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Flight 501 Memo #10

TO: Distribution
FROM: Jay Sampson
DATE: 26 October 1966
SUBJECT: Summary of Results of AS-501 Digital Simulations.

The following is a description and short summary of verification runs that qualified the AS-501 flight program. Since all the runs were not made using the final revision of SOLARIUM, a revision number is included for each run. Not included wherein are the Time-Line Summaries and Special (Boost Monitor, Attitude Maneuver, SPS Burn, Entry) Summaries. These will be available in a forthcoming E- or R- Document.

★ RUN NO.	★ DESCRIPTION	★ OBJECTIVE	★ REMARKS	★ RESULTS	★ REVISION
★ 1C	★ 3-SIGMA ERROR RUN FROM PRELAUNCH TO SPLASH WITH UPDATE IN ORBIT ONLY.	★ VERIFY AGC ABILITY TO IN-CORPORATE STATE VECTOR UPDATE INTO ITS NAVIGATION PROGRAM AND PROVIDE COMPARISON WITH RUN 1B.	★ 600 SECS OF PRELAUNCH. ★ THE UPDATE POINT IS 292 SECS BEFORE THE ILLI BURN, OR ABOUT 11.203 SECS AFTER L/O. ★ UPDATE POINT DATA IS TAKEN FROM THE ACTUAL POSITION AND VELOCITY IN RUN 1B. THIS RUN IS OTHERWISE A REPEAT OF RUN 1B, WITH THE SAME BIASES AND INITIAL CONDITIONS, ETC.	★ THE AGC POSITION AND VELOCITY ERRORS BEFORE ORBITAL UPDATE WERE 550,000 FT AND 448 F/3. ★ THE POSITION AND VELOCITY ERRORS AFTER THE UPDATE WERE 2069 FT AND 1.32 FT/SEC. AT TERMINATION THE AGC TFF ERROR WAS 03 SECS. AT 400,000 FT THE VELOCITY AND VELOCITY ERRORS WERE 36,333 AND 68 FT/SEC AND GAMMA AND GAMMA ERROR WERE -7.32 AND 0.05 DEG. MAX G DURING ENTRY WAS 8.4 AND R-TO-GO AT SPLASH WAS 15 N.M. FINAL POSITION AND VELOCITY ERROR WERE 116,934 FT AND 249.4 FT/SEC. THE COLD SOAK APOGEE WAS 9887 N.M., AND THE PERIGEE WAS -52 N.M.	★ 54
★ 1D	★ 3-SIGMA ERROR RUN FROM PRELAUNCH TO SPLASH WITH COLD SOAK UPDATE ONLY.	★ DEMONSTRATE EFFECT OF ROLLBACK OF RUN 1B FROM 28.778 SECONDS AFTER L/O, WITH AN UPDATED STATE VECTOR PATCHED INTO THE STBUFF BUFFER AND UPDATE FLAG PATCHED UP. THE UPDATE POINT DATA IS TAKEN FROM THE ACTUAL POSITION AND VELOCITY IN RUN 1B.	★ ROLLBACK OF RUN 1B FROM 28.778 SECONDS AFTER L/O, WITH AN UPDATED STATE VECTOR PATCHED INTO THE STBUFF BUFFER AND UPDATE FLAG PATCHED UP. THE UPDATE POINT DATA IS TAKEN FROM THE ACTUAL POSITION AND VELOCITY IN RUN 1B.	★ THE AGC POSITION AND VELOCITY ERRORS BEFORE THE COLD SOAK UPDATE WERE 15,299,202 FT AND 8512 FT/SEC, AND AFTER THE UPDATE 1754 FT AND 4.40 FT/SEC. AS SOON AS THE UPDATE WAS INCORPORATED, THE AGC TFF WAS 687 SECS, SO SPS2 IGNITION WAS SCHEDULED IN 2 MIN. AT 400,000 FT THE VELOCITY WAS 36,333 F/3, STBUFF GAMMA WAS -7.23 DEG, AND VELOCITY AND GAMMA ERROR WERE 24.8 FT/SEC AND 0.03 DEG. A MAX 8.1 G WAS PULLED DURING ENTRY AND AT SPLASH THE MISS WAS 26.7 N.M. THE POSITION AND VELOCITY ERROR AT SPLASH WERE 126,675 FT AND 304 FT/SEC.	★ 51, WITH PATCHES TO UPDATE TARGET VECTORS AT LIFT-OFF *CORRECTLY, *YAW STEER, *AND STATE *VECTOR UP--*


