F-15 ASAT

Dazzling technology and heated controversy surrounded the Air Force's prototype anti-satellite system--or ASAT. It consisted of a modified Boeing SRAM missile first stage, a modified Vought Altair III second stage, and a Vought miniature homing vehicle that would be launched from a modified single-place F-15 to intercept and destroy enemy military satellites in relatively low earth orbits by means of high-speed collision. Measuring 17 feet 10 inches in length and weighing just 2,700 pounds, the relatively small vehicle had aroused a huge storm of controversy in Washington, D.C., because of the alleged "de-stabilizing" effects it would have on the chances for meaningful arms reduction talks with the Soviet Union. The political debate in Washington had a direct impact on the progress of the test program at Edwards, as opponents of the system jockeyed to prevent testing of the missile against actual targets in space. This caused both uncertainty and delays as the F-15 ASAT Combined Test Force strove to meet critical milestones.[1/]

The Flight Test Center was actually only a partici-pating test organization (PTO) in the evaluation of the ASAT system. Space Division served as the system program office and the Western Space and Missile Center at Vandenberg AFB was the titular responsible test organization (RTO). The Flight Test Center, however, had a very substantial role to play. Because the ASAT had to be launched from a high-performance fighter and

because of the Center's wealth of actual flight test experience, the combined test force at Edwards was responsible for providing data on the compatibility of the missile with its launch platform and on the capabilities and performance of the total system. It was also tasked with the responsibility of establishing the F-15's operating envelope with the ASAT store (including the all-important launch parameters) and with training the pilots who would actually launch the missiles during the development test and evaluation phase of the ASAT program.[2/]

The program was scheduled to include 45 captive-carry tests and 12 live launches. Substantially more than 57 total missions, of course, would be required as unforeseen problems were encountered. The two test aircraft, F-15A No. 76-084 and F-15A No. 76-086, were originally scheduled to fly the ASAT program at Edwards through December of 1984. A number of problems, both political and technical, however, forced a slip in the scheduled date of the program's completion to September of 1986. Although figures for fiscal 1983 were not available, the combined test force's budget for fiscal 1984 came to $2.94 million.[3/]

The ASAT program (program element code No. 64406) had an Air Force priority of 1-1. It's initial precedence rating at the Flight Test Center, however, was only 5. As the program progressed, and as the time for potential launches neared, program officials became concerned that this relatively

low precedence rating could cause serious schedule slips. ASAT, like ALCM, GLCM, and B-1B, was a "window" type of program. For launch missions, in particular, a multitude of support resources --personnel, range time, and equipment--were necessary. The ASAT also had very specific "launch windows," precise blocks of time during which it had to be launched in order to intercept its designated target. There could be no delays. Thus, in September of 1983, ASAT's precedence rating at the Center was upgraded to 2 for the remainder of the development test and evaluation program. From thenceforth, the ASAT program would be subject to very few scheduling conflicts with other programs.[4/]

All phases of the program were subject to extremely tight security procedures. The commander of Space Division had imposed very strict "need-to-know" restrictions on all ASAT test information. Any public disclosure of such information would require either his approval or that of his deputy, the Space Division vice commander. This same "need-to-know" restriction would govern the flow of information within organizations such as the Flight Test Center. Basically, this meant that ASAT-related information would be limited to only those Air Force and contractor personnel who were directly involved in the test program.[5/] The Flight Test Center's internal security procedures were similarly restrictive:[6/]

- Access to flight test operations was controlled on a flight-by-flight basis using a combined test force access list. These operations included access to the aircraft, missile, pallet, pylon, test support equipment, and the mission control center during the preparations for, and the execution of each mission.
- Access to missile maintenance operations in the integrated maintenance facility was similarly controlled by an access list. Only those personnel with daily work requirements were permitted access.
- All flight test data transmitted to ground stations at Edwards were encrypted for transmission. All on-board recording was via magnetic tape and was hand-carried to the Ridley Mission Control Center by the CTF director.
- All post-flight classified test data were processed in the mission control center's secure area with the computer operating in a classified "system high" mode.
- Resulting classified data products were picked up and hand-carried by designated contractors and CTF personnel and stored in approved classified storage containers.
- Flight test results (data and comments) were not released to <u>any</u> agencies within or outside the AFFTC other than those directly participating in the test program (Space Division, 6595 Aerospace Test Group, Boeing Company ASAT, Vought Corporation ASAT, and McDonnell Douglas Corporation ASAT).

In addition, the combined test force established strict security procedures for the ASAT-unique F-15 central computer. It was flown only on the ASAT F-15s in support of ASAT test missions. When it was installed in the test aircraft, it was under 24-hour-a-day armed guard. When it was not required for flight test operations, it was stored in a GSA-approved safe.[7]

Flight Tests

Flight testing actually got underway on 4 October 1982(more than two months before the first flight with a missileinstalled) when the first flight in a limited performance eval-uation took place. From that date through 27 December 1983, a series of 30 flights, for a total of 46.6 hours, were intersper-sed between other tests.[8]

The limited performance evaluation was only a part of the build-up which served as a necessary prologue to actual launch missions. Supersonic zoom launch maneuvers were not accomplished during the initial performance evaluation, in part, because the first launch called for a subsonic zoom maneuver. Thus, during the first 19 captive-carry test missions (from 21 December 1982 to 22 December 1983), the test force concentrated on perfecting subsonic launch techniques during the course of at least a dozen simulated launches (see the ASAT Flight Test Mission Summary at the end of this section).[16/]

After two aborts, on 17 and 22 December 1983, the first launch of an ASAT test missile was successfully accom-plished on 21 January 1984 with Maj Ralph B. Filburn, III, the test force director, at the controls of the F-15. This first launch over the Western Test Range was referred to as a "point-in-space" test. No actual target was involved. The missile, which carried only a simulated miniature homing vehicle, was launched toward a predetermined location in space in order to test the performance of its two-stage booster and the booster's guidance system--in addition to the effects of launching the missile from the F-15. This initial launch, as much a political as a technological milestone, was considered highly successful.[17/]

With one successful launch completed, the test force proceeded to prepare for the next one. Scheduled for sometime later in 1984, the second launch mission would evaluate the ability of the miniature homing vehicle's flight sensor to acquire and track a fixed infrared-emitting object--in this case, a star. Throughout the rest of this reporting period, the test force's pilots flew both subsonic and supersonic zoom launch maneuvers--with increasing emphasis on the latter. One area of concern which turned up during these simulated launches (and which had also been encountered during the first launch) was a head-up display (HUD) abnormality. The HUD would "freeze" at T-115 milliseconds and would not update itself until the pilot made several hand entries to the F-15's central computer. For a period of time, this meant that the launch maneuvers had to be limited to daytime, visual flight rules conditions. McDonnell Douglas provided a fix for the problem and, by late April of 1984, the test force's deputy for engineering reported that "there are now no reasons to limit subsonic launch maneuvers to day, VFR conditions."[18/]

