SATURN STAGE S-II

July 7, 1961

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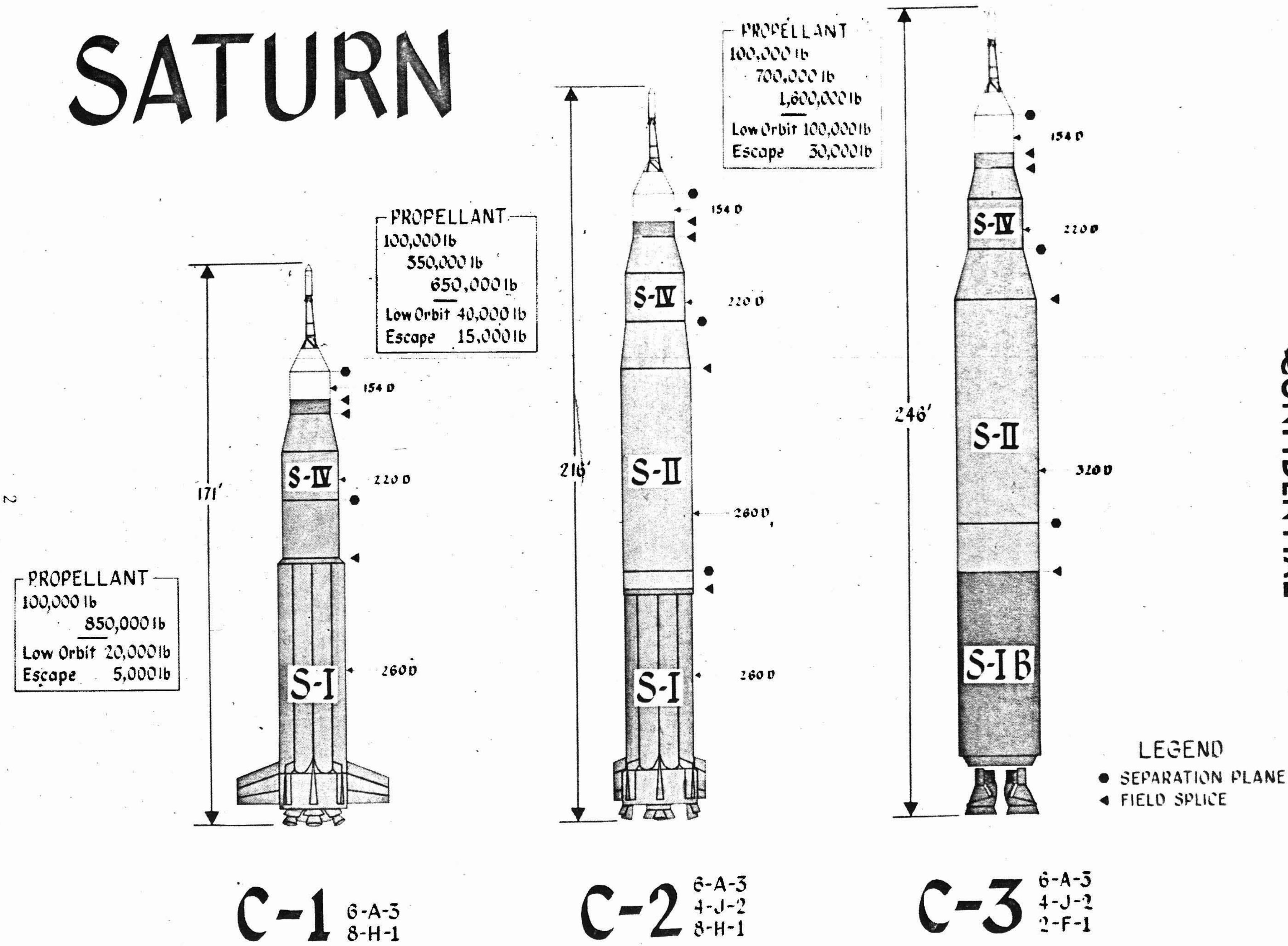
MINUTES OF THE PHASE II PRE-PROPOSAL CONFERENCE
FOR STAGE S-II PROCUREMENT ON JUNE 21, 1961

MORNING SESSION: Gentlemen, my name is Oswald Lange. I am Chief of the Saturn Systems Office here at Marshall. I want to welcome you to the Stage S-II, Phase II conference. The program this morning will consist of two parts. First I will give you a short technical presentation on where we stand today. Afterwards, Mr. Wilbur Davis of our Procurement & Contracts Office will talk to you concerning the request for proposal. This afternoon at 12:30 we will have a question and answer period.

Most of you know the Saturn story quite well so all I have to point out to you is an old story and a new one. The first vehicle shown on this chart is the C-1. As all of you know, the S-I is the first stage which has 850,000 lbs. propellant loading and 8 times 188,000 pounds of thrust or 1,500,000 pounds thrust total. The S-I stage is being developed here at Marshall. The second stage is the Douglas Stage S-IV which has 100,000 lbs. propellant loading and 6 times 15,000 pounds of thrust or 90,000 pounds thrust total. On top of that one, we have a payload; in this case it is shaped like the Mercury or Apollo spacecraft.

