access to the following data:

1. Real-time Shuttle/ISS S-band data (from MSFC and/or JSC).
2. Playback Shuttle/ISS S-band data (from the on-board recorders via MSFC and/or JSC).
3. Real-time CCSDS packetized Ku-band data from the MSFC Payload data Services System (PDSS).
4. Playback CCSDS packetized Ku-band data from the MSFC PDSS.

The JSC TSC HRF consoles shall accommodate processing and display software. Displays will accommodate both real-time and playback science and engineering data. The Human Research Facility team is responsible for the development and configuration management of HRF unique processing and display software. This software shall be compatible with NASA data standards adopted for ISS, and with the HRF Software Development Plan, Software Design Document, or this document.

The capability to send packetized HRF commands and data files to the Payload Operations and Integration Center (POIC) shall be provided. The Human Research Facility team shall develop and maintain a command database at the JSC TSC and at the POIC as applicable.

For HRF, the JSC TSC Ground Data System, with assistance from the Life Sciences Data Archive (LSDA), will serve as the ground data archive facility and will be responsible for storing raw and calibrated data coming into the JSC TSC. The HRF project requires that this data be stored for up to three (3) years. Once the PI no longer has exclusive use of the research data and the subject consent has been received, the HRF research data will be maintained in the LSDA at JSC indefinitely. This archive will have controlled access as determined by the SLSD.

The Mission Operations Group will serve as the responsible party for data distribution from the front end of the JSC TSC to the local HRF and/or remote end user. All other data distribution is the responsibility of the appropriate NASA or commercial organization.

The JSC TSC shall maintain Mission Elapsed Time (MET) and Greenwich Mean Time (GMT) for all increments where HRF is operating. The capability to time synchronize data with the ground data systems shall be provided.

Real-time and playback Shuttle or ISS video shall be provided to the JSC TSC from JSC Building 8. Video to remote PI teams shall be accomplished via restricted commercial data lines.

Shuttle and ISS A/G voice, and internal and external voice loops shall be provided in the JSC TSC at each console location. Internal voice loops shall be provided. Restricted access to standard Digital Voice Intercommunications System (DVIS) loops shall also be provided.

Access to Space Station Control Center (SSCC) and POIC scheduling and operations planning systems shall be provided in the JSC TSC.

A team of console operators shall be trained and certified by the Human Research Facility team to provide support in the following areas:

1. The JSC TSC shall be used to support JSC/KSC HRF development and verification tests (science verification tests, end-to-end tests, integrated verification tests) via interfaces to KSC and other JSC facilities. Scheduling of tests shall be coordinated between the Mission Operations Group, the HRF team and the appropriate NASA facility.
2. The JSC TSC shall be used to support crew training in Building 5, 9, and 241. It shall also be used to support HRF stand-alone simulations and simulations with the JSC SSCC and MSFC POIC.
3. The JSC TSC shall support real-time and near real-time Shuttle and ISS operations.

Testing of this nature may occur during scheduled HRF element bench tests that will also certify the JSC TSC ground data system capability to acquire and display known data from new ISS/HRF hardware elements.

Data from various racks in Building 241 shall be acquired in the Building 36 SMA to certify data format, acquisition, archival, and display of Health & Status parameters.

NOTE: The investigator should be aware that, at times during the mission, there may be no communications available between the spacecraft and the ground. If the experiment must be performed during periods of visual and/or audible contact, that requirement must be defined as mandatory under the timelining constraints of the appropriate table in section 3.2.

10.2 DATA MANAGEMENT REQUIREMENTS

In Tables 10.2.1 and 10.2.2, the investigator shall identify information regarding data management requirements at the JSC TSC and at a remote site, respectively.

10.2.1 TSC Data Management Requirements

In Table 10.2.1, identify the number of console workstation positions required and the approximate number of people that may be on console at any one time. Each workstation will include access to ISS and Shuttle data displays, video monitoring, and voice loops, and be configurable for Experiment data displays.

