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THE  
THOR-AGENA  
STORY

draft prepared by

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DOWNGRADED AT 12 YEAR  
INTERVALS; NOT AUTOMATICALLY  
DECLASSIFIED. DOD DIR 5200.10

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Chapter 1

INTRODUCTION

Since the close of the Second World War American military services have been actively interested in earth-circling satellites. Pertinent German research came to the attention of American military personnel and under the sponsorship of the

Army Air Corps, the RAND Corporation undertook feasibility studies of earth satellites. In September 1947, ~~the~~ <sup>an Air Force preliminary study + evaluation of RAND reports</sup> reported that a <sup>revealed</sup>

satellite was technically feasible, and in 1948 the Air Force, as

~~an~~ independent service, requested ~~that~~ <sup>P2</sup> RAND to establish a

program for the further investigation of possible satellite development.

During the next few years, RAND studied the problem under the code

name ~~XXXX~~ Feedback. <sup>By 1954 had</sup> The company reported that a space vehicle could

be placed in an <sup>earth</sup> orbit around the ~~earth~~ by a rocket powered booster.

RAND personnel recognized that numerous system component development

problems existed but such hardware development would not require

radically new technology or enormous costs

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1. Ltr. TSEON (TSEON-9) ~~8-11-47~~  
circa Dec 1947 from Ch Engr Dir  
Brig Gen Allen R Crawford to CofS  
21.4.11

2. Ltr 1 maj Gen Crawford to Douglas Air Corps, 1948, subject Satellite Project

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About the time RAND was completing its study, the Air Force established a research and development program on an advanced reconnaissance system, ~~the program was called Project 1115~~

The Wright Air Development Center, Dayton, Ohio, was responsible for managing the program called Project 1115. <sup>P3</sup> Air Force personnel made intensive feasibility studies including such critical component development areas as satellite-born electrical power for equipment operation and component reliability in a satellite environment.

By 1955, the Air Force had obtained sufficient data to insure that the problems were surmountable, which permitted system design studies to begin.

Consequently, in ~~the summer of 1955~~ <sup>that year</sup>, Wright center <sup>awarded</sup> design study contracts to Radio Corporation of America, Glenn L. Martin Company, and

Lockheed Aircraft Corporation for the purpose of determining if a reconnaissance ~~satellite~~ satellite system could be developed within a ~~reasonable~~ time span which would warrant a full scale development effort.

These "Pied Piper" studies ~~submitted~~ <sup>submitted</sup> by all three contractors showed that the system could be developed.

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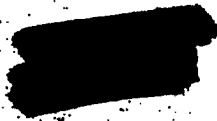


With these positive reports, the Air Force felt that it could begin hardware development under the title WS 117L.

The Air Research and Development Command believed that it would be best for Western Development Division located in the Los Angeles area to manage the program. The Los Angeles division managed the ballistic missile program, a top national priority program, and since the <sup>WS</sup> 117L system would have to use a missile as ~~the~~ the first stage booster and ~~the~~ <sup>the change of location was an attempt to remove</sup> ~~the~~ <sup>potential</sup> ~~potential~~ military satellite areas of conflict ~~between the two programs~~. During 1956, management functions ~~passed~~ from the Wright center to the missile division.

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Personnel from both Wright center and the <sup>Los Angeles</sup> ~~development~~ division

combined their ~~own~~ talents in the preparation of a WS 117L

development plan. In May 1958 ~~Washington authorities including~~ <sup>Washington authorities including</sup>

~~to Air Force agencies and to~~ Secretary of the Air Force Donald A.

Quarles, and the President's Science Advisory Committee <sup>approved & agreed to</sup> \* <sup>generally</sup> approved the plan.

The ~~plan~~ plan called for a two stage vehicle which could be launched

from United States territory. The booster or first stage would

be an intercontinental ballistic missile which would fall away

when the engine burned out at about 3,000 miles from the launch pad.

The second stage would be the orbiting vehicle, which would have a

~~propulsion~~ propulsion system to supply the necessary power

to propel the vehicle into a speed necessary for orbit.

The vehicle would ~~then~~ ascend to an altitude of about 300 miles

where an orbit would be assumed, and internal controls would orient

the vehicle in the proper attitude.

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\* from War History



*about  
typed as  
same as rocket motor*

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Meanwhile in March 1956, an Air Force board convened at Wright center to study the Pied Piper designs and to recommend a contractor for hardware development. The board recommended Lockheed as the prime systems contractor and this action was subsequently approved by <sup>the</sup> Department of Defense. The Air Force formally awarded the contract to Lockheed's Missile and Space Division at Sunnyvale, California on 29 October 1956.

