CONTRACTUAL HISTORY OF MAJOR IMPLEMENTATION AND OPERATIONS MILESTONES

April 1962

The Philco-Ford Western Development Laboratories (WDL) in Palo Alto, California was awarded a letter contract to perform a development study for Manned Space Flight Operation Control and Support. The result of that study was the system requirements and preliminary specifications for the Mission Control Center-Houston (MCC-H) as required to support the training, simulation and control for the Gemini and Apollo Missions. The results of this contract became the basis for the present MCC systems.

March 1963

Philco-Ford WDL was awarded NASA Contract NAS 9-1261 for the design, development, implementation, and maintenance and operation of the Mission Control Center-Houston. The implementation of this contract required that WDL establish the Philco-Ford Houston Operation (PHO). PHO, through its successful performance of NAS 9-1261, has remained a significant operation of WDL.

March 1965

The MCC-H monitored the control of the Gemini III mission with primary control responsibility resting with the Mission Control Center at Cape Kennedy (MCC-K). The MCC-H came on line and, though all systems were not in a completely tested and operational support mode, the MCC-H operated in such a manner as to convince NASA authorities that it could control Gemini IV with a high probability of satisfactory performance. PHO had been responsible for the MCC-H launch data, display/control, communications, and SCATS systems implementation. In addition, PHO had developed the requirements for the RTCC and the Communications Processor Systems. Also, PHO had installed and checked out the GFE Master Digital Command System.

June 1965

PHO, along with NASA and associate contractor personnel, manned the MCC-H to control Gemini IV with MCC-K functioning as backup. With the successful control of Gemini IV, the MCC-H became of age operationally and MCC-K was deactivated. The "H" was dropped from the name and Houston became the control center for all NASA manned space flights. While Gemini was being controlled from the third floor, PHO continued making the second floor of the MCC ready to control the Apollo-Saturn Series 200 missions.

November 1965

PHO was awarded the maintenance and operation of the MCC in addition to MCC logistics support. The Apollo Launch Data System (ALDS) became operational.

February 1966

PHO was awarded the Apollo Instrumentation Operations task. The task called for PHO to provide console operators for Telemetry Instrumentation, Tracking, Command, Communication Control, and Network Control. The task was fully manned in January of 1967 and has since been amended to provide ALSEP control.

The first mission was controlled from the second floor of the MCC. The mission was AS-201 and was unmanned.

June 1966

PHO, after a successful competition, was awarded NAS 9-6173 for the Apollo Process Control Unit (APCU). APCU incorporates a general purpose operating system including an executive system (SIMEX), assemblers (JIFI), symbolic-tape updater (STU), and other program development tools.

Major functions of the APCU include processing of telemetry data from the orbiting vehicle, format and output displays, format and output high-speed data and teletype printouts, reception and storage of digital commands for subsequent transmission to the vehicles, and processing and formatting of data for transmission to the Mission Control Center.

July 1966

PHO was awarded Schedule II of NAS 9-1261. Schedule II included CPFF/CPIF/CPAF provisions and was for two years duration. The incentive/award fee grading method was mutually concluded and imposed in January of 1967. The CPIF method consisted of a performance/cost interdependency whereby the performance grade was achieved by a mix of objective and subjective criteria which was graded by government task monitors. Logistic effort was on a CPAF arrangement and manual edition orders were CPFF, as were the entire first 6 months of Schedule II while incentive arrangements were being negotiated.

January 1967

The Communication, Command and Tracking System (CCATS) became operational. With the advent of CCATS, the MDCS was deactivated. The CCATS in the MCC provides the capability of simultaneously performing the functions of digital communications data handling, telemetry data decommutation and distribution and digital command initiation, verification and control. The nucleus of the CCATS consists of a real-time digital computing system (three Univac 490/494 computers) which processes and distributes large volumes of data on a real-time basis. With two exceptions, all incoming and outgoing traffic passes through the Communications, Command and Telemetry System (CCATS). The exceptions are television transmission lines, which are routed directly to the display and control system, and private telephone lines, which are routed to individual telephone sets located throughout the MCC.

July 1967

The Apollo Simulation Checkout and Test System (ASCATS) became operational in Building 422. ASCATS creates realistic simulations of Apollo missions for training of flight control and tracking station personnel. ASCATS integrates the MCC simulations with flight crew trainers at the Manned Spacecraft Center or at Kennedy Space Center. The MCC can be exercised from simulation control consoles, using source data from the flight trainers, ASCATS special equipment, a ground support simulation computer, or any combination of these.

November 1967

The first AS-500 series mission was controlled from the third floor of the MCC, which had undergone a major modification and reconfiguration since the last Gemini flight had been controlled. The mission was AS-501 and was unmanned.

July 1968

PHO was awarded Schedule III to Contract NAS 9-1261. Schedule III consisted of a one year contract plus two 1-year options which were subsequently exercised by the government. The CPFF/CPIF/CPAF arrangements continued with some adjustments to allow for Apollo requirements.

October 1968

The first manned Apollo mission was controlled by the MCC from the second floor. The mission was AS-205.

December 1968

Mission AS-503 (Apollo 8) was controlled from the third floor. This was the first manned 500 series mission.

March 1969

The Lunar Landing Training Vehicle (LLTV) operation task which had been added to Schedule III of NAS 9-1261 became operational. PHO provides two 4-man controller teams certified for the LLTV program. They operate the vehicle consoles during simulations, test flights and training flights. Control procedures are patterned after those used in directing Apollo missions from the MCC. The LLTV is a nonaerodynamic machine powered by rockets and a jet engine. Of all training equipment available, it most closely simulates in earth atmospheric flight the lunar module spacecraft's actual approach and touchdown on the moon.

