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NASA MANNED SPACECRAFT CENTER

FLIGHT CREW OPERATIONS BRANCH

SIMULATOR OPERATIONS

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EQUIPMENT UTILIZATION

OVERALL CAPE SIMULATOR UTILIZATION

5/67 6/67 7/67 8/67 9/67 10/67 11/67 12/67 1/68 2/68 3/68 4/68 5/68 6/68 7/68 8/68 9/68 10/68

CMS-2

SYS BUYOFF (8/67) — TOTAL BUYOFF (11/67)

- SYS & VISUAL RE-WORK REQD TO GO FROM S/C 012 TO S/C 101 CON-FIGURATION
- VISUAL REWORK
- SYS UPDATE
- EARLY S/C 101 ASTRONAUT TRAINING
- S/C 101 ASTRONAUT TRAINING

CMS-3

SYS BUYOFF (8/67) — TOTAL BUYOFF (12/67)

- SIMULATOR INSTALLA-TION & C/O (SYS) (MINOR VISUAL WORK)
- CONTD UPDATE OF SYS & IN-STALLATION & C/O OF VISUAL SYS
- EARLY S/C 103 ASTRONAUT TRAINING
- S/C 103 ASTRONAUT TRAINING

LMS-2

SYS BUYOFF (LM-2 CONF) — VISUAL BUYOFF

- SIMULATOR IN-STALLATION & C/O (SYS) (VISUAL NEEDED EX-TENSIVE REDESIGN)
- EARLY LM-2 ASTRONAUT TRAINING, R&D VISUAL ONLY
- LM-3 UPDATE
- CONTD VISUAL WORK
- EARLY LM-3 ASTRO-NAUT TRAINING
- LM-3 ASTRONAUT TRAINING

DESCRIPTIVE SIMULATOR

USE TO SUPPORT S/C 101 LAUNCH

(CMS-2 Typical Example)

-6 months*

Engineers provide classroom type systems briefings which lead to simulator time at each briefing completion. During this period 75% of the time is spent on system work alone, and only 25% on actual mission plan. Simulator update is quite heavy at this point picking up spacecraft changes.

-5 months*

Engineers systems briefings continue with more simulator time being utilized than briefing time. During this period mission work increases and the ratio of pure systems to Flight Plan related work becomes about 50%. Simulator update continues heavy during this period picking up spacecraft changes and evaluating the effects of trajectories, etc., on reset points.

-4 months*

Systems briefings continue with systems as related to Flight Plan and Mission Rules becoming prominent. Work is stepped up in specific procedures such as rendezvous and reentry, while the trajectory data and mission profiles begin to come to an early final configuration. Simulator update related to spacecraft changes begins to drop off, and the trajectory and mission profile changes resulting in new simulator reset points become the major mod effort.

-3 months

Routine work with systems applications to the Flight Plan and Mission Rules. Begin to finalize procedures for rendezvous or any major objective of the flight. Continue update, routinely installing all the latest spacecraft changes and revisions to the trajectories, etc., and run ground interface checkout with MCC-Houston in preparation for integrated training.

-2 months

Intensive study on launch/aborts, emergency procedures (Mission Rules), reentry, and overall systems. Also, final procedures for experiments, etc., are worked on. Final last minute spacecraft changes to the simulator are made, such as final weight and balance, L/D, and trajectory information. Continue ground interface checkout for integrated training.

-45 days

The following integrated simulations are run with MCC-Houston during this period to launch:

a.	Launch Simulations	20 hours (approximately)
b.	Simulated Network Simulations	40 hours (approximately)
c.	Reentry Simulations	20 hours (approximately)

-1 month

Final work on Flight Plan, Mission Rules, and any possible difficult portions of the flight is done during this period.

*NOTE:

Under normal conditions the Cape would go down at -4 months for the next configuration changeover for a 30 day period. For S/C 101 we are providing the basic training in addition to the usual -3 months final preparation. Training for -6, -5, and -4 months is normally provided at Houston. For S/C 103 it is planned for the Cape to provide the basic -6 months training similar to S/C 101 activities. For S/C 104 it is planned for Houston to provide the basic -6 months through -4 months basic training. The Houston simulator complex has worked at almost full capability developing modifications for S/C 101 and S/C 103 for the past few months.

AVERAGE MONTHLY COMPLEX TIMES

CMS-2 (September 1967 - January 1968)		Hours
Maintenance downtime		24
Crew training time		49
Crew training preparation time		120
Crew training tape checkout and copy		80
Ground interface checkout time		19
Ground interface preparation time		40
MCR work		115*
Preventative maintenance		40
Corrective maintenance (DR clearance)		190*
Approximately 6-1/2 days/week	TOTAL	677

LMS-2 (June 1967 - January 1968)		Hours
Maintenance downtime		16
Crew training time		27
Crew training preparation time		70
Crew training tape checkout and copy		50
Ground interface checkout time		8
Ground interface preparation time		20
LCR work		130*
Preventative maintenance		35
Corrective maintenance (DR clearance)		140*
Visual update		100
Approximately 6 days/week	TOTAL	596

*It should be noted that DR clearance and MCR/LCR work run simultaneous with other work and each other. The times shown are approximated allotted times for exclusive use. Both numbers should be multiplied by two to get realistic time they consume.