The following pages present a brief summary of F-15 ASAT test missions as compiled by the F-15 ASAT Combined Test Force.[19/]

ASAT FLIGHT TEST MISSION SUMMARY JANUARY 31, 1984

ASAT MISSION NO./LOCATION	FLIGHT DATE	TAKEOFF/ LANDING (Z)	RESULTS/REMARKS
800-1/EAFB	21 DEC 82	23:45/ 00:29	V/A Baseline Test Point and 3 JFS points accomplished - TM data lost prior to take-off and the I&CU shutdown shortly after take-off - Cryogen loaded.
800-2/EAFB	17 FEB 83	18:58/ 20:25	ECU Evaluation Flight Data acquired - verified I&CU software changes -inoperative L/S PCM TM became operative after take-off, but data quality was unsatisfactory - Cryogen loaded.
800-3/EAFB	4 MARCH 83	18:52/ 19:56	V/A Baseline repeated - cruise testpoint at 40,000 feet, Mach 0.95 with 3g turn achieved - L/S PCM TM data quality unsatisfactory - Cryogen loaded.
800-4/EAFB	8 APRIL 83	19:00/ 23:18	11 V/A and loads planned test points were accomplished - JFS test objectives completed - anomalous FM data from MC06V and MC07V - Cryogen not loaded.
800-5/EAFB	11 APRIL 83	17:18/ 19:58	13 V/A and loads planned test points accomplished - 2 ECS and 5 sets of rudder doublets completed - anomalous FM data from MC06V and MC07V - Cryogen not loaded.
800-6/EAFB	13 APRIL 83	22:54/ 00:56	5 V/A and loads planned test points accomplished - 2 sets of rudder doublets and 1 JFS test point completed - MC06V and MC07V had acceptable FM - 2 loads planned test points with 6g pull-ups not attempted due to load limits - Cryogen not loaded.

ASAT FLIGHT TEST MISSION SUMMARY JANUARY 31, 1984

ASAT MISSION NO./LOCATION	FLIGHT DATE	TAKEOFF/ LANDING (Z)	RESULTS/REMARKS
801-1/EAFB	26 MAY 83	18:00/ 19:09	HUD Steering and Missile/Pilot Navigation demonstrated - PMOC/ALCC generated DTM loaded - radar lock-on of missile beacon was received at VAFB - Cryogen loaded.
801-2/VAFB	4 JUNE 83	19:25/ 21:25	Aircraft/Pilot/Navigation System performed satisfactory -missile, TM, and C-Band Beacon experienced in-flight shutdown prior to obtaining launch point - Cryogen loaded.
802/VAFB	11 JULY 83	23:30/ 01:31	Aircraft/Pilot/Navigation System performed as planned with better than predicted accuracy - spiking of PCM data at VAFB was corrected by switching to San Nicolas Island T/M receiving station - Cryogen not loaded.
801-3/EAFB	15 JULY 83	15:46/ 16:46	Subsonic zoom launch/recovery maneuver performed as planned - PMOC/ALCC generated DTM loaded - pilot utilized HUD steering cues for aircraft maneuver control - afterburner applied on speed cue command prior to afterburner cue - Cryogen not loaded.
801-4/VAFB	22 JULY 83	18:30/ 22:42	Subsonic zoom launch/recovery maneuver performed as planned - HUD steering cues utilized - windshield wiper effect noted on HUD speed cue between maneuver point and launch point, afterburner applied on speed cue prior to afterburner cue - four heads-down simulated launches performed - Cryogen not loaded.
803/VAFB	27 JULY 83	19:58/ 00:06	Subsonic zoom launch/recovery maneuver performed as planned - HUD steering cues utilized - windshield wiper effect noted, speed cue ignored and afterburner applied at afterburner cue - five heads-down simulated launches performed - Cryogen not loaded.

ASAT FLIGHT TEST MISSION SUMMARY APRIL 30, 1984

ASAT MISSION NO./LOCATION	FLIGHT DATE	TAKEOFF/ LANDING (Z)	RESULTS/REMARKS
804-2/VAFB	26 SEPT 83	15:00/ 18:38	Horizontal Navigation maneuvers performed in NAV 1 Mode, switch to NAV 2 Mode accomplished 15 seconds late and horizontal and vertical maneuvers performed in NAV 2 - Two roll maneuvers performed at 30° pitch attitudes - one throttle transient accomplished at 30K/250 KCAS - Cryogen loaded.
804-1/VAFB	13 OCT 83	19:01/ 21:26	Subsonic zoom launch/recovery maneuver performed - missile NO-GO occurred at 11.5 seconds as expected from pre-flight checks - launch maneuver completed without HUD commands - one additional heads-down simulated launch performed - mission shortened due to high cryogen flow and due to exceeding the lower limits of critical temperature MC01T and MC06T - Cryogen loaded.
804-5/VAFB	27 OCT 83	22:15/ 00:50	Subsonic zoom launch/recovery maneuver performed as planned - three heads down maneuvers performed as planned for range compatibility and pilot training - lower temperature limits of MC01T and MC06T exceeded again - upper stage raceway cover noted loose by chase aircraft pilot - Cryogen loaded.
804-4/VAFB	10 NOV 83	23:00/ 00:19	Subsonic zoom launch/recovery maneuver performed as planned - transfer from external power to missile internal power accomplished - MGA subframe buffer sequence change, A/B to B/A, occurred upon transfer to internal power - Cryogen loaded.
501R/VAFB	1 DEC 83	18:59/ 20:23	Subsonic zoom launch/recovery maneuver performed as planned with captive carry of FTM-2 - MGA subframe buffer sequence change, A/B to B/A, occurred four times at random - Cryogen loaded.