TABLE 10.2.1. TSC DATA MANAGEMENT REQUIREMENTS

Experiment team location for Inflight monitoring:	**JSC TSC**	Y	**Remote site (PI, Co-I or team member facility). Please identify location, if known.**	ESA Flight Monitoring Center

JSC TSC based experiment team requirements		
Estimated # of people in TSC	6	
Unique GSE brought to TSC		
Hardware Item	**Description**	**Interface w/ TSC Equipment**
Laptops for log keeping and preliminary data analysis		

Display Requirements				
Parameter	**Graph (G) or Alphanumeric (A) Display**	**Data Rate (Kbps)**	**Nominal Range/Discrete Values**	**Limit check values**
TBD, similar to Neurolab E136	G, A, experiment audio, Video			

Strip Chart Requirement	
Parameter	**Nominal Range**
Real-time Report Requirements	
Deliverable Data Products	CD ROM with session data; videotape of surveillance video
Data Reduction Report Requirements	

Definitions applicable to experiment data management at the JSC TSC are as follows:

Unique GSE brought to TSC - identify a list of Ground Support Equipment (GSE) that might be brought to the JSC TSC to support inflight operations

Description - describe the GSE being brought in to the TSC, i.e., size, power requirements, etc.
Interface with TSC equipment - identify any interfaces with the TSC, i.e., printer connections, data connections, etc.
Display Requirements - if experiment display capability at one of the JSC TSC workstations is required, provide display description and formats based on experiment downlink data requirements.
Nominal range/discrete values - if the parameter has a nominal range or has discrete values associated with it, identify them.
Limit Check values - if a limit checking requirement exists, provide a list of parameters that need to be automatically checked for limit conditions and specific out of limit notation that can be easily seen on the workstation display pages based on changing color codes.
Strip Chart(s) Requirements - provide a list of parameters that need to be presented graphically on a strip chart and appropriate scaling factors to enhance the traces as needed.
Real-time Report Requirements - real time reports are presented on workstation display pages with the capacity of approximately 25 event lines. The information represents events that have occurred, and each line is time tagged.
Deliverable Data Products - provide a list of real-time data, file transfer data, and on-board recorded data that you want delivered to your experiment team post test and post mission. Post test data is defined as data acquired during bench tests, verification tests, crew training operations, and simulations. An agreement with the Life Sciences Data Archive group needs to be worked out prior to data delivery regarding the data format and media of delivery. Normal product delivery is distributed on CD-ROM; however, other sources may be available.
Data Reduction Report Requirements - if post test reports are required, provide a list of parameters that need to be reported on. If required, some of the parameters may be specified to print on change while the other parameters may be printed once a minute or some other specified time.

10.2.2 Remote Site Data Management Requirements

Remote PI Sites will allow investigators to monitor and perform telescience activities on their experiments without having to travel to the TSC. The TSC will receive and transmit data to/from these sites. Most remote user information will be sent via the Internet, providing an encrypted, secure means of transferring data. Digital voice connectivity will be utilized under an Internet Protocol. Twenty-four channel connectivity can be established to the POIC voice system, with a number of loops capable of being monitored at any one time. However, when talking, only the activated loop is capable of being monitored. Access is gained via web browser on Windows NT supported workstations.
Remote Operation capabilities include data distribution from the JSC TSC to the investigator's remote user location, Internet connectivity, and voice loop communications. In Table 10.2.2, any requirements for remote operations will be identified.

TABLE 10.2.2. REMOTE SITE DATA MANAGEMENT REQUIREMENTS

Remote site based experiment team requirements					
Voice Loop (Y/N)	Y	**Monitor**		**Two Way**	Y
Video (Y/N)	Y (down only)				
Data (Y/N)	Y				

Display requirements				
Parameter	**Graph (G) or Alphanumeric (A) Display**	**Data Rate (Kbps)**	**Nominal Range/Discrete Values**	**Limit check values**
Similar to Neurolab				

Strip Chart Requirement	
Parameter	**Nominal Range**
Real-time Report	
Deliverable Data Products	Downlinked data files accessible via Internet ftp. Streaming recordable video. Multiple loop Audio via Internet or POTS.