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* RUN * DESCRIPTION * OBJECTIVE * REMARKS * RESULTS * REVISION *
* NO. *
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* 1G * EARLIEST POSSIBLE TUMBLE *CHECK UPLINK ABORT AND *UPLINK ABORT AT 502 SEC.*THE 202 ABORT PROGRAM * 50
* * ABORT BURN TO ATLANTIC *202 ABORT PROGRAM CHECK *SEPARATION AT 508 SEC. * AND CONSTANTS SEEMED TO *
* * TARGET. *TUMBLE ABORT SEPARATION *THIS IS THE EARLIEST * WORK WELL FOR THE 501 *
* * *LOGIC. *AFTER LIFT-OFF AT WHICH *BOOST TRAJECTORY. THE *
* * * *AN ABORT BURN CAN BE *MADE. AN EARLIER ABORT *ACHIEVED SPLASH POINT WAS *
* * * * *BURN WOULD BE TERMINATED*THE ABORT BURN LASTED *
* * * * *BY THE 200 SEC. TFF *183 SECS. *
* * * * *INTERRUPT. *
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* 1H * SEPARATION JUST AFTER *CHECK THAT THE SPS1 BURN *S4B SEPARATION OCCURS *AFTER TUMBLING WAS * 50
* * INJECTION INTO PARKING *CAN PERFORM THE TRANS- *AT L/O + 695 SECS (JUST *ARRESTED, THE SPS1 BURN *
* * ORBIT (WITH TUMBLING) *LUNAR INJECTION AND THAT *AFTER 1ST S4B BURN CUT- *LASTED 420 SECS. TO *
* * TO SPLASH. *THE MISSION OBJECTIVES *OFF) WITH A +6 DEG/SEC *ACHIEVE THE DESIRED P *
* * *CAN BE ACCOMPLISHED. *YAW RATE. THE AGC USED *AND E. USABLE SPS FUEL *
* * *CHECK NOMINAL SPS1 BURN *A 280,000 FT *WAS DEPLETED 20 SECS. *
* * *FOLLOWING A TUMBLE ARREST*FREE-FALL REFERENCE *INTO THE SPS2 BURN, *
* * *LOGIC. *ALTITUDE THROUGHOUT THE *WHICH RESULTED IN A DELV *
* * * *FLIGHT BECAUSE REFSWITCH *ALARM AND A SHUT-DOWN *
* * * * *WAS NEGATIVE. *SEQUENCE. BECAUSE ENTRY *
* * * * * *WAS TWO ORBITS EARLY AND *
* * * * * *THE SHORT SPS2 BURN, A *
* * * * * *MAX 15.5 G, -8.85 GAMMA *
* * * * * *STEEP ENTRY WITH NO *
* * * * * *SKIP-OUT RESULTED. THE *
* * * * * *SPLASH POINT WAS OVER- *
* * * * * *SHOT BY 330 N.M. *
*****
* 1I * 502 NOMINAL MISSION *PROVIDE REFERENCE *FROM S4B SEPARATION TO *SEP OCCURRED 11.899 SECS * 54
* * PROFILE. *MISSION. *SPLASH WITH 501 *AFTER L/O. SPS1 BURN *
* * * * * *DYNAMICS. *LASTED 276 SECS. SPS2 *
* * * * * * * *BURN LASTED 186 SECS. *
* * * * * * * *COLD SOAK APOGEE WAS *
* * * * * * * *9000 N.M. AND PERIGEE *
* * * * * * * *WAS -55 N.M. AT 400,000 *
* * * * * * * *FT THE VELOCITY WAS *
* * * * * * * *36,330 FT/SEC AND GAMMA *
* * * * * * * *WAS -7.19 DEG. SPLASH *
* * * * * * * *MISS WAS 0.3 N.M. THE *
