Device Predictions, Mid-1960

At the end of April, Starbird asked the Laboratories for their opinions on what could be accomplished for the next few years in weapon development if certain kinds of operations were allowed, such as decoupled shots up to 50 kt, outer space shots, etc. The question was apparently triggered by a recent high-level briefing by Teller on the advantages of testing.

Harold Brown speculated for Livermore by discussing the possible yields that might be developed as a function of weight up to a 6000 pound, 50-megaton device, and the possible gains that could come about by testing at low yields underground or at high yields in deep space. He noted the many gains that might be achieved clandestinely by the U.S.S.R., and that in particular:

> The tactical weapons which we consider would be capable of producing an equal or greater imbalance in nuclear capability can all be done with tests in the kiloton range of whose easy concealability there would be no question.

In general, Brown and Teller were optimistic as to the advances that could be made with almost any kind of testing.

Bradbury also replied, stating that in his opinion, things were less optimistic than Teller seemed to feel and:

> In short, nothing has occurred in the last year and a half to change my own opinion regarding the extent of weapon gains possible with limited testing or even with unlimited testing. I am much less optimistic than Teller on both points . . .

In mid-May Mark and Bethe continued an exchange on the subject. The circumstance appeared to be roughly as appears in Table X below. "Essential weight" is the nuclear device component weight but not including firing set, bottle, etc. Case I was presumably numbers used by Teller in April as what might (optimistically? realistically?) be expected in a few years if testing were resumed. Presumably these advances could be obtained by testing in the few kt range for all but the largest yields, and they might be obtained without having to test above 100 kt. Case II was a November 1959 LRL prediction for 1970 if testing were allowed, and Case III was predicted at the same time for 1965. Case IV was intended to represent the "state of the art" at the time but in a slightly advanced form. The author has been unable to resist adding the "modern" case, representing approximately current thought and experience in 1980.

It was clear that some of the differences could come about by different assumptions. For example, the low weight row is controlled largely by one point safety considerations. But the large-weight, large-yield predictions of Case I pretty clearly required a "break through" which has apparently not yet come about. Mark concluded that surely some advancement would come over the "state of the art" (Case IV), and by detailed argument ended up concluding that Case III represented roughly "the present frontier between optimistic science and science fiction", and that the region of Case III "represents the area towards which and possibly into which one could work". Mark remarked that even Foster did not seem to believe the most optimistic case.

Bradbury later remarked to Starbird that he felt quite gloomy as to the future based on only limited-yield underground testing and felt that even "state-of-the-art" (Case IV) was about as adventuresome as the LASL was willing to imagine at that point.

Ex.(b)(3)

[redacted]

At the end of June, Starbird asked Bradbury and Brown for their judgement of the relative disadvantage of the U.S. vis-a-vis the U.S.S.R. in weapons development progress assuming that testing were to resume with the Russians testing in any manner they wished, but with the U.S. testing only underground or both underground and in space above 100,000 kilometers. Livermore replied that in their opinion, if we tested only underground, we would have relatively little disadvantage and that disadvantage would be a function of the yield range, with us being at greater disadvantage for high yields where we couldn't test underground so easily (if at all) in other than a scaled design configuration. If we could test both underground and at very high altitudes there would be a negligible disadvantage. The LASL, however, was more pessimistic. Bradbury felt that the first effect would be a time lag between ourselves and the Soviets of perhaps six months for underground to perhaps two years for high-altitude testing, while we developed the techniques. He also felt that even after that, we would fall behind at some rate unless we poured tremendous amounts of money and effort into our program to stay up with the Russian development accomplishments.

In early July, Starbird asked Brown and Bradbury to comment to the AEC General Advisory Committee (which would meet in Washington on July 26-28) on the U.S.S.R. capability in weapons development during the moratorium. Bradbury immediately replied by TWX that he hadn't the faintest idea. However, he would guess that since at the beginning of the moratorium we were apparently ahead of the Russians, the rate of progress should be a little less than ours, partly because they did not seem to diagnose their shots as carefully as we. If that estimate was wrong, then he would guess that they had the same capability for making progress during the last two years as we had. As for cheating, he stated that he had no idea whatsoever if they had been cheating nor any technical basis on which to hazard a guess. He sent Mark to the meeting, at which John Foster presented the Livermore feelings on the subject. Foster stated that in his opinion, the U.S. had no assurance that the Soviets were not now accomplishing improvements by actual testing. He then discussed the various kinds of improvements that could be made by testing, making the point that from now on, the yield versus weight question would probably be less important as compared with other aspects of the warhead, such as vulnerability, effects of the shot, etc.

Ex.(b)(3)

[redacted]

Ex.(b)(1)

Ex.(b)(3)

[redacted] Thus, if testing was resumed, the Russians would have more to gain from it than the U.S.

Ex.(b)(1)

Ex.(b)(3)

[redacted] Bethe commented that "such development is probably impossible in any militarily useful form." He had no comment on the Russian capabilities or possibilities in this class of device.

Vela Hotel, July-December 1960

By mid-July of 1960 Livermore had been funded by ARPA to look at some of the backgrounds that might affect Vela Hotel measurements in space. They were also seeking additional funding to expand their program to measure the neutron albedo of the earth's atmosphere, and x-ray, gamma ray and particle backgrounds at altitudes characteristic of both high and low orbit satellites. At the same time LASL and Sandia were building small "piggy back" packages scheduled for delivery in August in order to be launched on the JPL Ranger A-1 probe in April 1961. General Betts, ARPA Director, had arranged for joint AFSWC-LASL payloads to be flown on a dedicated inexpensive version of the TS609 A Scout system known as the 2356 configuration. While there was not as yet overall approval or funding for the AEC Vela Hotel effort, Starbird did arrange in late July to fund LASL and Sandia at a level of $1,000,000 each for FY 1961.

In late August LASL and Sandia summarized their interim capability status in a document entitled "ICOS and BLICOS". The document listed the rocket probe and piggy-

back flights planned, as well as the high altitude balloon flights to determine the effects of cosmic rays on the x-ray detectors. The overall schedule included the following milestones: delivery of several piggyback packages to the NASA Ranger program beginning almost immediately, launch of AEC detector and logic packages on Journeyman-B rockets beginning in October of 1960, and balloon flights in February and March of 1961. The balloon flights would provide data on parameters for the ICOS alarm system. The Journeyman-B flights would carry x-ray and gamma-ray scintillation detectors to about 30,000 miles altitude to look at the short duration pulse background.

At the previously mentioned symposium on Vela in early October 1960 the ARPA Vela Hotel Project Manager, Major John A. Poulson, described the Vela Hotel system currently being considered for full development as a combination of two major systems. The first, known as the "Far Earth" system and intended to detect unshielded detonations taking place in the region from about 30 to about 200 million kilometers altitude, involved six satellites, three each installed in two orbital planes at right angles to one another. The satellite orbit perigees would be outside the Van Allen belts. Each satellite would carry detectors for neutrons, prompt and delayed gamma rays, and x-rays. The other major system, known as the "Earth Proximity Solar Satellite System", would include a number of solar orbiting satellites instrumented only for prompt gamma and x-ray detection. It was thought that a shielded detonation could be detected to about ten million miles by observation of the prompt gammas, so that by putting enough satellites in solar orbit a treaty violator would have to test as far as 70 million miles from earth with a shielded detonation, which would be quite an effort. The program would be conducted in three phases. The first step would use existing components and technology to develop an early detection capability; then more advanced technology would be used to counteract the possible shielding an evader could employ, and the last step would be to provide a capability to collect some diagnostic data from a detected explosion. The overall program budget would be about 100 million dollars to be spent over a four year period.

On October 18, Starbird informed Bradbury of the current status of Vela Hotel funding. Having told Starbird on August 10 that a decision on proceeding with Vela Hotel would come within several weeks, ARPA had just advised Starbird that the program decision had still not been made, but ARPA was continuing to press for it. Starbird reaffirmed to Bradbury that LASL should continue the previous course of attempting to fly piggyback experiments on NASA and DOD missile flights, probes, and satellites. Starbird also stated that AEC Chairman McCone, in a letter to Secretary of Defense Gates on October 12, had requested DOD assistance in lifting AEC instrumentation packages into space.

On November 14, AFSWC published a report on their Blue Scout project entitled "Operation No. 10-61, Project Blue Scout, Jr." In an effort to develop a lower-cost sounding rocket, specifically to support preliminary developmental testing of instrumentation for detection satellites, AFSWC had developed the solid propellant vehicle, Blue Scout, Jr. (TS 609A). The initial launches, which were at least seven months away at this time, were to be performed by the Air Force Ballistic Missile Division (AFBMD). The first launch was to be from the Atlantic Missile Range (AMR) and the next two from the Pacific Missile Range (PMR).

LASL and Sandia Vela Hotel plans for the next two fiscal years were sent to Starbird on November 23, 1960. The overall program included detector packages, to be flown either piggyback or dedicated, aboard DOD small rockets and satellites from late 1960 through late 1962; three balloon flights to 120,000 feet in February and March 1961 (for BLICOS); and, perhaps most significantly, the launch of two 160-pound, modified ICOS, prototype protection satellites to 100,000 kilometers altitude,

the first in January 1962. The program was now emphasizing the x-ray detection system which had seemed the most promising to the Panofsky Panel. The report also stated that the growth of the satellite detection system could now take one of two different routes:

a. The moratorium may be maintained, resulting in the primary emphasis being placed on extending the detection range, or,
b. we may return to testing, causing the emphasis to be placed on intelligence diagnostics for relatively close-in detonations.