Definitions applicable to experiment data management at remote sites are as follows:

Display Requirements - if experiment display requirements at one of the JSC TSC workstations are required, provide display description and formats based on experiment downlink data requirements.

Nominal range/discrete values - if the parameter has a nominal range or has discrete values associated with it, identify them.

Limit Check values - if a limit checking requirements exists, provide a list of parameters that need to be automatically checked for limit conditions and specific out of limit notation that can be easily seen on the workstation display pages based on changing color codes.

Strip Chart(s) Requirements - provide a list of parameters that need to be presented graphically on a strip chart and appropriate scaling factors to enhance the traces as needed.

Real-time report requirements - real time reports are presented on workstation display pages with the capacity of approximately 25 event lines. The information represents events that have occurred and each line is time tagged.

Deliverable Data Products - provide a list of real-time data, file transfer data, and on-board recorded data that you want delivered to your experiment team post test and post mission. Post test data is defined as data acquired during bench tests, verification tests, crew training operations, and simulations. An agreement with the Life Sciences Data Archive group needs to be worked out prior to data delivery regarding the data format and media of delivery. Normal product delivery is distributed on CD-ROM, however, other sources may be available.

10.3 DOWNLINK/COMMANDING DATA REQUIREMENTS

For the early ISS missions, Downlink File Transfers may be the only downlink capability to get data from hardware and it is a near real-time process. If this option is desired and the ground data system will be used to either 1) acquire the file, 2) archive the file, or 3) distribute the file to the investigator, state those requirements along with any pertinent comments. Consider data distribution via ground file transfer capabilities or on CD-ROM deliverables.

TABLE 10.3. DOWNLINK/COMMANDING DATA REQUIREMENTS

Command requirements		
Downlink	**File Transfer Size**	Many small data files 5-600 KB in size.
	Realtime Data Rate	N/A. NRT required only.
Commanding	**Command spec.**	Upload software updates
	Uplink file format/spec.	TBD, probably .exe autoinstaller

If a display of the file contents is required at one of the JSC TSC Workstation, the format of the desired data parameters must be identified. During the International Space Station (ISS) era, ground operations support in the JSC TSC will additionally be able to support Uplink command and file transfer capabilities that are provided by ISS data flow and the HRF Workstation. If applicable, provide any known specifications regarding these types of requirements in Table 10.3.

10.4 ARCHIVED DATA REQUIREMENTS

Once the data media is returned to HRF postflight, the original data will be archived, by LSDA, with copies being sent to the investigator team. Under certain circumstances, original data may be returned to the investigator, with the investigator returning a copy at a later time. The format and media of the data product can also be altered from that returned postflight to one more advantageous for analysis by the investigator. In Table 10.4, describe the data product, returned from flight, archived, the data formats involved and the quantities.

TABLE 10.4. ARCHIVED DATA REQUIREMENTS

Original or Duplicate copy of Data Product Required	Duplicate
Data Format and media being returned postflight	Electronic (CD); video
Data format and media desired delivered to PI Team	Electronic (CD); video
Number of copies of data desired	4

Definitions applicable to any other experiment data management concerns are as follows:

Original or Duplicate copy of Data Product Required - identify if the original is to be returned to the investigator team, or whether duplicate copies will be sufficient.

Data Format and media being returned postflight - identify the format and media returned postflight
Data format and media desired delivered to PI Team - identify the format and media of data delivered to the team
Number of copies of data desired - identify the number of copies of the data desired by the investigator team

10.5 MISCELLANEOUS DATA REQUIREMENTS

In Table 10.5, the investigator shall identify any data requirement not covered by the tables in sections 10.2 through 10.4.

During training at JSC and/or during training or integration testing at KSC, performance of the experiment will allow verification of the data flow and also provide science verification data. If data support is required during either training, or KSC activities, identify this requirement. If any of the parameters are different in either of these activities than they would be from an inflight performance of the experiment, identify those differences.

