



Human Research Program Human Exploration Research Analog (HERA) Experiment Information Package

June 2015

**Flight Analogs Project
Human Research Program**

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Please use this document as an overview to the capabilities of the HERA analog for the purpose of preparing research protocols.

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INTRODUCTION

The NASA Flight Analogs Project (FAP) conducts research utilizing ground-based facilities that provide scenarios and environments analogous to those anticipated for exploration missions. The FAP supports the accomplishment of Human Research Program (HRP) objectives by investigating, acquiring, utilizing or operating high fidelity ground analogs of the space exploration environment aiming at the conservation of spaceflight resources while expeditiously and efficiently addressing research questions for future manned exploration missions.

The information within this document describes the standard conditions and capabilities provided for experiments performed in the Human Exploration Research Analog (HERA), as well as the services provided by FAP.

The Human Exploration Research Analog (HERA) plans for campaigns of incremental duration began in 2014 with four 7-day missions. A campaign is defined as one integrated protocol with one primary mission scenario consisting of multiple missions in order to meet study subject requirements. Studies designed to utilize the capabilities of HERA described in this document are integrated with other investigations on a non-interference basis and run together as one integrated campaign.

Planned mission durations may range from 7 days up to 45 days. The HERA planning schedule currently anticipates 4 missions per year (one per quarter) of 45-day duration in 2017.

HERA FEATURES

The HERA is a two-story, four-port habitat unit residing in Building 220 at NASA Johnson Space Center (JSC). It is cylindrical with a vertical axis, and connects to a simulated airlock and hygiene module (Figure 1). The total space comprises 148.6 m³, distributed as follows: core (56.0 m³), loft (69.9 m³), airlock (8.6 m³) and hygiene module (14.1 m³) (Figures 2 & 3).

HERA facility capabilities includes a network that allows electronic research data and voice to be exchanged between the crew and ground controllers located in Building 220. The research data can be securely accessed by remote investigators real-time or near real-time through the JSC Telescience Center. HERA has a surveillance video and audio system, flight-like timeline and procedure viewer to provide a space mission experience.

Currently, the HERA represents an analog for simulation of isolation, confinement and remote conditions of mission exploration scenarios. Studies suitable for this analog may include, but are not limited to behavioral health and performance assessments, communication and autonomy studies, human factors evaluations and exploration medical capabilities assessments and operations.

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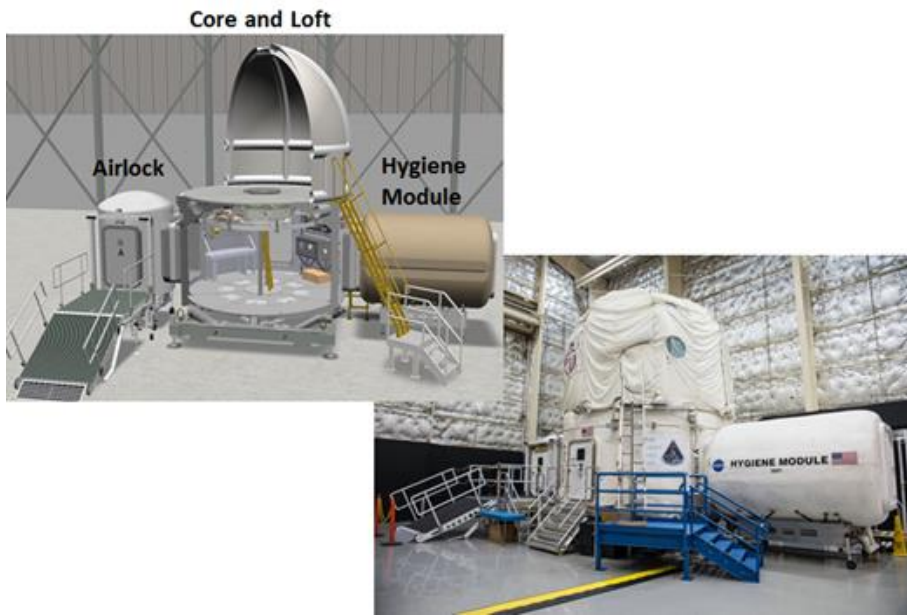