ASAT FLIGHT TEST MISSION SUMMARY AUGUST 24, 1984

ASAT MISSION NO./LOCATION AIRCRAFT T/N	FLIGHT DATE	TAKEOFF/ LANDING (Z)	RESULTS/REMARKS
501L/VAFB 76-086	17 DEC 83	18:01/ 19:22	Subsonic zoom launch aborted due to missile NO-GO as a result of U/S electronics battery low voltage - Cryogen loaded.
501L-2/VAFB 76-086	22 DEC 83	17:56/ 19:17	Subsonic zoom launch aborted due to missile NO-GO as a result of fin no. 1 hydraulics off test failure - Cryogen loaded.
501L-3/VAFB 76-086	21 JAN 84	18:03/ 19:25	Subsonic zoom launch of FTM 2 accomplished successfully. Missile flight appeared nominal - Cryogen loaded.
804-7/EAFB 76-086	19 APRIL 84	18:00/ 19:23	Subsonic zoom launch/recovery maneuver performed as planned - software modifications corrected previous HUD display problems - MGA subframe buffer sequence A/B problem correction was verified - new ECS control law was demonstrated satisfactory during both steady state cruise and throttle transient operation - Cryogen not loaded.
807/VAFB 76-086	27 JUNE 84	15:00/ 19:06	The HUD provided steering for a full complement of 11 waypoints and the subsonic zoom launch/recovery maneuver was performed as planned - four additional subsonic zoom launch maneuvers accomplished in the F-15 Training Mode - the aircraft right external fuel tank did not feed due to cocked filler cap - an MGA subframe buffer sequence A/B to B/A occurred during the preflight DTM load operation. Cryogen not loaded.
808/VAFB 76-084	22 AUG 84	17:01/ 20:34	Subsonic zoom launch/recovery maneuver performed as planned - four additional subsonic zoom launch maneuvers accomplished in the F-15 Training Mode - MGA subframe buffer A/B sequence maintained throughout mission - unable to track aircraft C-Band beacon - left external fuel tank did not feed - Cryogen loaded.

ASAT FLIGHT TEST MISSION SUMMARY NOVEMBER 1, 1984

ASAT MISSION NO./LOCATION AIRCRAFT T/N	FLIGHT DATE	TAKEOFF/ LANDING (Z)	RESULTS/REMARKS
W1528/VAFB 76-086	21 SEPT 84	17:00/ 18:35	Accomplished the TIPS objectives.
809-0/EAFB 76-086	22 OCT 84	14:30/ 15:54	Baseline - clean airplane with wing tanks installed - level accels accomplished at 21,30, 35 and 40K feet altitudes.
806-1/VAFB 76-086	23 OCT 84	03:01/ 05:23	Night subsonic zoom launch/recovery maneuver performed as planned - one additional subsonic zoom launch maneuver accomplished in the F-15 training mode - heads down display exercised along with HUD for steering - Cryogen not loaded.
809-1/EAFB 76-086	24 OCT 84	18:43/ 22:48	Aircraft performance level accels accomplished at 21, 30, 35, 40, 42, 44 and 50K feet altitudes with wing tank pylons installed - Engine trim 102.5% - MGA off - Cryogen not loaded.
809-2/EAFB 76-086	25 OCT 84	16:20/ 17:50	Aircraft cruise performance accomplished at 37 and 39K feet altitudes with wing tanks installed - Engine trim 102.5% - MGA off - Cryogen not loaded.
809-3/EAFB 76-086	25 OCT 84	19:17/ 20:41	Aircraft cruise performance accomplished at 40K feet altitude with wing tank pylons installed - Engine trim 102.5% - MGA off - Cryogen not loaded.
809-4/EAFB 76-086	29 OCT 84	19:16/ 20:21	Aircraft performance level accels accomplished at 30 and 44K feet altitudes with wing tank pylons installed - Engine trim 99.5% plus V max - MGA off - Cryogen not loaded.

F-15 ASAT Source Notes

1. See The History of the AFFTC, Jan-Dec 1982, pp 351-8. For examples of the controversy surrounding the missile and its test program see the following articles, "A Step Closer to Star Wars: Can a U.S.-Soviet Space-Weapons Race Be Slowed Down in Time," Time Magazine, 12 Dec 83, pp 28-30; "Approaching High Noon in Space," Wall Street Journal, 15 Mar 84; "Satellite Destroyers," Los Angeles Herald-Examiner, 4 Apr 84; "House Bans Anti-Satellite Space Tests," Los Angeles Times, 24 May 84; "Conferees Approve Defense Funds, Arms Tests in Space," Los Angeles Times, 26 Sep 84.

2. Msg, USAF/PAM, Washington DC to HQ AFSC/PA, Andrews AFB, subj: Public Affairs Plan--Second ASAT Test Launch, 131645Z Nov 84; msg, 6510 TESTW/CC, Edwards AFB to HQ AFSC/TE, Andrews AFB, subj: Request Assignment Extension for Two F-15A Aircraft, 141900Z Aug 84.

3. Ibid.

4. Msg, HQ AFSC/TEU, Andrews AFB to SD/YN, Los Angeles, subj: Justification for Upgrade of the Anti-Satellite (ASAT) Precedence Rating, 222100Z Jul 83; ltr, Maj Ralph B. Filburn III, Director, F-15 ASAT CTF, Edwards AFB, to 6510 Test Wing/TEV/TE, Edwards AFB, subj: ASAT Priority Increase, 13 Sep 83; memo, Lt Col William J. Brooks III, to Dr. James O. Young, AFFTC History Office, subj: ASAT F-15 Program Summary, 5 Jul 84.

5. Msg, HQ SD/CC, Los Angeles, to HQ AFSC/SD, Andrews AFB, et al, subj: Anti-Satellite (ASAT) Flight Test Information Security Contracts F04771-80-C-0040, F04701-80-O-0041, 291740Z Jul 83.

6. Ltr, Maj Ralph B. Filburn III, Director, F-15 ASAT CTF,

to AFFTC/CAI, Edwards AFB, subj: ASAT Computer Security Procedures, 3 Nov 83.

7. Rpt, AFFTC-TR-83-61, Limited Aircraft Performance Evaluation of the F-15A/ASAT System During Missile Captive Carry: Final Report, Jan 84.

8. Ibid.

9. Ibid.

10. Ibid

11. Ibid.

12. Ibid.

13. Ibid.

14. Ibid.

15. Ibid

16. Document, ASAT Flight Test Mission Summary, supplied to the AFFTC History Office by the director, F-15 ASAT CTF.

17. Ibid.; msg, USAF/PAM to HQ AFSC/PA, Public Affairs Plan--Second ASAT Test Launch.

18. Msg, USAF/PAM to HQ AFSC/PA, 131645Z Nov 84; Brooks memo to Young, 5 Jul 84; memo for record, Capt Ronald J.Faris, Deputy for Engineering, F-15 ASAT CTF, Edwards AFB, to AFFTC/SES, subj: Revision No. 13 to AFFTC Form 28, No. 82-69, 19 Mar 84, attachment to Faris memo for record, no date.