The next step in the building block program that we wanted to make, was to switch over from the C-1 to the C-2 as shown on this chart. The S-I would be essentially retained with slightly less propellant loading in order to optimize for escape. The C-2 would

SATURN


PROPELLANT
100,000 lb
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S-IV
S-II
S-I
S-IB
C-1 6-A-3 8-H-1
C-2 6-A-3 4-J-2 8-H-1
C-3 6-A-3 4-J-2 2-F-1
LEGEND
● SEPARATION PLANE
◄ FIELD SPLICE

have introduced a new stage, the S-II with the same caliber as the S-I stage—260 inches. You may remember that in the first phase of the S-II request for procurement, you were given to understand that it would be 260 inches in diameter. The Apollo spacecraft and the Douglas S-IV stage, were to be the same diameters as shown here for the C-1 vehicle.

Now, in the meantime, a number of things have happened, and what I shall give you today is a broad-brush briefing on the present line of thinking. We have found it necessary to make a jump at this time, in order to conform to the escape weight requirements of the payload people. Questions such as shielding of the payload, necessary because of the radiation problem between earth and the moon, have made it necessary to increase the payload weight from the original estimate of 15,000 lbs. to double the value or about 30,000 lbs. This increase would easily take care of the heavier sheilding. Now, in order to provide the capability, we had to go to a much higher thrust booster stage, and for that reason we would have to abandon the S-I stage with 1.5 million lbs. of thrust and change over to a stage using two F-1 engines providing 3 million lbs. total thrust. Therefore, if we discard the C-2 as a configuration, and look at C-3 configuration, we have a new stage called the S-IB. Very early optimization studies indicate that the C-3 vehicle will have a loading of 1.6 million lbs. propellant in the S-IB. On top of that one we have an S-II with a design capacity of 700,000 lbs. loading, and on top of that one, the S-IV stage with 100,000 lbs. design capacity. The payload is on top. In order to take care of the controlability of the vehicle, we show 320" as a caliber for the S-IB and S-II. At this time I want to answer a question which you will surely raise concerning the change from 260 in. to 320 inch diameter. The question; Whether this change in diameter would influence the evaluation of the first phase of this competition? The answer is no!

The so called C-3 vehicle is thought to be in a family with the NOVA. Both SATURN and NOVA constitute the lunar program of today. It will be a vehicle which shall be used for a great number of missions. What we call the S-II stage is the subject of our discussion today. To repeat once more, it has a different diameter—it is 320 inches caliber and has a very different loading from that required for the C-2. The 320 inches that I have mentioned, is called a preliminary final caliber. It will not be smaller than 320 inches but it might be even a little larger. It may be a little hard for you to speculate a design if we give you such soft indications of the configuration that we ultimately want, but we believe that based on what we give you today, you will be in a good position to give us a good design in very much detail assuming that the 320 inches is a likely caliber. It may be a little larger, it may be 360, but please assume for the purpose of your proposals that it is 320. We will issue to you today, in terms of technical papers, a statement of work for the old C-2 design and a small book called, Preliminary Design Criteria for the C-3, Stage S-II which is numbered MPR-M-Sat-61-3. We have not evaluated in detail all the necessary conditions concerning the design parameters required for the S-II (for C-3). What you receive today in the way of C-3 is preliminary data. However, we issue to you the C-2, S-II specs. based on which is in the document MPR-M-SAT-61-1 and we would like for you to consider these as guidelines only, taking out of them what you think is also applicable to the S-II for the C-3 configuration. We are very hopeful that you can use these documents to start the preparation of your proposal, and we are very hopeful that by 1 July we will be ready to issue a third document, similar to MPR-M-SAT-61-1, which we will call MPR-M-SAT-61-4 and which will be the so called "hard" specs for the S-II based on the C-3 configuration.

In summary you will be getting these two documents today, MPR-M-SAT-61-1 and ...-3, and on the 1st of July you will get another document (-4) of same size as (-1) which will be our final word and will be the basis for preparation of proposals.

Mr. Davis of our Procurement & Contracts Office will now brief you on the business phase of the request for proposal.

Davis

Gentlemen, the Marshall Center will be looking for a depth and width of competence in this procurement for stage management. I will touch briefly on some areas of particular business interest to us, on which I think you could do well to emphasize and make some very special effort in the preparation of your proposal to put these features in their best prospective. It is obvious that total cost including burden, G & A and fee will be given a great deal of examination during our evaluation process. The cost features of the proposal must be kept separate and apart from the technical proposal. The resulting contract will, because of the performance period and the duration in time, be incrementally funded. You should take this into consideration in the preparation of the proposal. The request for proposal will emphasize that NASA has overall technical direction of the SATURN program, but NASA has assigned to the Marshall Center, the immediate technical supervision. The successful contractor for this S-II stage effort will be one of several contractors involved in the total Saturn program. Therefore it will be mandatory that each stage contractor render complete cooperation with all other stage contractors.

All questions that are posed during the question and answer period after lunch today, which are not answered in this session, will be given an answer by publication at a later date. If any questions arise following the question and answer period today, we ask that you address them to the Office of Procurement and Contracts. A specific address is given in the request for proposal. We will broadcast to all potential bidders, the question and the answer. There will be no preferential treatment given in this respect.

It will be important to us to know whether a contractor is going to fabricate or sub-contract for a particular vehicle requirement. Careful consideration should be given to this make or buy provision that is contained in the request for proposal. All items should be identified on which a decision for this make or buy must be deferred. We would also like an estimate of what period of time you think would be involved in arriving at a make or buy decision if you are not able to express it in your response.