Figure 1 Schematic representation of HERA

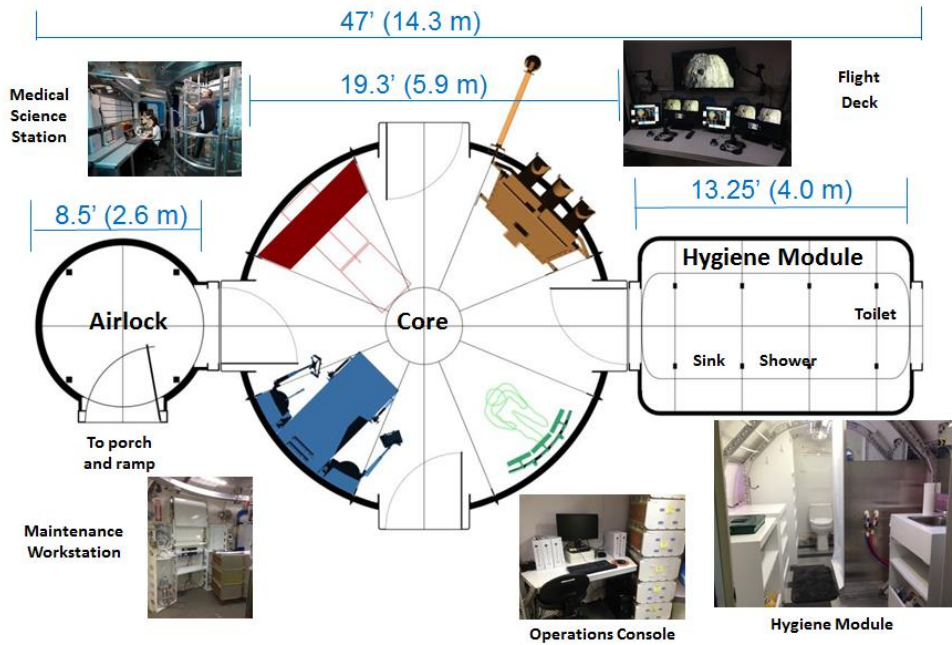


Figure 2 HERA First Level

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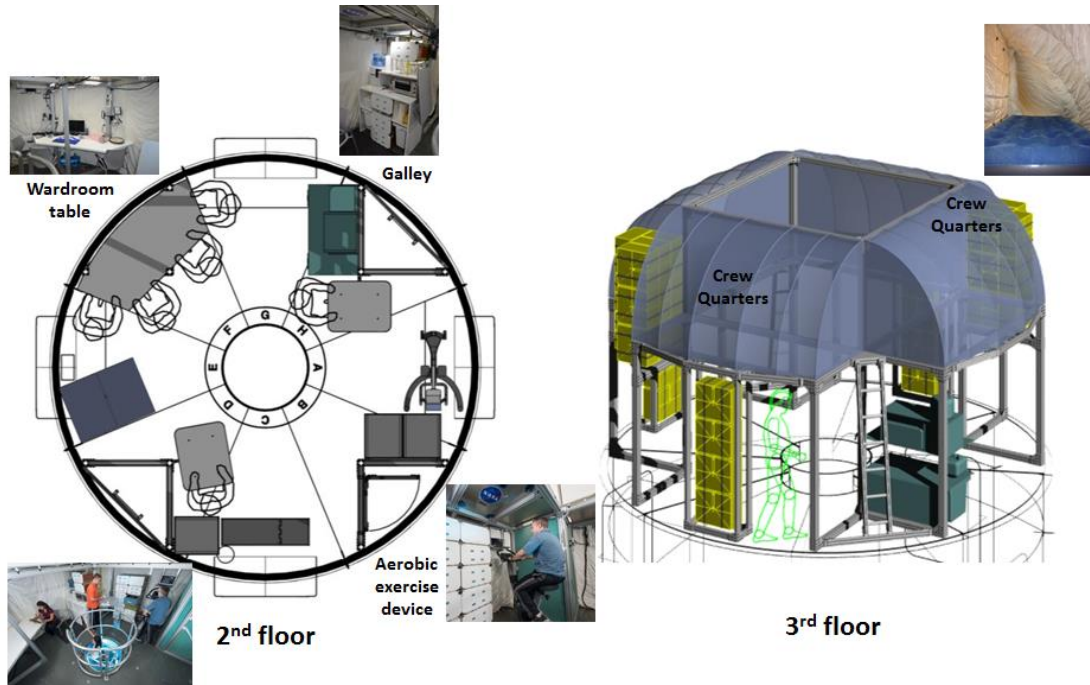


Figure 3 HERA Second and Third Levels

HERA STANDARDIZED CONDITIONS

- Duration: Up to 45 days confined habitation specific to science requirements; approximately 66 total study days inclusive of 14 days pre- and 7 days post-confinement
- Light/Dark Cycle: Lights on 0700, lights out 2300, 7 days per week,
- Typical crew day schedule requires 16 hours awake, 8 hours sleep scheduled, no napping is permitted
- Crew mission schedule based on ISS crew schedule, modified to reflect exploration mission activities and events
- Mission scenario constructed to simulate varying degrees of workload and includes specific stressful conditions commonly encountered in space flight
- Crew has no access to internet content, social media, television/radio, and telephone. Crew allowed private family conference and private medical conference once per week.
- Continuous monitoring of crew members during isolation, excluding sleep quarters, hygiene module, and private family/medical/psychological conferences

