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Prepared by: [signature]

Reviewed by: [signature]

Approved by [signature]

# RE-ENTRY BODY COMMITTEE REPORT DISCUSSION

"Good afternoon," said Commander Julian. "Dr. Mechlin, as you have noted, is not here today. He is participating in the deliberations of a new DOD study panel called PENEX. PENEX is a six-month study to begin within a week. It will involve large segments of the non-profit, DOD-oriented community in the country, and will be led by Ben Alexander of the Defense Research Corporation, who also led the INTERCEPT-X studies. The INTERCEPT-X studies were instrumental in setting up the NIKE-X program and the Bell-SRI-AMC work now being done to define a new SPRINT-MAR defense system.

"The study panel is headed by a three-man steering group. Dr. Fink, Assistant Director (Defensive Systems), DDR&E, is the chairman. Mr. Geckler and one other person complete the steering panel; these three coordinate and run the study.

"One of the two groups that will act as their staff is a service liaison committee. We have nominated two people from the Navy; JCS, DIA, and AEC have members as well. They will advise the steering panel and, I suppose, the chairman of the study. On the civilian side is the technical review panel of which Dr. Mechlin and Dr. Lobb are members. This panel and the service liaison committee advise the study chairman.

"Under the chairman are three working groups, headed respectively by Dr. Pierce of Aerospace, Dr. Earl Crisler -- temporarily, until Dr. Bruechner is available and Professor O'Neill, on loan from Columbia University. Mr. Leete (LMSC) will be working in these

groups. They have had some difficulty with the agenda the first two days of this week. However, I think the groups will see their task divided into three areas. One is an evaluation of the present U.S. strategic force capability. The second is the future of these systems--how they should perform against any postulated threat. The third area is that of the threat. In other words, what is a workable defense system and when will it be mounted?

"To recapitulate in perhaps a better order, the first group would evaluate present force capabilities and with the other two groups, decide which system can do the job best.

"The second group is concerned with the threat definition.

"The third group then deals with a postulation of various defense models, and examines all the techniques available for penetration. It trades these against each of the basic systems available to see which has the greatest potential.

"We have decided that the results of this study panel will greatly affect the future of all strategic missile program plans, including our own. Therefore, before the study is too far underway, we have asked to give the entire group a thorough and technically competent briefing on the content of our current and projected FBM programs. We have asked that this briefing be scheduled for 19, 20 and 21 October. Lockheed will lead the briefing and may require the participation of the other sub-system contractors.

"The Admiral would like the briefing to be in SP, or at least in Washington. Since there are so many people involved--50 or 60 in the study group alone--it seems logical to have it here rather than California. There are, however, some advantages to having the briefing at Lockheed in terms of viewing the mockups and the like.

"I do not know the agenda in detail at the moment, but I think we will be called on from time to time during the next six or seven months to provide study inputs for the panel. The study may be funded by foundation research funds from each of the contractors.

"As you know, we have added one more missile to the inventory of the A3X flights so now there are three rather than two remaining. The new missile is A3X-61. We did this deliberately for several reasons. We were criticized by the DDR&E review group directly and implicitly because our multiple objectives on the last two flights did not satisfy their objectives for testing the instrumentation complex at Kwajalein.

"As a consequence, we have changed the configuration on the three final missiles to fulfill rather specialized sub-system objectives, as well as the FBM system development objectives.

"On A3X-13, scheduled to be fired about 20 November, we have basic missile, re-entry system, and some wake investigations objectives. We have changed the material on the cover of two of the bodies--one to teflon; the other to beryllium.

"The next missile will carry only our PX-2, and will have a PX-2 system objective. The people at Kwajalein are most interested in this missile because they have objected to our combining wake and penetration aids objectives besides all the other system objectives. If we are looking for one objective, we may get some results; if we are looking for all of them, we may get none. While we do not really think this is true, the overriding importance of getting the system performance objectives accomplished has led us to accept this attitude.