The Labs were incorporating both of these possibilities in their thinking for future developments. The above-described program was planned to be completed within the then present DMA authorized budget for the two Laboratories of $1.86 million for FY 1961 and $2 million for FY 1962.

About this time, in the last month or so of 1960, the Department of Defense, who were providing the major part of the funding, reduced its effort in Vela Hotel R&D. This action was directed by the Secretary of Defense, who felt that the general objective should be to obtain as much pertinent experimental data as possible in order to increase basic knowledge and understanding of the physical phenomena affecting detection. Thus, as related by Starbird to ALOO and the Labs on November 25, ARPA, after discussions with LASL and Sandia, issued a new draft order to ARDC, initiating the reduced-scope program. Starbird requested that addressees comment on the new order which changed the concept from a four-year $100,000,000 system development program to one with much-reduced funding aimed at obtaining experimental data at the earliest practicable date. The new funding, exclusive of what NASA may have had, gave DOD and AEC only $13.8 million total for FY 1961 and 1962; $5 million for DOD and $1.9 million for AEC in each fiscal year. Specifically, the primary effort of the new program was to be directed toward utilizing x-ray and gamma-ray detection, with secondary attention given to neutron detection. There was to be maximum use of piggyback rides on currently planned space vehicles and carriers. Whereas the low-altitude piggyback experiments were to be carried out beginning immediately, in line with past planning, ARPA requested that ARDC, AEC, and NASA jointly prepare an updated development and funding plan by early January. Hertford replied within a few days to Starbird that the two Labs felt the general approach was reasonable and acceptable. He also pointed out that meeting the ARPA request for a new plan by January required that a group to work out the details must be formed immediately.

Ex.(b)(1) [redacted]

The joint meeting to work up a detailed, reduced-scope program for Vela Hotel took place at AFBMD in Los Angeles on December 15 and 16. Attendees included, among others, Taschek and Austin McGuire of LASL, Don Shuster and Jim Scott of Sandia, Steve White of Livermore, and Lew Allen of AFSWC. Minutes of the meeting indicated that there was disagreement about the distribution of funds and about responsibility for instrumentation packages and rocket flights. [redacted]

Ex.(b)(1) [redacted]

Vela Sierra, Late 1960

By early July theoretical predictions for the ground-based detection system of high altitude detonations indicated that placing the instruments about 1700 kilometers apart on the earth's surface would produce a system with essentially no blind spots. EG&G was committed to delivery of a first prototype of the air fluorescence system to LASL by August 1, and discussions were taking place concerning the design and test of a "direct" optical system to measure visible radiation from expanding bomb debris. The "Direct Optical" system was under order within a couple of months.

The first air fluorescence system was actually delivered on August 16 and was being used to gather data on discrimination between lightning and nuclear signals by the end of the month. A second prototype of the system was to be built while the first was being tested at LASL, with the intent of then testing both at Fairbanks, Alaska and Thule, Greenland between November 15 and December 15. Further reduction of data from the Teak shot of Hardtack was yielding phenomenological information and understanding of great help in the design of the system. By the end of October enough experimental data from the lightning experiments were available to design the necessary changes in the system to discriminate against lightning, and two new prototypes incorporating these changes were due by December 1.

The first new prototype system was actually shipped to Ladd Air Force Base in Fairbanks in late December, and "Project Big Moon", to test it against auroral background, was in operation in January 1961. The second system was shipped to LASL, first for further test, including observation of solar flares, and then to Thule for test in "Operation Brass Ring."

As Vela program managers, ARPA had responsibility to design an overall detection capability to as high a degree as feasible, with no particular attention to cost. However, AFTAC had responsibility to actually build, install, and operate a detection system quickly, under rather severe budget restrictions. Thus LASL was delivering to AFTAC the criteria for a complete direct optical and fluorescence system that would cost about $200,000 per station, and to other agencies the design of a system limited only by the physics involved.

While the optical techniques mentioned above were being developed, other techniques to carry out the Vela Sierra mission were also being investigated. Since one of the obvious effects of a high altitude detonation is to produce free electrons in the upper atmosphere, various methods of observing the effects of such free electrons were being investigated. In particular, the possibility of possible phase shifts in very-low-frequency radio propagation was being studied at the Navy Electronics Laboratory, geomagnetic perturbations were being studied at the Signal Corps Research and Development laboratories, other radio techniques were being investigated at the Institute for Defense Analysis, and the use of riometers was being pursued at the Stanford Research Institute. Ex.(b)(1)

Ex.(b)(1)

The AFTAC program clearly involved the need of stations in foreign nations. In late 1960 AFTAC queried Starbird concerning any problems that might come about if foreign nationals were used to man the stations. Starbird passed the question on to the Laboratories, expressing particular concern as to whether or not, especially in the case of the observation of electromagnetic (EM) signals, such use would require the transmittal of restricted data (RD) to the foreign nationals. Bradbury replied that complex sophisticated systems to observe diagnostic signals might reveal RD, but less elaborate equipment to observe gross signals probably would not. He went on to comment that the use of EM seemed to apply to atmospheric detonations, in which case if the bomb was big enough to be observed by EM at great distances we would probably also pick up debris, and if it were too small to find debris, EM probably wouldn't

see it either unless the stations were real close, in which case "watching the sky with a Bhangmeter may be a better technique."

Deep Space, Later-Half 1960

Progress on the Advanced System for Weapons Testing (ASWT) was reported to LASL by their representative on system studies, Don Westervelt, on July 5. The assumption was that the initial objective of the system would be [redacted] Ex.(b)(3) [redacted] The first flight of that system was not scheduled until mid-1961 so the system would not be adequately tested until early 1963. The lead time for the AEC part of the test was 18 months. The military had given attention primarily to launch sites in Florida and California, and the AEC, because of nuclear safety hazards, had pressed for additional consideration of an island launch site. Thus, the final report would include discussion of the possible use of Eniwetok, Johnston Island, and Christmas Island, with the Air Force having a strong preference for Eniwetok. [redacted] Ex.(b)(3) [redacted] The final program document on ASWT was forwarded to ARDC headquarters and to DMA on September 7, 1960. Subsequently, General Harrison, Deputy Chief of DASA, sent a letter to General Starbird stating that DASA was recommending to the DOD that the AEC be asked to join with the DOD in seeking executive approval for proceeding with the development of the ASWT capability. On October 5, Starbird advised Hertford that briefings for AEC and DOD on the ASWT program had not led to a commitment on the part of the AEC to attain this capability, and that for FY 1961 and FY 1962, the weapons budget would not reflect funding in support of ASWT beyond capability studies. Starbird directed Hertford to continue conceptual studies related to the engineering and safety aspects of the AEC payload.

Domestic and International Political Developments, May-December 1960

May 1960 was a month of change in the mood and trend of the Geneva test ban talks. Whereas, as discussed above, certain exchanges, especially at high level, through the February to May period had created a feeling that perhaps a signable treaty might be in the offing, events in Geneva and elsewhere in May substantially decreased these hopes. Just how much effect the infamous U-2 incident had on the test ban agreement is debatable, but the timing of that international incident is certainly noteworthy in the light of what happened at Geneva. On May 1, an American U-2 reconnaissance aircraft went down in Russian territory and both the pilot (Francis Gary Powers) and the aircraft fell into Soviet hands. After several exchanges between the U.S. and Soviet governments over the conditions of the incident and the Soviet demands for American compensation of some sort, the several world leaders went to Paris for the long-planned summit meeting on May 16. Khrushchev there confronted Eisenhower with a demand for discontinuance of the U-2 flights and punishment of those responsible. Eisenhower refused to comply with some of the demands and, consequently, Khrushchev refused to participate in the meeting. Thus ended the summit, which was to have addressed some of the hardest issues in the path of a test ban agreement. Immediately afterwards, in response to a question at the

May 18 press conference as to whether the Soviets would continue to participate at Geneva, Khrushchev replied that they would continue the negotiations, feeling that they had recently provided some clarification to the Americans of the Russian stance, and "if they understand that, then there is a possibility to reach agreement on the discontinuance of tests. But if Eisenhower threatens that he will continue testing, then we, too, will follow suit until the whole world learns who are the true guilty parties and who is resisting agreement." Eisenhower stated on May 25 that the U.S. would "not back away on account of recent events, from the efforts or commitments" that it had undertaken in the nuclear test and disarmament negotiations.

This strong shift in Soviet mood manifested at the Paris summit conference was echoed in the Geneva test ban conference during the rest of the year. In Eisenhower's words in his autobiography several years later:

> This completely ridiculous gesture (Tsarapkin's May 27 exposition of the new Soviet position) terminated, so far as I was concerned, the dreary exercise. In our years of effort, there had been accomplishment--unfortunately, too much of it theoretical--but it was obvious that for the moment we had reached a blind alley. . . .It was now clear that further voluntary suspension of testing was useless and would, if continued, place us in a disadvantageous position. Prudence demanded a resumption of testing, and except for the fact that my administration was reaching its end, I would have immediately announced such a decision. However, I felt that if the incoming President had a different judgment, it would be unwise to tie his hands by my action at this late date. Accordingly, we did no more testing during the remaining few months of my administration, but I emphasized to President-elect Kennedy my conviction that our nation should resume needed tests without delay.

Eisenhower also decided that if Nixon won the Presidential election he would announce before the inauguration that the U.S. would resume testing.

The authors of *Diplomats, Scientists, and Politicians* present their own opinion of the post-summit situation in a chapter with the telltale title "The Collapse of the Conference." In part it states:

> The attempt to solve the differences between East and West relating to the technical aspects of a control system for a test ban had failed. Agreement had not been achieved, and the attempt to bridge the disagreement through political compromise and scientific research had collapsed. . . .President Eisenhower--like many Americans--was greatly disheartened by the collapse of the summit meeting and the obvious stalemate in the nuclear test ban talks. He virtually gave up hope of achieving a test ban treaty, and his views were shared by a number of American policy makers. Nevertheless, Western, and more particularly American, policy seemed almost to have achieved a momentum of its own, and the policies established earlier in the negotiations were pursued with very little modification.