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~~Department of Defense~~ [REDACTED]

The development plan had specified \$32.1 million for fiscal 1957. However, despite the program's high national priority, there was a chronic <sup>low</sup> shortage of funds during the ensuing twelve months. The ~~Defense~~ department had already planned its fiscal 1957 budget and consequently there was a time lag while the budget was juggled. ~~But of even greater importance was the~~ <sup>appreciation of</sup> ~~extreme conservatism of the Secretary of Defense~~ <sup>finally</sup> Charles to the entire program. The first \$7 funds arrived on the West Coast in December 1956, but ~~that~~ only in the amount of \$3 million. Subsequently, <sup>1957</sup> during the year, this amount was incrementally increased to a total of \$18.9 million. The Western Development Division made repeated efforts to relieve the situation with no appreciable results.

1956

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Of greater importance was the extremely conservative approach Assistant Secretary of Defense Charles to the entire program. He would not authorize the fabrication of mock-ups or experimental vehicles. He wanted the development to continue at a slow pace, to be conducted along conventional lines, with an initial flight target date some time after 1 January 1960. Aside from the danger of ~~the~~ <sup>the</sup> ~~program~~ <sup>the</sup> ~~was~~ <sup>the</sup> ~~about~~ the usefulness of a military satellite, ~~was~~ there was concern over the possible political repercussions arising from the use of a military

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space vehicle.

~~As a matter of policy no model or experimental vehicle was to be fabricated without Guggenheim's permission. During this time period the program was suspended.~~

The fund limitation and the defense department's general attitude caused <sup>US</sup> 117L program activity to be channeled into component

rather than total system development. *On a short supply of funds,* During the pre-Sputnik

Lockheed began satellite airframe design studies, investigated sources ~~for~~ for satellite-borne auxiliary power and attitude control systems, and *selected a* searched for ~~proper~~ satellite propulsion systems which would be available at an early date. Indeed some technical progress was

equal made but of ~~some~~ importance a contractor team had been ~~well~~ assembled and a broad base established from which rapid expansion could grow.

(based largely on hist rpt, WS 117L, Jan-Dec 56; short hist & chronology WS 117L, 1946-1959)

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Acceleration

*In July 1957*

The division (renamed Air Force Ballistic Missile Division

on 1 June 1957) ~~presented~~ <sup>two a</sup> submitted new development plans ~~during~~ 1957.

~~The development plan was submitted by~~

*which specified*

~~that if the~~ <sup>current</sup> ~~present~~ level of

funding continued, ~~the~~ September 1959 would be a realistic target

date for the first launch. However, a more desirable level of funding--

~~\$7 million~~ for fiscal 1958 and \$14.5 million for fiscal 1959--

would enable ~~a~~ first launch in March 1959. The Air Force Council

~~recommended~~ recommended the "desirable level" of funds, but before

<sup>gave</sup> the Department of ~~the~~ Defense <sup>approval</sup> would ~~approve~~, <sup>Soviet Union launched</sup> the Russian Sputnik J on 4 October <sup>causing political and emotional repercussions.</sup>

~~would have been~~ <sup>the</sup> Secretary of Defense ~~in~~

*A few days later,* <sup>the "desirable level" and</sup> ~~the~~ Air Force secretary James H Douglas' approval, <sup>the</sup> Air Force

headquarters released ~~the~~ part of the 1958 funds to the

division. When the new defense secretary Neil McElroy was briefed

on 29 October 1957, he was so enthused <sup>is</sup> that he directed the immediate

release of the balance of the 1958 funds and that the <sup>the</sup> program

proceed as rapidly as good management would permit.

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Also during the crisis atmosphere following ~~the~~ the first Sputnik, both RAND and the Department of the Air Force urged that Thor boosters be used in conjunction with the <sup>planned</sup> Lockheed 117L upperstage to provide an early space demonstration. In addition two special advisory groups created to consider steps for reviving United States prestige arrived independently at the same conclusion.

In February the Secretary of the Air Force asked for approval of a program acceleration based on ~~the~~ expanded use of Thor-boosted satellites, but <sup>a</sup> decision <sup>was</sup> ~~was~~ delayed pending the/activation of the new Advanced Research Projects Agency. The overall management of the

*written 117*

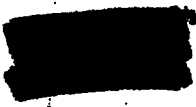
WS 117L program was <sup>to be</sup> ~~going to~~ one of the tasks of the new agency.

On 28 February, the new agency's director <sup>Roy</sup> Johnson approved the Thor-117L combination for early flight tests and as a means of conducting biomedical experiments.

The principal obstacle to WS 117L acceleration remained funding. Not until June 1958 were the various ~~and~~ proposals and counterproposals reduced to an approved program. At that point, the Thor-WS 117L phase

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received enough money to support the fabrication of the first 12 vehicles. By this time, the total 117L effort was under the new agency's control, the Secretary of Defense gradually making the shift between February and June.

During December 1958, the Advanced Research Projects Agency divided the original WS 117L program into <sup>three</sup> specialized projects, two of these ~~would~~ included the Atlas as a booster and the other would retain ~~the~~ <sup>the</sup> ~~the Thor booster~~ Thor booster.

