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THE THOR-AGENA STORY

draft prepared by

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Contents:

ROUGH DRAFT

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Chapter 1

INTRODUCTION

Since the close of the Second Workd War American military services have been activiay interested in earth-circling satellites.Pertinant German reasearch came to the attention of American military personnel and under the sponsorship of the Army Air Corps, (Forces) the RAND Corporation undertook feasibility studies of earth satellites. In September 1947, (an Air Force preliminary study & evaluation of RAND reports revealed) that a satellite was technically feasible,[1] and in 1948 the Air Force, as an independent service, requested RAND to establish a program for the further investigation of possible satellite development.[2] During the next few years, RAND studied the problem under the code name Feedback. (By 1954) The compnay (had) reported that a space vehicle could be placed in an (earth) orbit ~~around the earth~~ by a rockot powered booster. RAND personnel recognized that numerous system component development problmms existed but such hardware development would not require radically new technology or enormous costs

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1. Ltr, TSEON (TSEON-1) circa Dec 1947 from Ch Engr Div Brig Gen Allen R Crawford to CofS ...

2. Ltr, 1 Maj Gen Crawford to Douglas Aircraft, ... 17 Feb 1948, subj: 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, ~~[illegible]~~ ~~The~~ Wright Air Development Center, Dayton, Ohio, was responsible for managing the program called Project 1115. P3 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 enviornment.

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 ~~[illegible]~~ that year, Wright center awarded design study contracts to Radio Corporation of America, Glenn L. Martin Company, and Lockheed Aircraft Corporation for the purpose of determining if a [illegible] reconnaisance satellite system could be developed within a [illegible] time span which would warrent a full scale development effort. These "Pied Piper" studies [illegible] ~~[illegible]~~ submitted by all three contractors showed that the system could be developed.

ROUGH DRAFT

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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 beleived 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 top national priority program, and since the WS 117L system would have to use a missile as the first stage booster and the change of location was an attempt to remove potentail areas of conflict between the two programs. During 1956, military satellite management functions passed from the Wright center to the missile division.

ROUGH DRAFT

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Personnel from both Wright center and the ~~[illegible]~~ Los Angeles division combined their ~~[illegible]~~ talents in the preparation of a WS 117L development plan. ~~[illegible]~~ In May 1956 Washington authorities including ~~to Air Force agencies and to~~ Secretary of the Air Force Donald A Quarles, and the Predidnat's Science Advisory Committee* generally approved the plan. The ~~[illegible]~~ 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 ~~[illegible]~~ propulsion system to supply the necessary power to propel the vehicle into a speed necessary for orbit. The vehicle would ~~[illegible]~~ ascend to an altitude of about [illegible] miles where an orbit would be assumed, and internal controls would orient the vehicle in the proper attitude.

ROUGH DRAFT

*from Wash history

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Meanwhile im 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 the 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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~~Despite [illegible]~~ [redacted]

The development plan had specified $32.1 million for fiscal 1957. However, despite the program's high national priority, there was a chronic 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 [illegible] greater importance was the extremely conservative approach of Assistant Secretary of Defense Quarles to the entire program.~~ The first 1957 funds finally arrived on the West Coast in December 1956, but only in the amount of $3 million. Subsequently, during 1957, 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.

Of greater importance was the extremely conservative approach of Assistant Secretary of Defense Quarles 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 [illegible] about the usefulness of a military satellite, there was concern over the possible political repercussions arising from the use of a military

ROUGH DRAFT

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space vehicle.

~~Asx a matter of policy no mock-up or [illegible] vehicle was to be [illegible] without [illegible] permission. [illegible] During this time period [illegible] approved.~~

The fund limitation and the defense department's general attitude caused WS 117L program activity to be channeled into component rather than total system development. ~~During the pre-Sputnik~~ On a short supply of funds, ~~era~~ Lockheed began satellite airframe design studies, investigated sources ~~mfx~~ for satellite-born auxilary power and attitude contol systems, and ~~searched for [illegible]~~ selected a satellite propulsion systems which would be available at an early date. Indeed some tebhnical progress was made but of ~~more~~ equal impprtance a contractor team had been ~~mxkx~~ assembled and a bppad base established from which rapid expansion could grow.

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

ROUGH DRAFT

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Acceleration

In July 1957 The division (renamed Air Force Ballistic Missile Division on 1 June 1957) submitted a new development plan which specified that if the current level of funding continued, September 1959 would be a realistic target date for the first launch. However, a more desirable level of funding—$47 million for fiscal 1958 and $142.5 million for fiscal 1959—would enable a first launch in March 1959. The Air Force Council recommended the "desirable level" of funds, but before the Department of Defense gave approval, the Soviet Union launched Sutnik I on 4 October causing political and emotional repercussions.

A few days later, the "desirable level" and Air Force secretary James H Douglas' approval, Air Force headquarters released part of the 1958 funds to the division. When the new defense secretary Neil McElroy was briefed on 29 October 1957, he was so enthusiastic that he directed the immediate release of the balance of the 1958 funds and that the program proceed as rapidly as good management would permit.

ROUGH DRAFT

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Also during the crisis atmosphere following the first Sputnik, both RAND and the Department of the Air Force urged that Thor boosters be used in conjuction with the planned 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 expanded use of Thor-boosted satellites, but a decision was delayed pending the Department of Defense's activation of the new Advanced Research Projects Agency. The overall management of the WS 117L program was to be one of the task of the new agency. On 28 February, the new agency's director Roy Johnson approved the Thor-117L combination for early flight tests and as a means of conducting biomedical experiments.

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

ROUGH DRA

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received enough money to support the fabrication of the first 12 vehicles. By this time, thetotal 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 three specialized projects, two of these include the Atlas as a booster and the other retain [illegible] the Thor.

The Thor boosted program involved space engineering test functions, biomedical experimentation, development of recovery techniques, and associated military support activities. Eleven months later, on 17 November 1959, the Secretary of Defense transferred the Thor-Agena (as the second stage began to be called) to the Air Force. However, for any program changed, 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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The Thor-Agena, booster-satellite combination representdd an early and xxxbxx major Air Force achievement in that it was the first hardware combination to progress to almost routine launchings and payloads xxxx recoveryes. Although each stage was used with other space hardware combinations, the AirForce used the twotstages together for flight tests more freqeuntly than any other xxx combination. The original Thor-Agena flight proposal was five 5 in January 1958, increased to 10, 13, 15, 19, and then 25 flights by 30 April 1959. Shortly after the first complete flight sucesses, --launch, orbit, and capsule recovery--xx 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 xxxxx comparable or greater importance, Director of ~~Development~~ Defense ?, Research and Engineering in October 1961 had authorized indefinite continuation of ~~xxxxflights~~ production to provide xxxxxx 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 [redacted]

In November 1955 the Department of Defense assigned the
development of the Thor 1,500 mile intermediate range 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 backlog 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 longer 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 [illegible] component parts.
Actually the [illegible] 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.

ROUGH DRAFT

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Guidance

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

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

However, the AC Spark Plug system would not be ready for 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 ~~xxxx~~ since there was no interference with the AC Spark Plug system development, the Air Force allowed the schedule to ~~dxx~~ stand.

Beginning in July 1958 there was a series of three ~~space~~ lunar probes ~~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 propulsion system~~ Thor engines rather than due to ~~xxxx~~q 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 [illegible] and after all improvements [illegible], the system weighed 1,800 pounds.~~

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