Meanwhile, the Seismic Research Program Advisory Group, the experts from the three countries who were to work out a joint or coordinated underground detection research program, began their meeting at Geneva on May 11. The Americans opened by presenting their planned Vela Uniform program which included about a dozen underground nuclear tests and several underground HE explosions. Subsequently there was a presentation of the more modest British research program. Later, over a period of a few days, the Soviets presented a discussion of a somewhat ambiguous research effort that seemed clearly at times to point to a significant program of underground explosions and at times included reference to "a certain number of coordinated nuclear explosions" which, at one time, the Russians seemed to be saying, would be carried out by them. Following questioning, the Soviet's proposed program was clarified to indicate that no nuclear explosions would be planned within the Soviet Union. Discussion of these programs and ideas went on through the 24th of May and past the abrupt end of the summit conference. Then, on May 27, before the Geneva talks had reached a clear conclusion, Soviet Ambassador Tsarapkin announced, at what was the

first meeting of the diplomatic conference since May 12, that the Soviets had never doubted the validity of the Conference of Experts' report and had agreed to come to these technical discussions only because of U.S. insistence. He directly contradicted some of the statements made by Soviet members of the Seismic Research Program Advisory Group in stating that the Soviet Union saw "no need for undertaking any research or experiments on its own territory." Furthermore, he demanded that USSR scientists participate fully in any underground tests in Western territory and that there must be guarantees that these explosions would not be used for military purposes. Following this meeting, the technical advisory group met only once more, apparently, and ended up publishing only individual private reports to their own diplomatic delegations.

At the July 26 to 28 meeting of the AEC's General Advisory Committee, Dr. John Foster of Livermore stated his opinion that there was no assurance that the Soviets were not now testing clandestinely. The committee's public record included the conclusion that they were "convinced that it is technically possible for the U.S.S.R. to conduct, without serious risk of detection, significant weapons tests under the current test moratorium." Chairman McCone of the AEC emphasized in the last several months of 1960 that the negotiations could not continue indefinitely in a *de facto* moratorium with a total lack of safeguards. He also decried our lack of knowledge as to whether the Soviets had been testing or not.

The Geneva Conference continued through August 22 and then, following a recess, had another session from September 27 through December 5. In the break between the two sessions, Ambassador James J. Wadsworth, who had served from the beginning as U.S. representative, left to serve as U.S. Representative to the United Nations and was replaced by Charles C. Stelle as acting representative. It can be generally stated that although some of the most important issues were addressed--number of inspections, localization of areas which qualify for inspection, staffing of the control post, details of the detection and identification system and its installation, and appointment of deputy administrators to the control commission--almost no real progress and no important compromises were reached at the Geneva talks through the remainder of 1960.

During this same period other pressures against an indefinitely continued moratorium began to appear. On June 13, 1960, General Nathan F. Twining, Chairman of the Joint Chiefs of Staff, sent a memorandum to James Douglas, then acting Secretary of Defense, to present the JCS feelings on the important issues and status of the Geneva talks. He referred to an August 21, 1959, JCS memorandum to the Secretary of Defense in which the Joint Chiefs presented their views that "an adequate military posture for the U.S. will not be attained until there is available a complete spectrum of weapons compatible with modern delivery systems which will make it possible to apply selectively adequate force against any threat." The Joint Chiefs now recognized that the U.S. would not achieve such a spectrum of weapons if an enforceable test ban agreement were concluded and implemented, but also recognized the theoretical advantage to the U.S. "militarily" if a controllable test ban were reached. Twining emphasized that unless such a test ban treaty could guarantee test cessation in the Sino-Soviet bloc (not just Soviet) and thus result in the desired effect on Soviet weapons and stockpile development, further U.S. testing to develop new weapons would be vital, especially as it would increasingly affect sophistication of the existing and potential weapons systems, including the antiballistic missile. His statement of the present JCS position continued, stating that the JCS:

> . . . believe it essential to the maintenance of our nuclear deterrent to periodically detonate weapons to test systems and techniques to the employment of nuclear weapons to ensure operational realiability, and to further sophisticate weapons systems. . . . The most important matter of concern now, however, is the apparent movement

> of the U.S. away from a safeguarded treaty to one of "good faith" which has always been the Soviet approach. A prolonged moratorium without satisfactory development of a reliable control system achieves essentially the same results for the Soviets as an agreed and ratified treaty.

Chairman McCone, on July 21, wrote to Secretary of Defense Thomas Gates, addressing the problem attendant to the proper use of scientific data and scientific theory in the political and technical negotiations toward a treaty. As an example of his concern, McCone cited a recent Rand report entitled "The Capability of a Seismic System," which had been prepared largely on the basis of theory. When Albert Latter briefed the Principals on the study prior to their departure for the Paris summit meeting in May, "no one clearly expressed any such reservation or qualification. Hence, many who had had the briefing accepted the conclusions as authentic and dependable." McCone expressed concern that time and again in the diplomatic negotiations, beginning perhaps with the Conference of Experts, theoretical studies had been accepted as adequate, where the conclusions really should only have been considered dependable after further experimentation. McCone warned against this practice and sent a copy of the letter not only to the Secretary of Defense but to the other Principals and to General Goodpaster on President Eisenhower's White House Staff. Gates replied on August 10, stating his full agreement and his intention to make clear at the Principal's discussion his "feeling that the effectiveness of the proposed system should be proven by experimentation and research before the U.S. considers a treaty commitment to prohibit nuclear weapons tests in that environment."

On September 14, just before Geneva talks reconvened, Chairman McCone sent a letter to Secretary of State Christian Herter stating his strong personal feelings about how far the negotiations had come and how this affected the U.S. posture under the present uncontrolled moratorium. He felt that:

> . . . as a matter of policy, we should pursue in an aggressive manner during the month of October the unresolved questions which in the final analysis determine whether a satisfactory and adequately safeguarded control system will or will not be agreed to by the Soviets. I would hope that we could, by this negotiating tactic, reach a conclusion not too long after the meeting reconvenes as to whether the Soviets intend to conclude a reasonable treaty or, on the contrary, are employing the tactics of a protracted negotiation with no intention of settling the critical issues which separate us. If such is the case, we will face the necessity for an early decision as to whether we should continue the de facto moratorium without safeguards and without any reliable assurances that the other side is adhering to the same rules, or whether we should adopt a new and independent course of action.

Anticipating the forthcoming session of the Geneva talks on September 27, Starbird, in an August 24 message to the labs, noted the possibility that a specific definition of a nuclear explosion might be inserted in treaties as they would be tabled, and requested both laboratories to comment on possible definitions and how they would relate to treaty language. Harold Brown replied that a one- or five-ton limit on an explosion would be appropriate, although he didn't feel there was any particular difference between the two numbers as to whether the Russians would accept those yields in a definition. Norris Bradbury, on the other hand, felt that the number shouldn't be anything like that high since, if he were the Russians, he would scream bitterly about limits in the ton area on the basis that it was just a guise for developing tactical weapons. Bradbury felt the definition should not include any limit higher than about ten pounds. However, he added that as to its purpose and effects in various countries based on whether they had open or closed societies, he felt that about the only thing a limit in the definition would do would be to provide a basis for internal instructions, i.e., in the United States, the weapons laboratories would probably be directed to stay within the terms of the definition, whereas

in Russia, it is not clear at all that that would be the case.

Chairman McCone made some interesting comments about the international situation and the test ban discussions to the Commission staff in a briefing on August 25, 1960. Part of a summary of his discussion on international activities stated that:

> Test cessation negotiations have been recessed until September 27 as a result of his (McCone's) trip to London, at the request of the President, accompanied by Undersecretary of State Livingston Merchant, Mr. Philip Farley, and General Starbird. The visit afforded an opportunity to discuss with the British the various questions separating the U.S.-U.K. on the one hand, and the Soviets on the other, and to explain to the U.K. the difficulties involved in a unilateral offer to disclose devices used in seismic improvement work. The discussions identified about 12 areas of disagreement with the Soviets and, importantly, dispelled the impression that if agreement could be reached on site inspection, all other points of disagreement would be resolved. It was agreed to recess to let some of the issues become quiet and to review again our own position. Mr. McCone said he was anxious that the test suspension not become an issue in the election campaign because many of the issues were not clearly understood and the whole matter had assumed an importance quite apart from other aspects of our military stature. Competing campaign promises would prevent an objective analysis of the situation and might force us into an undesirable position in future negotiations.

However, the former commissioner, Thomas F. Murray, would not permit this subject to be ignored in the Presidential campaign of 1960. On September 6, he addressed an open letter to Vice-President Nixon and Senator John Kennedy, discussing the U.S. position at the test ban negotiations in Geneva and noting "the grave threat which our current nuclear test policy poses to the national security of the United States and that of our free world allies." After review of the issues of the current test ban situation, he expressed confidence that the two candidates would recognize the validity of:

> . . . the following proposal: (1) that the present ban on atmospheric tests should be retained; (2) that the ban on underground tests and on tests in outer space should be immediately revoked; (3) that these tests should be conducted not merely to enlarge our scientific knowledge of seismic or outer space phenomena but also and explicitly to develop the technology of nuclear weapons.