TYPICAL WEEKLY SCHEDULE
(CMS-2, S/C 101)

Shift	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
FIRST	Visual c/o 3 hours NASA c/o of new training load	Visual c/o 3 hours NASA/Link DR writing and final training load c/o	Astronaut Training	Astronaut Training	Astronaut Training	Astronaut Training	Link hardware or software DR and mod power down work this period Link software group assembles new training load using weekly Cape and Houston corrections on off-line complex
SECOND	Link software DR and mods	Link software DR and mods 4 hours G/I	Link software DR and mods	Link software DR and mods	Link software DR and mods 4 hours G/I	Link software DR and mods	Link hardware or software DR and mod power down work this period Copy new training load on off-line computer complex
THIRD	2 hr comp diagnostic Link hardware DR and mods	2 hr comp diagnostic Link hardware DR and mods	2 hr comp diagnostic Link hardware DR and mods Visual c/o for training - 3 hours	2 hr comp diagnostic Link hardware DR and mods Visual c/o for training - 3 hours	2 hr comp diagnostic Link hardware DR and mods Visual c/o for training - 3 hours	2 hr comp diagnostic Link hardware DR and mods Visual c/o for training - 3 hours	2 hr comp diagnostic Link hardware DR and mods Power down work this period

a. Approximately 12 hours per day is utilized for training when scheduled. Eight hours training and four hours checkout. Same time is used for NASA training load checkout.

b. An average of two hours per day for computer diagnostics.

c. Six to eight hours per training day for DR work-off.

d. Four to six hours per training day and weekend work for local mod effort.

EQUIPMENT MODIFICATION

MODIFICATION CHAIN

(CMS-2, S/C 101, Typical Example)

Modification of a spacecraft change is accomplished through three primary ways:

a. MCR (Master Change Request)

b. CCB Minutes (Change Control Board)

c. NAR Engineering Change Orders

Normally a change is reflected by all three means; however, by continuous review of all three separately, there is little chance of the simulator losing spacecraft configuration due to a loss of documentation in the system. Also, the urgency or priority that a modification should be given is readily apparent. A typical change would be accomplished thus by:

a. Upon the request by the CCB, an RECP (Request for Change Proposal) is transmitted to NAR, resulting in an MCR which must be returned to the CCB for approval to incorporate into the spacecraft. Simultaneously, at the time of the MCR initiation (not approval), copies are forwarded to the simulation groups for preliminary review and possible simulator impact.

b. Upon receipt of the MCR by the simulation group, we proceed to review it for system effectivity and revisions. An impact is made predicting design, documentation, parts cost, installation and checkout at one or both sites, and its schedule based upon work in-house. By experience, we have found 90% of the MCR's prepared in this way are approved by the spacecraft CCB and, by taking this forward step, the amount of time lost is negligible compared to overall gain if the CCB disapproves the MCR. The minutes of the CCB are monitored and, at approval of a given spacecraft MCR, we, in turn, submit to our internal CCP (Change Control Panel), chaired by Mr. Slayton, a completed simulator MCR ready for his review with appropriate recommendations for incorporation.

c. Assuming the simulator CCP approves the MCR, the responsibility is delegated to either the Cape or Houston simulation group for implementation. At this point we routinely design, fabricate, install and checkout the modification with complete and detailed coordination between sites. Expediting is accomplished (if required) by sharing the load. For example, Houston may design and procure where the Cape would follow-up with installation and checkout and final documentation. Normally this practice is employed where the prime crew is at the Cape and we have the simulator for said spacecraft (such as S/C 101 only mods).

d. Hardware design is accomplished by complete review of the NAR documentation, systems design, and related functional operations. The primary descriptive data utilized for our systems design is the Apollo Operations Handbook (AOH) published by NASA. Upon completion of the first cut, preliminary design parts are put on procurement to speed up the overall effort, and it is routed to the NASA simulation personnel for review as the contractor continues to work on final design. The simulation group then coordinates its review with the designer and the last minute update is accomplished. Most of all this effort goes in parallel to expedite simulation fidelity. At this point, as mentioned above, we fabricate, install, and checkout the mod depending upon its priority in the system.

e. Not all MCR's are of spacecraft origin. Mods which are required as engineering or training aids and/or product improvements are handled identical to the spacecraft MCR's except they are assigned a specific number and do not get involved with CCB action. The simulator CCP's handle these directly.

f. It also should be noted that anyone can generate a simulator MCR and present it to the CCP. This is exercised readily, of course, by the flight operations personnel who are very interested in changes affecting ground interface and MCC-Houston integrated missions.

g. A similar documentation scheme is used for hardware and software. The Cape would generally originate an HCR (Hardware Change Request), where revisions are required to a Houston mod, and vice versa. If a mod is originated and designed by the Cape we would generate a complete mod kit, including final documentation, as required.