March 1969

The Apollo Lunar Surface Experiments Package (ALSEP) ground support equipment became operational for Apollo 11. ALSEP Monitoring and Control System was the fifth major system to be implemented in the MCC.

May 1969

The APCU, which was developed by PHO under contract NAS 9-6173, was added to Contract NAS 9-1261, Schedule III.

July 1969

In July 1969, the first lunar landing mission, Apollo 11, was controlled by the MCC. With the success of Apollo 11, PHO deactivated the second floor since future Apollo missions needed only the third floor for mission control. Also, Option I of Schedule III to NAS 9-1261 was exercised by the government. The CPAF/CPIF/CPFF arrangement was continued with minor revisions; a sizable manpower reduction was accomplished to compensate for the reduced launch rate.

August 1969

ASCATS was relocated from Building 422 to the second floor of MCC by PHO. This relocation was executed to a very demanding schedule so as not to degrade the mission readiness simulation and checkout support.

January 1970

PHO provided the System Configuration Unit (SCU) for CCATS. The SCU is a device which provides multi-switching functions for the CCATS computers and its use significantly increases the flexibility and utilization of CCATS.

July 1970

The prototype Digital Television Equipment (DTE) was installed within the MCC for evaluation. The DTE provided a totally electronics capability of converting certain RTCC 360/75 digital output data into a high-resolution video picture. This function had previously been accomplished by the electronics-electro/mechanical/. optics DTV equipment. The DTE will replace the obsolete DTV equipment.

The government exercised Option II of Schedule III to NAS 9-1261. CPFF/CPIF/CPAF provisions were continued.

December 1970

PHO provided the Field Sequential to National Television Standards for Color (NTSC) converter for the MCC. This converter accepts sequential video signals from the spacecraft or lunar surface and converts them into a color TV picture suitable for television networks.

July 1971

The MCC controlled Apollo 15, the first mission to carry the Lunar Rover Vehicle. Also, in July of 1971 PHO was awarded Schedule IV to NAS 9-1261. Schedule IV is a thirty (30) month CPAF contract replacing the CPFF/CPIF/CPAF Schedule III.

PHO received direction from NASA via TA P2HOO to assume System Engineering responsibilities for specific RTCC interface System elements, (exclusive of software). This support includes (1) System planning and Analysis; (2) Detailed design and Implementation; (3) System Integration; (4) Documentation Control and Update. A series of coordination meetings were held with IBM in order to ensure an effective transistion of responsibilities in these areas formerly referred to as IBM Special Equipment.

September 1971

PHO provided the Computer to Output Microfilm (COM)equipment. This equipment takes computer output tape and converts it directly to a microfilm image which can then be viewed on special viewers. The use of this system constitutes a new discipline in the MCC mode of near real-time data display and analysis.

October 1971

The second floor of the MCC was reactivated prior to being modified for the control and support of Skylab.

January 1972

The engineering model alpanumeric CRT Terminal for the MCC Terminal System was installed in the MCC. The MCCTS is a system designed to provide users with access to applications programs within the RTCC via a network of remote terminals located within the geographic bounds of the United States. User terminal devices may include equipment ranging from simple alphanumeric devices to computers.

PHO Engineering assumed engineering and programming support for the ground equipment and computer programs used to process the Earth Resources Survey Program data. This included but was not limited to the Data Reformatter Assembly (EO 001K). Passive Microwave Imaging System Data Analysis Station (EO 007K), Multispectral Scanner DAS (EO 004K) and the Multi Imaging Scanner System. The majority of this equipment is located in Bldg. 17.

April 1972

The first complete subsystem element of the MOPS CRT Terminal Subsystem was installed and checked out by PHO. With the successful checkout of the element the MCC now had, operational, the first major change in its operational feature that has occurred since the initial MCC concept. The change was to be a completely interactive user/computer capability.

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July 1972

PHO completed re-activation and reconfiguration of the second floor for Skylab. This effort equated to supplying 79 consoles; 319 cabinets of electronics; 626,000 lines of software code plus laying over 60,000 feet of cable, and making in excess of 120,000 cross-connects.

PHO received direction from NASA via EO 010K to develop an Earth Resources Production Processing System. Initial data processing and formatting operations must be performed upon raw earth resources data obtained from aircraft and Skylab missions prior to use for data applications purposes. The system must accept earth resources sensor data recorded on magnetic tape in various formats and techniques, and reformat and record this data in computer compatible format. PHO responsibility includes total system integration including GFE equipment, PHO developed equipment, off-the-shelf purchased equipment and computer software. Basic system definition and design, sensor characteristics and processing requirements, and task requirements were accomplished under a PHO sponsored effort prior to contract award.

August 1972

The Mass Data Storage Facility was deemed operational and ready to support the RTCC Skylab Applications Programs development. The MDSF was the first major computer system to be added to the MCC since prior to Apollo. The MDSF is a data management facility which provides for storage and management of 2.1 billion 8 bit bytes of data. The system interfaces directly with RTOS and is the data pool for the MBPS CRT Terminal users. MDSF consists of two CDC CYBER 73 mainframes; 24 844-disk drives; 6 9-track tape drives plus the necessary controllers and peripherals to make a functional system.

October 1972

PHO assumed responsibility to furnish systems engineering and programming support for the Medical Information Computer System (MEDICS). This support includes the procurement, implementation, documentation and operation of the system.

The DTE System became operational with nine of the ten clusters. The ninth cluster is the landscape cluster, presenting 16 shades of grey for use with the DTIEOS. The tenth cluster, which is the prototype cluster modified to conform to the deliverable clusters, will be delivered and tested at a later date.

December 1972

The PHO CCATS Hardware Systems Engineering task was expanded to include UNIVAC furnished equipment. This effort includes, but is not limited to, analysis, system/subsystem design, specification development, implementation planning and acceptance/requalification testing of UNIVAC furnished equipment. A working arrangement has been established whereby UNIVAC performs the actual additions, deletions and modifications to their equipment as directed by PHO engineering instructions with the concurrence of NASA and UNIVAC.