19. ASAT Flight Test Mission Summary; memo, Lt Col Doug Pearson, Director, F-15 ASAT CTF, to Dr. James O. Young, AFFTC History Office, 3 Dec 85.

F-15 ASAT

The F-15 antisatellite missile (ASAT) program in the years FY 1985 through FY 1987 continued in fits and jumps because of congressional disagreement regarding the ASAT. Essentially, the U.S. Air Force, the Reagan Administration and the Republican-dominated United States Senate were of the belief that ASAT testing and development were highly necessary. The Democratic-controlled House of Representatives, however, repeatedly delayed or attempted to kill the ASAT program, seeing it as a destablilizing factor in the U.S.-U.S.S.R. arms race.

In spite of this erratic course for the ASAT program, the period from October 1984 through September 1987 was one of exciting steps forward for the antisatellite program. During these years F-15 ASAT test pilots launched the missile four times from F-15 aircraft (it had been launched once during the previous reporting period). One of those launches was a celebrated first: the missile destroyed a globe-circling satellite.

Background to FY 1985

F-15 ASAT testing began at Edwards AFB in October 1982. The ASAT weapon system consisted of a 17-foot long missile, with short-range attack missile (SRAM) motor first stage, a

Vought Altair second stage motor, and a miniature homing vehicle within it. After the two-stage missile's navigation system placed the homing vehicle (the "warhead," approximately one foot in both diameter and length) in the proximity of the target and on a course toward it, the missile would then launch the miniature vehicle on a mission to destroy the satellite simply by smashing directly into it. Through 1983, the ASAT program was a limited performance evaluation, testing the compatibility of the 17-foot long missile with the flying performance of the aircraft. Because of its importance, the F-15 ASAT program enjoyed a high resource allocation precedence rating in comparison with many other test programs at Edwards.[1]

Early in 1984, the ASAT missile was successfully launched from an F-15. The "target" of that first test missile was merely predetermined point in space, and the purpose was to evaluate the propulsion system of the missile. (As with all subsequent ASAT launches, this took place on the Western Test Range over the Pacific Ocean.) After the F-15 ASAT test force and the contractor worked through a few problems, the 1984 fiscal year ended with a second launch imminent.[2] (See Figure IV-F-1.)

Early Tests

That second ASAT launch took place on 13 November 1984. It was designed for the purpose of evaluating the capability of

OPS NUMBER	FLIGHT NUMBER	MISSION NUMBER	FLIGHT DATE	TAKEOFF TIME (Z)	LAUNCH EVENT	LAUNCH TIME (Z)	LANDING TIME (Z)	PILOT	ENG	CONFIGURATION	TRIM
	862/086	801-1	26May83	18:00	None	N/A	19:09	Filburn	1205/1166	CFTM 2 tanks cameras (3)	102.5/102.7
W3310	863/086	801-2	4Jun83	19:25	Abort	N/A	21:25	Filburn	0377/1166	CFTM 2 tanks w/ cameras (2)	99/99
W7864	865/086	802	11Jul83	23:30	None	N/A	01:31	Bohn	1205/1166	CFTM 2 tanks, w/ cameras (3)	102.5/102.7
W2174	866/086	801-3	15Jul83	15:46	Launch	16:35:00	16:46	Bohn	1205/1166	CFTM 2 tanks, and cameras (3)	102.5/102.7
W1535	869/086	801-4	22Jul83	18:30	Launch	19:16:00	22:42	Filburn	1205/1166	CFTM 2 tanks, and cameras (3)	102.5/102.7
W9456	870/086	803	27Jul83	19:58	Launch	20:38:00	00:06	Bohn	1205/1166	CFTM 2 tanks, and cameras (3)	102.5/102.7
W4538	875/086	804-2	26Sep83	15:00	None	N/A	18:38	Bohn	1205/1166	CFTM 2 tanks, and camera mount	102.5/102.8
W8767	880/086	804-1	13Oct83	19:00	Abort	N/A	21:26	Filburn	1205/1166	CFTM 2 tanks w/ cameras (3)	102.5/102.3
W1220	883/086	804-5	27Oct83	22:15	Launch	23:00:56	00:50	Filburn	1205/1166	CFTM wing tanks and cameras (3)	102.5/102.3
W1188	885/086	804-4	10Nov83	23:00	Launch	23:45:56	00:19	Filburn	1205/1166	CFTM wing tanks cameras (2)	99.6/102.3
W5404	891/086	501R	1Dec83	18:59	Launch	19:46:10	20:23	Filburn	1205/1166	FTM wing tanks cameras (3)	103.2/102.5
W3249	897/086	501L-1	17Dec83	18:01	Abort	N/A	19:22	Filburn	1205/1166	FTM, wing tanks, cameras (3)	103.2/102.5
W1781	898/086	501L-2	22Dec83	17:56	Abort	N/A	19:17	Filburn	1205/1166	FTM, wing tanks, cameras (3)	103.2/102.5
W1781	903/086	501L-3	21Jan84	18:03	Launch	18:50:10	19:25	Filburn	1205/1166	FTM, wing tanks, cameras (3)	102.8/102.6
W5552	940/086	804-7	19Apr84	18:00	Launch	18:46:00	19:23	Brooks	0513/1166	CFTM, wing tanks	102.1/102.7
W0488	966/086	807	27Jun84	15:00	Launch	17:14:00	19:06	Bohn	0513/1166	CFTM, wing tanks	99.6/101.5+V
W0038	1186/084	808	22Aug84	17:01	Launch	18:34:00	20:34	Brooks	0377/1205	CFTM, wing tanks, w/cameras(3)	99.6/100.0+V
W1528	992/086	502R	21Sep84	17:00	Launch	17:48:55	18:35	Bohn	0513/1166	FTM, wing tanks, w/cameras 3	102.4/102.9