SOFTWARE MODIFICATION CHAIN
(CMS-2 S/C 101 Typical Example)

Modification of simulator systems software is accomplished through an MCR written as a result of an NAR spacecraft MCR or a simulator change required for operational use.

a. Modifications to spacecraft systems by NAR are screened by FCSD personnel for simulator effectiveness. If a software change simulated system is required, that MCR is given to Link for impact and is then presented to the CCP for approval.

b. The programming of a system change for the simulator is done by Link following specifications supplied by NASA. The changes are incorporated into the Math Models of the simulator and are then programmed.

c. The MCR is checked out by Link, using cards and loading it in along with our operational program. If the MCR functions properly, the cards are added to the next training load tape made on-site.

d. Acceptance of the MCR by NASA is accomplished when the system is flown, using the newest training load tape, and found to function according to some accepted data source. (The MCR itself, an AOH, or Spacecraft Schematic)

Modification of interpreter software is accomplished through an MCR written against the interpreter.

a. A problem which is observed to occur in the interpreter software is usually reported as a DR. If the problem is resolved to need a change in the design of the interpreter, an MCR is generated by NASA personnel involved with interpreter development.

b. This MCR is submitted to the CCP, which approves or disapproves incorporation into the simulators.

c. If the change is entirely software, NASA and Link programmers do the work and check it on the respective simulator in Houston. When the change functions properly it is incorporated in the latest revision of the ISAGC software. If the change is hardware it would follow normal CCP action previously described.

d. This new ISAGC revision is sent to the Cape with the latest MIT revision on a normal operations basis.

e. The original DR is signed off at the Cape when the new MCR is observed to function correctly.

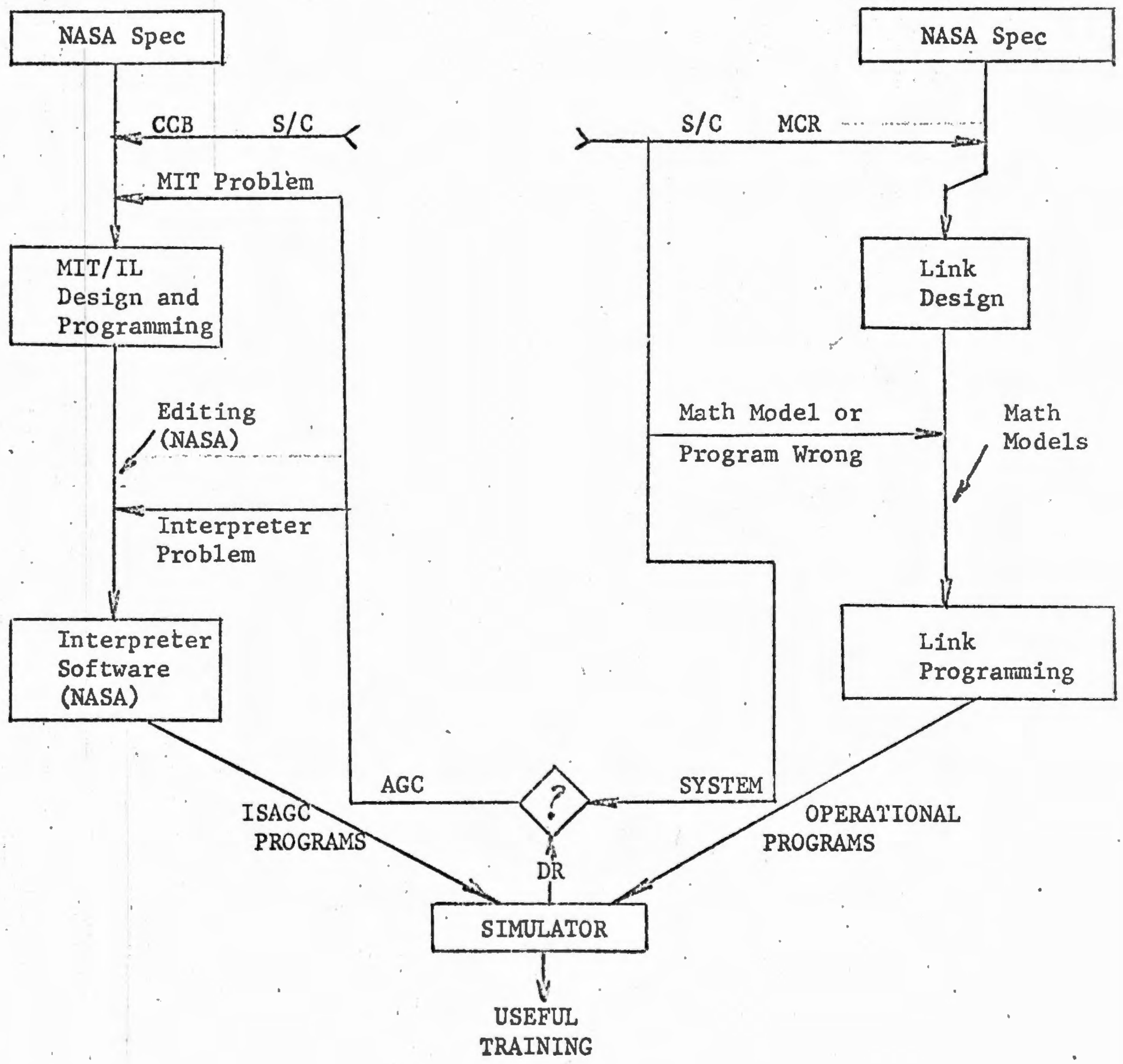
Modification of AGC software is accomplished through software CCB by a Program Change Request (PCR).

a. Inputs to the software CCB come from MIT itself, MSC G&C Division, NAR, or from the Apollo Mission Simulators. If a change is adopted, the next possible revision of the guidance software reflects that change.

b. New revisions of the software are sent to MSC every week. FCSD receives only one of these per week. Changes to the program which have been made by MIT are accepted by the Simulator system as a matter of course; only in rare circumstances does an MIT change necessitate simulator changes (fast DSKY, EDRUPT).

c. The MIT software is edited (changed from 15 to 24 bit format) and used on the simulator ISAGC. Any problems isolated as MIT software trouble are input back to MIT via telephone.

