

CREW AND THERMAL SYSTEMS DIVISION
 NASA - LYNDON B. JOHNSON SPACE CENTER
 HOUSTON, TEXAS

CTSD GENERIC EVA OPERATIONS PLAN

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Prepared By:	(HSMS) Sandy Anderson/HSMS
Approved By:	(Branch) William Spenny/EC5
Concurrence:	(Other) Glenn Lutz/EC5
Concurrence:	(HSMS) Charlie Porter/HSMS
Concurrence:	N/A

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REVISION

REV. LETTER	DATE	AUTHOR	SECTION	BRANCH	OTHER	DIVISION
N/C	10/28/95	Barbara Counts/HSMS	HSMS			
A	10/25/96	Sandy Anderson/HSMS	C. Porter	S. Poulos	B.Sauser	
A-1		Sandy Anderson/HSMS	C. Porter	G. Lutz	B.Sauser	
B	9/5/97	Sandy Anderson/HSMS	C. Porter	G. Lutz	W. Spenny	
B-1	11/6/97	Sandy Anderson/HSMS	C. Porter	G. Lutz	W. Spenny	
C	10/29/98	Sandy Anderson/HSMS	C. Porter	G. Lutz	W. Spenny	
D	3/31/00	Sandy Anderson/HSMS				

1.0 INTRODUCTION

This plan identifies the procedures that will be followed by CTSD and contractor personnel to provide real-time support for Space Shuttle flights that involve scheduled, unscheduled or contingency EVA activities. Interfaces with other supporting contractors or organizations are given. Details involving mission support provided by these organizations must be obtained from the mission support plans, which they generate and publish.

2.0 SCOPE

The scope of this plan is to describe the overall participation of CTSD/NASA and EMU/EVA personnel, their assigned organizational support areas and to delineate those functions and responsibilities during real time EVA activities. This plan is applicable for all shuttle missions. Mission specific details and personnel assignments will be provided as an appendix to this document ten days prior to a planned launch.

3.0 OBJECTIVES

The objectives of CTSD/EVA Mission Support are to provide real time technical support for all EVA activities, related mission anomaly investigations and contingency task evaluation as needed.

- 3.1 To monitor all EVA activities and EMU consumables
- 3.2 To define support responsibilities and communications protocol
- 3.3 To respond to questions and anomalies in support of real time EVA decisions
- 3.4 To record and maintain a permanent log of all EVA comments, problems, and experience
- 3.5 To provide and maintain a trained Mission Support Team
- 3.6 To provide a dedicated mission support work area

4.0 CTSD EVA MISSION SUPPORT OVERVIEW

4.1 Support organizations involved in this plan are:

- 4.1.1 Hamilton Sundstrand Management Services
- 4.1.2 Hamilton Sundstrand Space Systems International
- 4.1.3 ILC Dover
- 4.1.4 NASA/JSC Crew and Thermal Systems Division, EC
 - EC2 – Thermal Systems and Engineering Support Branch
 - EC4 – Systems Test Branch
 - EC5 – EVA and Spacesuit Systems Branch

Other organizations (i.e. USA, Lockheed, EC3, etc.) have their own mission support plans. Copies of these plans are sent to the EC Mission Support Coordinator or Mission Manager prior to launch.

4.2 The following facilities are dedicated to provide mission or mission simulation support:

- Mission Evaluation Room (MER), Bldg. 30S, Room 1345
- CTSD Central Operations Room for EVA (CORE), Bldg. 7A, Room 323

The following support areas are available for flights involving payloads that require EVA interface:

- Customer Support Room (CSR), Bldg. 30, Second Floor, x37995
- Conference Room, Bldg. 7A, Room 130, x34933
- Auditorium, Bldg. 7A, Room 141, x34207

In case of an in-flight anomaly, these facilities may be used by CTSD and other supporting personnel. Contacts and protocol are referenced in the mission specific plan, Appendix A:

- 11 Foot, ETA, and 8 Foot Chamber, Bldg. 7 High Bay
- CTSD Bonded Stores, Bldg. 7A, Room 320
- LSS/GSE Laboratory, Bldg. 7A, Room 239
- Neutral Buoyancy Lab (NBL), Sonny Carter Training Facility
- Crew Compartment Trainer (CCT), Bldg. 9A
- Air Bearing Table, Bldg. 9A