I wish to emphasize at this point that the important product that NASA will buy in this procurement is the efficient management of a stage system. This will explain I hope, our particular interest in knowing the experience, the background, and the specialities of any key contractor personnel who will be involved (these are key personnel) in managing, guiding, and directing the accomplishment of this action. There is a provision in the request for proposal to give the names, the specialized experience and the background of these personnel. It is of course, not our intent to participate in, directly at least, in the assignment, re-assignment,or the removal of personnel from the project. We do of course have a vital interest in knowing what is the caliber of the personnel that could be assigned to the work.

There were some weak points that were detected in all proposals that were received on the Phase I evaluation. I will mention four of the more significant weak features, with a suggestion to you that you try in the best way that you are able, to give us your best presentation on these points. The first point was a weakness in setting forth the adequacy of plant and test stand facilities. Point two: We would look for accurate, detailed identification of the company owned and government owned plants, facilities, special test equipment, severable and non-severable test facilities, special tooling and items in this broad category. Point three is transportation, including interplant transportation. We would like specifics not only in methods and routing, but also in cost pertaining to the transportation. Point four: And this is important; the method of managing the entire stage effort.

I understand that it was explained quite thoroughly in the pre-proposal conference for the first phase competition, that it was our intent to save the contractor's time and their cost by requesting proposals from only those firms that appear to be technically qualified and in a position to be competitive. After evaluation of the phase I proposals, four contractors were requested to submit detailed costs, and technical proposals for this phase II. This Phase II will lead to the selection of the particular successful contractor. It is not possible for this Center to furnish all interested contractors with copies of the request for quotation which will be supplied today, or with the specifcations, the technical booklets that were shown to you a few minutes ago. The solicitation to be made by us today for the two part proposal for the second phase of the evaluation process is necessarily limited to the four firms. I believe that is general public knowledge at this time. We have made a number of press releases. Those firms have not been mentioned today. If anyone would like to hear them, we will have them called off. If there are prospective sub-contractors who are competiting, then this contact would be a matter between the potential sub-contractors and all potential prime contractors. We will not be able to participate in setting up or approving any of those arrangements.

Any Questions? (none)

Gentlemen, the request for proposals will now be released to the four competing firms. I will repeat what Dr. Lange mentioned; we will return at 12:30 today for the question and answer session which will be both technical and business.

QUESTIONS AND ANSWERS

AFTERNOON SESSION:

QUESTION: Page one of the small booklet that came out this morning indicates that the stage may possibly be longer or shorter at some future date, and this should be considered in the design capabilities, particularly for the ground support equipment. Can you give us some indication of how much longer or how much shorter at this time.

ANSWER: I will have to give you a background on this question as to why we are a bit reluctant to freeze diameter of the S-II stage at this time. Our original intentions were to mate the S-II to our present Saturn booster, the S-I stage, which has approximately 260 inches diameter. The resulting vehicle would have been the Saturn C-2. In the rather recent past, our friends at the Space Task Group, have found, however, that the hazard caused by solar flares seems to be far more formitable than originally thought. Up to very recently, the prevailing opinion among our life-science people was that giant solar flares constitute a major hazard to man's space flight, but that prediction methods could possibly be developed so that we would not have to send an expedition around the moon or to the moon at a time when giant flares would be expected. In recent months this optimism of the predictiability of the giant flares has tapered off quite a bit and now most people feel that we ought to provide enough payload carrying capability to increase the shielding weights for the Apollo capsule. As a result of this, the weight carrying requirement for escape payloads, of 15,000 lbs., which had originally lead to the C-2 configuration, were replaced by a new set of payload requirements totaling about 25,000 to 30,000 lbs. This the C-2 just can't do! It is for this reason that NASA Headquarters said, "If this is so, we might as well skip the C-2 all together and go to the C-3 right away from the C-1". The C-1 of course will have a continued useful life as an orbital carrier of the Apollo capsule. Therefore, the C-1 is not a bit effected by all of this, but the C-2 cannot fly the circumlunar mission. Instead the C-3 is needed.

Now, since the President announced that he wants NASA to put a man on the Moon during this decade, it follows logically that the F-1 engine development must be speeded up. The F-1 engine, of course, is needed to provide a basement booster of twice the thrust of our S-I stage, so the decision was made to have the C-3 boosted by two F-1 engines. As far as this configuration and diameter is concerned, there would be nothing wrong with a 320 inch diameter Second Stage. Because we have 3 million pounds of thrust in the basement booster, rather than 1 1/2 million, we must, for optimum staging, put a lot more propellant load in the second stage, and if we had stopped at the 260 inch diameter, we would have a very slender vehicle which is undesirable. A basement booster of 320 inches, and a S-II stage of 320 inches would do the trick. This is essentially the configuration that you see portrayed in this folder.

