Remarks by Vaino J. Vehko, Director of Engineering, Chrysler Corporation Space Division at 30th Annual Meeting, Aviation/Space Writers Association, Las Vegas, Nevada, Thursday, May 18, 1967.

THE UPRATED SATURN I - ITS GROWTH POTENTIAL & FUTURE ROLE IN SPACE

Thank you for inviting me to be here with you today. It is always a pleasure to appear before a knowledgeable group such as yours, and in this instance, renew some old acquaintances. I would first like to review for you the status and current characteristics of the Uprated Saturn I, and then describe its growth potential and future roles in our space activities.

Probably the very first thing I should do is clear up the fairly recent nomenclature change in the designation of the Saturn I family of launch vehicles. The first Saturn, the Saturn I, which used the S-I first-stage and the 90,000 pound thrust S-IV second-stage, successfully completed all of its ten missions, the last one on July 30, 1965. The Saturn I was used for launch vehicle development, Apollo boiler-plate testing, and orbiting of the three Pegasus Meteoroid Technology Satellites.

The Uprated Saturn I, which uses the much lighter although almost identical S-IB first-stage and the 205,000 pound thrust S-IVB second-stage, is the vehicle that is currently in production and will be used for the balance of its missions in the Apollo Program and many missions planned for the Apollo Applications Program. The third Uprated Saturn I mission was flown on August 25, 1966 and was the 13th consecutive successful launch in the Saturn I family of flights. The first and third flights of Uprated Saturn I tested the Apollo Command Module heat shield for the re-entry heating it will encounter on return from earth orbital missions. The second flight was an orbital test of the S-IVB Stage and instrument unit and carried out a zero-gravity liquid hydrogen experiment.

Present rescheduling indicates that Uprated Saturn #4 (AS-204) will launch and orbit an unmanned lunar module. The succeeding launch is now planned as the first manned flight in the Apollo Program. This mission will test the command module and the service module in orbit.

The next mission may combine two launchings. A manned command/service module payload will be launched on the first vehicle and an unmanned lunar module will be launched on the other vehicle about a day later. They will rendezvous and dock and conduct manned tests of the lunar module in orbit.

Subsequent deliveries under the initial Uprated Saturn I order, vehicles 208 - 212, and the initial follow-on orders, may be utilized in the Apollo Applications Program, assuming no further need develops in the mainstream Apollo program.

The first four missions in the Apollo Applications Program are now scheduled to start in 1968.

AAP Launch No. 1 will be the launch of the command and service module with three men into orbit. AAP Launch No. 2 will be the launch of the S-IVB orbital workshop. They will rendezvous and dock to the multiple docking adaptor. The astronauts will transfer to the S-IVB through an air lock module after the stage has been prepared for entry and set up the workshop. An orbit time of 28 days is planned for the first phase of this mission. After this time they will reenter, leaving the workshop in orbital storage. It is planned to return to the workshop after about six months with two other launches to carry out different experiments and operations. Lifetime in orbit of the workshop at 260 nautical miles altitude is about two years.

AAP Launches Nos. 3 and 4 are similar to 1 and 2 in that the manned command and service module will be orbited initially followed by the launch of a second payload, after rendezvous and docking. The combined payload will increase altitude for rendezvous and docking with the workshop which was left in orbital storage. In this case the second payload will be the Apollo Telescope Mount, and the crew will spend 56 days in orbit. This is twice the mission time of the previous AAP manned operation. Upon the completion of this mission, the workshop and the Apollo Telescope Mount will be left in orbit with the intention of revisiting this cluster the following mission.

Subsequent Apollo Applications Program activity may include the launching of earth resources satellites, manned photographic telescopes, and use of a modified command module as a logistics vehicle. The earth resources satellite will help us manage our resources to improve man's standard of living. The satellite sensors will be capable of such things as detecting and surveying crop damage and disease, and collection of oceanographic and marine biological data for better utilization of the food potential of the ocean. We will be able to survey ground water, lake levels, and snow cover for better flood control and optimum water distribution for agriculture, industry, personal, and recreational uses. The design of this satellite is still evolving.

This slide shows one of the manned telescope concepts developed in the Chrysler Corporation Space Division Optical Technology Study. This is only one of a variety of configurations and operating modes. One concept that we have found attractive is a partially manned operation. That is, astronauts will set up the observatory, program remote operating equipment, and then leave the observatory. The observatory will then operate automatically for some period of time. The astronauts will then return to the observatory to retrieve data, conduct maintenance, and prepare the observatory for another period of remote operation. This concept has the advantages of greatly reduced life support requirements and removal of disturbances caused by man's presence during observations.

Contracting for the Uprated Saturn I follow-on vehicles has already been initiated by the government. We received $7.2 Million in 1966 for long lead time items for vehicles 213 through 216. This year's NASA Budget submittal proposes $78.5 Million for these same four vehicles plus funding for long lead time items for three others - 217 through 219.

The capabilities of the Uprated Saturn I have been steadily increasing with weight reductions of both stages and increased engine thrust. We are presently capable of boosting in excess of 40,000 pounds into 100 nautical mile orbit on an easterly launch from KSC. This places the Uprated Saturn I, contrary to quite a bit of popular opinion, in a class by itself. There is no other existing launch vehicle in this payload class, and proposed growth versions of the Uprated Saturn I stretch this all the way to 110,000 pounds in low earth orbit and with correspondingly heavy payloads for other types of missions.