* * * * * * * *MAX G PULLED DURING *
* * * * * * * *ENTRY WAS 8.3. *
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* RUN NO.	* DESCRIPTION	* OBJECTIVE	* REMARKS	* RESULTS	* REVISION
* 2A-1	* ENTRY WITH LOW FLIGHT * PATH ANGLE (-6.76 DEG) * AND LOW L/D (.3)	* CHECK OUT ENTRY STEERING * UNDER 3-SIGMA DISPERSION * IN GAMMA PLUS EXTREME * CONSTANT L/D VARIATION.	* FROM START OF ENTRY * (ALT. OF 400,000 FT) * TO MACH = 0.5 APPROX. * THE AGC WAS INITIALIZED * AT A NOMINAL GAMMA OF * -7.12 DEG, AND THE * ENVIRONMENT AT A * GAMMA OF -6.76 DEG. * THE DYNAMICS SIMULATION * WAS PERTURBED TO USE * AN L/D OF 0.3.	* ENTRY OVERSHOT THE * TARGET BY 139 N.M. * THE LATERAL MISS WAS * 26.4 N.M. AND A MAX * OF 7.3 G WERE PULLED.	* 54
* 2A-2	* ENTRY WITH HIGH FLIGHT * PATH ANGLE (-7.50 DEG) * AND LOW L/D (.3)	* CHECK OUT ENTRY STEERING * UNDER 3-SIGMA DISPERSION * IN GAMMA PLUS EXTREME * CONSTANT L/D VARIATION.	* FROM START OF ENTRY * (ALT. OF 400,000 FT) * TO MACH = 0.5 APPROX. * THE AGC WAS INITIALIZED * AT A NOMINAL GAMMA OF * -7.12 DEG, AND THE * ENVIRONMENT AT A * GAMMA OF -7.50 DEG. * THE DYNAMICS SIMULATION * WAS PERTURBED TO USE * AN L/D OF 0.3.	* ENTRY WAS SHORT OF THE * TARGET BY 361 N.M. * THE LATERAL MISS WAS * 19.6 N.M. AND A MAX * OF 10.9 G WERE PULLED.	* 54
* 2A-3	* ENTRY WITH LOW FLIGHT * PATH ANGLE (-6.76 DEG) * AND HIGH L/D (.43)	* CHECK OUT ENTRY STEERING * UNDER 3-SIGMA DISPERSION * IN GAMMA PLUS EXTREME * CONSTANT L/D VARIATION.	* FROM START OF ENTRY * (ALT. OF 400,000 FT) * TO MACH = 0.5 APPROX. * THE AGC WAS INITIALIZED * AT A NOMINAL GAMMA OF * -7.12 DEG, AND THE * ENVIRONMENT AT A * GAMMA OF -6.76 DEG. * THE DYNAMICS SIMULATION * WAS PERTURBED TO USE * AN L/D OF 0.43.	* ENTRY WAS SHORT OF THE * TARGET BY 19.8 N.M. * THE LATERAL MISS WAS * 17.7 N.M. AND A MAX * OF 5.9 G WERE PULLED.	* 54
* 2A-4	* SHALLOW ENTRY (LOW * FLIGHT PATH ANGLE OF * -5.5 DEG.)	* CHECK OUT ENTRY STEERING * FOR A SHALLOW, LIFT-DOWN * ENTRY.	* FROM START OF ENTRY * (ALT. OF 400,000 FT) * TO MACH = 0.5 APPROX. * BOTH THE ACC AND ENVIRO- * NMENT WERE INITIALIZED * FOR A GAMMA OF -5.5 DEG.	* ENTRY SPLASH WAS WITHIN * 1 NAUTICAL MILE OF THE * DESIRED TARGET IN BOTH * LATERAL AND CROSS RANGE. * A MAXIMUM OF 3.9 G WAS * PULLED.	* 54

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* RUN *      * DESCRIPTION *      * OBJECTIVE *      * REMARKS *      * RESULTS *      * REVISION *
* NO. *
* 2A-5 *      * ENTRY WITH LOW FLIGHT *      * CHECK OUT ENTRY STEERING *      * FROM START OF ENTRY *      * ENTRY OVERSHOT THE *