But, as we look a little bit further into the future, the questions is: Since we have to develop the basement booster from scratch, and we have to develop an S-II from scratch, and since the S-II compatibility with S-I booster is necessary anyway, are we to deny ourselves any growth potential in the future if we stick to 320 inch diameter, in other words, would we make a better future vehicle out of this thing if we picked a bigger caliber than 320 inches from the outset? The big question here is, how about the nuclear upperstages? A nuclear upper stage, whether you fly it as a second stage or a third stage in the final nuclear vehicle, will always carry pure liquid hydrogen which requires a vast volume for adequate propellant loading. Our S-II stage, of course, has liquid hydrogen and oxygen so the combined density is far greater than that of hydrogen alone. Having only hydrogen in the nuclear powered upperstage means that you have a very low density stage. Now, the next question is, what will be the optimum staging ratio for the Saturn C-3, using the 2 F-I engine basement booster and the S-II and then a nuclear stage on top. This depends mainly on the question of the power rating available in the nuclear third stage. In other words, how much thrust will the Nerva engine really give us a couple of years from now? If we stick to conservative assumptions, and say Nerva would have 75 or 80 thousand lbs. of thrust, then the propellant load needed in the third stage would be relatively small. If we are able to get 200,000 lbs. of thrust, then of course we would like to cash in on the higher specific impulse of the nuclear upper stage and would like to put a greater investment of the total take-off weight into the upper stage, which means we would like to provide a large propellant volume to the top stage. And, if we can do better than 200,000 lbs, we would like to add even more hydrogen. When we talk to our friends in the nuclear propulsion field such as Lewis Research Center and people like Harry Finger in Washington and Col. Fellows, who is in charge of the nuclear vehicle here at Marshall, the degree of optimism as to how much power you can squeeze out of the basic Nerva reactor differs quite a little bit. Some people say there would not be much difficulty in getting twice as much thrust out of the same reactor. Other people are not so optimistic. The problem is, if we limit ourselves to 320 inches at this time, and a few years from now, the Nerva reactor comes out on top with more power than expected and we are stuck with a 320 inch diameter, then we would have a vehicle with a slenderness ratio that we couldn't handle dynamically. It is for this reason that the nuclear people bring a lot of pressure to bear on us ---- make it bigger, they say, make it as big as 360 inches diameter now! There is a pretty good reason for not doing that! Number one is: Our launch facility VLF 37 at Cape Canaveral is good for up to and including 320 inch diameter. If we go to 360, we have to move the foundation of the umbilical tower and a few other things. We would also have to go back into A & E (Architect and Engineering) design of the facility, and the facility completion would slip about six months, which is something that we probably couldn't afford. Secondly, the question arises, in what position do we maneuver politically if the VLF 37 facility cannot accomodate the C-3 vehicle, but only the C-1? In that case, we would surely lose a lot of flexibility. If we modify it later on, we might have to shut down the thing for a whole year which is undesirable also, and not compatible with the firing schedules presently envisioned. Therefore, our launch operations people at Canaveral urge us to stick to 320 and not make it fatter. A third consideration is this: If our Nova basement booster would be of a clustered design; specifically if it were clustered with four modules, each 2 x 1.5 K thrust - the same as the C-3 booster - then you get an odd looking configuration. If you go beyond 320 (because obviously the Nova diameter is twice that of the C-3 basement booster and the diagonial diameter would exceed 640 inches) this would make an awfully fat first stage which would taper down to 320 inches for example, or 360 inch or 390 inch second stage. So, if we are considering using the basement C-3 booster as a module for the Nova basement booster, then 320 inches would also be the upper limit. On the other hand, there are pretty good reasons for not going to the clustered basement booster at all. The Nova could have a single tank with all eight engines in the basement booster under that single tank. If that is the case then the 320 limit is no criteria. You can see that we have a whole lot of doubt in what we say here, and there are a lot of conflicting problems. We are presently trying to resolve them. We could have asked you not to come here today and could have taken say six weeks time to resolve these several problems internally in which case we would have lost six weeks on the S-II contract or we could do what we decided to do. We told you that we would furnish you the information we have now, and by the time you have worked out your proposal we will be ready to tell you what the diameter will be. This of course puts the monkey on your back, and we know that! What you are confronted with now, is one book based on

260 inches diameter which gives you a lot of small print on welding qualities, etc., and then you have another book that tells you the technical criteria if you go to 320 inches. But, in addition to the basic request for a 320 inch diameter stage proposal it might be a good idea if you have attached to your proposal a little appendix on how your proposal would be affected if you go to 360 inches, including an estimate of the effect on price. In some areas I think this is a pretty straight forward thing; for example, if you have transportation problems, when you analyze 320 inches, you might as well analyze for 360 inches right away. When it comes to facilities, we realize very well that the increased diameter will have an effect on the cost. Maybe you have to put in a higher bid somewhere; maybe the test stand modifications would be affected severely. If so, we would like to know that. One thing is certain, that when the final contract is written, there will be a firm diameter in that contract, and we want to have your price estimate before we come to an agreement. We will not sign a 320 inch contract and then switch the diameter later on, because then you have us over the barrel, and this we do not want to happen.

QUESTION: The question seems to be whether the propellant is going to increase also?