Kennedy responded first in a letter to Murray released on October 10 which gave a general outline of what he would do about these matters if elected President. First of all, he stated that the U.S. would not be the first to resume testing in the atmosphere. Addressing the subject of the Geneva Conference, he noted that if it were to terminate before the inauguration, he would immediately (after inauguration) invite Britian, Russia, and France to participate in a new conference for the same purpose. Thus, whether the talks had ended or not, he would intend either to continue or reopen them. He stated the following as his feelings about how they should be continued and on what time scale:

> I intend to prescribe a reasonable but definite time limit within which to determine whether significant progress is being made. At the beginning of the period, I would direct the Atomic Energy Commission to proceed with preliminary preparations for underground tests of the type in which radioactive substances would be forever sealed within the explosive cavity. If, within the period, the Russians remain unwilling to accept a realistic and effective agreement, then the world will know who is to blame. The prompt resumption of underground tests to develop peaceful uses of atomic energy, research in the field of seismic technology, and improvement of nuclear weapons should then be considered, as may appear appropriate in the situation then existing. (Emphasis added.)

Nixon gave his reply to Murray's letter in a speech delivered at Toledo, Ohio, on October 26. The following are extracts from Nixon's speech:

The security of the U.S., and of the entire free world, simply will not permit either such a surrender (referring to lack of adequate inspection and control) or the indefinite continuation of the present moratorium, entirely without inspection. . . . The time and patience which we have already expended to explore this way out of the disarmament dilemma have been fulsome proof of our own intentions and of the Soviets'. The blame rests squarely on them. We cannot permit further delay. . . . Another delay of the length indicated in Senator Kennedy's proposals could be decisive in a struggle for peace and freedom. . . . If I am elected, I will, on November 9 ask the President to designate Ambassador Lodge to go to Geneva personally to participate in the present negotiations with a view to resolving this question by February 1. . . . I would have Mr. Khrushchev know that if Ambassador Lodge and the Soviet negotiator are able to bring an agreement in sight in this 80-day period, I would be prepared to meet with Prime Minister Macmillan and--so important do I hold this question to be--with Mr. Khrushchev to make the final agreement at the summit. But I would have him understand that if at the end of the 80-day period--by February 1--there is no progress, the United States will be prepared to detonate atomic devices necessary to advance our peaceful technology. Such devices already are prepared for underground use in such a way as to guarantee no contamination. Further, I would have him understand that the United States is willing to continue negotiations for a nuclear weapons test ban as long as the Soviet representative will sit, but not under an uninspected moratorium of indefinite duration. I would have Mr. Khrushchev understand that if an agreement is not signed within a reasonable period after February 1, the United States will have no alternative but to resume underground testing of atomic weapons. I say underground testing because there is no question of resuming tests in the atmosphere, where some still undetermined danger of contamination exists. The United States has abandoned such testing, certainly until more knowledge is available as to the exact consequences.

To Murray, these two responses seemed not to recognize the gravity of the situation and the need for specific and immediate test resumption. Accordingly, he wrote a second open letter on November 4 adding what he felt was a very strong reason for getting back to the business of weapons development unhampered by a test moratorium. This was to him the necessary step that must be taken to develop what he called a "third generation" of weapons (after the fission and fusion devices), referring to enhanced radiation weapons and, specifically, the "neutron bomb." Murray stated that "the necessity for negotiations is no excuse for delay in resumption of the tests necessary to put us in possession of third generation weapons. The question of who will first get these weapons is the new form of the old question of survival." Although this letter apparently led to no further statements by either candidate, a number of scientists reacted negatively to Murray's statements about the "neutron bomb," among which were Hans Bethe and Jerome Wiesner, soon to become President Kennedy's Scientific Advisor.

Given below are a few extracts from weekly status reports written by Dr. Carl Walske, the AEC's representative to the Geneva diplomatic delegation through all of 1960 and the first part of 1961. Walske's comments, with the date on which they appeared in his weekly report to the Director of the Office of Special Projects at Headquarters, AEC, give some interesting insight into how an observer sitting in on the conference meetings viewed the whole situation after the May 1960 summit conference:

June 3: I do not know what the new hard Soviet line means and can hardly guess. It looks to me, though, like the treaty here is going to have slow going for some time to come.

June 17: One might say that the events of this week are merely a simple repetition of the ills that this conference has known for a long, long time. The fact that the proposed research program detonations are in an almost hopeless mire, and that we are stalemated on almost every outstanding major issue the conference has left, are in a way old news. Still, here in Geneva, I can couple these events to a visible Soviet inflexibility and, in fact, a certain indifference on their part to whether the conference makes progress or not. . . . It has always been

the case the U.S. needed to be more decisive in either getting out of or getting into this negotiation. We always said, too, that time worked against us and the longer we waited, the harder it would be to drive a good bargain with the Soviets. My personal feeling is that we have already waited too long, and while it is still possible to decide that we must settle for whatever treaty we can get, it looks like a poor treaty is all that we can now expect.

July 1: In Geneva this has been "Save the Conference Week." After the Soviet bloc walked out of the Ten-Nation Conference this last Monday (June 26), the British developed a bad case of nerves, with Sir Michael and Ormsby-Gore terribly worried that the Soviets would break off our negotiations also. . . . In a prepared statement, Tsarapkin announced that the Soviets would not send observers to our July 12 Plowshare chemical explosion. He stated flatly that there could be no Western observers at future U.S.S.R. industrial explosions. In answer to his claim that observation at industrial chemical explosions is an inappropriate subject, Wadsworth replied that the present test ban negotiations had made such observations singularly appropriate. Tuesday (June 27) saw a continuation of the British nervousness over the negotiations. In the morning, Sir Michael met with Wadsworth to convey his great concern that the Soviets were in an excellent propaganda position to break off our talks. He argued that if they walked out now, they could declare that they would not be the first to resume nuclear testing, thereby placing the West in a very hard position. (Reference is to the Ten-Nation Committee on disarmament which met at Geneva beginning on March 15, 1960.)

August 5: For the last two days, the delegation has been in a state of shock arising out of an August 4 *New York Times* story by John W. Finney. This story reported consternation of officials in the Department of State and the Atomic Energy Commission on the delegation's recent tactics in handling the safeguards issue. The feeling of all members of the delegation is that while there is room for sincere differences of opinion on tactics it is nevertheless disastrous for stories such as this to appear. The feeling is that this story may well lead to the discrediting of the present negotiating team and to the projection of the issues of the conference into the present political campaign. . . . The direction I would have liked to have seen the delegation take on safeguards was somewhat different than that actually taken. I had a chance to put forth that idea to the whole delegation. I thought that we should vigorously continue the argument for our original pool idea. The State Department element felt, however, that we should not overextend ourselves in that one direction if we were in fact likely to fall back at a later time. While I did not agree with this, I think that it is certainly a matter of opinion, and there is no doubt that they are the bosses here in Geneva.

August 12: We hear rumblings of the interagency battle on safeguards clear over here in Geneva. We are all most anxious to see how it all comes out. . . . In the briefest of terms, my view is that it is no longer possible (if it ever was) to obtain Soviet agreement to a treaty with adequate safeguards. This belief is predicated on my estimates that the Soviets will stop far short of agreement on the measures necessary to 'shore-up' the control system.

October 14: It is to the regret of all elements of the delegation that our negotiation is merely treading water. The U.S. seems to be waiting for the proper moment before deciding whether it will accept a technically imperfect treaty or whether it prefers to have no treaty at all. In our discussions here we have been talking about ways in which the day of decision might be speeded up. However, in view of the recent Kennedy statement to the effect that, if elected, he would like to take his own look at the negotiating situation, we are not hopeful. In the event of a Nixon victory in the elections perhaps we could hope for action soon after November 8.

November 3: He (Ambassador Stelle) pointed out that both candidates for the Presidency have indicated that the U.S. should make one more effort to break the deadlock in our conference. Stelle said that in his opinion, the U.S. would be remiss in its duty if, upon failure of such a last effort, it continued the *de facto* moratorium. He was confident, he said, that either candidate as President would not relax the U.S. insistence on effective controls. . . . Yesterday, Tsarapkin gave a fuller response to Stelle's speech on Monday . . . He interpreted Stelle's remarks about the feelings of the Presidential candidates as indicating the U.S. foresees the failure of the talks and the renewal of tests. He claimed further that our Monday statement indicated that the U.S. wants everything its own way. . . . Stelle, in his reply . . . said that the U.S. does want a treaty with adequate controls, however, continued negotiations without control and a treaty causes increasing concern in the

U.S. Particularly to the officials who are primarily charged with our defense, the continued absence of testing without accompanying controls is distressing. Stelle countered a Tsarapkin remark--to the effect that our moratorium position is aimed at resumed testing--by pointing out that we are in fact now free to resume tests upon prior announcement of our plans. The moratorium was agreed to by the U.S. and the U.K. in response to a Soviet request. A moratorium implies a certain definite time at the end of which freedom of judgment will be possible. If the Soviet attitude is that this is not the case, then the treaty is in effect comprehensive, and the Soviet acceptance of a threshold treaty is hollow, said Stelle.

November 10: We have now heard the results of the election and are trying to guess what the future will hold. If, as we expect, it will not be possible to get major decisions on this conference until after the inauguration, then we feel a rather long recess would be best. Under the circumstances, such a recess would enable the U.S. to maintain the best possible posture until it was once again ready to negotiate actively. At the moment, it would seem appropriate to begin a recess in a couple of weeks, and to have it last until early February.

Following the recess in December, the Chairman notified the Commission at a meeting on December 19 that they had received a Presidential request to join with the Departments of State and Defense in preparing a coordinated position paper on the subject of nuclear testing. In the same month, McCone received a letter from Herbert Loper, the Assistant to the Secretary of Defense for Atomic Energy on the subject of discussing possible benefits of nuclear testing.