"The result of the briefing given to DDR&E about a month ago on this subject is that they expect something else as a response. The

something else was a full-fledged proposal from us to mount a program for IRBM-observables testing in Kwajalein. This would be specifically directed at the data objectives for defensive system development of the Army, Lincoln Laboratory, and DDR&E.

"I think we should pursue with PMR discussions already begun on the configuration of a range ship to perform the launch-safety functions. We have been firing from Johnstone Island and using the radars based on Johnstone Island. The range safety officer has required PMR safety criteria there, which are somewhat more stringent than AMR safety criteria. The A1, for example, was evaluated because of the over-all interest in the Mark 2 and Mark 12. The preliminary range investigations indicate we cannot go the necessary 1423 miles; we would be 100 to 150 miles short. This means we could not use Johnstone Island for the same range safety purposes that we did before. It will mean moving in to accommodate the range safety requirement. This is where the range ship comes in. The proposal for A1s would not require our money; it would be funded by ARPA or DDR&E and managed by SP.

"We have plans, but not money yet for flying six A1s with Mark 12s specifically for verification of the Mark 12 fuzing system in POLARIS trajectories. It may be possible to divert a batch of these A1s into Kwajalein rather than AMR as we now tentatively plan.

"The Air Force interest in the IRBM-observables proposal would be quite limited per se. I think this proposal might be oriented more towards the Army objectives."

"There could have been other ways that DDR&E could seek to stimulate management of this program," remarked Dr. Bandtel. "They could have had the Army run it or have done a number of other things. Am I to understand that they are really soliciting

this proposal from you? If this is true, the only conclusion I can draw is that there seemed to be no other effective program manager that would satisfy the requirements from their view."

"You can look at this two ways," explained Captain Christman. "One way would be that the U.S. ought to know what the POLARIS looks like so we can see whether an enemy would knock it out of the sky. If you think of it this way, you would be establishing the vulnerability of the POLARIS system. It appears this is primarily the way the program will be oriented.

"The other side of the story is what the Army can see from the ground. If you were primarily interested in that, it would be an Army project which is the way Commander Julian describes it."

"Mr. Eyestone asked if the proposal were for A1s or A3s. Commander Julian replied that SP would probably respond with an A1 program. "I do think closer examination of the interface hardware requirements may show that an A1 could get there with a single Mark 12 or a single Mark 2," Commander Julian said.

"The primary interest at Lincoln Laboratory is with sharp-pointed vehicles," continued Commander Julian, "because the Bell, AMC, and Stanford Research Institute discrimination studies show that there is an intermediate class of sharp bodies which may be indistinguishable. The blunt bodies are fairly easily identified because there appears to be quieting of the cross section at a certain altitude where the normal shock becomes very intense. The opacity of the shock wave results in backscatter from it rather than the re-entry vehicle. The shock wave has about the same nose radius of curvature as the body. At about 200,000 feet, the cross section which has been jiggling all over quiets and becomes very close to the value that is measured in static range of that body.

"The blunt bodies seem to be discriminable. Heavy cones seem to be discriminable because they dump so much energy into the atmosphere that the wake velocity and temperature can be measured. Techniques for sampling wake temperature and velocity are well advanced."

Captain Sadler asked why A1s were selected with their poor reliability factor, and Commander Julian answered that the A1s will be available and are relatively cheap. "They have poor reliability compared to A2 and A3," said Commander Julian, "but are still much better than some systems which have been flying this kind of experimental program. The ATHENA program, for example, has had one success in five firings. The A2s are quite expensive. The people who are funding this program may be able to buy an expensive vehicle, but if not, one alternative would be an A1-based program.

"Recently, as a result of CNO Advisory Board action, the PX procurement plan was revised slightly. For PX-1, we will have bought, in effect, 4-1/2 systems per boat for 13 boats, the number needed to cover our DASO expenditures, plus a few that went into special tests, and one quarter of the total OT's and FOT's through Procurement Year 1966. This turns out to be a total of 85; we have in fact more than that in inventory. Our present plan is to procure no more PX-1s.