TABLE 10.5. MISCELLANEOUS DATA REQUIREMENTS

Training/ KSC Data Requirement (Y/N)	End-to-end verification of HRF workstation downlink desirable prior to experiment ops
Different from Inflight parameters? If so, explain	
BDC Data Requirement? (Y/N)	Y, archiving of BDC data.
Different from Inflight parameters? If so, explain	
Data flow monitoring in transit (to/from SS) reqt.	N/A

Definitions applicable to any other experiment data management concerns are as follows:

Baseline Data Collection requirements - if data support is required during either preflight or postflight baseline data collection activities, identify this requirement. If any of the parameters are different than they would be from an inflight performance of the experiment, identify those differences.

Experiment teams should be self supporting whenever possible during pre and post flight data collection operations, however, NASA's commitment to support their various activities is firm. Data system support could possibly include the same capabilities as those required for inflight console operations.

Some investigations may require data flow monitoring on the flight to, or from, the ISS, either as experiment sessions or monitoring of hardware performance. Special arrangements will need to be made for this data flow. If this is a requirement, provide any known information.

11.0 DOCUMENTATION REQUIREMENTS

This section describes the documentation products that the PI is required to deliver in support of this experiment project.

In addition to the requirements for filling out the information tables contained within the ED, there are a number of other items of documentation that are required to be delivered in support of this experiment project. The listings in this ED section should not in any way preclude documentation requirements or other deliverables that may be imposed on the PI as a consequence of their contract or an EUE HRD.

Experiment Phase	Deliverable	ED Section	To be submitted by
Definition	Experiment Management Plan	11.1.1	1 month after experiment selection
Definition	Experiment Activities and Milestones Schedule	11.1.2	1 month after experiment selection
Definition	Monthly Progress Reports	11.1.3	10th day of each month
Definition	Draft Human Research Protocol	11.2.1	1 month prior to PDR
Definition	Supporting Studies Impact Report	11.2.4	As soon as study indicates impact to experiment
Definition	Final Supporting Study Report	11.2.5	60 days after completion of experiment
Design	Draft Experiment Operating Procedures	11.2.2	1 month prior to PDR
Design	Final Human Research Protocol	11.2.1	L-14 months (for each increment)
Design, Development	Safety Documentation	11.4	60 days prior to each Safety Review
Development	Experiment Operating Procedures	11.2.2	60 days prior to crew training
Development	Experiment Manual	11.2.3	60 days prior to crew training
Development	Science Verification Testing Report	11.2.6	60 days following receipt of SVT data
Development	Payload Crew Certification Report	11.2.7	L-3 months (for each increment)
Development	Experiment Unique Software Documents	11.3	See Section 11.3
Data Distribution	Preliminary Science Report	11.2.8	6 months following receipt of increment data

11.1 EXPERIMENT MANAGEMENT DOCUMENTATION

11.1.1 Experiment Management Plan

The purpose of the experiment management plan is to document the organizational relationships within the PI's team and the management approach that the PI will take for his/her experiment implementation. This plan is a useful tool in establishing the lines of communication and points of contact for the NASA experiment development team. Since this plan helps to define the working relationship between NASA and the PI team, international PIs should consult their appropriate sponsoring agency representative regarding organizational and administrative requirements.

The experiment management plan should provide a detailed explanation of the PI's approach or techniques for executing essential management functions such as: delegation of tasks and authority, appraisal of task progress and status, and monitoring and control of costs. If applicable, the plan should describe the management approach for each of the three following types of activity: (1) in-house tasks not related to spacecraft equipment development; (2) tasks related to the development of equipment for use aboard a spacecraft; and (3) out-of-house contracts.

Personnel who will carry out the experiment should be identified, along with a description of expected activities during all phases of the program. A graphical illustration of the relationships for managing and conducting the work is very helpful. The illustrations should include an explanation of the internal structure and lines of authority and/or responsibility for the PI's institution. External interfaces and relationships with NASA, support organizations, and associated investigators should also be delineated.

The Experiment Management Plan is a Definition Phase deliverable item and is provided to the Experiment Systems Manager.

11.1.2 Experiment Activities and Milestones Schedule

The PI shall prepare and maintain two types of schedules showing experiment milestones and activity time spans. One schedule will highlight activities performed during the experiment design, definition, and development phases. A second schedule will be created for each increment on which the given experiment is manifested. This schedule will highlight activities that will take place during the experiment's flight phase and will be developed with the help of the NASA experiment team.