5.0 LEVELS OF SUPPORT BY FLIGHT TYPE

Levels of EVA support are determined by each flight's Flight Requirements Document, NSTS-17462-XX. FRDs are available via the internet at: <http://sspweb.jsc.nasa.gov/pils/>

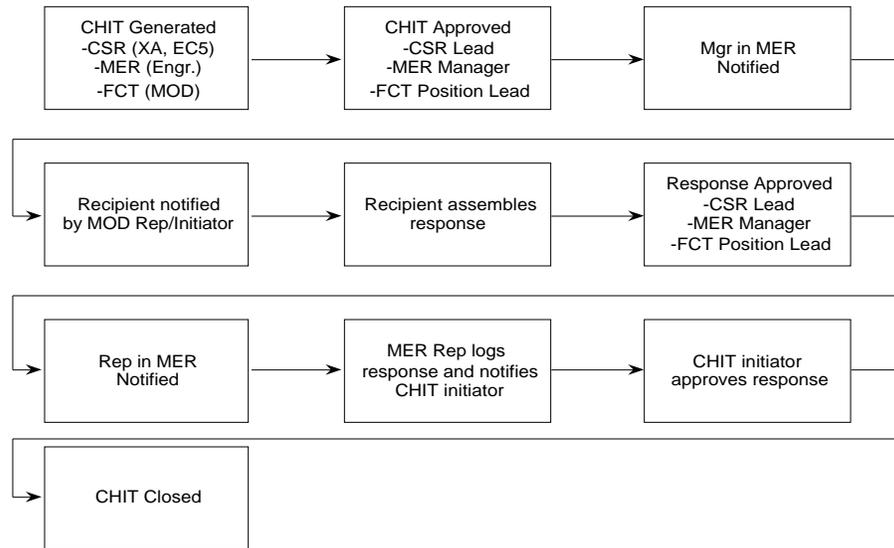
- 5.1 Scheduled EVA Flight is a mission with one or more EVAs included in the Flight Plan. The MER is fully staffed throughout all EVA activities. Assigned personnel are on-call during periods before and after EVA activities. The CORE is supported only during EVA activities. Otherwise, personnel are considered on-call at all times. CORE activation and shutdown is planned per the mission specific appendix but must be approved by MER Console Engineers. Support personnel may leave their stations for the day when all EMU/EVA activities are complete and concurrence is received from the MER Manager, or as directed by the EMU Subsystem Manager. Supported EVA activities include the Airlock equipment prep, the EMU checkout, EVA prep and donning, depress/repress, the actual EVA plus post EVA activities including EMU maintenance/recharge required to support a second planned EVA or the standard orbiter contingencies.
- 5.2 Non-EVA Flights are flights for which no EVA activities are scheduled. The MER and the CTSD CORE are not staffed. A mission specific support plan will be issued for use in the event that support is needed. Assigned personnel are considered on-call from launch until landing.
- 5.3 An Unscheduled EVA results from unforeseen developments during a flight that lead to one or more EVAs being conducted for mission success. Since by definition, no procedures or timelines exist for any unscheduled EVA, this type is much more likely to require chamber or NBL runs. These would be used to verify procedures and timing before the EVA instructions were up-linked to the crew. Once the decision has been made to go EVA, an unscheduled EVA flight is supported exactly as a scheduled EVA flight.
- 5.4 Contingency EVA is similar to an unscheduled EVA flight in that it results from problems that occur during a flight. The difference is that the problems that could lead to such an EVA have been foreseen and detailed procedures already exist. Examples would be EVAs required to close a malfunctioning payload bay door or to jettison the Ku-Band antenna. All crews are trained in such contingency procedures in the NBL. Two EMUs and associated hardware and expendables sufficient to accomplish three two-man EVAs are manifested for all non-EVA flights for such contingencies. This is a Level II requirement that is imposed by NSTS 07700, Volume X. As with an unscheduled EVA, once the decision has been made by the Flight Director to go EVA, a contingency EVA flight is supported exactly as a scheduled EVA flight.
- 5.5 MOD EVA Training Simulations are supported by on a case by case basis. These simulations are supported as close to flight like as possible. Differences from actual flight processes will be presented during briefings to prevent negative training.