"For PX-2, our plan is to purchase 4-1/2 systems per boat for 28 boats, six for DASOs, plus one quarter of the total OT's and FOT's through Procurement Year 1966. This turns out to be about 134 systems. We are tooling the PX procurement line to a rate capability of 21 per month although we will not need that rate to produce 134 PX-2s.

"We have prepared a schedule of costs showing the lead time and number of dollars required to start from the interim inventory which has been accumulated according to the present plan and fill a

heavy demand. In the case of the PX-1, since we are not buying any additional tooling, we would have to continue at the rate of roughly nine systems per month, and it would be approximately 22 months from the time of the initial demand to the time we reach the rate of nine a month. In the case of the PX-2 systems, it would take about 24 months from initial demand until full-rate production, and it is expensive. Administration, procurement, fabrication, and lead time and reaching full-rate capability are appreciable periods and are costly. We made this revision in PX plans to ensure against buying something that would become obsolete before we needed it or could find a requirement for it.

"Today was the date the UK re-entry system people needed the first increment of their R&D order, and all the parts to be sold under the POLARIS Sales Agreement are available for shipment. All the parts to be sold under the 1958 agreement are awaiting air shipment to the UK, so we have satisfied the first increment of the R&D order. This hardware and the other parts of the R&D order will be used to educate the people at the Royal Ordnance Factory in assembly techniques, to assist them in sizing and fitting the warhead and help them plan their capability and confidence test program.

"Because we had a favorable schedule position at this time, we were able to satisfy this first increment. The order was filled partly with tactical hardware and partly with production sampling and test and trainer hardware which were diverted. Satisfying the other increments of this order will in turn depend on our schedule position at that time. We have not given the UK any assurances that we can do this and we guarantee delivery in about 12 months from receipt of the purchase order. I think we will be able to do it.

"Right now we are evaluating their tactical procurement order. A UK production survey team left yesterday to visit Lockheed. From

there they will go to the Cape and AEC installations and then to AVCO and back here. While at Lockheed, they have a very important job to do; they must go through what they consider to be their operational requirements to get the required capability in five boats. They must ensure that their lists are correct in segregating the AEC from DOD parts according to the 1958 agreement, and in differentiating between parts under the Sales Agreement and parts for which an AEC procurement document must be developed. Pricing will have to be handled here at SP because the material is in three different categories and different pricing schedules will apply. They will have to define at each point in their stockpile-to-target sequence their handling, processing, assembly and dismantling requirements so we can advise them on the surface support requirements.

"Because of the administrative and contractual lead times, they must give us a firm production order by 15 December 1964 in order to start their hardware program in the middle of 1966. It is also quite apparent at the present time that although they would like to extend their buy through several years, fitting it in with the rate at which their ships will be deployed may require the pre-buy of a large inventory and then storing of these components for their ships.

"This, of course, raises problems of packing for storage, storage inspection, whether the storage need be environmentally controlled, what re-acceptance is necessary, what inspection they must do out of storage, what refurbishing must be done, and so on. So they have to decide back home among these alternatives based on what we suggest to them as the best course of action. It would be totally uneconomical, for example, for them to insist on our producing AFDs for three years after our line is done. They just could not afford it; it would be foolish. There may be a way at the end of our production line to produce at a rate not quite as high as ours but still somewhat greater than their need. This would save them money and still not give them too much of an inventory problem.

"The statutory determination, which is an agreement between the AEC and the Department of Defense, that the UK may buy certain parts and have access to certain information, was passed through the Military Liaison Committee yesterday and is on Mr. Vance's desk today for signing.

"In Article VII of the POLARIS Sales Agreement, is a commitment by the U.S. that the UK can participate in the inspection process. This means that their inspectors can walk down our lines and review what is going on at each point for over-the-shoulder fabrication techniques. This license does not extend to DOD plants for parts destined to be sold under the 1958 agreement. A part sold under the 1958 agreement is designated as a non-nuclear part of an atomic weapon and, therefore, inspection of our lines will disclose stockpile information. Since the British are already privy to most of this information because of their own program, they are going to be allowed into DOD plants making parts to be sold under the 1958 agreement, under the terms of the statutory determination.