*      *      * PATH ANGLE (-6.97 DEG) *      * UNDER 3-SIGMA DISPERSION *      * (ALT. OF 400,000 FT) *      * TARGET BY 54.6 N.M. *      * 54
*      *      * AND LOW L/D (.3) *      * IN GAMMA PLUS EXTREME *      * TC MACH = 0.5 APPROX. *      * THE LATERAL MISS WAS *
*      *      * *      * CONSTANT L/D VARIATION. *      * THE AGC WAS INITIALIZED *      * 35.6 N.M. AND A MAX *
*      *      * *      * AT A NOMINAL GAMMA OF *      * OF 10.3 G WERE PULLED. *
*      *      * *      * -7.12 DEG. AND THE *      *
*      *      * *      * ENVIRONMENT AT A *      *
*      *      * *      * GAMMA OF -6.97 DEG. *      *
*      *      * *      * THE DYNAMICS SIMULATION *      *
*      *      * *      * WAS PERTURBED TO USE *      *
*      *      * *      * AN L/D OF 0.3. *      *
*      *      * *      * *      *
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* RUN *      * DESCRIPTION *      * OBJECTIVE *      * REMARKS *      * RESULTS *      * REVISION *
* NO. *
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* 2B *      * NOMINAL RUN FROM S4B *      * DEMONSTRATE EFFECT OF *      * S4B SEPARATION OCCURS *      * AS A RESULT OF NOT PER- *
* *      * SEPARATION TO SPLASH, *      * NO SPS1 BURN ON MISSION *      * AT L/O + 12,430 SECS. *      * FORMING THE 1ST BURN, *      * 51
* *      * WITH SPS1 BURN INHIBITED *      * PROFILE. *      * SPS1 BURN IS INHIBITED *      * THE APOGEE WAS LOWER *
* *      * *      * VIA AN ENGINE FAILURE, *      * (8987 VS. 9887 N.M.), *      * CAUSING A DELTA V ALARM, *      * THE 2ND BURN LASTED *
* *      * *      * 20 SECONDS LATER, THE *      * LONGER (289 VS 262 SEC). *      * SPS1 CUT-OFF LOGIC IS *      * AND ENTRY WAS VERY MUCH *
* *      * *      * ENTERED JUST AS IF THE *      * THE SAME AS RUN ID-1. *      * SPS1 CUT-OFF CONDITIONS *      * *      *
* *      * *      * WERE MET. *      * *      *
*****
* 2D *      * LATEST POSSIBLE ABORT TO *      * CHECK UPLINK ABORT AND *      * UPLINK ABORT AT 593 SEC. *      * ABORT BURN LASTED ONLY *
* *      * THE ATLANTIC TARGET. *      * 202 ABORT PROGRAM. *      * SEPARATION AT 610 SEC. *      * 7 SEC BECAUSE ABORT WAS *      * 50
* *      * *      * THIS IS THE LATEST AFTER *      * SO LATE. THE DESIRED *      * LIFT-OFF AT WHICH AN *      * SPLASH POINT WAS ACHIEV- *
* *      * *      * ABORT CAN BE MADE TO *      * THEED TO WITHIN 1 N.M. *      * ATLANTIC SPLASH POINT. *      * *      *
*****
* 2E *      * NOMINAL PROFILE FROM *      * DEMONSTRATE THAT BOTH *      * FROM 10 MINUTES OF *      * THE PRELAUNCH PROGRAM *      * 54
* *      * PRELAUNCH INTO BOOST *      * GRR AND L/O ARE BACKED *      * PRELAUNCH TO L/O + *      * RELEASED THE PLATFORM AT *