Summary of 1960

At the end of the year 1960, test ban negotiations were essentially at a stalemate, partly because of U.S. insistence on the various aspects of underground test safeguards and the Russian reluctance to accept our view, and partly because of the personal vendetta between Eisenhower and Khrushchev, who intended to await a new U.S. administration before agreeing to further moves. The French had entered the nuclear community by conducting three tests. President-elect Kennedy, in pre-election statements, had made it clear that he intended to break the deadlock in some fashion, insisting on "adequate controls," and had stated that he would direct the AEC to begin preliminary preparations for testing but not in the atmosphere. The overall governmental system had conducted a review of the value to the country of further nuclear weapons testing without arriving at any particular conclusion. The Atomic Energy Commission and it's General Advisory Committee seem to have convinced themselves that the odds were fairly high that the Russians were testing clandestinely. With respect to our ability to go back to nuclear weapons testing, the national philosophy that any future testing would be either underground or in deep space had hardened and, hence, our capability to test in the Pacific had been degraded so as to become almost miniscule. The Eniwetok Proving Ground had been turned over to the Pacific Missile Range and the Task Force and Task Groups either inactivated or degraded strongly. The likelihood of Army installation of missile launchers on Johnston Island that could be used for Willow had been reduced to almost zero and all work on Willow had been stopped. However, in Nevada, an appreciable amount of work had been done during the year to produce tunnel sites for detonations either under the auspices of readiness in the early part of the year, or Vela Underground later. The Nevada organization had found a great deal of work to do, not only on the above subjects but also on Plowshare. For similar reasons, the AEC Laboratories' testing capability, in one way or another, had been preserved either by conscious readiness effort or by transfer of people to related efforts such as Vela Uniform, Plowshare, Rover, Pluto and special laboratory experiments. In some fields that would be important in future weapons testing, effort had actually increased. At LASL, there were many new people involved in Vela Hotel and Vela Sierra who would later use this know-

ledge in conducting experiments on Dominic. The DOD, after having gone through some sort of minimum in their capability in the middle of the year, were in some ways on the way back up and had managed to continue their preparations for Jericho (or Marshmallow). AFSWC was getting increasingly deeper into the need for high-altitude detonations and the study of the phenomena. Thus, it appeared that the odds of resuming testing had increased appreciably over those at the beginning of the year, and the capability to test underground had been improved, although many of the diagnostic methods were still poorly defined.

Personnel Changes

In the early part of 1961, there were a number of personnel changes amongst the people considering nuclear weapons testing and the test ban problem. Some of the more significant of these are shown in Table XI. Spurgeon Keeny stayed on the staff in the office of the President's scientific advisor, where he had been since the formation of that group. Stelle was temporary head of the United States delegation at Geneva until Dean's appointment.

TABLE XI
KEY PERSONNEL CHANGES

Position	Incumbent/ Date of Leaving	Replacement/ Date of Arrival
President	Dwight D. Eisenhower January 1961	John F. Kennedy January 1961
President's Special Asst. for Science and Technology	James R. Killian June 1959	George B. Kistiakowsky June 1959
President's Special Asst. for Science and Technology	George B. Kistiakowsky January 1961	Jerome B. Wiesner January 1961
Secretary of Defense	Neil H. McElroy December 1959	Thomas S. Gates, Jr. December 1959
Secretary of Defense	Thomas S. Gates, Jr. January 1961	Robert S. McNamara January 1961
Deputy Secretary of Defense	Donald A. Quarles May 1959	Thomas S. Gates, Jr. June 1959
Deputy Secretary of Defense	Thomas S. Gates, Jr. December 1959	James H. Douglas, Jr. December 1959
Deputy Secretary of Defense	James H. Douglas, Jr. January 1961	Roswell L. Gilpatric January 1961
Secretary of State	John F. Dulles April 1959	Christian A. Herter April 1959
Secretary of State	Christian A. Herter January 1961	Dean Rusk January 1961
Chairman, AEC	Lewis L. Strauss June 1958	John A. McCone July 1958
Chairman, AEC	John A. McCone January 1961	Glenn T. Seaborg March 1961
U.S. Ambassador to Geneva Test Ban Talks	James J. Wadsworth September 1960	Arthur H. Dean January 1961
Advisor to the President on Disarmament	None (new position)	John J. McCloy January 1961

TABLE XI (continued)

Position	Incumbent/ Date of Leaving	Replacement/ Date of Arrival
Director, Advanced Research Projects Agency	Roy W. Johnson October 1959	Austin W. Betts February 1960
Director, Advanced Research Projects Agency	Austin W. Betts January 1961	Jack P. Ruina January 1961
Director of Defense Research and Engineering	None (new position)	Herbert F. York December 1958
Director of Defense Research and Engineering	Herbert F. York 1961	Harold Brown May 1961
Asst. to the Secretary of Defense (Atomic Energy)	Herbert B. Loper 1961	Gerald W. Johnson August 1961
Chief, Defense Atomic Support Agency	Edward N. Parker August 1960	Robert H. Booth[a] January 1961
Director of Military Applications (AEC)	Alfred D. Starbird January 1961	Austin W. Betts January 1961
General Manager, AEC	Kenneth E. Fields June 1958	Paul F. Foster July 1958
General Manager, AEC	Paul F. Foster November 1958	Alvin R. Luedecke December 1958
Director, Lawrence Radiation Laboratory, Livermore, CA	Herbert F. York March 1958	Edward Teller April 1958
Director, Lawrence Radiation Laboratory, Livermore, CA	Edward Teller June 1960	Harold Brown July 1960
Director, Lawrence Radiation Laboratory, Livermore, CA	Harold Brown March 1961	John S. Foster, Jr. June 1961 (acting: March 28-May 31)
President, Sandia	Julius P. Molnar August 1960	Siegmund P. Schwartz September 1960
Commander, Field Command, DASA	Louis T. Heath June 1960	Harold C. Donnelly[a] June 1960

[a]Donnelly acted also as Chief, DASA, from August 1960 to January 1961.

Growth of Readiness Interest, Early 1961

The change in administration as a result of Kennedy's election in November 1960 led to renewed consideration by the Commission and other portions of the government of the test ban treaty negotiations and the wisdom of continuing the moratorium. On January 13, Starbird sent to McCone a long report on the possible benefits of nuclear testing, emphasizing some of Loper's points made slightly earlier, and saying, among other things:

> I believe these ideas constitute a much more powerful support of a position that we must resume testing . . . Only by increasing the capability of our present state of the art by factors of two, three, or more can we

> expect to deliver the yield which the DOD now estimates necessary for targeting purposes . . .If, through testing, it is possible to go the other way and through better warheads actually reduce the number of missiles, aircraft, logistics, support equipment, and men required, the net savings in better defense posture would indeed be spectacular.

On January 18, McCone stated before the Joint Committee:

> Further attempts to reach agreement with the Soviets should be made promptly. If an agreement is reached promptly, the United States, under safeguards, it is proposed, and in coordination with the U.K. and the U.S.S.R., should pursue vigorously the development of improved techniques and equipment for use in a control system on which an agreement would depend. If, however, the Soviets attempt to continue indefinitely the present unpoliced moratorium by prolonging the negotiations, the Commission believes that there is only one prudent course for the U.S. to follow. This course is a resumption of testing of nuclear weapons underground and possibly in space.

On January 18, Harold Brown wrote to Shute (San Francisco Operations Office), giving some of his thoughts on the subject of the requirement for testing:

> Very much more elaborate techniques of calculations and nuclear weapons design, along with a certain amount of laboratory experimentation, has [sic] served as a partial substitute for weapons tests. The result has been very real and important but considerably diminished progress in weapons design and development. If testing is not resumed, we expect, in the period through FY 1963, to proceed with work on such items as a pure thermonuclear explosion, variable diameter warhead, Ex.(b)(3) and so forth on which some progress can be accomplished without test. . .The exigencies of the seismic improvement program have essentially eliminated the readiness capability for resumption on short notice of full-scale underground testing . . . If such testing is resumed, we would be in a position to test (and stockpile if successful) a variety of items Ex.(b)(3)

He concluded that the test moratorium had considerably impeded weapons development, and that while some progress could be made without full scale nuclear testing, great care had to be exercised in stockpiling new designs.

On January 25, 1961, the President appointed a disarmament study group headed by Dr. Fisk and reporting to John J. McCloy, the President's Disarmament Advisor. General Starbird, General Betts, Spofford English, and others from the AEC staff were participating members of this study group. Among the studies to be made were the probable gains to the United States from various types of nuclear tests, probable gains to the U.S.S.R. from various types of nuclear tests, and a comparison of the relative gains to each side in terms of improved weapons systems. At the January 28th meeting of the Commission, Carson Mark, pointing out the difference between his evaluation and that of Harold Brown of Livermore, stated that he was "essentially pessimistic about gains which might be made from additional testing." Ex.(b)(3)

At the February 1, 1961, Commission meeting General Betts, who had just taken over from Starbird as head of DMA, in a briefing for Chairman-Designate Seaborg, said a major problem faced by the Disarmament Study Group (Fisk) was to determine the validity of weapon capability projections in the absence of testing. Ex.(b)(3) He offered the opinion that the Russians might find it possible to develop weapons in the megaton range by clandestine testing. As to developments in

our own future, he pointed out that the U.S. was engaged in the development of enhanced radiation weapons, noting that such weapons would be especially effective in inflicting casualties upon personnel in foxholes and tanks while minimizing fallout.