ANSWER: No. The amount of propellant is affected by the choice of thrust. When we go to the three million lb. booster, then we know that the maximum tank design capacity for the S-II stage, at least on the first go around, what we are talking here, will be approximately 700,000 lbs. We will freeze that. Much later of course but you can completely forget about this--if and when we ever have that nuclear upper stage, it may well be, at that time, we will want to have a somewhat shorter S-II stage, because it may be smarter to put more propellant into the upper stage where we have the higher specific impulse. But you can forget that for the time being. What we want is a design capable of easy modification so that tooling and test facilities are not seriously affected by a change in tankage volume. We have to optimize the C-3 vehicle, as far as staging is concerned, for the circumlunar mission. On the other hand, there is an obvious advantage in staging between the second and third stage at orbital speed. So we try to work out a solution whereby that staging could take place at orbital speed without paying the penalty on the circlunar or escape mission. If we could stage at orbital speed, it would give this whole system a much greater flexibility in usefulness for any kind of orbital rendezvous-operation. After approximately six weeks we will be able to tell you what the diameter is and the exact propellant loading. For the purpose of proposals: 320 inch diameter and 700,000 lbs. numbers are to be used. If any one of you feel it is unwise to even make a proposal on this basis, I would appreciate your telling us this, because, maybe you would, indeed, be smarter to just wait six weeks. We just hate to lose that time; maybe you don't want to lose it either.

QUESTION: Page 2 indicated that other missions may include a cargo haul into low altitude orbits and also be used for one-way cargo transportation----what is meant in this particular case by one-way cargo transportation? Is this a surface-to-surface mission?

ANSWER: I think what was meant here is that in the long run it may be that certain high priority cargo missions—for example Mercy missions or this kind could use a system like the Saturn C-3 combined with a recoverable nose cone to fly some equipment [illegible] somewhere. For example, if you had an earthquake in Chile and you want to fly medical stuff in there, you could use such a system in lieu of cargo aircraft. I would disregard this whole thing for the time being completely. It is just the opinion of a few people that this may be a useful application of such large rockets. I don't think it has any effect on the design of the S-II at all.

QUESTION: In the old spec., it says we are to assume a pitch rate velocity of 1 degree per second at staging of S-II from S-I. When we go to two F-1 engines, does that figure still hold? Is there an inequality of shutdown of the two engines that may cause a higher angular velocity than that? Reference Page 64.

ANSWER: As yet we do not have good data on the two F-1 engine shutdown characteristics, so we have to leave this open, but we feel that this is a good starting value for the separation study.

QUESTION: Along the same line, what can the staging Q be? We have a trajectory which seems to be not for the 700,000 lbs. propellant, therefore, can we use the staging Q in the book or if there is a large variety of upper stages, such as nuclear stages, is this staging Q going to vary. Which one shall we use?

ANSWER: You will have to recognize that since many of these values are not studies and fully evaluated yet, we cannot answer this question concerning other missions specifically. The one typical trajectory, which is furnished at the end of the small book, shows a 380 $K_g/_m{}^2$ Q at staging. It is quite clear that we can raise our trajectory in the first stage to a steeper one or we can lower it. It is also clear that we lose payload by this either way we go but it may be this will take more study. We have a typical trade-off argument here which is to be investigated. Perhaps in six weeks we can give a better answer to this.

QUESTION: IN THE MEANTIME I TAKE IT THAT WE SHOULD USE THE NUMBER GIVEN HERE?

ANSWER: Yes, I would recommend that you use this figure-about 400 Kilograms per square meter.

QUESTION: STILL ON THE SAME LINE, HOW IN THE WORLD CAN WE DESIGN THE OTHER PART OF THE SYSTEM FOR RECOVERING FROM THE STAGING IF WE DO NOT KNOW THE GEOMETRICAL CONFIGURATION OF WHAT'S ON TOP?

ANSWER: The geometrical configuration of the payload is, as we know it now, shown in the picture opposite page 1 of the small book—namely the Apollo spacecraft. A better definition of the payload is not available now. The separation problem between SI-B and S-II is given as part of the contract to the S-II contractor for the study of this separation problem. It is indicated that vanes located at the interstage between the S-II and S-IV may eventually be considered. However, I would mention that there is one complication. If we introduce vanes—if it comes out that it is necessary that we have vanes for this separation problem—then this has a feedback into the S-IB stage, stability wise. We specify for the S-IB stage, a gimbal angle of 3.2 degrees for the two engines. The maximum value is larger—4 degrees. If you introduce vanes at an interstage between the S-II and S-IV, this means that we will eventually have to reconsider this problem in order to live within the 4 degrees maximum on the first stage swivel angle, and we eventually will have to consider fins on the first stage. So there is a somewhat complicated problem which is to be investigated. It is more or less a complete vehicle integration dynamics problem.

QUESTION: I TAKE IT INTERSTAGE FLIPPERS ARE NOT DESIRED?

ANSWER: They are not desired, but if you come out that they are necessary for man-rating, then they have to be introduced.

QUESTION: IT ALSO MENTIONS CONTROL OF THE STAGE WITH ONE ENGINE OUT. UNLESS THE SWIVEL ANGLES OF THE J-2 ENGINES ARE INCREASED, THIS IS IMPOSSIBLE TO CONTROL WITH ONE ENGINE OUT.

ANSWER: Is this formulated as a one engine-out situation? I think the formulation provides for an uneven ignition of the second stage.

QUESTION: IT SAYS THAT AND IT ALSO SAYS, ON PAGE 54, ENGINE-OUT FOR SAFETY CONSIDERATIONS. WHY SHOULD YOU CONSIDER THE ONE ENGINE-OUT CONDITION?

ANSWER: Engine-out for safety means that the divergence rate shall be low enough, if one engine fails to ignite, so that time is sufficient to permit separation and escape of a manned capsule.