Initially NASA will use the Experiment Activities and Milestones Schedule to evaluate the feasibility of developing the experiment on a timetable that is consistent with program objectives and to determine which ISS increment should be targeted for flight. Periodic updates of the schedule are then used to assess the progress of experiment development activities and to re-evaluate compliance with increment and program schedule requirements.

The schedule should reflect the major development activities and milestones for the experiment, including (but not limited to) ground supporting studies, PI-provided EUE and EUSW activities, protocol development activities, BDC or other hardware procurements, etc. The schedule should be prepared in Microsoft Project.

The Experiment Activities and Milestones Schedule will be continually updated during the course of the experiment development, but should be initially submitted to the Experiment Systems Manager during the definition phase.

11.1.3 Monthly Progress Reports

In order to effectively track the development of the experiment, the NASA ESM will need a monthly progress report from the PI. This requirement can be met through means other than a formal written report, such as monthly teleconferences, frequent regular communications, etc. In some circumstances, however, the generation of a written report may be the most effective way of meeting this requirement (example, a foreign PI under direct experiment development management by his/her sponsoring agency). If the NASA Experiment Systems Manager and the PI sponsoring agency representative agree to a written report, it should include separate discussions of science activities and engineering activities (as necessary). Each of these discussions should include the following information:

a. A quantitative description of overall progress
b. A discussion of the work performed during the past month
c. A discussion of the work to be performed during the next monthly reporting period.
d. A description of any current problems which may impede performance, and a discussion of proposed solutions for those problems.

In the discussions in the monthly reports the PI should provide a clear picture of where the PI stands with respect to meeting the major milestones of the project (the ERR, the PDR, the CDR, etc.). Any proposed changes or updates to the Experiment Activities and Milestones schedule changes should also be included in the report. This report should be provided to the Experiment Systems Manager by the 10th day of each month for the previous month's work.

11.2 SCIENCE SUPPORT DOCUMENTATION

11.2.1 Human Research Protocol

All investigators proposing experiments involving humans shall adhere to the principles governing such research that are set forth in Protection of Human Research Subjects, NMI 7100.8A, which establishes the requirements for the contents of a protocol.

A copy of the latest revision of JSC-20483, "JSC Institutional Review Board: Guidelines for Investigators Proposing Human Research for Space Flight and Related Investigations," will be provided to the PI. This handbook describes the format that the PI will use for submitting human research protocols.

The PI shall submit a draft version of the proposed Life Sciences Research and Training/Baseline Data Collection (BDC) Protocols at the PDR. The final Protocols will be delivered to NASA either a) at least 60 days prior to the CDR or b) at least two months prior to the informed consent briefing of the increment to which the experiment has been manifested. Protocols will be submitted to the respective agency Institutional Review Board (IRB) two months prior to the first training session. All action items resulting from IRB review must be closed prior to the first training session, although authority may be granted to conduct informed consent briefings with the crew. Action Item closures should be forwarded to the ESS for submission by the Increment Scientist to the IRB. Tests using non-crew subjects also require the investigator to obtain IRB approval of a human research protocol and will follow a similar process.

Protocols will be promoted to the Human Research Multilateral Review Board (HRMRB) for review prior to the first preflight baseline data collection session. Action items resulting from this review will be handled in a manner similar to that of IRB Action Items.

The PI shall update protocol information when requested by NASA.

For each protocol submission, one reproducible signed copy shall be submitted to the Experiment Systems Manager. Twenty copies will be made by the ESS for submission by the Increment Scientist to the IRB.

11.2.2 Experiment Operating Procedures

The PI, with the assistance of the ESS, will develop procedures that describe the steps to perform the experiment and explain how to operate the experiment equipment. These procedures will be formatted by NASA and used by the flight crew for experiment training and on-orbit operations. Due to the limited opportunity to train with the crew, these procedures must be test verified prior to formal submission and will be reviewed by both the JSC and MSFC training groups prior to the training session. This will help insure that a certain stability is maintained over the experiment operations and procedures in order to maximize the effectiveness of our extremely limited time with the crew.