Ex.(b)(3)

[redacted]

The uncertain future of weapons tests in political circles was evinced in *Headline Series #145*, published by the Foreign Policy Association of the World Affairs Center and entitled, "The Future of Nuclear Tests." Teller and Bethe, in this January-February 1961 issue, published opposing viewpoints on continued nuclear testing. Bethe argued that there was little to gain from further testing and little risk of the Russians catching up with us under a complete test ban. Teller, on the other hand, argued that testing would allow the development of an effective "second strike force" and of small tactical bombs to increase our options in the realm of limited warfare. He also gave Plowshare as a reason for continuing testing. He argued that the moratorium had been seen by some as a first step toward relaxation in further arms control, but that, obviously, there hadn't been relaxation in arms control, but rather increased intensity in the cold war. There was no notable reaction to this publication.

On February 16 the Commission briefed the new President on nuclear weapons subjects, hoping to get some indication of his intent. He does not seem to have committed himself in any way, but did request the Commissioners' judgment on the effects of a continuation of the test ban through June of 1961. The various Commissioners answered that there was no particular concern about another six months extension of the test ban, but that there was a real concern if it were to continue much longer.

The Fisk panel continued its work through February and March, with some notable nervousness on the part of the Commission. On March 1 Betts reported to the Commission that

Ex.(b)(3)

[redacted]

Bradbury, in his April 13, 1961, program letter to DMA, commented:

> Military requirements continue to appear for new nuclear weapons in spite of the moratorium on full-scale testing which has existed for the past 30 months. These demands, coupled with the Presidential directive to the Laboratory to maximize its progress in nuclear weapon development within the restriction of no nuclear testing have materially increased the theoretical and experimental effort which is required to assure ourselves and others that new weapons introduced into the stockpile will be certain to perform approximately as expected.

He went on:

> The Laboratory is conducting an extensive theoretical and experimental program whose ultimate objective is to provide a common basis of fundamental data and calculational procedures which will bring together in an understandable whole all of the results of previous nuclear testing. It is clear that there is available to us an enormous quantity of valuable experimental information from previous nuclear testing. This information, if it could all be reduced to a common calculational basis, would obviously provide the strongest support for the firm prediction of performance of new weapons with thorough confidence in their behavior. Furthermore, the Laboratory is aware that there has been a steadily increasing emphasis on the nuclear safety of atomic weapons and, indeed, this feature now dominates the design of all primaries.

In April, Bradbury, as a member of the USDA* "Disarmament Consultative Group," discussed for the Chairman, Harvey Brooks, an interesting proposal:

> It is possible that the intransigence of the U.S.S.R. in the test ban negotiations is due to the fact that they do not regard the game as worth the candle. It is perfectly obvious that the current difficulties over inspection procedures, vetoes, and so on would, if extended into a disarmament situation, make it completely unworkable. Some real step toward disarmament might seem to them worth more effort.

He then discussed the possibilities of an agreement to stop producing fissionable weapon material for weapons use or, later on, stopping the production of fissionable material completely. He commented that he could see no way to verify that fissionable material was not being produced for weapons in a situation in which production for other purposes was allowed. He further commented that an agreement to stop production was not entirely incompatible with the continuation of nuclear weapons testing since the production agreement might be Phase I of a multiphase agreement. He suggested that it would be folly to discuss the details of Phases II or III before entering into the first phase, which "will certainly be an educational process." He felt that a stoppage of production would not hurt us unduly, apparently because from a strategic and national deterrent standpoint, we already have plenty of material, and he also felt that there were no strong reasons to enter into development of a large tactical device inventory, which, of course, would require vast amounts of new fissionable material. Carson Mark commented (to Bradbury) that we could perhaps accept less assurance of our control and inspection if that circumstance were coupled with a reasonably well-assured disarmament system that would stop the material production in the other country. He added:

> In my opinion, of course, we (the United States) have somewhat overdone things in our insistence on having a high degree of assurance that even rather unlikely things were not going on. This attitude has gained considerable support from the frequent repetition of rather exaggerated estimates of the gains likely to be realized from testing accompanied by, if anything, even more exaggerated estimates of the case in which tests could be conducted illegally and the certainty with which the fully developed fruit would fall neatly into the hand of whomever might jostle the tree, however imperceptibly.

On April 28, at the 300th meeting of the Geneva talks, Dean commented that, "To me it seems much more likely that within some reasonable period, our fate will have been determined and our success or failure written down upon the pages of history." Tsarapkin claimed the West wanted to wreck the negotiations and shift the blame to the other side.

During this period other detailed discussions were taking place. On January 25, 1961, Starbird answered Reeves' November request for guidance:

> In spite of . . . budget restrictions, there are desirable actions in the line of planning which might lead to a more complete test capability . . . Problem areas may be revealed which by anticipation may be more quickly and easily overcome. . . . By revealing positive and indisputable restrictions to possible future test programs . . . we may be in a better position to request budget relief for such purposes or use monies available later in the year from programs which underrun. . . Any test effort in NTS which might be accomplished within the next few years can be expected to be underground. . . . Initially, the yields would be restricted to relatively low levels, perhaps on the order of 50 kt maximum.

*U.S. Disarmament Administration.

He suggested that planning assume a very few high priority tests commencing quickly after a decision to proceed, and being completed in perhaps three to six months from go-ahead. "Such a program might be along the lines of an abbreviated Succotash of the order of six tests, and should involve experiments from both laboratories which urgently require testing because of existing and critical weapons requirements." He also suggested a second program to be accomplished in perhaps a year from go-ahead that would have the Laboratories testing when and as required, beginning with the most promising new ideas in developments. He cautioned: "I would like to emphasize, however, that no impression should be conveyed or implied that a resumption of testing is imminent." He directed Reeves to ask LRL to redefine the Succotash program and to also approach LASL, DASA, Division of Biology and Medicine, and others with the thought of producing an overall plan which could then be examined by DMA with the idea of authorizing such portions of the new plan as might be feasible, considering budget restrictions and political implications.

The Labs responded leisurely, with Graves commenting that it was worthwhile to have some general plan of what weapons tests should have first priority, but that he couldn't see the likelihood of major construction effort, and, furthermore, he would in general rather see planning done on a less formal basis rather than trying to develop a single plan or a set of alternate formal plans. He commented in mid-February that LASL could organize any test effort within the time that would be required for the Lab to prepare the test devices for use. At the March 2 LASL Weapons Working Group (WWG) meeting, Graves noted that with the Geneva talks starting later in the month, and in their present status, the end of the moratorium would probably be abrupt, and he raised the questions of the wisdom of a readiness program and production of appropriate devices. The feelings of the Laboratories were illustrated at a March 17 meeting at Livermore, attended by members of all three Laboratories, at which Bradbury commented that he didn't understand why there should be great urgency to resume testing immediately after receipt of permission since it did not seem likely that testing, once resumed, would soon again be subject to pressures to stop. On the other hand, Harold Brown of Livermore expressed urgency to develop a readiness program because by reducing the present six months readiness to approximately two months, the urgency of any future decisions regarding nuclear testing would be increased and the possibility of using a long lead time as an excuse to delay decision would be eliminated. Brown commented that LRL would send a letter to DMA in the near future which would outline an up-to-date readiness program. Reeves then requested a joint meeting in Albuquerque on April 20 to lay the groundwork for a test readiness program.

True to his word, on April 10, Harold Brown proposed to General Betts (DMA) a new LRL test readiness plan. [redacted] Ex.(b)(3) [redacted] Overall Nevada costs would be just short of $2,000,000. Brown requested that Betts authorize the program. Bradbury apparently did not follow a similar path; however, the level of LASL in-house discussion on the subject grew. On May 3, in order to get a little further along with the definitive program, the discussion in the LASL WWG was continued, with Harold Agnew noting some interesting ground rules:

> The AEC wishes the Laboratories to be able to start on short notice, i.e., within three weeks to a month, simultaneously stating that no advance preparations will be made at NTS. . . . Surface contamination from the underground shots is to be contained within the test site. . . . It is believed that something like 1 kt is possible in the 450-foot holes now available to LASL, but that this is probably the upper limit for at least the first few unless some of the LRL facilities are made available to us. Ogle noted that if alpha measurements are desired, then two to three months would be required for the first test whether the holes are available or not.

A tentative list of possible shots was given, [redacted]
Ex.(b)(1)
Ex.(b)(3)
[redacted]

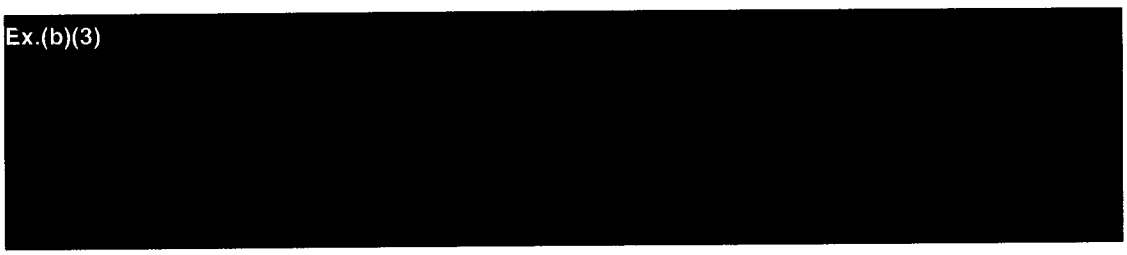
On April 13, in a report to DMA on overall LASL activities, Bradbury commented:

> The Laboratory is not making any specific plans for an immediate resumption of testing in the event the moratorium is abandoned. Since the circumstances under which this could occur and the restrictions which might be placed on testing in any event are so varied, detailed planning seems futile. Furthermore, if the Geneva negotiations are abandoned, and testing resumed, it is not easy to see what combination of political circumstances would suggest it be important to start testing very quickly, or could lead to its early abandonment again. Nevertheless, the Laboratory will rather rapidly acquire a number of systems in which it would be interested for testing. . . . Clearly, what actually would be planned would depend to a very large degree on what we are allowed to do--and this, of course, remains to be seen.