F-15 ASAT Flight L

Figure IV- -1a

OPS NUMBER	FLIGHT NUMBER	MISSION NUMBER	FLIGHT DATE	TAKEOFF TIME (Z)	LAUNCH EVENT	LAUNCH TIME (Z)	LANDING TIME (Z)	PILOT	ENG	CONFIGURATION	TRIM
W1003	1003/086	809-1	24Oct84	18:45	N/A	N/A	22:48	Bohn	1205/1166	CFTM, wing pylons	102.5/102.2
W3376	1004/086	809-2	25Oct84	16:20	N/A	N/A	17:50	Bohn	1205/1166	CFTM, wing tanks	102.5/102.2
	1005/086	809-3	25Oct84	19:15	N/A	N/A	20:41	Brooks	1205/1166	CFTM, wing pylons	102.5/102.2
	1006/086	809-4	29Oct84	19:15	N/A	N/A	20:21	Brooks	1205/1166	CFTM, wing pylons	99.2/100.5
	1007/086	809-5	29Oct84	21:30	N/A	N/A	23:08	Bohn	1205/1166	CFTM, wing tanks, w/cameras(3)	102.5/102.2
	1008/086	809-6	30Oct84	20:45	N/A	N/A	21:20	Brooks	1205/1166	ASAT pylon, wing tanks	102.5/102.2
	1009/086	809-7	31Oct84	16:05	N/A	N/A	17:30	Bohn	1205/1166	ASAT pylon, wing pylon	102.5/102.2
W6378	1015/086	502-L	13Nov84	1 :23	Launch	20:17:14	20:50	Bohn	1205/1196	FTM, wing tanks, w/cameras(3)	101.9/102.6
W8211	1020/086	810	14Dec84	17:45	N/A	N/A	20:15	Brooks	1205/1196	CFTM, wing pylons	99.8/102.6
W6727	1050/086	812	20Mar85	18:00	Launch	18:42:00	20:24	Bohn	1205/1196	CFTM, wing pylons	102.0/102.2
W5971	1053/086	811	3Apr85	19:09	Launch	20:01:07	20:50	Brooks	11 6/1196	CFTM, wing tanks	102.2/102.2
W7393	1237/084	545-0	23May85	17:10	Launch	17:43:00	17:50	Brooks	0989/1166	FTM4, wing tanks	100.1/99.2+V
W2103	1270/084	815	29Jul85	19:37	N/A	N/A	20:09	Pearson	0989/0087	CFTM, wing tanks w/cameras (3)	102.5/101.5
W7770	-- /084	511R	8Aug85	N/A	N/A	N/A	N/A	Brooks	0989/0087	FTM4, wing tanks w/cameras (3)	102.5/101.5
W8892	1281/084	545-1	21Aug85	19:40	Launch	20:34:01	21:13	Pearson	1270/0087	FTM4, wing tanks w/cameras(3)	102.2/101.5
	-- /084	511L	4Sep85	N/A	N/A	N/A	N/A	Pearson	1270/0448	FTM4, wing tanks w/cameras(3)	102.2/102.1
W2884	1290/084	511L	13Sep85	19:44	Launch	20:36:30	21:17	Pearson	1270/0448	FTM4, wing tanks w/cameras(3)	102.2/102.1
W3745	1298/084	800-7/1	9Oct85	18:02	N/A	N/A	20:36	Pearson	1837/1838	CFTM, wing pylons	-220 levels

15 ASAT Flight L

Fi ure IV- -1b

OPS NUMBER	FLIGHT NUMBER	MISSION NUMBER	FLIGHT DATE	TAKEOFF TIME (Z)	LAUNCH EVENT	LAUNCH TIME (Z)	LANDING TIME (Z)	PILOT	ENG	CONFIGURATION	TRIM
W0655	1314/084	800-7/1A	29Oct85	19:41	N/A	N/A	20:17	Bohn	1877/1838	CFTM, wing pylons	-220 level
W0678	1315/084	80●-7/1B	30Oct85	19:01	N/A	N/A	21:37	Bohn	1837/1838	CFTM, wing pylons	-220 level
W0672	1319/084	800-7/2	5Nov85	18:55	N/A	N/A	21:07	Pearson	1837/1838	CFTM, wing pylons	-220 level
W0554	1321/084	800-7/3	19Nov85	18:56	N/A	N/A	20:56	Bohn	1837/1838	CFTM, wing pylons	-220 level
W1946	1148/●86	805-2	11Feb86	20:00	Launch	20:54	22:27	Bohn	1205/1059	CFTM, wing pylons	101.8/101.8
W6569	1149/086	805-1	13Feb86	19:01	Launch	19:55	21:08	Bohn	1205/1059	CFTM, wing pylons w/cameras(3)	101.8/101.8
W8319	1195/086	820	2May86	17:59	Launch	18:51	19:45	Pearson	1205/1059	CFTM, wing tanks	101.7/101.4
W0708	1200/086	821-0	13May86	23:54	N/A	N/A	00:47	Pearson	1205/1059	CFTM, wing tanks	101.7/101.4
W3376	1201/086	814-1	16May86	17:23	Launch	18:40	19:08	Bohn	1205/1059	CFTM, wing tanks	101.7/101.4
W5239	1442/084	818-1	15Jul86	20:15	Launch	N/A	22:33	Pearson	0513/1196	CFTM, wing pylons	95.8/ 95.3
W4189	1223/086	805-3	25Jul86	20:30	Launch	21:21	22:57	Pearson	1205/1059	CFTM, wing pylons	99.0/ 99.8
W0934	1225/086	510-R	1Aug86	13:30	Launch	14:14	15:01	Bohn	1205/1059	CFTM, wing tanks, with cameras (3)	102.6/102.7
W6632	1234/086	510-L	22Aug86	13:06	Launch	13:50	14:30	Bohn	1205/1059	FTM, wing tanks with cameras (3)	102.6/102.7
W9962	1450/084	818-2	26Aug86	13:40	N/A	N/A	14:45	Bohn	1196/0513	CFTM, wing tanks	
W3304	1451/084	818-3	27Aug86	11:55	N/A	N/A	14:00	Bohn	1196/0513	CFTM, wing tanks	96.3/98.3
W0272	1459/084	512L-1	20Sep86	10:40	Abort	N/A	12:10	Pearson	1196/0513	FTM, wing tanks with cameras (3)	101.1/103.7
W5488	1462/084	512L-1	30Sep86	09:55	Launch	10:45	11:24	Pearson	1270/0513	FTM, wing tanks	102.5/102.2

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OPS NUMBER	FLIGHT NUMBER	MISSION NUMBER	FLIGHT DATE	TAKEOFF TIME (Z)	LAUNCH EVENT	LAUNCH TIME (Z)	LANDING TIME (Z)	PILOT	ENG	CONFIGURATION	TRIM
W9897	1515/084	818-7	29Jan87	19:01	N/A	N/A	20:54	Bohn	1196/0513	CFTM	95.5/97.9
W6663	1516/084	818-8	13Feb87	18:59	N/A	N/A	20:59	Pearson	1196/0513	CFTM	95.6/95.3
W5224	1345/086	822-1	7Apr87	19:00	N/A	N/A	21:00	Arnold	1200/0995	CFTM, wing tanks	99.6/99.8
W9540	1346/086	822-1	8Apr87	18:00	N/A	N/A	19:42	Rollins	1200/0995	CFTM, wing tanks	99.6/99.8
W3278	1434/086	825	7Oct87	07:34	N/A	N/A	09:15	Arnold	0532/1489	CFTM, wing tanks	98.1/98.5