NASA will combine individual experiment procedures in the User Requirements Collection (URC) database which will consist of integrated flight crew procedures, crew checklists, cue cards, and other materials that will assist the crew in carrying out the planned flight activities. From time to time the PI will be required to assess the adequacy of these materials, and the PI will ultimately provide a certification of flight readiness for the final version of the URC database.

In order to accommodate these reviews and to allow for Russian translation, experiment operating procedures and updates shall be submitted 60 days prior to each training exercise that requires such procedures. The format will be supplied by NASA. One reproducible copy shall be submitted to the ESM and another copy to the ESS.

11.2.3 Experiment Manual

The PI is required to provide a training workbook to be used as a reference by the payload crew. The initial submission of this workbook shall be no later than 60 days before the first experiment training exercise to allow for review and translation into Russian. The workbook shall be updated as needed, and no later than 60 days preceding each subsequent training exercise. The exact format for the workbook will be provided to the PI prior to the initial training exercise. These workbooks will be very useful in bridging the gaps in the training sessions for the crewmembers.

The following information should be included in the crew training workbook:

1. A description of the experiment team, including all Co-Investigators and support personnel. This description shall present the team organization and describe the role of each member of the team.
2. A description of the interfaces between the experiment and the NASA experiment project organization. This consists of a listing of the names, office codes, and telephone numbers of the Experiment Systems Manager, Experiment Project Engineer, Experiment Support Scientist, Increment Scientist, and other key NASA Experiment Project personnel.
3. A discussion of the objectives of the experiment training program.
4. An overall schedule for the training program and a training syllabus that outlines the activities to be carried out during the first training exercise.
5. A summary description of the flight experiment.
6. A detailed overview of the experiment, including the historical background leading up to the present experiment concept, the objectives of the experiment, and the justification for conducting the investigation in space.
7. A description of the planned investigative approach. For the initial submission this shall include a discussion of the methods or techniques planned to be used in the conduct of the experiment, detailed descriptions of the tasks to be performed in conducting the experiment, a discussion of the possible results of performing the experiment, and flow charts depicting the sequence of experiment activities from preflight through inflight to postflight.
8. Experiment Operating Procedures, if these are required for the initial training exercise (See description in Section 11.2.2).
9. An appendix containing copies of publications that are relevant to the experiment.
10. An appendix containing descriptions of the supporting studies planned to be conducted in association with the experiment. If results are available from already completed studies, they should be included.

As it becomes available, information describing the experiment equipment and explaining how to operate that equipment shall be incorporated into the training workbook.

As the experiment training progresses, inflight operations procedures, inflight timelines, and contingency operation procedures will be developed and incorporated into the training workbook.

The crew training workbook will be updated as dictated by changes in the above-listed items. In addition, an updated training syllabus and any new or modified experiment operating procedures will be added to the crew training workbook. These updates and changes are due to NASA 60 days prior to each training session.

One reproducible copy of each workbook submission shall be submitted to the Experiment Systems Manager and one additional copy to the ESS.

11.2.4 Supporting Studies Impact Reports

In general, supporting studies are conducted to provide information about some undefined aspect of the experiment concept. The PI must advise the ESM immediately when the results of such studies indicate that there will be a previously unforeseen impact on the experiment project. Any study result that will affect the experiment project cost or schedule; the form, fit, or function of the experiment equipment; the crew time required to perform the experiment; or the feasibility of the present experiment concept, shall be reported.

A supporting study impact report should be submitted as soon as the study results indicate that there is an experiment project impact. The report needs to describe the relevant results and define the impact to the experiment project that the results suggest.

If the study results indicate the need for a modification to the flight experiment in an area that is under configuration control, then the impact report shall clearly specify the anticipated change and state the date when a Change Request will be submitted. Changes to baselined requirements require HRF Configuration Control Board (CCB) approval.

One copy of each impact report shall be submitted to the Experiment Systems Manager.

11.2.5 Final Supporting Study Reports

For each authorized supporting study, the PI is required to submit a final report that describes the conduct and the results of that study.