HERA FACILITY CAPABILITIES

- Mission Control Center (MCC) for real-time interaction with HERA subjects
 - 24/7 mission video surveillance with audio
 - Voice communication recordings between HERA and MCC of the mission
 - Communications delay, voice and/or text, up to 10 minutes each way

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- Simulation of AOS/LOS (Acquisition of Signal/Loss of Signal) of varying duration **
- Ability for investigator data collection to occur via the internet through pre-approved websites and forms
- Study and mission data product distribution through TSC WebMirage
 - Mission data includes temperature and relative humidity
- Limited real-time access to surveillance video for study team
- Two High Definition Pan/Tilt/Zoom cameras
 - 1080P at 60 Frames per second
- Medical Workstation
 - Remote medical procedures and examinations
 - Biological sample collection
 - Venous blood/saliva/urine**/fecal** collection
 - Heart Rate Monitoring to support cardiovascular exercise or research
 - Ultrasound to support research or medical objectives
- Adjustable LED lighting on Level 2
- Simulated stowage module (pass through for hardware and garbage shoot)
- Flight Simulator to support an exploration mission scenario
- Virtual reality for simulated EVA tasks**
- Modifiable window views
- Ability to control temperature and humidity for subject comfort.
- Exercise equipment (cycle ergometer, yoga mat and weights) to simulate daily operational activities.
- HERA-provided Windows-based laptop and iPad for each crew member for investigator data collection

** New capabilities for 2016/2017 campaigns

HERA DIETARY CONDITIONS

Participating subjects will be provided a minimum of 3 meals each day. Diet and core menu is based on NASA spaceflight nutritional requirements. Once a crew is selected, specific crew member caloric requirements are determined using the Mayo Clinic calculator. A core menu of food items is provided with a flight like combination of thermostabilized, rehydratable, and natural food items. Food items may be provided by the JSC Food Lab as well as off the shelf food items as needed to meet caloric requirements. Feasibility of studies with specific dietary needs will be assessed on a per study basis. Investigators should budget for study related dietary requirements that are beyond what is typically provided in the HERA missions.

NASA FLIGHT ANALOGS PROJECT TEAM RESPONSIBILITIES

- Prepare complement protocol submission for the JSC Institutional Review Board (IRB) for the campaign.

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- Maximize resources by combining individual investigations into integrated studies within a campaign.
- Develop customized mission scenario and stressor plan as needed to meet investigator requirements
- Ensure consistency for studies in the campaign by maintaining identical HERA study conditions and mission scenario for all missions in the campaign

Pre-Mission

- Develop and manage schedules associated with implementation of integrated studies
- Coordinate investigator meetings
- Coordinate preparation and submission of the complement package to the JSC IRB
- Assist the investigator in acquiring a Telescience Center (TSC) account to enable the capability to transfer electronic data from HERA to remote investigators via the TSC
- Facilitate access to NASA LSDA for approved PI data sharing agreements
- Recruit and perform standard subject screening through the JSC Test Subject Screening (TSS) facility
 - Provide subject reimbursement and transport for study purposes
- Coordinate receipt of investigator hardware shipment and coordinate with the investigator for integration, setup and checkout of their hardware
- Provide facility and mission training
 - Coordinate PI specific training for all primary and secondary crew members
 - Provide test subject facility and medical staff orientations
- Coordinate on-site PI baseline data collections
- Conduct integrated Test Readiness Reviews, safety walk-throughs and operations check-outs prior to starting the study

Mission

- Provide 24/7 real-time on-site mission support for all mission operations.
- Provide medical monitor and psychological support as required throughout mission operations.
- Provide a daily operational status report during mission.

Post Mission

- Coordinate post study subject follow up testing and debriefings if required.

CAMPAIGN CHARACTERISTICS AND STUDY REQUIREMENTS

A HERA Campaign is defined as one integrated protocol with one primary mission scenario. An integrated protocol consists of a number of individual investigator studies that can be combined

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on a non-interference basis. Each campaign is expected to consist of 4 to 8 missions, providing a total of 16 to 32 subjects for each study. Power analyses for each study will determine the number of missions needed to achieve the required study sample size.

- Each HERA mission will consist of:
 - *Access to the subjects for mission activities:*
 - Up to 14 days of pre-confinement activities (i.e. baseline data collection (BDC), training, informed consent); final duration will be dependent on research requirements
 - In phase (confinement) 45 days depending on campaign requirements.
 - Up to 7 days of post-confinement activities (i.e. endpoint data collection, debriefing); final duration will be dependent on research requirements
- To support the isolation requirement, no access to email, phone calls or the internet will be allowed; family conferences are scheduled. FAP personnel will send news in periodic uplinks (exception for family emergencies which require intervention) consistent with simulating the space flight condition.
- A mission control center (MCC) is located within Building 220 to support HERA operations including surveillance, communications, computers and phones. The extent of investigator support during the testing will be determined in each case.