F-15 ASAT Flight Log

Figure IV-F-1d

the flight sensor on the miniature vehicle to locate and track a fixed infrared-emitting object. In this test, the infrared-emitting "target" was a star. Unfortunately, cryogenic cooling lines on the infrared seeker of the miniature homing device did not work properly. The manufacturer, LTV, made some minor but necessary changes during the ensuing months, to keep this from happening again.[3]

In 1984, the House of Representatives had voted a one year moratorium on ASAT testing. Later, a conference compromise with the Senate revised that ban to extend only until 1 March 1985. A Democratic bid to renew the moratorium failed in the Senate in May 1985. At the same time, the Senate voted overwhelmingly to allow the Air Force to carry out three more ASAT tests in the coming summer. This congressional action was not unexpected by the Air Force, for in mid-April the AFFTC had assured ASD planners that ASAT testing would be resumed at Edwards sometime between May and August. And, in late May, an independent Air Force technical review group had issued a report on ASAT mission readiness, finding no less than 30 technical problems that the board members deemed necessary to be resolved before the Air Force used the ASAT against an actual object in space.[4]

Because the great majority of ASAT tests were of "captive" missiles, in which the missile would not be released

from the F-15, the missile in those ASAT tests did not need to actually be carrying a miniature homing vehicle with which to strike a satellite In early June 1985, the second one of those miniature vehicles (MV) arrived at Edwards.[5]

The congressional tug-of-war over the ASAT program dragged on--to the detriment of the testing. Under Secretary of the Air Force Edward C. Aldridge, Jr., in testimony before Congress during the early part of 1985, stated that congressional vacillation--along with some technical difficulties--had caused the ASAT program's schedule to slip by a year, with its cost increasing correspondingly from $3.89 billion to $4.08 billion. In July 1985, the House of Representatives once more passed a moratorium on ASAT testing, contingent upon the Soviet Union similarly refraining from testing antisatellite weapons systems. Again a conference with Senators won additional time for the ASAT program: three more tests would be allowed by the end of the 1985 fiscal year.[6] The F-15 ASAT CTF would make the most of this congressional leeway, by carrying out the most convincing example yet of the feasibility of ASAT technology: a rendezvous in space between the ASAT homing vehicle and an orbiting satellite.

Satellite P78-1 Takes a Hit

Major Wilbert D. (Doug) Pearson, the director of the F-

15 ASAT combined test force, flew that historic mission September 1985. Major Pearson took his F-15 to 39,000 feet over the Pacific Ocean, about 200 miles west of Vandenburg AFB. Then, using steering cues provided only by his heads-up-display (HUD), Pearson spent the final 226 seconds before launch shifting his course and speed several times until, at 18 seconds before launch time, HUD cues directed him to climb into the launch position. As Major Pearson's F-15 climbed at 65 degrees and the raft slowed slightly to .934 Mach (top speed just before the pullup had been 1.220 Mach), the missile system automatically launched the ASAT at 38,100 feet.[7]

Meanwhile, at about 345 miles above the ground, a satellite named P78-1 was unsuspectingly whisking along in an orbit around the Earth, the same laps it had been repeating every 100 to 110 minutes since its launch into space in 1979. 11-foot by 6-foot satellite, which weighed 1,936 pounds, over the years carried out a number of experimental functions for the Air Force, Navy and Army, but had outlived its useful life, though it was still transmitting some data back to Earth.[8] P78-1 had been chosen as the first solid target in the sky for an ASAT missile.

The ASAT flight report for that day stated laconicall that, "The missile achieved the mission objectives including Resident Space Object (RSO) intercept." In fact, what happen

the miniature homing vehicle did intercept satellite P78-1 (the RSO), was that at exactly 1:42 p.m. PST, both the signals from the satellite and the signals from the ASAT vehicle stopped abruptly, for the impact of the ASAT projectile at that moment smashed P78-1 into approximately 150 pieces. The ASAT vehicle used no explosive, but relied solely upon the force of its impact into the satellite to destroy it.[9]

Air Force and DOD officials were ecstatic at the news of this result. Lt Gen Bernard P. Randolph, then Air Force deputy chief of staff for research, development and acquisition, told reporters that the ASAT test "went absolutely flawlessly." Secretary of Defense Caspar W. Weinberger issued a statement that the test was "a great step forward." General Randolph noted that the P78-1 satellite had presented a more difficult target than a specially designed target satellite that had been created for use in ASAT testing. That target device had needed repair by its manufacturer, Avco Corporation, because of communications systems problems within the newly constructed satellite.[10]

Two More Years of Uncertainty

Soon after the successful 13 September 1985 ASAT test, USAF Space Division announced a plan for nine additional test launches. Five vibro/acoustic test missions, flown in October and November, completed the full envelope clearance for the ASAT

carriage on the F-15.[11] An important point that was shown by the ASAT testing, as early as the fall of 1985, was that very little modification of the standard F-15 "Eagle" aircraft was necessary to enable it to serve as an ASAT missile launch platform (thereby becoming a "Celestial Eagle"). Essentially, the necessary modifications consisted of a centerline pylon for the missile carriage, and some computer software.[12] The antisatellite missile program seemed to be fully on track again.