"DOD has requested that this agreement not be implemented until the President has signed the sales program. This is troublesome, because on 11 November, the UK people had planned a visit through our plants, with their electrical inspection personnel and representatives of the Chief Inspector of Naval Ordnance. And administrative delay is inevitable in getting this agreement to the President after Mr. Vance signs it, so we have asked that the visit be postponed for about two weeks."

"We do have a problem on handling equipment for the re-entry system hardware," remarked Captain Christman. "They had not originally asked for it and we thought they did not want it. Recently they have changed their minds. We can furnish it to them, but unfortunately we need it back in about four months. We have a procurement problem."

"We cannot give them the production drawings for the SSE," commented Commander Julian. "We can give them production drawings for any part of the atomic weapon only. The Sales Agreement states that we will not give them a production capability. It is very involved. They have a lot of money committed in the program, over a $100 million to date. They are buying from AEC, complete flare assemblies, bond shell assemblies, AFDs, and the thermal battery. They are buying some honeycomb and various connectors and cables. They are going to put their own back coverplate on and the inside has to be of their design.

"We have discovered a number of minor problems during the few weeks that we have been assembling the Mark 2 re-entry body at POMFLANT. None of these is caused by design deficiencies, but there are problems. For example, we carry extra missiles on the DASOs which are completely assembled as though they were going to be fired. During the disassembly of two of these re-entry systems, we found the monoballs were completely stuck. The monoball is like a universal joint through which is a bolt that the flare and separation ring are attached to. It took an awful lot of work and torque to free it.

"The monoball is not a functional part to the system; its position dictates the alignment, but not too critically, when the system is assembled and it does not stop the tilt-out. Nevertheless, we would like to know what made it stick in the bearing. The bearing race is made of teflon. It may be that in the assembly operations, which are horizontal, the teflon is loaded and deformed. Subsequent vibration may set it so it cannot be moved.

"Another minor problem is a number of instances where we have discovered minor nicks and cracks and surface defects in the ablative shell. As a matter of fact, we had initially set up a repair

or reject critieria which I thought was pretty generous, but we got a lot of defects which did not fall within the criteria, so we further relaxed the criteria. Of approximately 100 assembled warheads which have been delivered to NWA, there are about 11 that arrived with cracks and nicks in the shell. And after an examination we still have just three out of a hundred that we have not yet resolved. We are trying to determine if these can be repaired.

"The defects are all in tactical shells. We have agreed with the AEC that they must inspect these shells at each point in their assembly sequence. Our ablative shell goes to Bendix; it is bonded there by AEC to the magnesium sub-structure. The bonded structure goes from Bendix, Kansas City to Oak Ridge where the secondary nuclear system is put in, and from there to Pantex, the final assembly point. We and the AEC have agreed that at each point where a defect that is repairable is discovered, it will be fixed at their facility. This includes Pantex as well. In fact, we decided earlier that any defects discovered at Pantex would be noted and sent on to Charleston for repair, but the AEC has decided it can repair at Pantex as well as we can at Charleston.

"It is important to note that the two A3X underwater firings and all the DASO shots to date were successful; we have had no system deficiencies disclosed in the re-entry system. All of the AFDs performed satisfactorily.

"The Mark 12 program is the joint Navy-Air Force development of a re-entry body, and is on schedule.

"We, the Air Force BSD, and Aerospace have been studying a set of weight reduction proposals. We hope to reduce the weight of the bare vehicle from 365 to 350 pounds. We have been told, as a matter of fact, that anything over 350 pounds will not be acceptable.