SOFTWARE DEVELOPMENT
(AGC)



SOFTWARE DEVELOPMENT

(AGC Software)

Primary software development is done by MIT/IL. In the early development phases of a set of guidance programs, MIT has utilized a reassembly mode of operation. That is, every day the program is reassembled or relocated to incorporate new changes to individual programs.

Arrangements with MIT have one of these revisions sent to Houston per week (e.g., the Friday revision is always sent).

These tape copies of the latest configuration of the flight program are edited by NASA in Houston. (The 15 bit AGC words are changed to a 24 bit format to be compatible with the DDP-224).

The edited ISAGC load tape is used in Houston for primary Interpreter development. This tape was used during the primary development period as the best available G&N program. The Interpreter program was developed and debugged, using the MIT programs. Obvious problems are encountered trying to use MIT programs which are not completely operable to checkout Interpreter programs.

Parallel checkout was carried on at Houston and the Cape. Generally, the Cape was, and is, one MIT revision level behind Houston. The reasoning here was not all MIT revisions were usable. Revision N + 5 could be worse than Revision N. If a new revision from MIT looked bad at Houston it was never sent to the Cape. During these times, both Houston and the Cape would remain with whatever revision level they had received the week before.

Problems encountered in flying the guidance software were difficult to pin down. The simulator is generally suspected. Simulators, by nature, are guilty until proven innocent. At least this was the reasoning under which work was carried on. MIT was notified when a problem was found, but the immediate remedial work which went on centered around the Interpreter.

Many observed problems were the fault of simulation software, some were admitted MIT faults, and some were never really explained. They simply disappeared in later MIT revisions, no comments made.

During early days, MIT documentation was a large problem. This has cleared up significantly, but mostly through the offices of TRW, GE, and other contractors who have printed documents to satisfy their own internal needs.

Using the flight software at the Cape, DR's are written as anomalies just like any other software/hardware problem. These are investigated by the contractor and the problem area (hardware, software, etc.) is assigned. If it appears to be an MIT problem, the Cape coordinates with Houston to see if the same problem has been observed there or if it can be made to happen there. If it is generally agreed that a flight program problem does exist, then MIT is notified.

If MIT concurs that they have a problem, then the change is made via Mission Design Review Board (MDRB). If they disavow the problem, the Interpreter is looked into more closely (current LGC problems).

NASA supplied the Interpreter software as GFE for Block II simulators. Link contractor support is being phased into the maintenance of the Interpreter software as well as continuing to keep the simulator interface programs up-to-date. This interface consists of the input/output signals from AGC to simulator systems (IMU, optics, control systems, etc.).

Coordination of all problem areas concerning guidance software and ISAGC between the Cape and Houston is accomplished in biweekly meetings, alternating between each site. Operational problems, modifications, and flight software problems are discussed in these meetings. (See attached memo, CF3-7M-231 dated November 17, 1967, subject: ISAGC Coordination).

<u>Current Problems</u>

SUNDISK - No major problems. Revision 282 (A-release) is currently in use on CMS-2. CMS-3 is using Revision 281 because of a timing modification still to be performed on that simulator.

a. DAP problems when making a manual DAP maneuver.

b. Entry DAP is nervous. Uses too much fuel and deadband is too wide.

c. PIPA pulses sometimes lost on interface (critical inter-computer timing is a problem here). Result is a slight difference in orbit achieved in boost as sensed by MIT. Entry guidance does not terminate at 1,000 ft/sec because it never learns that it is below 1K ft/sec. *

SUNDANCE - Revision 263 is currently being flown.

Complete wipeout of DSKY displays occurs randomly. Recovery is possible only via V36E (Fresh Start) or a reset (reinitialize whole simulator). Fix on-site.

* Watching an entry on 2/20 we noticed that the PIPA bias is quite high.

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TO: See list below

DATE: Nov 17, 1967

FROM: CF3/Assistant Chief for Crew Training

In reply refer to: CF3-7M-231

SUBJECT: ISAGC Coordination

This memorandum defines the channels of communications to be utilized between Houston and Cape Kennedy relative to Interpretively Simulated Apollo Guidance Computer (ISAGC) matters in order to assure proper coordination in this area.

As a primary means of maintaining coordination, a regularly scheduled ISAGC coordination meeting will be initiated. These meetings will be conducted in accordance with the following guidelines:

a. Meetings will normally be biweekly and will alternate between Houston and Cape Kennedy.

b. Meetings will normally be relatively brief and informal, but minutes will be prepared to apprise all interested personnel of results. Minutes will identify actions, anticipated agenda items, and date and place of the next meeting.

c. Meetings will be planned to minimize the number of people required to travel.

d. The persons responsible for arrangements for these meetings will be W. B. Goeckler, ISAGC Project Manager, at Houston, and F. Hughes at Cape Kennedy. The chairman of a specific meeting will be W. B. Goeckler at Houston and F. Hughes at Cape Kennedy or their designated alternate.

e. Specific objectives for this meeting will include the following:

(1) Transmittal to Cape personnel of ISAGC documentation including ISAGC assemblies, flight program listings and load tapes, utility programs and patches.

(2) Discussion of ISAGC status, appropriate operating configuration, MCR constraints, IDR status, etc.