Congressional division over the ASAT program, however, did not end with the 13 September launch that destroyed satellite P78-1; if anything, that test seems to have increased the opposition to the program. Opponents noted that, even though the ASAT missile had rather easily knocked out a satellite that was less than 400 miles above the Earth, and even if it was true that--as was surmised--the ASAT missile was capable of bringing down satellites as high as 900 miles in the sky, that was still a far cry from effectiveness against Soviet satellites in geosynchronous orbits 22,000 miles above Earth.[13] And the more successful the ASAT missile was, its opponents pointed out, the more likely it was that the program could fuel Soviet distrust of American claims of wanting arms control. In December 1985, the House of Representatives again put the ASAT program on hold, this time through a compromise agreement among the House, the Senate and the Pentagon. That agreement, paving the way for passage of a military appropriations bill, stipulated that the Army and the

Reagan Administration would receive permission to proceed with development of nerve gas weaponry in exchange for a renewed moratorium on live firings of the ASAT against targets in space. White House spokesmen expressed their unhappiness at losing the full ASAT program, even temporarily, for the Reagan Administration had keenly wanted both ASAT and nerve gas production.[14]

A few days before this agreement became law in December 1985, the Air Force, working with NASA, managed to put a pair of targets for future ASAT missiles into orbit around the Earth. The targets, 180-pound canisters, were sent up within a single satellite from a NASA facility on Wallop's Island, Virginia. The two instrumented test vehicles had design lives of only six months. Equipment on the two targets would measure the accuracy of the ASAT missile, and provide space and ground command and control. After the 13 September test in which a satellite was targetted, General Randolph had pointed out to the press that hitting it had been a more difficult feat than had the ASAT been aimed at an instrumented target vehicle of the type boosted into orbit in December. However, there would now be two of those targets in the sky--fully functional for about six months--ready for any renaissance of the ASAT program.[15]

Republican Congressman Lawrence Coughlin, of Pennsylvania, asked the General Accounting Office (GAO) for a

briefing report on six questions that he had about funding of the ASAT program. The GAO reply, in June 1986, informed Congressman Coughlin that the ASAT program had procured, as of 30 May 1986, a total of 15 missiles, four miniature homing vehicles, and parts for nine more miniature vehicles. Thus, the ASAT program had 13 complete missile systems and two additional missiles without miniature homing vehicles; those two missiles were used for captive-carry flights, as well as the first launch, which had not included a miniature vehicle. The program, at that time (mid-1986), was costing about $10 million per month.[16]

Military attorneys interpreted the congressional moratorium on further testing of the ASAT as meaning only a ban on targetting the ASAT at such concrete items as satellites, not halting test shots aiming at stars or points in space. Thus, the position of the Air Force in 1986 was that it had until the end of the fiscal year to accomplish two more launches of the missile. On 22 August, the first of those two missions was carried out, with Lt Col Gary D. Bohn piloting the F-15 with the ASAT missile. The target in this test was again a star, but the purpose of the mission was to perform a medium altitude probe (MAP), or in other words, to locate and track a target low on the horizon. Most of the flight parameters of Lieutenant Colonel Bohn's aircraft in the final minutes and seconds before the launch were quite similar to those of Lieutenant Colonel Pearson's flight on the occasion of the launch against a

satellite. Lieutenant Colonel Bohn reached a top speed of 1.185 Mach just before pulling up into the launch position a few seconds before the ASAT missile left his F-15, with the launch occurring 37,300 feet altitude.[17]

The F-15 ASAT test force just squeezed in the fifth actual launch of the missile before the end of the 1986 fiscal year. On 30 September 1986, Lieutenant Colonel Pearson was the pilot for a mission, termed a low altitude probe (LAP), in which the antisatellite system was to locate and track a target (again, a star) lower on the horizon than even the target of the previous launch mission. Lieutenant Colonel Pearson wrote that this was an "excellent mission," in spite of the necessity for taking off two minutes earlier than originally planned. This was a night mission on a moonless night. Even though the lack of a moon resulted in "no discernible horizon," Lieutenant Colonel Pearson noted that because all launch conditions were able to be met by flying with reference only to the HUD and other flight instruments, "the night launch maneuver was not particularly difficult to perform," with only a "slightly higher workload" than with a daytime launch maneuver.[18]

Into the fall of 1986, the conflict over the future of testing ASAT continued in Congress. The House of Representatives wanted to extend the moratorium through the 1987 fiscal year, but the Senate wanted no such ban. Meanwhile, the Air Force had

plans to conduct three launches during that fiscal year, all against instrumented test vehicles such as the two that had been carried aloft from Wallops Island, Virginia, the previous December.[19]

Congressional negotiation on the ASAT question resulted in an extension through the 1987 fiscal year of the moratorium on launch testing against targets in space. Air Force officials expressed their intention of continuing the ASAT program, yet not declaring it operational and beginning full-scale development. The Air Force cancelled the three live launches proposed for FY 1987, and the number of missiles being purchased (112?) was reduced by two-thirds. Meanwhile, Air Force officials continued to ask Congress to permit them to begin the three tests in October 1987, as a step toward initial operating capability of the ASAT system by the early 1990s. An ongoing problem was the possibility that the $20 million procurement and launch of the instrumented test vehicles, in December 1985, would prove useless if the satellite and test vehicles (which were Kevlar target balloons) stayed in space too long. Air Force officials spoke of extending the lives of those mechanisms by decreasing the number of contacts with them so as to conserve battery power on each satellite.[20]

Some of the F-15 ASAT test flights were aimed at the full-system integration of the aircraft, which had Multi-Stage

Improvement Program (MSIP) modifications, with the ASAT system. For example, in the fall of 1985 a total of five sorties were flown in F100 engine trim evaluations, with the technical report concluding that, "The F100-PW-220 engines should be installed in the ASAT operational fleet."[21]

In FY 1987, while waiting to see how Congress would respond to Air Force and Reagan Administration arguments supporting a renewal of ASAT testing in FY 1988, the F-15 ASAT test force was able to accomplish some testing. Seven test flights of the ASAT system were held between the 30 September 1986 test and 7 October 1987. None of those tests were launches, of course, but they were steps forward in the program. Four of the tests in January and February 1987, for example, were demonstrations of the capabilities of ASAT in cold weather situations. Also, further study continued regarding doubling the strike range of the ASAT. In March 1987 a significant exercise, with all the offices and people who would be involved in an actual wartime operation of ASAT activation and launch (the office of the Joint Chiefs of Staff, the Space Command, the centers at Cheyenne Mountain, and the complete ASAT organization) was held with great success. The exercise (planned and directed by AFOTEC) included every aspect of an ASAT event except the actual takeoff and flight of an F-15 with an ASAT missile, even to using an actual orbiting satellite as the target. At the end of 1987, the total number of F-15 ASAT missions flown since the

beginning of the program stood at sixty-one flights, five actual launches of the missile.[22]

In FY 1987 deliveries of miniature vehicles (MVs) to the ASAT test force "continue[d] to fall further behind schedule." In spite of that tardy record, the amount of ASAT equipment to be stored at the test force location mushroomed because all the flights were non-launch exercises using a captive flight test missile (CFTM). As storage space became increasingly limited in the Integrated Maintenance Facility (IMF), two new storage structures were erected nearby in June, each structure designed to hold two assembled missiles in a temperature-controlled environment.[23]