Responsibility for the RTCC commercial equipment was added to the systems engineering task for the RTCC special interface equipment previously assumed under T.O. P-21100.

March 1973

PHO completed a modification to the CCS significantly increasing the number of loops or lines selectable from a keyset. This increase in the number of loops selectable has been implemented on thirty CCS keysets to date. The modification consisted of conbining a keyset Talk-Listen and the monitor functions of a loop appearance on one PBI instead of the two PBI's required in the original design. (EO 075E)

April 1973

All hardware deliverables under the basic MOPS Terminal Subsystem subcontract received and installed (EO 030E). MOPS is a complete digital CRT display and storage system which serves as an interface between an operator and a local or remote computer. The system provides for both operator/computer entry, and display of alphanumeric and graphics data.

June 1973

The Earth Resources Production Processing System was deemed operational upon splashdown of Skylab 2 (EO 010K). This system takes earth resources sensor data recorded on magnetic tapes in various formats and techniques, and reformats and records this data in computer compatible formats.

July 1973

A multifunction CIM capability was added for Skylab allowing individual controllers access to as many as 15 computers on 15 core segments of the mission computer in the Display/Control System. Some of the multiple functions are mission, MDRS, ASP, COHORT, etc. (EO 077F)

PHO completed a major addition to and reconfiguration of the combined Voice and Data Recording subsystem. (EO 090E and EO 173E) GFE multiplexing equipment was interfaced with PHO provided modified tape recorders to accept Skylab Voice Dump information at a rate of 1.5:1 reducing transmission time from the remote sites. An operator console was added to allow centralized control of much of the recording equipment.

A Patch and Test Facility was installed in Bldg. 12 to provide an interface between the terminals and the UNIVAC 1106 and between modems. (EO 120E) Basic facility was operational in July 1973. Subsequent requirements are being implemented at this time.

<u>October 1973</u>

A Medical Information Computer System (MEDICS) was installed for use as a real-time generalized record keeping system for users such as Skylab Crew Health Stabilization Program, JSC Dispensary Support, Flight Medicine Program, etc.

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March 1974

All applications programs on the Earth Resources Production Data System (ERPDS) were qualified to the point that full processing of Skylab data could be started. (EO 013K)

March 1975

Processing of all required earth resources sensor data from Skylab 2, Skylab 3, and Skylab 4 was completed. This processing started in July 1973 and was originally to extend through April 1974. Due to the higher than anticipated demand for the processed data, the program was extended for almost a year.

April 1975

The Screwworm Eradication Data System (SEDS), utilizing the Earth Resources production Data System (ERPDS), was deemed operational and as such was capable of processing SEDS data. This system accepts NOAA-4 sensor data that is recorded on 14 track magnetic tapes, formats and processes this data, and outputs several film products which are used in predicting areas of potential screwworm habitation. "(EO 029K)

Julv 1975

Special purpose video systems developed by SISO were operational for ASTP. These included: "the vertical internal reference signal" (VIRS) to standardize colors between SOYUZ and APOLLO broadcasts; "the digital color video synchronizer" (DCVS) which allows simultaneous split screen display of APOLLO and MCC signals and finally the "automatic color compensator" which kept the colors produced from each of the APOLLO's four onboard television cameras uniform. (EO 292F)

August 1975

The Medical Information Computer System (MEDICS) was upgraded to include a new 116 megabyte disk, additional memory, VORTEX II operating system, expanded terminal capability and execution of the online software from two frames in core. New software developments include the Keyword Retrieval program, BASIC programming from an online terminal, and the capability to perform background operations and programming while MEDICS is online.

March 1976

A new computer system (ADAPTS) was installed in the Neuroscience Laboratory. Many software enhancements have been made since the system was installed.

A complete microprocessing laboratorv was installed in Building 36. The laboratory contains an Intel 8080 microprocessor and supporting software. SISO trained approximately 150 people in operations and programming of microprocessors.

June 1976

The complete set data collection and analysis programs obtained from the University of Arizona were implemented for the Cellular Analytical Laboratory on the PDP 1145 in Building 30.

Julv 1976

Aeronutronic-Ford was awarded NASA Contract NAS 9-15014 for the design, development, implementation, test, and maintenance and operation of the Mission Control Center - Houston, covering the Shuttle Program, Design, Development, Test and Evaluation (DDT&E) period. The contract included Aeronutronic-Ford responsibilities in the following areas: Medical Data Systems (MDS), Lunar Science Data System (LSDS), Earth Resources Data System (ERDS), Software Development Laboratory (SDL), Orbital Flight Test Data Systems (OFTDS), Shuttle Operation Data Systems (SODS), Approach and Landing Test System (ALT), Shuttle Program Information Management Systems (SPIMS), Digital Avionics for Shuttle Training Aircraft (STA), Large Acreage Crop Inventory Experiment Production Data System (LACIE), and the Display Evaluation Laboratory.

August 1976

The Network Interface Processor (NIP) System was installed and qualification tested for the ALT Missions. This included the Network Communication Interface (NCI) provided under EO-091C which provides the Wideband telemetry data inter-faces with the Telemetry Pre-processing Computer (TPC) provided under EO-092C.

The MCC Equipment was relocated and reconfigured to meet the ALT Mission requirements under EO-093C. This included the relocation and reconfiguration of the telemetry equipment, relocation of the Historical Recording Facility, Relocation and Reconfiguration of all MCC Consoles and implementation of a Central Configuration Management Control Room.

December 1976

The ALTDS Software was completed on December 20, 1976. The software was configured to Revision Level B. This revision level is the one that will support Flight Control simulation commencing June 24, 1977. This software system includes a U418 and U1218 computer.