QUESTION: I'M TRYING TO SAY THAT WE WILL HAVE TO DESIGN THE PRODUCT. IF WE HAVE A LARGE NUCLEAR UPPERSTAGE AND WE WILL HAVE CONSIDERABLE DYNAMIC PRESSURE, WE CANNOT TELL YOU WHAT THE GAINS HAVE TO BE IN ORDER TO STAGE SUCCESSFULLY.

ANSWER: I think as far as that nuclear vehicle is concerned, the simple matter of the fact is, we cannot now and will not be able for about two or three more years, to really define the third stage of the nuclear vehicle because everything will depend on the outcome of the reactor engine tests. Nobody can say today what thrust level will be attainable in the Nerva engine. The only thing that we can say is, if everything comes out very fine, then we may have made the wrong move if we have limited ourselves at this time to 320 inches diameter because we may not be able to cash in on the full advantage of nuclear propulsion, but we are simply unable to say today what that configuration will look like and we may very well limit the length of the nuclear configuration for missile dynamic reasons.

QUESTION: THE SAME THING I SUPPOSE HOLDS TRUE FOR THE STRUCTURAL DESIGN? SHALL WE USE THE BENDING MOMENTS GIVEN IN THIS

BOOK WITHOUT WORRYING WHAT CAUSES THESE BENDING MOMENTS?

ANSWER: I would very strongly suggest that --- the main purpose of the S-II Stage and, in fact, the Saturn C-3 will be to fly an Apollo capsule around the Moon. This is very definitely the criteria against which you are to propose. We will at the same time, try to arrange it in such a way that staging between the second and the third stage takes place at circular orbital speed at a relatively low altitude in order to give us the additional advantage of flexibility of orbital rendezvous operations. But beyond this, we will not compromise the design in any way just because there are some pretty big future possibilities which we do not want to completely disregard. So the S-II stage should not be stronger than necessary to fly this mission, the circlunar mission, with orbital staging. If at some later time we have a nuclear stage, and if that whole vehicle is a lot longer, and if as a result of that, the bending moments are higher or the staging Q is less favorable, then we will simply come out with a modification and say now lets build up a big S-II that can handle this additional problem also. But we will not penalize the design now for this reason. I THINK THESE BENDING MOMENT LOADS AND q's OF COURSE, DEPEND STRONGLY ON THE POINT THAT WAS MADE AMOMENT AGO: WHATEVER FINAL TRAJECTORY WILL BE

SELECTED IS SUBJECT TO FURTHER STUDY, ALL THIS INFORMATION IS PRELIMINARY AND IS SUBJECT TO CHANGE. I WOULD SUGGEST THAT FOR THE PURPOSE OF YOUR PROPOSAL THAT YOU JUST ASSUME THAT THIS IS THE RIGHT DATA AND THEN BEFORE YOU REALLY START DESIGNING, I THINK WE WILL ALL BE TOGETHER ON WHAT WE WILL DO, AND SHOULD BE DONE. One complication is that the trajectory depends also on your weights. What is the dead weight of the S-II? Here we have just made some assumptions. There is probably nothing wrong with your setting up your machines back home and program an optimum staging ratio for the S-II design that you can envision. In other words, you know we have two engines in the first stage, and you know the purpose of the exercise is to carry a maximum weight into the circumlunar orbit. We would also like to have orbital staging, if possible, so after you know what your estimated weights will be, there is nothing wrong with you cranking this through your machines and telling us what propellant load you would recommend with your configuration.

QUESTION: IF WE ARE TO USE YOUR BENDING MOMENT ON THE GROUND THAT WERE GIVEN FOR A 40 KNOT STEADY WIND, WE CANNOT COMPUTE THE BENDING MOMENT IF WE DO NOT KNOW THE CONFIGURATION BETTER; secondly, WHAT KIND OF A GUST DO YOU HAVE IN MIND? TRIANGULAR ONE, WHAT DURATION, ETC.?

ANSWER: I think we should answer this question later. We have to enter some additional information on this point. We are not prepared to answer this question at this time. This morning we gave July 1 as a tentative date for giving you the final spec. for proposal. At that time we will try to incorporate all the answers.

QUESTION: IN SEVERAL PLACES IN THESE BOOKS THERE IS MENTIONED A DIGITAL CHECKOUT SYSTEM, AND THAT THE VEHICLE AND THE GSE SHOULD BE DESIGNED TO BE COMPATIBLE WITH THIS SYSTEM. WILL YOU FURNISH US WITH A SET OF CRITERIA AS TO WHAT COMPATIBILITY MEANS? IN OTHER WORDS, IF I REMEMBER CORRECTLY, IN THE ELECTRICAL SYSTEM AND TELEMETRY SYSTEM, THERE WERE STATEMENTS MADE IN THESE PARAGRAPHS SAYING THAT THESE SYSTEMS MUST BE DESIGNED TO BE COMPATIBLE WITH THE DIGITAL CHECKOUT SYSTEM. CAN YOU FURNISH US DATA AS TO HOW THESE THINGS MUST BE DESIGNED IN ORDER TO BE COMPATIBLE?