(3) Coordination of development testing effort, and plans and exchange of testing results.

TRUE COPY

(4) Discussion of selected ISAGC technical topics, current problems, proposed changes, etc.

For matters not clearly the subject of the ISAGC coordination meeting or requiring resolution between meetings, the following guidelines are established:

SUBJECT	HOUSTON CONTACT	CAPE KENNEDY CONTACT
Requests for ISAGC personnel support at MSC or at KSC	W. B. Goeckler	F. Hughes
Requests for data, tapes, etc., on ISAGC	"	"
AMS No. 3 Mission Training	"	"
Technical information exchange	Not specified	Not specified
Utilization and scheduling of test beds at MSC or at KSC	W. B. Goeckler	Willard Steele

The objective is not to restrict communications but to assure adequate coordination.

ORIGINAL SIGNED BY:

C. H. Woodling

EQUIPMENT MAINTENANCE

DISCREPANCY REPORTS

Hardware

Another everyday routine is discrepancy reports (DR) which is the method used for maintaining and/or reporting a simulator malfunction. In this case the following steps are taken:

a. Any person involved in operating or maintaining the simulator writes a DR when he thinks he has found a discrepancy.

b. The discrepancies are reviewed by NASA and contractor personnel for validity and are assigned a priority for clearance or closed if not valid.

c. To close a discrepancy, the contractor must find the problem, fix it, get the workmanship and configuration bought off by the Quality Control and then present it functionally to NASA engineering for operational check-out. If continual failures are reported in an area, an MCR is submitted to correct it.

Software

Discrepancy reports are written by anyone seeing something wrong with a software program. The DR is assigned a category by the lead engineer on the simulator in question. These are:

I - Mandatory for Crew Training
II - Desirable for Crew Training
III - NASA Problem (MEP film, MIT software)

a. If the problem occurs in a spacecraft system the DR is assigned to a specific system engineer.

b. When the engineer has a fix for the problem, he demonstrates it, on cards, to NASA. If the problem is cured with the cards, the NASA engineer OK's these cards to be added to the current correction deck.

c. Once a week these corrections are placed on a tape and flown by NASA engineers to define the latest training tape.

d. If the correction appears on this tape and functions correctly, NASA signs off the DR (pending completion of documentation of the software patch).

e. If the DR concerned an ISCMC problem, investigation is made to determine whether the problem lies in the CMC itself or in the simulator interface programs. If the interface program is at fault, Link fixes the problem as described above.

f. If the problem is found to be a flight program problem, FCSD-Houston is notified and they coordinate directly with MIT. The DR is signed off when a new flight program revision does not exhibit the same problem.

g. If the problem is in the interpreter then NASA programmers in Houston fix the software as described in b. above. The DR is signed off when a new interpreter revision arrives with the problem cured.

TRAINING

TRAINING

Simulator astronaut training is accomplished in early stages (-6 months or so) by Houston (normally) or Cape by the simulation engineers preparing systems courses setup for classroom type instruction. The engineers prepare schematics, flip charts, and brief hardware and functional descriptions. In conjunction with the Apollo Operations Handbook (AOH) the engineers then proceed to define in detail the spacecraft systems and their operations, working continuously with the AOH as a baseline. During these briefings, specific points are noted and then are reviewed in great detail in the simulator.

Training sessions in the simulator in later stages (-4-1/2 months) are conducted with the flight crew utilizing all available flight data file material such as checklists, flight plan, area maps, flight curves, etc. The simulation engineers study ground-to-air communications thoroughly, and when we get into intensive mission training (after general system briefings are completed), we assume the position of the Flight Controller and provide realistic mission effects. During all simulator training sessions, the AOH and Flight Controllers Handbook (FCH) are kept at the console for ready reference. Training data configuration is kept current through two methods which have been quite effective in the past. We are on standard distribution for revisions to the AOH, FCH, and flight data file package, and are also provided two points of contact - the assigned Training Coordinator and assigned Spacecraft Team Leader. Daily contact with these individuals and the standard revisions distributed have proven quite satisfactory.

Training records are kept religiously and are in detail required to provide later research if the need arises. Basically, we provide to the Training Coordinator and the assigned Flight Crew Director (Mr. Slayton or CAPT. Shepard) a complete set of training session documentation and their fulfillment of the overall training plan published for each mission. Our records indicate such things as failures inserted, suited or unsuited, equipment configuration, equipment operational status, and what portions of the Mission Training Plan is fulfilled by that session. During our training before a flight, periodic reviews are made with the Training Coordinator, Flight Crew Director, simulation engineers, and the prime and backup crews to discuss areas of work yet required and how the overall training requirements are at these points.

PROBLEMS

PROBLEMS

Documentation

Documentation in Apollo continues to be a problem. In the case of our local operation, data requirements are extreme. Each engineer is expected to know the spacecraft systems (not just one but all of them, in order to do adequate mission training), flight control information, trajectory information, site interface data (data transmission for integrated missions), and etc.

The greatest problem is obtaining data when it is needed. The problem is not a new one nor does it belong solely to Apollo. But in a program of the magnitude and scope that this one has, lack of documentation can be catastrophic. The problem extends to all NASA, NAR, GAEC, AC Electronics, MIT, and any other support contractor documents.

Solutions for a problem this vast in nature, of course, are not easy to come by and we regret to say that, from our limited view point, we cannot recommend any solution.