The NIP Software was completed and sold off on December 20, 1976. This software will be used to support ALT, and then modified for OFT. The software was con-figured to Revision "B" for support of simulations commencing June 24, 1977.

April 1977

The SMD-III Data System end-to-end tests were supported successfully on April 4-17, 1977. The SMD-III Varian Data System provides the capability to collect data from Spacelab Mock-up onboard experiments, and to provide real-time recording, monitoring, distribution and control capabilities in support of Spacelab III training exercises in JSC Building 36.

June 1977

The MCC successfully supported the first Captive-Active flights (CA-1A & CA-1) of the ALT Missions with the newly configured ALT equipment systems and ALTDS software.

June 1977

The new timing subsystem for the MCC provided by EO-336F was successfully Q/T and sold off to NASA in June. This subsystem replaced the older MITE subsystem which had reached its lifetime expectancy. This new system was designed to satisfy the requirements of the Shuttle program.

September 1977

The MCC ALSEP Support was terminated after approximately 8 years of successful support of 5 ALSEP packages on the lunar surface. The ALSEP lunar transmitters of all 5 packages remained on the air as navigational aids for deep space programs. All MCC equipment was deactivated to allow for Shuttle program equipment utilization.

<u>October 1977</u>

All Display Control equipment was successfully interfaced and tested with the SDPC's.

November 1977

The ALTDS was officially released from ALT Support on 9 November at the conclusion of a two week hold period following FF-5. ALTDS equipment is being relocated and dispositioned in accord with several EO efforts.

The fourth TPC (TPC-4) for the NIP System was delivered from the vendor and successfully qualification tested. This TPC is primarily being used for TPC operational S/W Development and Confidence Tape generation.

December 1977

The third NIP TPC (TPC-3) was relocated from the SISO warehouse where it had been used for hardware checkout and TCOS development to on-site and successfully qualification tested.

Januarv 1978

The TOTAL Data Base Management System Software and Extended Instruction Set hardware were accepted by NASA on 1/24/78. The TOTAL DBM software is a vendor supplied off-the-shelf data base management system. The MEDICS II system will be based on TOTAL rather that the Ford developed MEDICS software.

February 1978

The QT of the first NIP String and QT-B (MBI) for the Launch and Landing Interface Unit was successfully accomplished.

March 1978

The TPC software to the SDPC software interfaces were successfully demonstrated by use of a Confidence Tape at the front of the system with the SDPC driving displays at the end of the system.

The QT of the second NIP String was successfully completed.

April 1978

The MEDICS and MEDICS II Computer Systems were moved from NASA Building 30-to Building 37 under EO-040M and successfully requalified.

The NIP String 3 was successfully tested and sold-off by QT during the month.

The Network Output Multiplexer (NOM) under EO-332E was also successfully soldoff by QT in April.

Mav 1978

The Multi-bus Interface (MBI), EO-086D, has been completed with the successful running of its QT-A and QT-B in May.

June 1978

The NIP String 4 was successfully OT'd. This completes the individual qualification testing of all four NIP systems and all that remains is an overall system test scheduled for July.

The SISO Software groups successfully qualification tested the TCOS Version C Software Checkout Software, and the TPC OPS Software for OFT during June. These software programs have been turned over to Operations for IBM and equipment systems support.

Julv 1978

The Analog/Event Distribution Subsystem (EO-345F) was successfully qualification tested on July 7 and turned over to M&O for operational use.

August 1978

The design and delivery of prototype Universal Emulating Terminals was successfully sold off under EO-348F.

October 1978

The A/G Voice System (EO-384E) Phase I was implemented and successfully Q/T'd in October.

November 1978

The system PDR for STS and POCC was accomplished successfully in conjunction with NASA/JSC and other contractors.

December 1978

The Building 12 communication patch and test facility (EO-350E) was completed and turned over for operational use.

January 1979

SISO was turned on February 3, 1978, to develop and implement a SKYLAB Monitoring System as part of NASA's effort to prolong the SKYLAB's time in orbit. The system was to accept block format data from Goddard and display this data on a CRT monitor. The hardware was implemented and tested March 6, 1978. The system was integrated with the software and tested April 18, 1978. Since the initial delivery the software has been modified from two displays to six displays, to provide command load generation capability, tabulation capability and the amount of data to be processed increased by a factor of 3. The last test for the sixth display was accomplished on January 12, 1979. A subsequent NASA decision then terminated all further SKYLAB Reboost efforts and this support was terminated.

March 1979

The initial STS-1 integrated simulations were successfully supported utilizing all of the recently developed Orbital Flight Test Data System hardware and software systems. The STS OPS and JSC POCC System Specifications were published and distributed. Phase 1 testing of the Automated Logistics Management System (ALMS) was completed.

July 1979

The SKYLAB Mission was successfully supported through re-entry on 07/13/79. This culminated a year long support effort as the SKYLAB trajectory fell toward Earth. In July the second floor MOCR large screen displays were put into use for the JSC Public Affairs Office and News media during re-entry.

September 1979

In the operations area a tracking data flow test was successfully performed using live data from the HEAO-C satellite launch to test the KSC/GSFC/JSC tracking data system under live mission conditions.

October 1979

The System PDR for Secure OPS was successfully presented to NASA, DOD and other contractors.

November 1979

Took delivery of and installed the POCC Concentrator under EO-133D. Also took delivery of the 3 PEP's (Payload Experiment Processor) mini-computer under EO-500E, as well as TPC's 5 and 6 under EO-490E.

The first pre-launch PAD test (APO hot fire test) for STS-1 was supported with both realtime and playback activity in support of Flight Control.

June 1980

Successfully supported live tracking exercises utilizing the GEOS-3 satellite, to exercise the remote sites and fully check out the Shuttle S-Band and C-Band Tracking Data Systems.