ANSWER: The problem is the following, we are presently studying a launch concept for Canaveral that will permit us a much higher launch rate than complex 34 and 37. We call this complex, Complex 39. The basic idea departs from previous concepts in that we propose to incorporate in 39 a different method of operations. There will be no blockhouse. Instead there will be a hanger about 2 miles away from the launch site, where the vehicle will be put together in a verticla position. The second stage will be piled on top of the first, and third on top of the second and finally the Apollo capsule put on top of the whole thing, and we would checkout, pneumatically and electrically, the entire vehicle in this hanger. There will be checkout rooms in this hanger, and after the checkout has been completed, the entire multi-stage vehicle will be moved in a vertical position to the launch site two miles away. We will not disrupt a single cable and will fire the vehicle from the checkout room where it has been checked out before with that same ground instrumentation. In other words, the vehicle has been checked in the hanger with all the ground equipment in one of the rooms in that hanger, and now we move the vehicle out and fire from the hanger rather than from the blockhouse. The advantage of this system is that you do not break into the cables after you have completed your checkout. Our trouble in the past and the thing that has always caused the most delay in firing missiles has always been to check out the bird with one set of ground equipment then you declare the missile o.k. Now you move it to the blockhouse; plug it in with the blockhouse equipment, and all of a sudden everything is off again. Then you start troubleshooting while the missile sits on the pad. With this system we would not tear into the electrical system at all. We use this same missile ground system for the checkout as we do for the firing. Unfortunately, you cannot have a cable of 2 miles length and roll it out for the firing and roll it up again using analog methods. This just doesn't work. Your voltage drops in these long cables are to high, so you can use this technique only if you provide digital data and a digital command link between the checkout room and the bird. You would use that digital data and command link for the checkout and then later on for the firing. For a digital command link which reduces everything to pulses, you don't depend on voltage drops and these kind of things in the two or three miles distance between the building and the launch site. An automatic telephone system uses this principal. When we say the stage must be compatible with digital checkout, it means that when we transfer from our present launch methods to the one here, compatibility should be retained. On the other hand, we still want to continue to fire these birds from complex 37 where we do not have that digital data link. What we are actually proposing then, is that we may have a set of analog digital convertors and that the vehicle itself uses both analog and digital techniques throughout but that all data going into the launch control area from the vehicle will be digital.

If some analog channels in the vehicle are to be fed to the launch control area, they shall be converted to digital through a translator box located on the ground at the foot of the vehicle. All we are saying is that your wiring and networks system ought to be compatible with such a digital translation technique. There are certain things that do not lend themselves too well to this, but most things actually do.

QUESTION: I GATHER FROM THIS THAT THE S-II CONTRACTOR WILL DESIGN THE HYDRAULIC SYSTEM FOR CONTROL. DOES HE DESIGN THE ELECTRONICS THAT CONTROL THIS SYSTEM? IT IS GOING TO TO BE VERY DIFFICULT TO DO THIS JOB BY CONSIDERING THE HYDRAULICS ALONE. WE ALL KNOW THAT THESE TWO ARE VERY CLOSE TOGETHER AND IN OUR EXPERIENCE WE CANNOT DESIGN THE ELECTRONIC PART WITHOUT HAVING THE OTHER HYDRAULIC PART AVAILABLE FOR TESTING AND MEASURING FOR COMPLIANCE, TIME DELAYS, ETC. HOW WOULD THIS BE RESOLVED?

ANSWER: The intelligence as far as sensors are involved is in the forward stage, above the S-IV stage. This consists of gyros, accelometers, and other guidance eqiupment. Accelometers are mounted to platforms and integrators.

QUESTION: SO THEN THE SIGNALS THAT ARE FED TO THE HYDRAULIC SYSTEM ARE PROVIDED TO THE S-II FROM THE INSTRUMENT COMPARTMENT?

ANSWER: Yes. The signals are provided in the form that is important to the actuators so they can use them. This is necessary from an overall system standpoint since there is more than one stage involved and all stages will receive their required signal to their actuators from control computers which will be located in the so called Instrument Compartment on top of the missile.

QUESTION: We cannot alter the signals or combine them to give our signals to the Hydraulic System?

ANSWER: They will be provided in exactly the form the actuators will use them. That means, combined already in the form to control the different deflection angles of the engine as required.

QUESTION: CAN THE AC POWER FROM THE PAYLOAD BE USED TO EXCITE ENGINE ACTUATOR POSITION PICKOFFS DURING THE S-II BOOST PHASE OR IS THAT SUPPLIED FROM THE S-II ELECTRICAL POWER SUPPLY.

ANSWER: The S-II stage is supposed to be self-contained in its entirety. In other words all the measuring and pickup voltages you have to provide in the stage yourself. The only signals fed to the actuators are actually control signals, and are not supposed to be considered a power source.

COMMENT:

I would like to say one thing if I may by way of further clarification of an announcement this morning; this concerns the make or buy program of the four firms that are competing for this procurement. I announced this morning that we did not feel that it would be proper on our part to release copies of these documents to potential subcontractors. I have since learned that one or perhaps two people in the audience did not understand that. We feel that it is very proper for the potential subcontractors to make application to the four firms that are in competition for this procurement. We would not insert the procurement office or the Marshall Center between the potential prime contractor or any of his potential subcontractors.

ANSWERS TO QUESTIONS RECEIVED AFTER JUNE 21, 1961

QUESTION: REFERENCE MPR-M-SAT-61-1, PAGE 86, PARAGRAPH 3.8.5.1.4. INFORMATION AND/OR SPECIFICATIONS REGARDING THE CHARACTERISTICS AND FUNCTIONS OF THE GFE DESTRUCT SYSTEM CONTROLLERS IS REQUESTED TO DETERMINE REQUIREMENTS OF OTHER EXTERNAL CIRCUITRY.