"The weight reduction program indicates that we can cut the weight to 350 pounds without prejudice to our vulnerability criteria. I admit that it was our insistence on the vulnerability criteria that added some of the weight to this vehicle. A weight of 350 pounds can be reached by taking advantage of other weight-saving features possible.

"I think that our criteria are realistic, and I think the Air Force agrees with us, although they find it difficult to admit."

"Do the vulnerability criteria have to do with the radar cross section?" asked Mr. Eyestone.

"No," replied Commander Julian. "This concerns neutron vulnerability basically. The system that was in has been shown in a brief experimental test at Livermore to have very poor resistance to high-energy neutrons, whereas the system that is now in has much better resistance."

"Did they ever open up the definition of the warhead classification?" queried Captain Christman.

"That is still being argued," explained Commander Julian. "The AEC would like the entire re-entry vehicle to be classified SRD or RD in some way. The Air Force strenuously objects to this because the vehicle is in three sections: the forward cone, the middle section containing the warhead, and the aft section containing more of the fuzing device. If it is classified RD, they will have nothing but problems in their logistics sequence. This is not resolved. The AEC is certain they will win. The Air Force is certain they will. I do not know what is going to become of it.

"In the last few weeks, we have undertaken several studies which might interest you. The studies are made generally in response

to requests from CNO. The most recent one is a study of providing the Mark 1 and the Mark 2 re-entry body or warhead with the ability to be fuzed at a very high altitude, as a percursor bursts at 200,000 or 225,000 feet. We have been asked to try to devise a very quick method to use for both systems, and then to study a sophisticated approach which would preserve all the fuzing options we now have.

"We have preliminary answers on the quick, unsophisticated fix and it was not as quick as I had hoped. The preservation of nuclear safety imposes some criteria which state that there must be sampling of two different kinds of environment unique to flight. We have considered, therefore, using a very low level G integrating device, or a vacuum sensor. These do not operate until you are well up in the exosphere. They have not been developed yet and will take an appreciable amount of time and money. As a matter of fact, it is thought that those two safety devices would be the pacing items in a quick fix and would take about 18 months. I think it can be done a little more quickly.

"Aerojet (Dr. Kirchner and Dr. Wetmore) have studied the comparative features of a hydrazine fuel and a solid power fuel power unit for our advanced PX program requirements.

"Another study is one that examines the sensitivity of POLARIS against advanced defense models -- rather unique ones. This study is called Project HIGHBOY. We have conceived a defense model that uses a radar frequency quite unlike those that are normally projected. It does not, in fact, include the characteristics of a terminal defense system but rather those of a multistatic area defense system where there is one transmitter and a number of receivers which are passive, and the receivers receive the reflected signal from the transmitted beam. It is possible to speculate that such a system used in certain

ways would have a capability for tracking a re-entry cloud in mid-course well enough to send up an interceptor."

Captain Christman asked Commander Julian to speak about the FOOTPRINT program.

"Single re-entry body ejection from the B3 re-entry platform and the ability to direct the platform and fly it to a new velocity vector each time also gives you, depending on total fuel and energy capacity in the platform, the potential ability to attack widely separated targets -- one vector for each of the re-entry vehicles on the platform.

"Our preliminary studies show that it may be possible indeed to interdict with a single missile a very large area in which there could be half a dozen or more targets and put one re-entry vehicle/warhead on each of these targets. This means in effect if you go after undefended targets and you have five or six re-entry vehicles, you can fly one missile and attack five or six targets. It is a way of increasing very substantially the total number of targets attacked with a limited missile force. The size of the area depends on the geometry that you really want. The shape is quite sensitive to where the targets are.

"The Air Force is quite interested in this as well. Their program is called MIRV -- Multiple Impact Re-entry Vehicle. In the MAILMAN program, we have a somewhat limited capability without putting more fuel on the platform, but there are ways of putting more fuel on a platform, in fact, on a trade-off basis. If you look ahead a bit, using a smaller warhead like PEBBLES, you might be able to put 12 warheads on 12 individual targets in that manner. DDR&E is making an intensive study of this same capability.

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