Reeves' meeting was finally held on May 10, 1961, with representatives from LASL (Graves), LRL (Bacigalupi), EG&G (John Lusk), H&N (Hal Perla), Field Command (Carse and Tate), Las Vegas Area Office (Yelinek), and others. Graves and Bacigalupi outlined the available LASL and LRL facilities and suggested a strawman distribution using some of the Vela Uniform sites. [redacted]
Ex.(b)(3)
[redacted] The discussion led to the suggestion that LASL use the e.03 tunnel complex as well as the Area 15 tunnels, including 15a, the 950-foot deep, 36-inch granite hole (Lollipop-High Hat). It was agreed that DMA would be asked for guidance on the question of planning to use Vela Uniform sites. EG&G reported that they had approximately four weeks readiness for timing and firing, using some five minimal timing systems available either at NTS or elsewhere, and five tunnel-type zero racks which could be adapted to almost any use. Assuming they promptly purchased an inventory of film, they had a similar readiness for photography. Because of the previous LRL commitments for Plowshare, EG&G could put together a system of 32 oscilloscopes for LRL alpha measurements, for which they had about six weeks readiness, depending upon the test area. They (EG&G) were committed to LASL for a 15-scope system to be ready by July 1 for use on Vela shots, and there was a 27-scope alpha system at LASL which was committed. Bacigalupi noted that an initial survey of the cable available showed enough for the proposed LRL shots, but that if LASL were to use any of the tunnels, there then might not be enough cable. EG&G noted that for LASL there were only 10 alpha detectors available, which would be enough for two shots. The lead time on detectors could be as long as 130 days because of photocell procurement. Bacigalupi noted that seven e tunnel sites were available, the yield capability running from 0.86 kt to 49 kt, and that four b tunnel sites were available with yield capability from 0.1 kt to 3.6 kt. The yield capability was based on the 450 times the cube root of yield rule for containment and a 600 times the cube root of yield estimate to preclude damage to adjacent tunnels. The meeting ended with an agreement that both Labs would make a firm outline of a proposed program for planning purposes and recommend sites for the location of the events.

Considerations were also taking place in the DOD during this period. In early January, General Schriever, Commander of Air Force Systems Command, in preparation for impending congressional hearings, asked AFSWC to prepare a study on their needs

were testing to be resumed. The initial reply on January 18 stated AFSWC's belief that nuclear tests would not again be conducted in the atmosphere, but emphasized the need for high-altitude or space tests and even suggested attempting some of the high-altitude phenomenology underground. AFSWC in-house studies (Thayer and Eddy to McCorkle) mentioned other items that could not be studied properly without further testing; x-ray phenomena, including output and lethality questions; turbulent Argus, which was the effect of radio noise produced from high-altitude events; the space and time extent of blackout effects; further information on the transient radiation effect on electronics (TREES); the experimental verification of neutron and gamma transport codes from airbursts; and tests to look at pusher ablation, etc., for Project Orion (which the DOD called Project Putt-Putt). It was expected that most of these would be very difficult to investigate by underground testing. In mid-February, the weapons effects board of DASA recommended an increase in the AFSWC budget, apparently especially for increased effort in high-altitude effects and underground protective construction. Herb York, now DDR&E, stirred up further interest with the comment to Booth on February 22: "It is expected that during the next six weeks, a decision will be made which will further determine national policy in the matter of weapon testing." Booth, on March 15, offered guidance to Field Command, including continued direction of the Marshmallow (Jericho) program, which presumably had a 12-month readiness, commenting that he was considering actions to reduce lead times, provided the costs were not prohibitive. Furthermore, he directed them to "discontinue planning for inclusion of military weapons effects tests in the Vela Uniform explosion program" (presumably speaking of Lollipop) and "within current personnel and fiscal ceilings continue to maintain a capability to resume nuclear tests." At a briefing for General Schriever given by AFSWC in mid-February, some of the penalties of not testing for the last two and one-half years were noted. For example:



In spite of the thinking that any future testing would only be underground or in deep space, and perhaps simply as a matter of inertia, the MLC noted in early April that the Air Force had retained a capability to provide sampling support to the AEC in the event nuclear testing was resumed, and asked for a review, in the light of the present situation, of future AEC sample support requirements. Betts transmitted the request to the Labs on the assumption that a 6- to 12-month buildup period would be required, but he also asked the Laboratories to give their judgment on the buildup time. After the appropriate inputs from the Laboratories, Betts replied to Major General Bruce Holloway at Headquarters U.S. Air Force in early May that some six sampling aircraft with appropriate spares would be the minimum for overseas tests and four for Nevada tests. If drones or rockets were developed and proven, the aircraft requirement could be reduced or even eliminated. Betts also added that if a situation should arise which would dictate atmospheric testing:

> A buildup period of 6 to 12 months testing at NTS is realistic. We would assume that a longer period, perhaps 18 to 24 months, would be required for comparable tests overseas, although a simplified test might be conducted in somewhat less time. . . . For a possible underground sustained testing series at the NTS, a 6- to 12-month

> preparatory period is generally applicable. We would be prepared, however, to conduct a limited number of simple experiments such as safety tests or low-yield proof tests within one to three months should circumstances demand.

In mid-April 1961, Colonel Byrne (4950th Test Group), because of informal discussions with various personnel closely associated with various phases of work on atomic energy, observed that "the Geneva talks may culminate in the resumption of testing prior to the end of CY 1961." Still trying to carry on his job of providing air support for nuclear weapons tests, he rather plaintively requested that AFSWC headquarters provide information on the current test planning. To our knowledge, Byrne was never answered.

Demise of JTF-7

Except for the Air Force, the overseas test organization gradually disappeared in early 1961. As had been planned in mid-1960, the Task Force Headquarters had been reduced to a planning element within DASA by February 1, 1961. During January, 22 out of the last 24 people in the headquarters were transferred out of JTF-7, with Colonel Thomas L. Mann and Commander Frederick E. Bitting remaining. Thus, by March 1, JTF-7 had become an integral part of DASA.

The JTF-7 Draft* "Operations and Reactivation Manual" of March 1961 notes that after the report of the "Study Group on the Organization for Future Test Operations" was accepted for implementation in the fall of 1959, certain difficulties were noted. Specifically it did not seem feasible to maintain the required twelve month readiness status. As a result another study, the Reappraisal of Requirements for the Eniwetok Proving Ground and the Readiness Status and Functions of JTF-7, was conducted. A part of it states:

> Study of the effect of the disestablishment of the Task Force led to the conclusion that this was too drastic a step. Instead, it was determined that deactivation was a more proper attitude with the Task Force remaining in existence less personnel and material. In this way, the Task Force "know-how" could be maintained by keeping a live file of plans, records, instructions, and pertinent information in an available location. A capability to keep abreast of current thinking would be maintained and broad, flexible plans kept up to date. If, at any time in the future, a decision was made to activate a joint task force, the information on which to build would be available and plans would be in existence that required only details and further updating to bring into full use.

In spite of the above reasoning, Joint Task Force 7 was discontinued on June 30, 1961. Colonel Mann remained in DASA. On June 30, 1961, pursuant to JCS Order SN928-60, dated September 30, 1960, DASA issued orders for the discontinuance of JTF-7 effective June 30, 1961.

The AEC Support Task Group 7.5 had been discontinued on December 1, 1960, and 7.2, the Army Task Group, was discontinued by order of JTF-7 on January 24, 1961. 7.2 had been simply a paper organization since 1960, with no personnel or equipment. 7.3, the Navy Task Group, had been relieved from assignment to JTF-7 and assigned to Headquarters DASA on March 22, 1960, by JCS authority. On January 11, 1961, it was transferred back to JTF-7, where it apparently remained until the disestablishment of JTF-7 on 30 June 1961. Tom Mann, the last commander of JTF-7, was reassigned to

*DASA-70-03346.

DASA, and lasted there long enough to assist in establishing JTF-8, joining it in 1962.

The odd existence of 7.4 continued in its uncertain fashion. It was never really clear whether the 4950th was 7.4 or not, but they continued to wear that hat through part of 1961. Apparently triggered by conversations with Kenner Hertford, Colonel Byrne of the 4950th prepared in February a "fill in the blanks yourself" skeletal operation plan for a future open seas nuclear test operation, which was released on March 27 as a Task Group 7.4 document. It commented that ALOO had recommended to the AEC (early in the moratorium) the resumption of nuclear weapons testing at an early date. [redacted]

Ex.(b)(3)

Byrne managed to keep samplers operating not only for Rover missions, but also, in coordination with AFTAC, with flights out of East Sale Air Base, Australia, in May and June 1961. The discussion about the existence of the 4950th and the proper place for the 4926th sampling group continued. On May 1, 1961, McCorkle, commander of AFSWC, wrote to Schriever, Commander of Air Force Systems Command, among other things, "Most Air Force requirements for nuclear testing could be satisfied with underground and space tests, and political considerations would dictate that large-scale atmospheric tests such as Hardtack and Redwing would probably not take place." Speaking of the 4950th planning function, McCorkle added:

> The function now becomes one of realistic planning based on the nature and scope of any future testing and the scientific parameters that would be related to such testing. Test plans should be prepared and maintained based more objectively on envisioned scientific requirements related to space and underground testing rather than on a contingency support. . . . Plans for future tests should include active support that would be required from all AFSWC agencies, such as space vehicles, instrumentation, satellites, space hardware, launch crews, and the like.