* *      * WITH NO GRR OR L/O RE- *      * UP BY UPLINK COMMAND. *      * 545 SECS. THE UPLINKED *      * 15.36 SECS AND STARTED *
* *      * CEIVED BY AGC. UPLINK *      * *      * LIFTOFF RACK UP ZFROS *      * THE AVERAGE G ROUTINE. *
* *      * BACK UP BY V 75 E 3 E *      * *      * THE AGC CLOCK AT 15.27 *      * THE MAXIMUM POLL MONITOR *
* *      * AT L/O + 15.27 SECS. *      * *      * SECS AND INITIATES THE *      * ERROR WAS 14.6 DEGS AND *
* *      * *      * BOOST MONITOR SEQUENCE *      * MAXIMUM PITCH MONITOR *      * ERROR WAS 11.4 DEG. AT *
* *      * *      * THE AVERAGE G ROUTINE *      * AGC LIFT-OFF. THE *      * *      *
* *      * *      * IS IN ERROR THROUGH *      * POSITION ERROR WAS 2302 *      * *      *
* *      * *      * MISSING ABOUT 15 SECS *      * OF THRUST DELTA V, AND *      * *      *
* *      * *      * OF THRUST DELTA V, AND *      * THE TARGETS ARE IN *      * *      *
* *      * *      * ERROR BY 15 SECS OF *      * EARTH ROTATION. *      * *      *
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*   RUN *   DESCRIPTION *   OBJECTIVE *   REMARKS *   RESULTS *   REVISION *
*   NC. *
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* 2F *   DE-ORBIT JUST AFTER S4B * DEMONSTRATE CAPABILITY OF S4B SEPARATION OCCURS * SPS2 IGNITION OCCURRED 9 *
*   *   SEPARATION IN ORBIT. *   MISSION CONTROL PROGRAM * AT L/O + 695 (JUST * MINUTES AFTER SPS1 DELTA *
*   *   *   LOGIC TO RETURN TO EARTH * AFTER 1ST S4B BURN CUT- * V CUT-OFF. THE BURN *
*   *   *   SHORTLY AFTER A SEPARA- * OFF). SPS1 RUPN IS * LASTED 74 SECS. THE *
*   *   *   TION IN ORBIT. * INHIBITED VIA AN ENGINE * ENTRY MISS WAS 8600 N.M. *
*   *   *   *   FAILURE (GROUND CUT- * (AFRICA). *
*   *   *   *   OFF), CAUSING A DELTA * *
*   *   *   *   V ALARM. 20 SECS LATER, * *
*   *   *   *   THE SPS1 CUT-OFF LOGIC * *
*   *   *   *   IS ENTERED. SINCE TFFNOM * *
*   *   *   *   CONTAINS 30 MIN AND A * *
*   *   *   *   DE-ORBIT P AND F ARE * *
*   *   *   *   USED INSTEAD OF THE * *
*   *   *   *   NOMINAL SPS2 P AND E, * *
*   *   *   *   SPS2 BURN PERFORMS THE * *
*   *   *   *   DE-ORBIT. * *
*****
* 2G *   ABORT BURN TO THE COR- * CHECK UPLINK ABORT AND * SEPARATION AT 552 SEC. *
*   *   RECT ATLANTIC TARGET. * 202 ABORT PROGRAM. VERIFY * UPLINK ABORT LATER. *
*   *   *   *   THAT THE ABORT KEYCODE * *
*   *   *   *   CAN BE RECEIVED WITHIN * *
*   *   *   *   1.7 SECS AFTER SEPARA- * *
*   *   *   *   TION. * *
*   *   *   *   *   *   *
*   *   *   *   *   *   *
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