SUBJECTS REQUIREMENTS

- Four subjects per mission
- Goal of 50/50 male:female ratio for each mission and campaign
- Age range from 26 – 60 may be considered for candidate subjects; the preferred age range is from 30 to 55.
- Height limited to 6'2" maximum
- Technical Skills demonstrated through professional experience. Advanced degree (e.g. M.S., M.B.A.) or equivalent years of experience.
- Must have demonstrated motivation and work ethic similar to the current astronaut population.
- Psychological assessment by a clinical psychologist to qualify for participation
- Astronaut-like characteristics that are considered during HERA test subject selection include the following criteria used in astronaut selection:
 - The requirements for Astronaut Candidates are a bachelor's degree from an accredited institution in engineering, biological science, physical science, or mathematics. Quality of academic preparation is important.
 - An advanced degree is desirable and may be substituted for experience as follows:
master's degree = 1 year of experience,
 - Doctoral degree = 3 years of experience.

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SUBJECT DAILY AND WEEKLY WORK REQUIREMENTS

The operational plan uses the ISS Program nominal 24-hour work day structured as a guideline. Below is the HERA mission plan:

- All time spent in the facility will be working on tasks related to the study.
- Subjects awake at 0700 and are off duty at 2300 with one shift operation for all subjects.
- Sleep period (8.0 hours).
- Post-sleep period, includes morning meal (1.5 hours).
- Daily planning conferences, medical conferences, work preparation, and plan familiarization (2.0 hours).
- Work, consisting of scheduled research tasks and HERA operations tasks, i.e. HERA maintenance, flight simulator for an asteroid based rendezvous mission, public affairs office, education outreach, etc. (6.5-8.0 hours).
- Midday meal (1 hour).
- Exercise period (1.25-2.5 hours, includes time for setup, cardiovascular/resistive exercise, stowage, hygiene (cool down and cleanup)).
- Pre-sleep period, includes evening meal (2.0 hours).
- A nominal 7 day work/rest cycle will consist of 5.5 days available for working planned utilization and non-utilization activities and 1.5 consecutive off-duty days. Housekeeping and 1.0 hour of scheduled work on the weekends is included in the 5.5 working days.
 - Rationale: The crew week should align as closely as possible to the typical ground work week. Nominal scheduling of consecutive days off during a 7 day week for ISS crews is a behavioral health and medical countermeasure necessary for maintaining individual health and performance as well as maintaining performance and effective functioning of the entire crew as a unit. In a nominal 7-day week the crew works 5 days and the 6th day is a half duty day for housekeeping and 1 hour of scheduled work. The 7th day is a full off duty day. For planning purposes, the one hour of scheduled work may be planned across the 6th and 7th day.

HERA SUBJECT RECRUITMENT AND SCREENING

The NASA JSC TSS provides advertising, recruiting and health screening for subject candidates. Once subjects pass the health requirements of the TSS, they will be provided to FAP to coordinate any additional screening required by investigator studies. Only subjects who pass all screening (psychological and physiological) criteria will be considered for enrollment in the campaign.

INVESTIGATOR RESPONSIBILITIES

- Participate in meetings with Flight Analogs Project team and investigators of other studies to develop integrated protocols to support a campaign.
- To be cognizant of the campaign schedule deliverables for investigators.

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- Ensure the investigator study requirements are compatible with the standard conditions of HERA to the degree that this is possible without compromising scientific results
- Provide for on-site or remote study support at the HERA facility at Johnson Space Center, Houston TX including investigator resources and scientific expertise as needed.
- Budget for costs associated with on-site support
- Carry out investigator science according to protocols with integrity and professionalism
- Participate in periodic data debriefs
- Provide complete experimental data sets to the NASA Life Sciences Data Archive per the terms and conditions of their grant
- Provide manuscript(s) within 2 years of study completion for inclusion into final project report

INVESTIGATOR PREPARATIONS FOR HUMAN SUBJECTS BOARDS

- Work with the FAP Project Scientist to determine needed approvals from the investigator's home institution.
- Prepare individual protocol submissions with the assistance of FAP Project Scientist to the JSC IRB

INVESTIGATOR RESOURCE/FISCAL RESPONSIBILITIES

- The investigator will provide resources for their experiment unique requirements
- The investigator will provide subject consent briefings for their specific study
- The investigator will have responsibility for the costs of any investigator protocol specific screening requirements, equipment, and other investigation specific requirements.
- The investigator is responsible for costs associated with his/her specific protocol operations
- The investigator is responsible for test subject travel costs for follow up testing required beyond the standard schedule
- The investigator is responsible for data sharing arrangements with other investigators.