In March 1987, Lieutenant Colonel Pearson left the post of ASAT F-15 CTF Director, to become commander of the 6512th Test Squadron. He was followed at the ASAT CTF by Lt Col Phillip B. Arnold. Lieutenant Colonel Arnold flew two of the three remaining ASAT missions for the year.[24]

During 1987, Headquarters AFSC cancelled a planned F-15 ASAT mission in which an actual telemetry stream would have been provided from the missile, simulating an actual launch against an instrumented target vehicle. The cancellation was prompted by a desire to keep the ASAT program "low profile" congressional debate on the FY 1988 budget.[25]

) The Reagan Administration throughout 1987 continued to push for a resumption of ASAT testing. In May President Reagan issued a white paper that called ASAT a "key element" in U.S. space policy, and stated that continued delays in the program undermined national security.[26]

F-15 ASAT SOURCE NOTES

1. Book, History of the Air Force Flight Test Center, Jan 83- Sep 84, 394-412; Article, "Air Force Tests Antisatellite Payload," Aviation Week & Space Technology (19 Nov 84), p 28; Article, Robert C. Toth, "Anti-Satellite Test Political, Critics Say," Los Angeles Times (8 Sep 85), n.p.

2. Ibid.

3. Article, "Air Force Tests Antisatellite Payload," Aviation Week & Space Technology (19 Nov 84), p 28; Article, "Defense Dept. Plans Next Test Firing of Air-Launched Asat System," Aviation Week & Space Technology (23 Sep 85), p 20-21.

4. Ltr, AFFTC/XR to ASD/TAFA, subj: AFFTC Statement of Capability (SC) No. F-84-02-06, F-15 ASAT Training Mode Evaluation (MSIP Phase II), AFFTC JON 328ACO, 18 Apr 85, Doc IV-F-1; Article, Sara Fritz, "Senate Lifts Ban on Anti-Satellite Tests," Los Angeles Times (25 May 85), n.p.; Article, "House Votes 1-Year Ban on Asat Tests," Aviation Week & Space Technology (1 Jul 85), p 27-28.

5. Ltr, 6510 TEST W/TEVS to (various organizations), subj: ASAT Miniature Vehicle Handling at EAFB, 30 May 85, Doc IV-F-2.

6. Article, "House Votes 1-Year Ban on Asat Tests," Aviation Week & Space Technology (1 Jul 85), p 27; Article, Robert C. Toth, "Anti-Satellite Test Political, Critics Say," Los Angeles Times (8 Sep 85), n.p.

7. Report, F-15 ASAT Flight Report, 13 Sep 85, Doc IV-F-3.

8. Article, James Gerstenzang, "ASAT Destroys Target in Space," Los Angeles Times (14 Sep 85), n.p.; Article, James Gerstenzang, "Target Satellite Operating Prior to Weapon Test," Los Angeles Times (20 Sep 85), n.p.; Article, "Defense Dept. Plans Next Test Firing of Air-Launched Asat System," Aviation Week & Space Technology (23 Sep 85), p 20.

9. Report, Doc IV-F-3; Article, James Gerstenzang, "ASAT Destroys Target in Space," Los Angeles Times (14 Sep 85), n.p.; Article, "McDonnell Douglas F-15 Launches Asat in Third USAF Test," Aviation Week & Space Technology (21 Oct 85), p 19.

10. Article, James Gerstenzang, "ASAT Destroys Target in Space," Los Angeles Times (14 Sep 85), n.p.

11. Article, "ASAT To Be Tested Nine More Times," Desert Wings (27 Sep 85), p 14; Memo, 6510 TESTW/TEVS to Dr James O. Young, subj: ASAT Missions, 15 May 86.

12. Article, A. L. Randolph, "Anti-Satellite Testing Put On Hold," Antelope Valley Press (26 Dec 85), p A1.

13. Article , A. L. Randolph, 'Anti-Satellite Rocket Testingput On Hold," Antelope Valley Press (26 Dec 85), p A1.

14. Article , "Defense Package Includes Nerve Gas, Omits ASAT Weapons," Bakersfield Californian (17 Dec 85), n.p.

15. Article , "First Two ASAT Targets Launched Into Orbit," AFSC Newsreview (7 Mar 86), p 8; Article (), James Gerstenzang, "ASAT Destroys Target in Space," Los Angeles Times (14 Sep 85), n.p.

16. Report , GAO Briefing Report to the Honorable Lawrence Coughlin, House of Representatives: U.S. Antisatellite Program, Responses to Questions on Program Funding (Jun 86), p 2-3, Doc IV-F-4.

17. Report , F-15 ASAT Flight Report, 22 Aug 86, Doc IV-F-5; Article , A. L. Randolph, "Edwards F-15 Shoots at a Star," Antelope Valley Press (24 Aug 86), n.p.

18. Report , F-15 ASAT Flight Report, 30 Sep 86, Doc IV-F-6.

19. Article , A. L. Randolph, "Edwards F-15 Shoots at a Star,"Antelope Valley Press (24 Aug 86), n.p.; Article (U), "ASAT System Tested," Aviation Week & Space Technology (1 Sep 86), p 45.

20. Article , John H. Cushman, Jr., "Air Force Seeks 3 Space Tests Of Antisatellite Weapon in '87," New York Times (9 Jan 87), n.p.; Article , "USAF to Push Asat Tests Despite Congressional Ban," Aviation Week & Space Technology (22 Dec 86), p 27; Article , "Defense Dept. Unveils $1.2-Billion Asat Restructuring Plan," Aviation Week & Space Technology (16 Mar 87), p 19-20.

21. Plan , Statement of Capability: F-15 MSIP/ASAT Integration FOT&E Testing, 11 Aug 86, Doc IV-F-7; Report , AFFTC-TR-85-40, F100 Engine Trim Evaluation in an F-15A Aircraft, Jan 86, p3; Msg , 6510 TESTW/CC to SD Los Angeles AFS/CN/CNA, subj: F-15A MSIP ASAT Flight Test Aircraft Requirements , 012130Z Apr 87, Doc IV-F-8.

22. Memo , 6510 TESTW/TEVS to Dr James O. Young, subj: F-15 ASAT Program, n.d.; Article , Rudy Abramson, "New Space Satellite-Killer Tests Planned," Los Angeles Times (11 Mar 87), n.p.

23. Memo , 6595 Missile Test Group/OLAA to Dr James O. Young, subj: F-15 ASAT, FY 1987.

24. Ibid.

25. Ibid.

26. Article , "Paper Hits Delays in Anti-Satellite Program," Desert Wings (29 May 87), n.p.