November 1980

The Acceptance Test on the Dump Data Handling System (EO-333E) was successfully completed in the SISO Manufacturing facility and was shipped to the MCC.

April 1981

The Shuttle STS-1 flight was successfully supported. Performance of supporting equipment and personnel was excellent from the beginning of terminal count to the completion of the mission with only four minor equipment problems. SISO Flight Control personnel supported flight operations of the STS-1 Mission as well as development of the required post-mission reports.

June 1981

The Dump Data Handling formal on-site Qualification Test was successfully conducted on June 17th and the equipment turned over to NASA (and SISO M&O) as operational.

Completed Delivery II Qualification Testing for Applications Software and Software Checkout Software.

Upon SISO's recommendation and NASA's concurrence an MCC Integration Team was established on-site. This team, consisting of Engineering, Maintenance, Installation and Scheduling personnel will integrate all on-site activities. This includes coordination of all EO and reconfiguration activities to minimize downtime and interference to simulations and operations prior to missions.

July 1981

The Acceptance Test for the Secure Ops AED (EO 493F) was successfully completed July 24.

August 1981

The Life Sciences VAX/LSMDC Operations Plan was completed and submitted to NASA on August 13.

STS DDH Qualification Testing completed.

September 1981

A Medical Operations five (5) year plan was developed for the Medical Sciences Division.

POCC Terminal/Concentrator interface testing completed, as well as POCC Terminal S/W QT.

October 1981

Secure Ops AED QT completed, as well as RDCS I S/W QT.

November 1981

The Shuttle STS-2 flight was successfully supported. As with the STS-1 flight, personnel and equipment support was excellent.

The Acceptance Test for the Secure Ops MBI (EO 139D) was completed.

December 1981

The Acceptance Test for the NOM/NASA Encryption Mod (EO 649E) and the Qualification Test for the first three deliveries of CONIS were completed.

February 1982

The SDP-4 relocation and installation on EO 180D was completed, qualification tested and turned over to NASA as operationally available.

April 1982

The Secure OPS NOM under EO 551E had a successful Qualification Test in April 1982 and was turned over to M&O as operational equipment.

May 1982

The MBI's "C" and "D" for Secure OPS (EO 139D) were Qualification Tested, the loading tests completed and the equipment was made available for operational use.

All 60 POCC Terminals were installed and Qualification Tested on EO 472F. The POCC Terminal users operational software testing was completed and these terminals were turned over to the customer for operational support use.

This month also saw the successful Qualification Test completed on the STS Data Select Switch (SDSS) under EO 534E.

May 1982

Single System Trainer (SST): A new computer system was procured and installed as a backup to the present CAPS computer system. The SST Station was upgraded with a new computer system. Two new work stations were provided for the FOD Training Planning System (TPS) in JSC Bldg. 4. A Radar Data Remoting Receiver was procured and installed to track weather in the Houston/Galveston area for FOD.

June 1982

Shuttle Training Aircraft (STA): A Head Up Display (HUD) was procured and is now undergoing final testing in the Validation System (VAS). The HUD consists of a Rolm 1666 computer, a Smiths Industries Programmable Display Generator (PDG) and a Astionautics Corporation of America Pilot Display Unit (PDU).

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July 1982

The Head-Up Display (HUD) hardware was installed in the STA and made operational. The hardware system consists of a ROLM 1666 computer system, a programmable display generator (PDG) and the Pilot Display Unit (PDU).

October 1982

The TOX/TGA Automated Analysis software, the Trace Gas Analyzer software and Toxicology Compound Library software were completed.

October thru December 1982

Phases I thru IV of the Shuttle Food Support Facility system software were successfully tested and delivered to NASA Medical Sciences Division during this period.

December 1982

This month saw the culmination of considerable engineering efforts on numerous EO's which were qualification tested and released to M&O as operational. These included: EO 566F - Console Interface Subsystem (CONIS); EO 533F - Control and Monitoring Isolation Subsystem (CMIS); EO 537F - Video Isolation and Channel Identifier (VICI); EO 536F - Video Switch Matrix (VSM); EO 617E - COMSEC Equipment Facility (CEF); and EO 616E - Separator-KG Recombiner (SKR).

May 1983

Completed implementation of the Control Mode capability and received IDAA Certification.

May 1983

Completed POCC implementation, checkout and initiated support to POCC Mission Manager.

October 1983

MCC DCS Replacement Improvement Studies conducted.

December 1983

STARS/SOSC Improvement Studies conducted.

December 1983

Completed integration of POCC for support of STS-9 Spacelab experiments.

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December 1983

Dual MOC Development Tasks completed.

December 1983

All CONIS delivered (except FCR-1 scheduled 1/84).

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March 1984

The final CONIS Console deliveries were installed, tested and became operational.

April 1984

Three DGE Clusters were QT'ed.

May 1984

Equipment Replacement/Refurbishment Plan (ERRP) System Design, including Digital Voice Subsystem (DVS) Design activities commenced.

May 1984

Implemented MCC System to support Dual MOC/Dual Flight activities.

July 1984

Console-Interface Subsystem (CONIS) - the replacement and upgrade of the consoles and the console interface equipment to support STS and secure operations was completed and was operational during FY84. Major EO's included 475F, 566F, 567F and 647F.

November 1984

Secure Communications Consolidation study culminated in a meeting of all affected NASA and USAF sites. Subsequently EO 073H and EO 084H were issued with additional EO's expected.

January 1985

Digital Voice Intercom System (DVIS) - the digital voice system replacement of the original MCC analog system was directed to proceed as a "make". This was the result of an extensive market survey to determine if commercial systems were available to satisfy NASA's requirements.