Spacecraft Changes

The spacecraft has changed at a rate which exceeded all our expectations and plans. We are averaging seven to ten changes per week which affect simulation and they are having a major impact. Due to the frequency and magnitude of these changes, our maintenance and modification contractor manloading and available machine time will not accomplish the job, as it is now known, in a reasonable length of time (we average 2-1/2 months behind the spacecraft at this point).

Our planned solution to this problem is to increase present overtime drastically, bring in some short-term help from the contractor's home plant, and use some job shop type personnel for drafting to maintain configuration. It should be noted, however, that this is only a catchup mode and could not be considered to continue efficiently if the spacecraft changes do not slow down.

A brief CMS-2, S/C 101, status, per system, is included in this report for general information.

VISUAL SYSTEM

The Visual System is very close to meeting the Spacecraft 101 configuration, but there are yet many problems which combine to make the over-all operation of the system unsatisfactory.

The starball performance is generally good in all the windows.

There is one MEP window down due to six cassettes waiting for parts; the rest of the windows are good.

Window No. 2 R&D is operational, but window No. 4 R&D is down while installation of a new CRT is underway.

The SCT occultation is inoperative preventing a real simulation of when the stars are no longer in the field-of-view. The slide selector for the SXT has problems with gears worn and brocken which prevent the usage of the Lunar slides for navigation.

There are no outstanding MCR's which will at this time affect crew training. The most important MCR's are 10101 that will install additional illumination to the CMS R&D models (due April 17), 10115 which will correct for the halo and star color of SXT navigation star (due April 29), and 10004 which will add a filter to reduce the illumination in the SCT (due April 10).

There are many outstanding DR's against the Visual System, some of the problems being: No MEP cassettes available for window 5 (date unknown), SCT occultation inoperative (date unknown), gears in SXT slide selector are worn and broken (date unknown), window 4 R&D display inoperative, cracked CRT (due February 14), and the C/S in the SCT glitches χ 5° (due February 20).

The system should be effectively ready for training on March 1, 1968.

There is no estimated date for the system to be completely ready for training because of ECP's and studies underway, plus long lead time on some parts.

Flight Hardware

Combined with the problems noted under Spacecraft Changes above is the complication of the simulator obtaining flight hardware which is used as an expedient and/or efficient method in some cases. At present, if our status were reviewed, one would discover that most of our late items are of this nature and do not necessarily reflect simulator design problems. The lateness appears to be due to the lack of priority in the system being given to first line mockups and simulators for hardware delivery. Our recommendation for the solution to this problem is to apply a high priority (next to prime spacecraft) to mockups and simulators as related to the next sequential spacecraft in line (for example, 103, 104). This solution is recommended as the problem appears to be more of a manufacturing priority rather than direction to perform a task.

Visual Display

Problems are continuously plaguing us in this area in both LMS and CMS areas.

a. As the schedule indicates, the LMS was accepted in June 1967, less visual, and it is anticipated visual will be ready for buy-off next month. This, however, is after extensive redesign at NASA direction and constant driving of contractor. It is also noted the resolution and operation of the originally designed system may not be satisfactory for Lunar landing training, and redesign is contemplated.

b. The CMS also has its difficulties in the visual area, primarily with film handling and some picture transmission problems. At present redesign and/or fixes are under way to improve the system for training; however, satisfactory operation is going to be very difficult and expensive to achieve.

AURAL CUE

The Aural Cue is in configuration and is effective for training according to existing information. There are no MCR's or DR's on the system at this time. Updating or correcting this system can best be done by using the knowledge obtained by a crew after they have made an actual flight. It sould then be a matter of having the crew listen to the Aural Cue in the simulator and determine what must be changed in order to have it sound like they heard.

CSM-2 S/C 101

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MISCELLANEOUS

This group includes those functions, hardware and/or software, which in some way affect the over-all operation of the simulator and its design philosophy. Computer, cabinet, and IOS operation and maintenance are all included. Basically, the CMS-2 is in good shape for 101 training in this area.

There are two MCR's which, when installed, will greatly enhance the 101 effort. The first of these, MCR 10091 RO, provides a master software source deck for Spacecraft 101 and subs. This source deck should be operative by March 1, 1968. The second MCR, 11124 RO, provides simulator reset points for AS-205/101. As simulator philosophy requires that all major mission phases be simulated, this MCR is a must for the 101 effort. A separate summary is attached concerning reset points.

There are no major DR's against this group.

This group should be effectively ready for 101 crew training by March 1, 1968.

By March 15, the group should be completely ready for 101 crew training.

COMMAND MODULE STRUCTURES

This grouping involves any physical change to the interior of the 101 simulated command module not directly associated with any particular system. There are quite a few additions to be made to the present command module configuration before the 101 configuration is complete. The changes will involve nomenclature changes, hardware changes, and hardware additions.

There are presently 26 outstanding MCR's affecting this group. Each MCR in some way prevents the simulator from being exactly in the 101 configuration; however, none are critical enough to seriously inhibit crew training.

There are no major DR's against this group.

Effectively, the command module interior is presently ready for crew training.

The command module interior should be completely up to 101 configuration by May 15, 1968.

SERVICE PROPULSION SYSTEM.

The Service Propulsion System (SPS) is very close to being in the Spacecraft 101 configuration. There are only two MCR's outstanding against the system, neither of which represents a major system change. Functionally, the system performs as per specifications and presents no hindrances to crew training.