6.0 EVA FLIGHT SUPPORT POSITIONS AND RESPONSIBILITIES

The Mission Support Team consists of trained EVA support personnel. Management approval of the support plan documents personnel certification.

- 6.1 MER EVA is the central point of contact for all flight-related EVA technical issues. This position serves as the engineering back room to MOD. Communications is direct with the MOD Mission Planning and Support Room, MPSR via the DVIS communications system. MOD will specify DVIS protocol preflight but generally, EVA SUPPORT will be used as the primary loop. Communications with the MER Manager can be either via DVIS loop MER MGR-1 or via e-mail. Actions to the CORE are handled by telephone but permission can be obtained from the MER Manager to use a MER DVIS loop if needed.

The MER facility is managed by the Operations Engineering Office/MV3. Any PC's brought into the MER must be checked in to have a quality stamp for power requirements. Pagers are allowed.
Cellular phones are prohibited.



Formal actions during flight are typically handled as a CHIT. The CHIT process is defined in the flow chart above. The MER workstation is used to create, answer, and approve these CHITs.

6.1.1 The MER console is supported by two people. 1st chair MER is the position which is responsible for making real-time EMU engineering decisions during EMU checkout and the EVA. During non-EVA shifts, the person in the 1st chair position does not need to be MER console certified, but he or she should be in the process of becoming certified. The 2nd chair MER console position supports the 1st chair position, keeping logs, running CHITs, faxing and e-mailing information as necessary, etc. This person must also be in the process of becoming MER console certified. These positions are filled by HSMS/ILC engineering personnel. Duties include:

- a) Prepare for all flights in advance by reviewing applicable hardware test data, failure history/workarounds, and most likely problems given recent hardware history and EVA rules and procedures.
- b) Configure and bring up the MER EVA console for support. This involves starting up the workstation console, Laptop MER Log, and accessing the needed DVIS voice loops.
- c) Monitor all comm. loops, EVA parameters, and video downlink for EMU/EVA related issues.
- d) Maintain a log of support provided by MER EVA personnel, including NASA.
- e) Monitor all EMU consumables management (i.e., LiOH, battery, O₂) in accordance with the HSSI EMUM and EVA Console Handbook.
- f) Generate graphs and printouts of EMU parameters.
- g) Log all EMU/EVA comments made by the crew. Make note of any unusual occurrences in the video downlink, such as unusual movements, difficulty in movement, etc.
- h) Maintain communications between MOD, EC, and XA during each shift turnover.
- i) Support or lead any CHIT or IFA action received during flight. Notify MER Manager of all formal actions in work by the EVA console. Assign and track actions delegated to the CORE. Notify the CORE when a problem has been solved or an issue closed or canceled.
- j) Provide all technical support required in answering inquiries from the EMU/EVA MPSR and the MER Manager.
- k) Provide a written report of significant events including times and resources used at the end of each shift to the MER manager. Distribute via e-mail to EVA management.
- l) Record all EMU time/cycle data and submit a copy to USA Engineering.
- m) Make copies of the MER EVA console logs and graphs and provide to the Mission Manager at end of mission.
- n) Conduct all required post-mission analyses, obtaining data from the MER workstation laptop files and CORE logs.

6.1.2 Mission Manager Specific Duties

- a) Issue Appendix A, flight specific support details, due launch minus 10 days
- b) Prepare and present preflight mission briefing for all support personnel

- c) Be cognizant in EMU hardware aspects
- d) Maintain mission-related procedures, instructions and plans, logs, files and indexes.
- e) Prepare the MER and CORE books for that mission.
- f) Maintain mission action list with current status.
- g) Ensure adequate staffing during EVA operations.
- h) Update the flight experience database, crew comments and anomalies lists.
- i) Generate and release the EMU/WCS Flight Experience Chart after the mission.
- j) Support from building 7A CORE or in the building 30 MER during missions as needed.
- k) Attend MER post-flight IFA review, typically landing plus one day. With XA support, coordinate IFA tracking and hardware return from KSC. Communicate meeting decision to EMU management.
- l) Lead/monitor post flight In-Flight Anomaly process.
- m) Attend the post-flight EVA crew debrief, log comments and generate/track/close any applicable mission related actions.