ANSWER: Two preliminary drawings were sent June 30, 1961 mechanically and electrically describing the EBW Destruct System Controller. These drawings illustrate the design concept and are subject to change prior to assignment of an MSFC drawing number.

QUESTION: REFERENCE MPR-M-SAT-61-1, PAGE 86, PARAGRAPH 3.8.5.1.6. DRAWINGS AND/OR SPECIFICATIONS OF THE S-I AND S-IV GSE CONTROLLED SAFE-ARMING UNIT AND ORDNANCE INTERFACE ARE REQUESTED.

ANSWER: No drawings are available at this time. These will be supplied at a later unspecified date.

QUESTION: MPR-M-SAT-61-1, PAGE 85,PARAGRAPH 3.8.3.1. REQUEST COPY OF DRAWING DAC 7866039.

ANSWER: Drawing sent June 30, 1961.

QUESTION: REFERENCE MPR-M-SAT-61-1, PARAGRAPH 5.2.5.3. DOES MIL-STD-804 APPLY TO THIS PARAGRAPH.

ANSWER: MIL-STD-804 is not a referenced document in this procurement request.

QUESTION: REFERENCE MPR-M-SAT-61-1, PARAGRAPH 3.5.5.2., WHICH SETS UP A REQUIREMENT FOR EACH ENGINE HYDRAULIC SYSTEM TO BE COMPLETELY MOUNTED ON EACH ENGINE. WE QUESTION WHETHER THE DESIGN ALLOWABLES FOR THE PUMP MOUNTING PAD PERMIT THIS INSTALLATION.

ANSWER: The Model Spec. for J-2 (R-21585) specifies the design requirements which the engine manufacturer is required to meet under the contract. The maximum accessory weight listed in R-2661-4P is well within the limits of off-the-shelf hydraulic pumps which have been qualified for such use. If the weight of the electric driven circulation pump is the factor causing concern, it could be mounted elsewhere, ie. on the actuator, or thrust frame.

QUESTION: REFERENCE MPR-M-SAT-61-1, PARAGRAPH 3.9.1., WHICH INDICATES THAT AIR CONDITIONING EQUIPMENT IS PROVIDED BY NASA ON THE UMBILICAL TOWER. THE CAPACITY OF THE SYSTEM IS DESIRED PERTAINING TO:

AIR TEMPERATURE
FLOW-RATE
PRESSURE
HUMIDITY

ANSWER: Air conditioning will be available for each stage depending upon it's individual requirements. In general, the unit will supply conditioned air for three purposes:

(1) To heat components and systems
(2) To cool components and systems
(3) To ventilate for human environment

Air Temperature for heating will vary from 150°F to 200°F depending upon need. Cooling temperature of conditioning air will be approximately 45°F. Flow rates and pressures will depend upon design requirements.

The component and system heating or cooling gases will have a -35°F dew point. Ventalation air for human environment will be approximated ambient temperature and humidity.

QUESTION: REFERENCE MPR-M-SAT-61-1, PARAGRAPH 3.4.1. DOES THE WORD "PROPOSAL" IN THE THIRD PARAGRAPH REFER TO THE TECHNICAL PROPOSAL FOR S-II OR THE PRELIMINARY SUBMITTAL OF THE DETAIL STRUCTURAL ANALYSIS TO BE ACCOMPLISHED UNDER CONTRACT. IF IT IS INTENDED TO MEAN THE TECHNICAL PROPOSAL, DOES NASA DESIRE JUST AN EXAMPLE ILLUSTRATION OR A COMPLETE SUMMARY OF STRUCTURAL ANALYSIS PERFORMED IN SUPPORT OF THE PROPOSAL.

ANSWER: NASA desires to have a summary of the Structural Analysis perfromed in support of the proposal. The summary should illustrate the method and depth of analysis used by the contractor to support the reasons for his proposed structural design. Proposals will <u>not</u> be evaluated by weighing the quantity of paper submitted—only quality.

3.2.10 Man-Rating Requirements

3.2.10.1 General. Proposing contractors shall prepare a scope of work, as part of their initial proposal, to include a definition and program recommendations toward the accomplishment of objectively attaining a stage S-II which can be considered man-rated. To perform this task, proposing contractors shall consider the following methods (in addition to other proposed approaches) of pursuing the man-rating philosophy.

3.2.10.2 Failure Mode Analysis. Proposing contractors shall prepare a "failure mode analysis" as a part of their initial proposal and, following contract award to the successful proposer, shall expand the analysis in detail parallel with design of the stage system. Emphasis shall be placed on preparation of a list of expected stage S-II malfunctions which might occur during the entire launching operation---from countdown through separation of stage S-IV from stage S-II.

3.2.10.3 Abort Sensing System. An abort sensing system shall be designed into stage S-II which shall be capable of sensing a critical condition of failure and be able to relay a signal to the C-3 vehicle instrument compartment where a command can be signaled to all other required systems, and the spacecraft. The instrument compartment will have an abort distributor which will receive all abort signals for distribution and execution. This arrangement will provide enough flexibility to sense abort conditions in all stages, including the spacecraft, and will give abort parameters to the spacecraft. In event of conditions where there will be insufficient warning for crew action, aborts shall be initiated without crew recognizance. For deferred type failures, amplifying information shall be displayed for crew decision.