The only DR's outstanding against the system (two) involves a software malfunction of the SPS PU SENSOR caution and warning light.

Effectively, therefore, the SPS System is presently ready for training.

By April 1, the Service Propulsion System should be completely correct and operational.

INSTRUCTOR AIDS

This phase of simulator training represents those displays, readouts, real-time print capabilities, etc., available only to the instructors on the Instructor Operator's Station (IOS) and does not affect the Spacecraft 101 configuration in any way. Simply stated, it better enables the CMS instructors to provide a more illustrative and descriptive training environment for each crew.

Hence, there are no outstanding MCR's or DR's which will in any way inhibit crew training.

This group of training aids should be complete by May 1, 1968.

REACTION CONTROL SYSTEM

The Reaction Control System (RCS) is very close to being in the Spacecraft 101 configuration. There are only two outstanding MCR's which will effect changes in the system. Functionally, MCR 11099 ROTA will make a software change in the Propellants Consumed Equations. The present method of computation of RCS propellants used is in error by a minimum of 10% and a maximum of 15% for long duration RCS burns, or during minimum impulse burns. This MCR should be installed by February 16, 1968. The second MCR, 3807 R3, involves only the removal of four switch guards over the Secondary RCS Propellant switches on MDC-2, and should be installed by February 14. Several other MCR's indirectly affect the RCS System. MCR's 3897 A and B R4 make electrical circuitry changes in the CM, particularly to the CM RCS heater logic. MCR 4011 R3 makes changes to several caution and warning limits in the RCS System.

There are no major DR's against the system.

The system is effectively ready for crew training at present.

The system should be completely ready by February 16, 1968.

CAUTION AND WARNING SYSTEM

The Caution and Warning System needs to have some of its warning limits changed. Also, two of the warning lights need to be removed.

There are three MCR's which are desirable for crew training. MCR 4011 R3, which changes many of the warning limits, should be completely installed on February 23, 1968. MCR 4304 RO, which removes the PGNS light, will be installed by February 24, 1968. The third MCR, 4352 RO, which removes the SPS PU sensor light, will be completed by March 15, 1968.

There are no important outstanding DR's.

The system will be effectively OK for crew training on February 23, 1968.

The system will be complete on March 15, 1968.

TELECOMMUNICATIONS SYSTEM

The Telecommunications System is close to meeting the Spacecraft 101 configuration, but there are yet many small problems which combine to make the over-all operation of the system unsatisfactory. Communication between the IOS and the simulator is good by means of the AL-1, AL-2, and AL-3 loops. The regular spacecraft modes (intercom, VHF-AM, and S-Band) have many minor problems associated with them, however.

There are no outstanding MCR's which will at this time affect crew training. The most important MCR is 10,063 RO, which changes the communications pre-amp to improve reliability. The work should be almost completed.

There are many minor DR's which indicate that the regular spacecraft communication modes are not operating very well.

The system should be effectively OK for crew training February 16, 1968.

The system should be completely ready on March 14, 1968.

STOWAGE

CMS-2 stowage lags far behind the Spacecraft 101 configuration. The main problem is the lack of stowage items, containers, and mounts, making our simulation poor.

There are several outstanding MCR's which are needed. MCR 1859 R10 (March 8) provides a portable floodlight. MCR 3572 R1 (February 20) adds markings for the operation of certain mechanisms and identification of hardware. MCR 3817 R5 (February 23) provides stowage provisions which are nonflammable. MCR 3827 R2 (February 15) provides a crescent type wrench. MCR 3830 R3 (February 23) provides redesigned stowage containers and fasteners in RHFEB, RHEB, RHIEB, and LHIEB. MCR 3883 R3 (March 1) provides nine fire resistant bags. MCR 3905 R2 (May 15) provides revised markings for stowage volumes. MCR 4010 R0 (March 1) provides stowage containers B-3, B-4, and B-7. MCR 4096 R5 (April 10) provides a CM fire extinguisher. MCR 3952 R1 and R3, which will be provided by the crew support team, redefine Spacecraft 101 experiments and camera operation.

The only major DR outstanding concerns the difficulty in locking the left-hand couch leg pan in the 180° position.

Stowage will be effectively OK for training on April 10.

Stowage will be completely OK for training on May 15.

GUIDANCE AND NAVIGATION SYSTEM

Guidance and Navigation (G&N) is near Spacecraft 101 configuration. Of the thirteen MCR's still outstanding against this system, only two are necessary for a 101 configured training situation. These two MCR's, in order of importance, are: (1) MCR No. 11240 R0, reset points for AS-205/101 (estimated completion date is February 15), and (2) MCR No. 11067 R0, GNC panel change (estimated completion date is March 1). Other MCR's, which are important but not absolutely necessary for 101 configured training, are 11135 R0, addition of PIPA bias (February 23); 11087 R0, update Spacecraft 101 mass properties (February 20), and 11145, update of aerodynamic force coefficients (no estimated completion date).

Of the nine outstanding DR's in the G&N System, two are important for 101 configured training: (1) DR No. 2083, GSSC L/B tape - the IMU and GDC do not track together and pitch error needle cycles up and down (no estimated correction date), and (2) DR No. 2306, no error needles at reset 100 after V60E/V62E (estimated completion is February 14).