Each final report should contain an abstract summarizing the study plus a complete description of the study, including the study objectives, methods, results, conclusions and recommendations. The report should include all calculations, data, charts, photographs and drawings necessary to comprehensively explain the results. The report should also discuss any supporting study impact reports (See Section 11.2.4) associated with the study. A copy of all papers and reports pertaining to the study should be included as an appendix to the report.

One copy of each report shall be submitted to the Experiment Systems Manager. These shall be submitted no later than 60 days after the completion of the study.

11.2.6 Science Verification Report

When all elements of the experiment are sufficiently mature, including flight hardware, software and crew procedures, a Science Verification Test (SVT) and analyses will be performed to verify that the overall experiment system satisfies the scientific objectives stated in Section 2.0 of this ED. As a part of this process, the PI shall prepare and submit a Science Verification Report.

Science verification will begin with the conduct of an SVT by JSC personnel. This test will consist of a flight-like sequence of experiment operations which includes ground support and monitoring activities and the collection of experiment data in the same format planned for the collection of actual inflight experiment data. In some cases, the entire flight protocol may be performed, and in others a representative portion of the experiment may yield enough data for evaluation.

The verification test data will then be provided to the PI who shall reduce and analyze the data using the same techniques and methods planned to be used for the actual flight data. When the analyses have been performed, the PI will prepare and submit a Science Verification Report that describes the results of the analyses. The PI will end the report with a statement certifying the adequacy of the experiment system to support the scientific objectives of the experiment.

The Science Verification Report is due to NASA no later than 60 days following receipt of the SVT data. Copies shall be addressed to the Experiment Systems Manager.

11.2.7 Payload Crew Certification Report

The PI will be required to submit a report certifying that the payload crew has been trained according to the requirements specified in Section 5.0 of this ED and is, therefore, prepared to perform the experiment during inflight operations.

This report will be submitted after the completion of the experiment training and payload related simulations that may involve the experiment - approximately three months prior to launch. The report may be in letter form and shall be addressed to the Increment Manager with an information copy to the Experiment Systems Manager.

11.2.8 Preliminary Science Report

No later than 6 months following the receipt of each flight increment's data, the PI is required to submit one reproducible copy and five printed copies of a Preliminary Science Report. This report shall describe the development and inflight operation of the experiment and shall present the experimental findings to date. Detailed instructions on the content of the report and its format will be provided to the PI in the ISS HRF Reporting Guideline. A copy shall be mailed to the Increment Scientist, and the remaining copies should be provided to the Experiment Systems Manager. Brief informal reports on inflight activities accomplished and preliminary status of results may be requested at earlier intervals.

11.2.9 Life Sciences Flight Experiments Symposium Report

The PI shall plan to present a report of the findings of his/her experiment at a Life Sciences Flight Experiments Symposium to be held at JSC. This symposium will take place approximately one year after the PI has received the experiment data from the last flight increment associated with the given experiment. The proceedings of the symposium will be published by NASA. Five copies of the symposium report shall be submitted. Three of the printed copies shall be mailed to the ESM, and the remainder shall be mailed to the Increment Scientist. The format for the symposium report will be distributed with the announcement of the symposium.

11.3 EXPERIMENT UNIQUE SOFTWARE DOCUMENTATION

If EUSW is included in the experiment system, and the PI is providing that software, then the PI is required to provide an Experiment Software Document and other supporting documentation as described in section 8.0 of this ED and according to the document LS-40072, Experiment Software Documentation Guidelines and Requirements.

11.4 SAFETY DOCUMENTATION

11.4.1 Payload Safety Data

A detailed safety review will be conducted for the flight experiment and equipment. This safety review is conducted in several stages or phases, and the PI is required to provide certain information for inclusion in the safety data package. (Those PIs who are developing EUE will find additional safety reporting requirements in their HRDs.) This information shall, at a minimum, include the following items at the appropriate phase:

1. Phase 0
   a. Experiment description and operation.
   b. Inputs on hardware description of safety critical subsystems.
2. Phase I (Phase 0 and I are usually grouped into a single review.)
   a. Input for block diagrams, schematics, and/or a description of safety-critical subsystems and their options.
   b. Input for Hazard Reports (JSC form 1230/542B).

c. Radioactive source questionnaire (JSC form 44).