6.1.3 NASA EMU SSM position is the responsibility of CTSD/EC5. The SSM is responsible for evaluating the functional criticality of any part involved in a flight anomaly. He or she is also responsible for evaluating the mechanical criticality of the part, providing a history and possible cause in writing to the MER manager. In case of an EMU anomaly, the SSM has the authority to request suited test support at his or her discretion. All support is initiated through the MER manager. Chamber support is also requested through building 7A, room 130, CTSD management, x34933 or the EC4 Branch Chief as listed in the mission specific appendix.

6.2 CTSD Central Operations Room for EVA (CORE)

The CTSD CORE will be staffed during scheduled EVA activities or planning as required by NASA. Activation and shutdown of the CORE not documented in a plan will be authorized by EC/EC5 management or the MER Team. EC/EC5 management will also notify other EVA organizations of the CORE status. The duties and responsibilities of the CORE are summarized below.

6.2.1 CORE primary duties include:

- a) Notify Mission Manager, SSM, and support personnel of unexpected changes to the timeline.
- b) Maintain a complete, chronological, legible log of all support provided by the CORE.
- c) Assign and maintain a status of all actions received from the MER or from other supporting organizations.
- b) Log in all EVA/EMU comments made on any DVIS loops.
- d) Run the voice activated tape recorders and the VCR.
- e) Operate the Flight Data System (FDS) as follows:
 - i. Maintain/operate the Flight Data System.
 - ii. Prepare for all EVA flights in advance by reviewing applicable hardware test data, failure history and EVA rules and procedures, as well as the LSS Engineer's calculated consumable curves.
 - iii. Real-time provide hard copy of FDS data, graphs of metabolic rates, O2 use rates, primary bottle pressures, battery voltages and currents for EVA crewmen.

6.2.2 CHIT Chasers are called in by CORE personnel as needed. This person will lead the effort required to respond to any CHIT received by the EMU/EVA Team until the CHIT or anomaly is closed. Status of the effort will be maintained in the CORE. Coordinate post-flight troubleshooting plan for any hardware anomalies or funnies.

6.2.3 On-call Personnel

If additional staffing is needed to work issues they will be called in by the Mission Manager, MER Team or HSMS/ILC management. A list of personnel on-call will be provided for each mission. All personnel called in to support EVA activities will report to the CORE. Duties covered are as follows but not limited to:

- a) Act as "CHIT Chaser" for the MER and CORE. This means obtaining hardware from Bond, procedures or drawings from Data Center, running data faxes, etc.
- b) Hardware/mockup preparation if needed.
- c) Transcriptions, copies, data research.

7.0 INTERFACES WITH SUPPORTING ORGANIZATIONS

7.1 Hamilton Sundstrand Space Systems International, Inc.

HSSSI personnel will be on-call during non-EVA flights through their work or home numbers. During scheduled EVA flights, a mission support room will be staffed with representatives from Systems and Electrical Engineering. HSSSI will have the capability of monitoring downlink video and downlink FDS information. A support plan is issued after launch.

7.2 ILC Dover

ILC Dover personnel will be on-call during non-EVA flights through their work or home numbers. During scheduled EVA flights staffing will consist of a Systems Engineer and a Glove Engineer. Their support is included in the Hamilton Sundstrand plan.

7.3 United Space Alliance FCE/EVA group

The USA contract and statement of work require them to provide Class I hardware for a chamber run and/or Class III hardware for a NBL run or Bldg. 9A support from their normal processing flow should this hardware be requested to support an anomalous condition. This scenario is applicable for scheduled EVA flights only. The USA SOW states that support for non-EVA flights must be determined in advance by MV. All actions required from USA must be requested from their Mission Manager. Their support plan is published approximately one week prior to launch.

7.4 SCTF and Building 9 Trainers

Facility support required for Sonny Carter Training Facility, SCTF and the Building 9 Trainers will be initiated by the MER Manager.

7.5 EVA Subsystem Engineering Support

JSC Subsystem engineering support will be provided in building 30 MER and the 7A CORE during EVA activities.