SEQUENTIAL EVENTS CONTROL SYSTEM

The Sequential Events Control System (SECS) is very close to the Spacecraft 101 configuration, making our simulation very good.

There are two MCR's outstanding which would bring SECS up-to-date. MCR 3750 R2 (February 11) provides redesigned event pushbutton guards allowing operation with the gloved hand. MCR 6204 R0 (February 29) incorporates a new "OFF" position for the tower jettison switches, thereby eliminating the possibility of an inadvertent CM/SM separation in the event of a short in the tower jettison relays.

There are two DR's outstanding. SM RCS is not commanded on at CSM/SIVB separation. Also, CM/SM separation cannot be accomplished at reset 220. Both DR's are ready for NASA verification.

The SECS is effectively OK for crew training now.

The SECS will be completely OK for crew training February 29, 1968.

ELECTRICAL POWER SYSTEM AND ELECTROLUMINESCENT PANELS

The Electrical Power System (EPS) is generally in configuration and effective for training, but all Electroluminescent (EL) Panels have been removed and will not be replaced with new ones until April 1, 1968. The two major problems with EPS are the addition of CB Panel 229 and associated power distribution changes, and the change of EPS parameters for the C/W System.

The major MCR's in EPS are 3897 AR4 and 3897 BR4, which change CB rating, change wire guages, add and delete certain CB's, and 4011, which changes the limits of EPS C/W. The major MCR's in EL are 11083 R0 and 11096 R1, which update the EL panels. The EPS MCR's should be installed by February 23, 1968; EL panels by April 1, 1968.

There is one major DR for both EPS and EL Systems. The DR concerning the pressure drop in O_2 tank No. 1 and surge tank should be cleared by February 19, 1968, and the DR covering the removal of all the EL panels should be cleared by April 1, 1968.

The EPS and EL should be effective for training February 13, 1968 and April 1, 1968, respectively, and in configuration March 8, 1968 and April 1, 1968, respectively.

STABILIZATION AND CONTROL SYSTEM AND ENTRY MONITOR SYSTEM

The Stabilization and Control System (SCS) is close to spacecraft configuration and is effective for crew training. The major problem in this system is that the simulator uses the old mass properties. The Entry Monitor System (EMS) is up-to-date and effective for training. The only major change involving this system is the addition of a TV monitor for viewing a remoted EMS scroll.

There are four major MCR's concerning these systems. MCR 11087 R0 updates Spacecraft 101 mass properties; it should be installed by February 20, 1968. MCR's 4008 R0, 10052 R0, R3, and 10088 R1 provide for the TV monitor. These MCR's should be installed by February 23, 1968.

The major DR's involving SCS are erroneous error needles during entry (this should be cleared by February 14, 1968), and the ORDEAL System driving at the wrong speed. The latter DR is new and has no estimated clear date as yet.

The effective date for SCS is February 14, 1968, while the EMS should be effective for training February 23, 1968. The SCS and EMS should be in configuration April 30, 1968 and February 23, 1968, respectively.

INTERFACE

The state of the Interface System does not affect training as of this date. There are several MCR's that are designed to add or change items which will improve existing systems and broaden the capability of the over-all system. Many of these MCR's will be included in load AM 02.

The two major MCR's in this system are 11129 R0, which corrects CMS/GSSC initialization parameters (March 20, 1968), and 11140, which revises the SC/LV steering interface (February 16, 1968).

There are no major DR's involving interface.

Interface will be effective for training February 16, 1968, and should be in configuration by April 12, 1968.

205/101 RESETS

The simulator resets for AS-205/101 training have been generated at KSC. These resets are presently available for crew training with the following discrepancies outstanding.

a. Inertial platform attitudes at each reset are not satisfactory. The reason for this is the problem of making all the 205 burns out-of-plane. How soon is the platform to be aligned for the burn? (Having it 90° out-of-plane makes it useless for an emergency de-orbit.)

Operationally this problem is cured by simply doing an inflight alignment after each reset.

b. DAP inertias loaded at the resets are wrong. The proper numbers must be DSKY loaded during the run.

These problems will be cured completely by March 1, 1968. (Allowing time for investigation of this out-of-plane problem.)

ENVIRONMENTAL CONTROL SYSTEM

The Environmental Control System (ECS) is far from meeting the Spacecraft 101 configuration. There are at least eight MCR's out of the 24 for this system that are essential in order to give a positive ECS training. Four of the above mentioned MCR's will change or modify the ECS controls and the valves' nomenclature. These are 3841 AR5 (due April 15), BR5 (no estimated date), CR5 (due February 19), 3957 (due February 16), 4292 (due February 29), and 11072 (due February 19). MCR 3777 R6 and R7 (due February 23), provides for the rapid C/M repress capability; MCR 3842 (due March 15) will replace the primary O_2 regulator with two Carlton control regulators; the glycol measurement and readout box will be implemented by MCR 3838 (due March 29), and the ECS close out panels will be installed by MCR 3834 (due March 8).

There are five major outstanding DR's against ECS, three of which are related. They should correct the oxygen subsystem from pressurizing the suits with the "Direct O_2" valve open and no O_2 supply available, also the meter not reading when O_2 is flowing. A heat transfer problem in the IMU causes the "CMC TEMP" light to come on during launch. Evaporation in the primary glycol loop during launch after T+2:40 does not occur.

The system should be effectively ready for training March 29, 1968.

The system should be completely ready on April 15, 1968.