3. Phase II
   a. Updates to all phase 0/I data.
   b. Safety-critical subsystem descriptions (update).
   c. Inputs to the list of Orbiter and/or ISS provided critical services.
   d. Inputs to the list of hazard controls that require crew procedures and/or training.
   e. Inputs for updated hazard reports and support data including the following:
      (1) A list of equipment generating hazardous radiation.
      (2) Radioactive source questionnaire (update).
      (3) List of toxic materials.
4. Phase III
   a. Updates to all Phase II data.
   b. Inputs to final as-built payload description.
   c. Results of applicable safety verification tests and analyses.
   d. A summary and safety assessment of all test failures, anomalies and accidents.
   e. Inputs to Payload Flight Safety Verification Tracking Log (SVTL).
   f. Assistance with identification of flight safety non-compliances.

11.4.2 Payload Ground Safety Data

In addition to the flight safety review process referenced in section 11.3.1, there is a ground safety review process which covers activities conducted at KSC. As with the flight safety process, the PI is required to provide certain information for inclusion in the safety data package. (Those PIs who are developing EUE will find additional safety reporting requirements in their HRDs.) The safety analysis data shall consider all experiment hardware and GSE. The hazard analyses shall consider the effect of each hazard on the Orbiter, the launch site facilities, other payloads, and personnel. This information shall, at a minimum, include the following items at the appropriate phase:

1. Phase 0
   a. Experiment/GSE conceptual design established.
      (1) Provide experiment description and operation.
      (2) Assist with identification of potential hazards and applicable safety requirements.
      (3) Help perform preliminary safety analysis.
2. Phase I (Phase 0 and I are usually grouped into a single review.)
   a. Experiment/GSE preliminary design established.
      (1) Help to provide block diagrams, schematics, and/or a description of safety-critical subsystems and their operations.
      (2) Inputs to the ground operations concept for the integration and testing of the experiment at KSC.
      (3) Inputs to the preparation of hazard reports (JSC form 1230/542B).
      (4) Help to prepare radioactive hazard controls and safety verification methods.
      (5) Help to evaluate preliminary hazard controls and safety verification methods.
      (6) Inputs to define and expand safety analysis to reflect the preliminary design: define the hazards, define hazard causes, evaluate actions for reducing or controlling hazards, showing approach for safety verification.
3. Phase II
   a. Experiment/GSE final design established.

(1) Help to refine and expand safety analysis, evaluate interfaces, and ground operations procedures.

(2) Update hazard descriptions, causes, and controls.

(3) Update hazard reports and radioactive source questionnaire.

(4) Help to finalize test plans, analysis procedures, or safety verification.

(5) Inputs to update safety-critical subsystems descriptions.

(6) Provide a list of technical operating procedures related to identified hazard controls.

4. Phase III.
   a. Experiment/GSE fabrication and testing complete.
      (1) Inputs to complete safety analysis.
      (2) Help to complete all safety verification tests and/or inspections.
      (3) Submit results of applicable safety verification tests and analysis.
      (4) Provide technical operating procedures (provide inputs).
      (5) Provide a list of safety-related failures or accidents.

11.4.3 Baseline Data Collection (BDC) Safety Data

Prior to any BDC activities at JSC or at KSC, the BDC equipment and operations must be reviewed by the appropriate local safety organization. The BDC safety process at JSC will be conducted in the same manner as a TRR, described in section 6.1. The formal safety process for KSC for BDC is somewhat undetermined; however, it is safe to assume that the PI will be required to provide the same sort of information as already defined for JSC. When the formal KSC process is better understood, the PIs will be informed, and this ED section will be updated.

DISTRIBUTION LIST
FOR
LS-20427

NASA/JSC
SF4/M. Buderer, Ph.D.
A. Lee
STI Center/Building 36 (8)

LOCKHEED MARTIN
S03/Science Payloads Library
S22/M. Pickett
S363/A. Kulhanjian