February 1985

Equipment Replacement/Refurbishment Plan (ERRP) - the ERRP System Design review was held and direction was received to proceed to the Subsystem Design stage for all elements. The basic system release (BSR) of the CAS LAN was demonstrated in the MCC and was made available to support CAS development activities.

April 1985

Workstation/Local Area Networks are in place to support development efforts on MITS and SDRS.

May 1985

Level B Subsystem Requirements for all ERRP Subsystems were distributed for review and RID's were submitted. RID cycled scheduled for June 1985 completion.

MCC MISSION CHRONOLOGY

<u>Gemini 3</u> (23 March 1965)	Grissom/Young 3-revolution flight. Control exercised from MCC-K with MCC-H monitoring data and communications.
<u>Gemini 4</u> (3-7 June 1965)	MCC-H assumed prime control responsibility for the 4-day McDivitt/White flight. MCC-H proved operational.
<u>Gemini 5</u> (21-29 Aug 1965)	MCC-H control of the 8-day Cooper/Conrad flight.
<u>Gemini 6</u> (15-16 Dec 1965)	The Schirra/Stafford 26-hour flight which provided first space rendezvous (with Gemini 7)
<u>Gemini 7</u> (4-18 Dec 1965)	The Borman/Lovell 2-week flight which was first rendezvous (with Gemini 6). Third floor Control used for both flight, including pad tests, launch, rendezvous and monitoring.
<u>AS-201</u> (26 Feb. 1966)	Unmanned, first flight of Saturn lB and CSM; suborbital; second floor MCC control.
<u>Gemini 8</u> (16 March 1966)	Armstrong/Scott 7-revolution flight, with first docking; aborted because of failure in Altitude Central System. Alert network support personnel permitted safe landing.
<u>Gemini 9</u> (3-6 June 1966)	Stafford/Cernan 3-day flight, establishing new EVA record (2 ^h 09 ^m). Docking with the ATDA was attempted. Third floor MCC control continued.
<u>Gemini 10</u> (18-21 July 1966)	Young/Collins 3-day flight, with dual rendezvous with Agenas 8, 10; 2 EVA's and 410 nm apogee with Agena boost. Third floor control.
<u>AS-203</u> (5 July 1966)	Second unmanned Saturn 1B flight to test hydrogen tank. Boilerplate spacecraft. Second floor control.
<u>AS-202</u> (25 August 1966)	Third unmanned Saturn 1B with CSM for spacecraft performance study; suborbital; second floor control.
<u>Gemini 11</u> (12–15 Sept. 1966)	Conrad/Gordon 3-day flight, with 2 EVA's and new record of 740 nm apogee.
<u>Gemini 12</u> (11-15 Nov. 1966)	Lovell/Aldrin 4-day flight, set new EVA record (5 ^h 37 ^m). Completed MCC support of Gemini program. The first floor started a conversion to the Apollo 500 series configuration.
<u>Apollo 4</u> (9 Nov. 1967)	Initial flight of Saturn V (AS-501) with CSM and boiler- plate LM for an 8 ¹ ; hour flight. CCATS equipment was used and ASCATS operated from Building 422; control from third floor.
<u>Apollo 5</u> (22 Jan. 1968)	First flight of working LM aboard Saturn 1B (AS204/LM-1); Unmanned; Flight duration was $2\frac{1}{2}$ days; control from second floor.
<u>Apollo 6</u> (4 April 1968)	Second flight of Saturn 5 (AS-502) with working CSM, boilerplate LM; control from third floor.
<u>Apollo 7</u> (11-22 Oct. 1968)	First manned Apollo CSM flight and last use of Saturn 1B (AS-205/Schirra, Eisele, Cunningham). Second floor control.

<u>Apollo 8</u> (21-27 Dec. 1968	Second manned Apollo flight (AS-503) and first aboard the Saturn V; lunar fly-by (Orerational LM not carried). (Borman, Lovell, Anders)
<u>Apollo 9</u> (3-13 March 1969)	First flight with manned LM and first active hard docking between LM and CSM. EORP/AS-504. (McDivitt, Scott, Schweickart)
<u>Apollo 10</u> (18-26 May 1969)	Lunar orbital mission with LM. Transfer from CSM to LM in lunar orbit and descent to 50,000 feet, but no landing. Third floor control/AS-505. (Stafford, Young, Cernan)
<u>Apollo 11</u> (16-24 July 1969)	Lunar Landing. EASEP deployed. Third floor used; upon successful completion, the second floor was ordered moth- balled. (Armstrong, Aldrin, Collins)
<u>Apollo 12</u> (14-24 Nov. 1969)	Second lunar landing; ALSEP 1 deployed. MCC systems performed at their highest level of support with no significant discrepancies in any equipment. (ASCATS support was returned to Building 30 for Apollo 12 Sims.) (Conrad, Gordon, Bean)
<u>Apollo 13</u> (11-17 April 1970)	Flight aborted due to on-board failure. Safe return in 6 days. SCU operational. (Lovell, Swigert, Haise)
<u>Apollo 14</u> (31 Jan-9 Feb 1971)	Fourth manned lunar landing; emplaced ALSEP IV. Several changes to CSM resulted from Apollo 13 abort. (Shepard, Roosa, Mitchell)
<u>Apollo 15</u> (26 July-7 Aug 1971)	First J-mission for extended lunar exploration (with LRV, TV and extended life support systems) and extensive SIM bay experiments from lunar orbit. ALSEP 2 and P&FS 1. (Scott, Worden, Irwin)
<u>Apollo 16</u> (16-27 April 1972)	Second J-mission for extended lunar exploration with LRV/LCRU. Scientifically oriented mission with expanded orbital science experiments and long duration particle and fields sub-satellite. ALSEP 3 and P&FS 2. (Young, Duke, Mattingly.)
<u>Apollo 17</u> (6-19 December 1972)	Third J-mission for extended lunar exploration with LRV/LCRU. The eleventh and last manned Apollo mission. Scientifically oriented mission with expanded surface and orbital experiments and a scientist Astronaut crew member for the first time. Emplaced ALSEP-5. The first night launch.(Cernan, Schmitt, Evans)
<u>Skylab 1 and 2</u> Q4 May-22 June 1973)	First Skylab mission primarily oriented to conduct Earth Resources and Biomedical experiments. One solar wing and the meteorite shield was lost, the other solar wing did not deploy. The remaining solar wing and temporary heat shield manually deployed by astronauts. First mission to be supported by MDSF, MOPS, DTE and Earth Resource PPS. First use of Voice Dump Recording System controlled from 2nd MOW. (Conrad, Weitz, Kerwin)