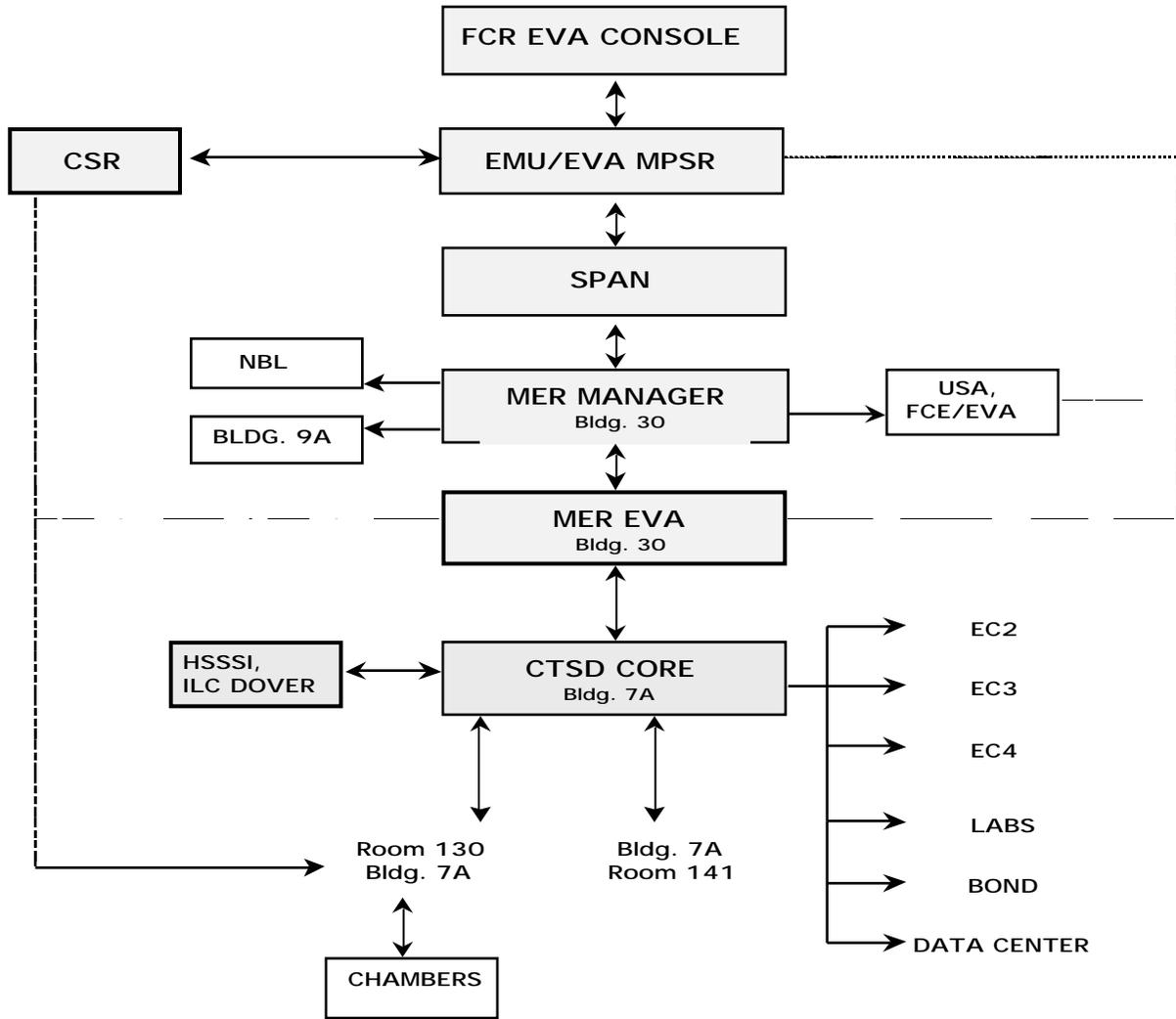
7.6 Payload/Vendor Interface

Interfaces with payload vendors will be determined and level of support agreed to before each flight. The mission specific support plans put out by those organizations and the applicable Appendix A to this generic plan will call out such interfaces.

APPENDIX A MISSION SPECIFIC

Appendix A to this document will be released one week prior to the scheduled launch of every shuttle mission.

COMMUNICATION NETWORK FOR SCHEDULED EVA FLIGHTS



Legend

- Realtime Support of On-orbit EVA activities
- On Call Support As Needed

- Communication path for responding to calls, actions initiated above
- Direct two-way contact allowed for non-mission critical requests