This basic vehicle is the mainstay of the current Apollo earth orbital flight program and is planned for missions in the Apollo Applications Program previously mentioned. It has the power to boost bulky payloads. Payload cost effectiveness is good. This is in keeping with the general improvement in cost effectiveness as the boost capability of the launch vehicle increases. For the Uprated Saturn I, this cost effectiveness is about $500.00 per pound of payload boosted into orbit. It is operational, has manrated reliability, all of the required facilities and supporting equipment are in existence, the entire vehicle is currently in production, and it has excellent systems growth potential.

The basic Uprated Saturn I and five growth versions are arranged in order of increasing boost capability. The vehicle designations are those used in the second phase of a Saturn Improvement Study that was just completed. The 'MLV' stands for Modified Launch Vehicle .

On the extreme left is the vehicle as it exists today. The next configuration has four Minuteman first-stage solid rocket motor strap-ons and a 10 ft. extension to the S-IB first-stage. This is a boost assist version in that all eight engines of the first-stage and all four solid rocket motors are ignited on the launch pad.

Next is the baseline vehicle with four 120-inch diameter five-segment solid rocket motor strap-ons. This is a zero-stage configuration in that only the four solid rocket motors are ignited on the launch pad. The eight engines of the S-IB are ignited at altitude just before jettison of the solid strap-ons.

The fourth configuration has two seven-segment solid rocket motor strap-ons and a 20 ft. extension to the S-IB. This is also a boost assist version with all eight S-IB engines and the two solid rocket motors ignited on the launch pad.

The fifth configuration has four five-segment solid rocket motor strap-ons and a 20 ft. S-IB extension. Although at first glance the solid rocket motors appear to be seven-segment rather than five segment, this is not the case. The upper portions of these strap-ons are dummy segments and are required for structural purposes. The dummy segments allow us to tie into the S-IB spider beam; otherwise, we would be required to provide additional structure on the S-IB tanks at about the location of the dotted lines on the drawing. This is a modified boost assist version. The four solid rocket motors and the four outboard engines of the S-IB are ignited on the launch pad. The four remaining S-IB engines are ignited at altitude just prior to staging the four solid rocket motors. The vehicle continues through the boost stage on the eight S-IB engines until booster cutoff and ignition of the S-IVB stage.

The extreme right configuration has four seven-segment 120-inch diameter solid rocket motors and a 20 ft. extension to the S-IB. This is also a modified boost assist version. The four solid rocket motors and the four outboard S-IB engines are ignited on the launch pad. The boost phase proceeds in a manner similar to that of the previous vehicle except, of course, the solid rocket motor burning time is extended.

All of the growth versions were developed with these common program considerations: Payload and mission flexibility, maintenance of manrated reliability, minimum facilities modifications, low development risk, low investment cost, excellent cost effectiveness, and early availability. These considerations highlight our conservative approach and emphasis on reliability that has paid off so well in the past.

This is the degree to which the already substantial capability of the Uprated Saturn I can be increased for likely manned earth orbit missions. It is noteworthy that the vehicle today has a payload margin over that currently required for the Air Force Manned Orbiting Laboratory and the early Apollo Applications missions.

For the NASA Manned Orbiting Research Laboratory and the Manned Orbiting Telescope, existing concepts lie well within the capability of growth versions of the Saturn I and some of these concepts are within the capability of the existing vehicle. All launches are out of KSC and, in the case of polar orbits, an allowance is included for the required dog-leg maneuver.

With a chemical third stage and a fourth or kick stage, payloads can be launched on high energy missions. The mission details might require a little explanation since on all of the missions the energy required will vary with the trajectory that is flown. In the case of the Saturn fly-by, flight time has been selected as the third variable - on a two year mission about 2,000 pounds could be boosted with the chemical third stage and about 4,000 pounds could be boosted with the chemical third stage plus a kick-stage. For a solar probe orbiting the sun at about the same distance from the sun as the earth but inclined to the earth's plane of orbit, the third parameter is this angle of inclination to the ecliptic. For the third plus kick-stage version, about 1,000 pounds could be boosted at a 35-degree inclination and about 3,000 pounds could be boosted at the 30-degree inclination.

Nuclear propulsion applications, which seem to be the most likely next step in rocket propulsion, open up the performance potential shown on this slide. Nuclear characteristics are: Engine thrust - 10,000 pounds, engine weight 3,500 pounds, engine ISP - 800 seconds, and stage dry weight - 0.2 of the weight of the propellants. The nuclear upper stage is, of course, a hypothetical one but is still a very conservative projection of our current technology. It is evident that very substantial payloads can be boosted for just about any type of mission you might select.

The Uprated Saturn I has a growth potential that approaches one-half the capability of the giant of the Saturn family, the Saturn V, and has potential applications for all types of space missions. All of the potentials that have been presented today are well within our capability for accomplishment. In fact, these concepts have been the subject of a series of Saturn Improvement Studies conducted by Chrysler Corporation Space Division for NASA of which the final pre-hardware phase is now under contract.

In today's Uprated Saturn I we have a launch vehicle system that can boost over 40,000 pounds into low earth orbit; it is manrated; it has already flown successfully three times; the Saturn program has a record of 13 successes out of 13 flights. Overall, going back eleven years to the launching of our first Redstone on July 19, 1956, 80 booster stages built by Chrysler have been launched with no failures.

We have the hardware systems today for boosting very heavy and bulky payloads into orbit and these vehicles have a one-hundred per cent success reliability record. We plan on increased applications for the Uprated Saturn I vehicle and its growth versions, and a continuation of our reliability record in the nation's space program.

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