The Thor boosted program and involved space engineering test functions, biomedical experimentation, of development/recovery techniques, and associated military support activities.

Eleven months later, on 17 November 1959, the Secretary of Defense transferred the Thor-Agana (as the second stage began to be called) to the Air Force. ~~However~~ However, for any program changed, ~~Los Angeles~~ the Air Force Ballistic Missile Division would have to receive approval from the Department of Defense Director of Development, Research and Engineering.

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*memo*

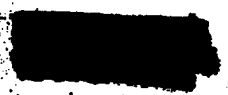




The Thor-Agena, booster-satellite combination represented an early and ~~major~~ major Air Force achievement in that it was the first hardware combination to progress to almost routine launchings and payload ~~recovery~~ recoveries. Although each stage was used with other space hardware combinations, the Air Force used ~~the~~ <sup>for flight tests</sup> ~~two~~ stages together ~~more~~ more frequently than any other ~~combination~~ combination. The original Thor-Agena flight proposal was ~~five~~ <sup>5</sup> in January 1958, increased to 10, 13, 15, 19, and then 25 flights by 30 April 1959. Shortly after the first complete flight successes, --launch, orbit, and capsule recovery-- ~~in~~ a new production growth began in August 1960. The approved total moved upward from 35 to 41, then to 44, 60, and 65 by July 1962. Of ~~these~~ comparable or greater <sup>Defense?</sup> importance, Director of Development, Research and Engineering in October 1961 had authorized <sup>production</sup> indefinite continuation of ~~launches~~ to provide ~~adequate~~ adequate numbers of Thors and Agenas for a variety of space projects.

(based largely on USAF Space Programs, 1945-1962)

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Chapter 2

THOR ADAPTATION

In November 1955 the Department of Defense assigned the development of the Thor 1,500 mile intermediate <sup>RANGE</sup> ballistic missile to the Air Force. By the end of the year the Air Force's Western Development Division ~~had solicited Ramo-Wooldridge to perform system engineering and technical direction and~~ had let a letter contract with Douglas Aircraft Company to develop the airframe, assemble the various systems, and test the entire package under the technical direction of Ramo-Wooldridge. With the back log of experience gained during the early development of the intercontinental ballistic missile, and with the decision to use components and facilities under development for the long range missiles, the Thor development time was greatly lessened. In fact, just fourteen months after the contract award, flight tests began at Cape Canaveral, and they continued until February 1960 after 48 Thors had been expended perfecting the ~~the~~ <sup>is a whole and</sup> component parts. Actually the ~~the~~ <sup>is a whole and</sup> system which eventually came to be used in the Thor booster had gained considerable early experience in ~~many~~ special reentry vehicle tests and other satellite launches.

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Guidance



~~Ballistic Missile Development Program~~

For ~~the~~ intercontinental ballistic missiles the Air Force had let two <sup>1955</sup> ~~contracts~~ <sup>for</sup> development guidance systems. AC Spark Plug Company--a subsidiary of General Motors--was <sup>to</sup> developing an all-inertial ~~guidance~~ system and ~~Bell~~ Western Electric's Bell Telephone Laboratories was to develop <sup>a</sup> radio-inertial ~~guidance~~ system. ~~Following the decision to to develop the Thor there was~~

After the Thor became part of the Air Force missile development program, there was no immediate decision on which guidance system to apply to the <sup>(short)</sup> short range missile. However, after a series of program changes ending in May 1958, the Air Force Ballistic Missile Division definitely assigned ~~development~~ the AC Spark Plug <sup>to</sup> ~~would be used in~~ the Thor and the Bell <sup>to</sup> system ~~in~~ the early Titan combat squadrons.

However, the AC Spark Plug system would not be ready for <sup>until</sup> flight tests ~~until~~ November, while Air Force planners had scheduled some Thor development flights between June and October to carry the Bell system.

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The necessary ground equipment for the radio-guidance would be ready at Cape Canaveral and ~~was~~ since there was no interference with the AC Spark Plug system development, the Air Force allowed the schedule to ~~be~~ stand.

Beginning in July 1958 there was a series of three *luna probes* ~~space~~ ~~launches~~ from Cape Canaveral using the Thor as the first stage booster, but without a guidance system. All three were failures ~~but~~ primarily due to instability in the *Thor engines* ~~propulsion system~~ rather than due to ~~the~~ inadequate guidance.

In the meantime, the Air Force Ballistic Missile Division was making plans for the first Thor-117L launches from Cooke Air Force Base, ~~later Vandenberg Air Force Base~~. By September 1958, the division had definitely decided not to use any of the unproven guidance systems and to rely on the Thor's autopilot and electronic programmer. (contr -65, sup 15, amend 1, 29 Sep 58)

~~During 1959 the development of the AC Spark Plug system continued until and after all improvements were incorporated, the system weighed 1,800 pounds.~~

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