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Skvlab 3 Second Skylab mission oriented towards Earth Resources (28 July-25 Sept 1973) and Biomedical experiments. Significant solar flare activity observed and recorded. First Skylab mission with a scientist astronaut crew member. "B" and "D"RCS failures reduced CSM maneuvering safety margin. Temporary sun shade replaced. Longest full supported mission (59 days) by PHO to date. (Bean, Garriott, Lousma) Third Skylab mission accomplished experiments in the Skvlab 4 following catagories; Earth Resources, Medical, ATM, (16 Nov-8 Feb 1974) Corollary, and student investigation. Comet Kohoutek Observations were also made. Extravehicular activities totaled twenty two and one-half hours. Longest fully supported mission. (84 days) (Carr, Pogue, Gibson) First joint American and Russian earth orbital mission. ASTP An APOLLO and a SOYUZ, after being launched from their (15-24 Julv 1975) respective countries, linked together in orbit for an international "first" in manned spaceflight. The American and Russian crews visited each others space-. craft through a common docking adaptor. Five joint scientific investigations were performed plus those conducted by the APOLLO crew. SISO support included first time use of special video systems including VIRS, DCVS and an automatic color compensator. (Stafford, Slayton, Brand) (Leonov, Kubasov) CA-1A First manned Captive-Active ALT flight of the airplane (18 June 1977) and the orbiter for the purpose of checking out the orbiter systems . (Haise, Fullerton) Second manned Captive-Active flight to continue check-CA-1(28 June 1977) out of orbiter systems. (Engle, Trulv) CA-2 This mission was scrubbed due to the highly successful results of CA-1A and CA-1. First free flight of the Shuttle aircraft. (Haise, FF-1 (12 August 1977) Fullerton) Second free flight of the Shuttle aircraft to test the FF-2MSBLS (Micro Scanning Bean Landing System). (Engle, (13 September 1977) Truly) Third free flight. Extension of FF-2 with added test-FF-3 ing of the brake system. (Haise, Fullerton) (23 September 1977) Fourth free flight. First free flight with tail-cone FF-4off. (Engle, Truly) (12 October 1977) Second tail-cone off free flight and first landing on FF-5 a hard runway. (Haise, Fullerton) (26 October 1977)

<u>STS-1</u> (12-14 April 1981)	First orbital flight of the Space Shuttle with a successful landing at Edwards AFB, California (3-day mission). (Crippen, Young)
<u>STS-2</u> (12-14 November 1981)	Second orbital flight of the Space Shuttle with a successful landing at Edwards AFB, California. This was the first reuse of a spacecraft. (Engle, Truly)
<u>STS-3</u> (22-30 March 1982)	Third orbital flight of the Space Shuttle with a successful landing at Hollomon AFB, New Mexico. This was first Space Shuttle landing at site other than Edwards AFB. (Fullerton, Lousma)
<u>STS-4</u> (27 June - 4 July 1982)	Fourth orbital flight of the Space Shuttle with a successful landing at Edwards AFB, California. (Mattingly, Hartsfield)
<u>STS-5</u> (11-16 November 1982)	Fifth orbital flight of the Space Shuttle with a successful landing at Edwards AFB, California. First satellite was launched from shuttle on this mission. (Brand, Overmyer, Lenoir and Allen)
<u>STS-6</u> (4-9 April 1983)	Sixth orbital flight of the Space Shuttle with a successful landing at Edwards AFB, California. A TDRS satellite was launched on this mission. (Weitz, Bobko, Peterson and Musgrave)
<u>STS-7</u> (18-24 June 1983)	Seventh orbital flight of the Space Shuttle with five crew members, including the first American woman, was completed with a successful landing at Edwards AFB, California. In addition to launching two communication satellites, the STS-7 crew deployed and retrieved a TV camera with the manipulator arm and obtained the first pictures of the Shuttle in orbit. (Crippen, Ride, Hauck, Fabian and Thagard)
<u>STS-8</u> (30 Aug 5 Sept.)	Eighth oribtal flight of the Space Shuttle with five crew members was completed with a successful landing at Edwards AFB, California. This mission marked the first night launch and landing. Satellite INSAT 1B was deployed, TDRS was tested and the Payload Manipulator Arm was tested with a test article weighing over 5,000 pounds. (Truly, Bluford, Brandenstein, Gardner and Thornton)
<u>STS-9</u> 28 Nov 8 Dec.)	Ninth orbital flight of the Space Shuttle was extended one day and was completed with a successful landing at Edwards AFB, California. This was the longest mission to date (9 days) and the first to carry 6 crew members. STS-9 was the first Spacelab mission and the first to carry a non-NASA crew member. This was also the first 24 hour crew duty mission with 3 crew members on 12 hour shifts. In addition to Space Shuttle tasks, short

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STS-9 (Continued)	wave communications were donducted throughout the world with amateur radio operators. (Young, Shaw, Parker, Garriot, Lichtenberg and Merbold)
<u>STS-11</u> (3 - 11 March 1984)	The tenth orbital flight of the Space Shuttle with five crew members was completed with a successful recovery at the Kennedy Space Center landing site. Two satellites were deployed during the mission and the first untethered space walk with the Manned Maneuvering Unit was demonstrated. (Gibson, McNair, Stewart, Brand and McCandless).
<u>41-C</u> (6- 13 April 1984)	The eleventh orbital flight of the Space Shuttle with five crew members was completed with a success- ful landing at Edwards AFB, California, the alternate site. Recovery was diverted from KCS due to unfavor- able weather conditions. During this mission, the LONG DURATION EXPOSURE FACILITY, a large payload, was deployed. Very significant was the inflight retrieval repair and re-deployment of the disabled MAX SOLAR satellite thus allowing it to continue its' normal function. The Manned Maneuvering Units and Flight Support Stations were used by Nelson and Van Hoften. (Crippen, Scobe, Hart, Nelson and Van Hoften).
<u>41-D</u> (30 Aug - 5 Sept)	The twelfth orbital flight of the Space Shuttle with six crew members was completed with a successful landing at Edwards AFB, Calif. SYNCOM IV satellite was deployed by the "Frisbee" method. NASA owned satellite OAST-1 payload was deployed with three experiment packages and the Telestar satellite was deployed. Some 41F experiments were incorporated in this mission. (Hartsfield, Coats, Resnik, Hawley, Mullane and Walker).
<u>41-G</u> (5 - 13 October)	The thirteenth Space Shuttle orbital flight with the largest crew to date (seven) landed successfully at Kennedy Space Center, Florida. The crew included a Canadian payload specialist and two women, one of which was the first American woman to perform a spacewalk. Major payloads flown on the mission were ERBS, OSTA-3, Orbital Refueling system experiment and the Canadian scientific experiment CANEX package. (Crippen, McBride, Ride, Sullivan, Leestma, Garneau, Scully-Power).
<u>51-A</u> (8-16 November)	The fourteenth Space Shuttle flight with five crew members was completed with a successful landing at Kennedy Space Center, Florida. Most significant events in this mission were the retrieval and return of two satellites, "Papala B-2" and "Westar VI", that were placed in an unusable orbit during mission 41-B. This was the first time that any satellite has been returned to earth from orbit. During this mission, the Canadian communication satellite "Telesat H" and Syncom IV-1 communications satellites were placed in geosynchrous orbit and the DMOS experiment was conducted in the mid-

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51-A (Continued)	deck as an attempt to grow crystals by mixing organic solutions in the micro-gravity environment. (Allen, Fisher, Gardner, Hauck and Walker).
<u>51-C</u> (24-27 Jan. 1985)	The fifteenth Space Shuttle flight with five crew members was completed with a successful landing at Kennedy Space Center, Florida. This was a DOD mission and all activities were classified. (Mattingly, Shriver, Oniquka, Buchli and Payton).
<u>51-D</u> (12-19 April 1985)	The sixteenth Space Shuttle flight with seven crew members was completed with a successful landing at Kennedy Space Center, Florida. Syncom IV, Tele Sat I and CFES satellites were deployed. Syncom failed to activate after deployment and efforts to trip the switch with "Flyswatters" on the RMS was unsuccessful. (Babko, Williams, Seddon, Hoffman, Griggs, Walker and Garn).
<u>51-B</u> Skylab-3 (29 Apr- <u>6</u> May 1985)	The seventeenth Space Shuttle flight with seven crew members was completed with successful landing at Edwards AFB California. Experiments with Spacelab-3 payload with two monkeys and 24 rats were conducted. (Overmyer, Gregory, Lind, Thagard, Thornton, Van Den Berg and Wang).
<u>51-G</u> (17-24 Jun 1985)	The eighteenth Space Shuttle flight with seven crew members was completed with a successful landing at Edwards AFB, Calif. Three satellites (Morelos-A, Arabsat-A, and Telestar-3D) were deployed. Spartan 101/ MPESS was deployed to operate independently at 100 mile range from the Shuttle for astronomy observations and was retrieved successfully. (Brandenstein, Creighton, Lucid, Fabian, Nagel, Baudry and Al-Saud).
STS-24 <u>51-F</u> Challenger (29 July-6 Aug 1985)	The nineteenth Space Shuttle flight with Seven crew members was completed with successful landing at Edwards AFB, CA. Mission was Spacelab two experiments. (Fullerton, Bridges, Musgrave, England, Henize, Acton and Bartoe.)
STS-27 <u>51-I</u> Discovery (27 Aug-3 Sept 1985)	The twentieth Space Shuttle flight with five crew members was completed with successful landing at Edwards AFB, CA. Three satellites were launched with the highlight being the capture and repair of previously launched Syncom IV-3. (Engle, Covey, Van Hoften, Lounge and Fisher.)
STS-27 <u>51-J</u> Atlantis (3 Sept-7 Sept 1985)	The twenty-first Space Shuttle flight with five crew members was completed successfully with landing at Edwards AFB. This was a DOD mission and all activities were classified. (Babko, Grabe, Hilmers, Stewart and Pailes.)

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61-A Challenger SLD-1 30 Sept-6 Nov 1985) The twenty-second Space Shuttle flight with eight crew members was completed with successful landing at Edwards AFB, CA. This was first flight with eight crew members and first foreign dedicated Spacelab (German). (Hartsfield, Nagel, Buchli, Bluford, Dunbar, Furrer, Messerschmid, Ockels.)

<u>61-B</u> Atlantis 26 Nov-3 Dec 1985

The twenty-third Space Shuttle flight with seven crew members was completed with successful landing at Edwards AFB, CA. Two EVA's were conducted to demonstrate ease of and access to construction. (Shaw, O'Connor, Cleave, Spring, Ross, Vela, Walker.)