He recommended that the 4950th be deactivated, that the 4926th (Sampling) be re-assigned within AFSWC, and that a test planning office be established within his own headquarters, taking over most of the spaces remaining in the 4950th. Some of the slots from the 4950th would be used to man the Nuclear Warfare Laboratory (which was under construction) and to establish an active Nuclear Reactor Safety program.

Colonel Byrne, however, continued to struggle, and on July 20 he pointed out that for the first time since September 1960, Field Command DASA was now allowed to design nuclear test experiments in environments other than underground or space, and that the Rover and Pluto efforts were growing, with NASA planning to put approximately 1,000 people in residence at the Nevada Test Site. He speculated that while testing might begin underground and in deep space, "with the restrictions having been lifted on planning for tests in the atmosphere, both atmospheric and underwater tests would also occur." He added:

> The current belief of Field Command, DASA, is that DASA will be given the responsibility which will further be delegated to Field Command to be the focal point of all planning and executive agent for the DOD responsibilities to nuclear test activities. . . . Such an organization or organizations would place Field Command, DASA, in the same relation to the conduct of all types of nuclear testing activities as Joint Task Force 7 was placed in regard to overseas weapons tests.

In this situation, he suggested that DASA would rather "have an Air Force organization speak to other Air Force organizations in support matters rather than a blue-

suited member of a joint command performing this activity" and suggested, therefore, that DASA would prefer to continue the present arrangement, since the 4950th had had this function since 1956. Nevertheless, in August 1961, the 4926th was transferred to the Air Weather Service on the basis that most of their missions were for U.S. weather programs, and the 4950th went out of existence. The Laboratories, especially LASL, were most concerned about the transfer of the sampling capability to the Air Weather Service and did manage to get an agreement that the sampling mission would have the highest priority.

Vela Uniform: Black Box, Etc., 1961

In the early part of 1961, Vela Uniform, the seismic improvement program, continued to represent one of the major efforts at NTS. However, the program was essentially stuck without further decisions. The U.S. had not come to any agreement with the Russians on a joint test program, and could not make up its mind to go ahead unilaterally. The device to be used depended upon political considerations which could only be decided after further negotiations with the Russians. The Geneva negotiations had been recessed on December 5, 1960, and were not to convene again until March 1961. Furthermore, the Bureau of the Budget had indicated that funds for the program would be cut for the next fiscal year. On February 6, Betts informed the community that no decision approving the go-ahead for Vela Uniform would be forthcoming before April 1.

Nevertheless, work continued. Livermore continued preparation for their polyethylene yield determination method on the appropriate events of Shade and Dribble. The decision was made to move the Lollipop event from the 950-foot hole to a 1,500-foot hole and work was going on to locate the proper geology for such a hole. Early in the year Lollipop was scheduled for August 1, 1961. On January 19, Roger Batzel of Livermore was designated as Scientific Advisor to Reeves for Project Shade.

Construction continued on the Cottontail site (now called Linen, 5-kt high explosive) in the U-12b.07 shaft. The progress of digging was hindered by a water seepage problem, and in March, to eliminate the problem, the depth of burst was raised by about 120 feet. However, for this and other reasons, the digging schedule could not be maintained. In early April, Reeves told Betts that a seven day workweek of construction and loading of the Linen cavity would be needed to reach a readiness date before winter, as was desired for seismic reasons. The alternative was to stop work until a firm schedule was established. Betts' choice was to stop work on May 7, with the intent of establishing a firm date for the shot in the spring of 1962.

The debate concerning the device to be used for Vela Uniform continued. In early March 1961, Betts notified the Laboratories of a proposed change in the Geneva negotiations, in which we would remove the requirement for joint contribution of nuclear weapons to the pool and would offer to reveal to the original parties detailed drawings or blueprints of the devices used in conjunction with U.S. tests, including actual inspection of the device. He pointed out that this still had to be agreed to by the JCAE. Ex.(b)(3) Betts also asked how long it would take to provide detailed drawings suitable for display to the Soviets, as well as an exploded drawing of the Mark XI illustrating the parts of the device which could be disassembled and displayed for visual and manual examination. In that query he noted that if the Mark XI were used, hydrodynamic yield measurements would not be technically feasible, and he asked for comments on other types of yield measurements that might be done. Harold Brown promptly answered that hydrodynamic yield measurements were possible. In an 18-inch diameter hole, one could use shock time-of-

arrival in the medium, and in a 3-foot diameter hole the polethylene-type measurement could be done. However, if the device were to be a Mark XI, then Livermore recommended alpha measurements. Reeves suggested on March 8 that if the Mark XI were to be used, LASL should take on the primary yield determination rather than Livermore, and noted that it was quite difficult to proceed with further planning for Shade until it was determined whether the shots would be Mark XIs or Mark VIIs. Bradbury consistently predicted problems with the disclosure of various blueprints or assemblies to the Soviets only, and again stated his feelings that the blueprints or drawings or both should simply be declassified rather than trying to figure out how to control the information disclosure to the appropriate people. He did not believe that the possible gain to nth countries warranted any rational concern. He wrote:

> As said before, any group that can accumulate the required amounts of material will be able to engineer an effective method of assembly without seeing our drawings just as well as after having seen them. At worst, the whole situation will provide no more than a textbook example of a classic weapon design calculation, together with the answer in the back of the book as to the yield it gives. . . . While my personal opinion is along the latter lines, I really do not care and I do not believe that it affects the national security in the slightest either way.

He went on to request more specific information on just what yields and yield measurment methods were contemplated, continuing:

> If LASL is to undertake the procurement of these devices, measurement of alpha, and other activities beyond those contemplated in our normal activities, we will need money. Nor can we guess how much until we have some idea of what the program is actually likely to be and when. How serious is this possibility anyway?

On March 21, the opening day of the Geneva session, Arthur Dean did make, as part of the Western proposal, an offer to allow Soviet inspection (assuming Congress concurred) of U.S. nuclear devices to be used for the proposed program to perfect the detection of small underground detonations. On April 4 and 10, Tsarapkin, among other things, agreed to the details of control, inspection, and monitoring of seismic research detonations.

On March 29, 1961, Schwartz of Sandia informed Betts that the total estimated costs to Sandia for the Vela Uniform program for 1962 and 1963 would be $2,600,000 for the Mark XI path and $2,000,000 for the Mark VII path.

On March 29 Betts notified the Laboratories that DMA would recommend to the Commission that only Mark XIs be used, and that DMA would also recommend relying on alpha as the primary yield measurement, supplemented wherever feasible by shock time of arrival and/or prompt sampling methods. He directed, however, that work on the Mark VII be continued in case it should be needed as a fallback position for all or some of the shots. [redacted]

Ex.(b)(3)

Two days later he informed Harold Brown and Norris Bradbury of the Commission's decision that declassifying a device and publishing blueprints of it for all to see would be extremely harmful to the United States from a political standpoint and he suggested that we not again explore the declassification possibility. In mid-April Betts requested more information about the devices for discussion with the Commission, and brought up the possible use of the Mark 23 gun device. Bradbury answered that he would not like to see the Mark 23 used [redacted]

Ex.(b)(3)

Within LASL, there was worry about the yield measurement. Ogle pointed out to Bradbury that a satisfactory value of the yield could only be obtained from alpha

data by going through our weapon design calculations, which were highly classified in some portions and which we would probably resist showing to the U.S.S.R.

> Thus, it seems to me that we should point out to DMA that the measurement of alpha on the seismic improvement shots will give us, the U.S., a good value of the yield, but that it cannot be considered as a yield measurement with respect to the U.S.S.R. unless we are willing to release sensitive detailed weapon design calculational methods and constants. Obviously, my point of worry is that DMA may be sold on a method that will not actually satisfy the ground rules and may tell us to prepare for such measurements. This could lead to a lot of J-Division effort to no point.

Bradbury commented that the amount of effort involved in the Mark XI program, as far as LASL could see now, would be comparable to that which was required a year ago for the Mark VII Black Boxes. On April 19, Bradbury commented to DMA that the accuracy of yield prediction for the Mark XI [redacted]

Ex.(b)(3)

[redacted]

In early April, an Orchid zero-point compatibility test was run using the Whirlaway Black Box. The LASL radiochemical sampling pipes fit reasonably well, and as far as LASL was concerned, all equipment for the Orchid test was now on hand at NTS.

Also in early April, the Commission discussed possible methods of getting the mineral rights for the Hattiesburg site, but deferred action on the subject.

In May, DASA, assuming that it would be the single U.S. point of contact for all foreign participants for both close and long-range measurements for Vela Uniform, arranged for a visit by a team of United Kingdom atomic energy personnel to Albuquerque and Hattiesburg to discuss United Kingdom participation in the Vela Uniform program. LRL participation was requested at the NTS for further visits there. The chairman of the United Kingdom planning committee was Mr. Edmond Richard Drake-Seeger. The United Kingdom projects to be discussed were in the areas of strong motion and electromagnetic measurements. In mid-May, the site selection process for Shoal had narrowed down the possible sites to the Wonderland of Rocks and Lost Valley in California, and the Sand Springs Range in Nevada (near Fallon). Reeves recommended the Nevada site to DMA, and, after coordination with ARPA, DMA agreed to that site, the final decision to be based upon further field exploration.

At Geneva, Tsarapkin had asked for more details on our proposals concerning inspection and monitoring by the Russians in our Vela Uniform activities, and Betts requested Laboratory suggestions and comments on these. Bradbury answered that we should move ahead on working out actual arrangements, and deal with difficult parts and disagreements when they came up. Hancock of ALOO suggested to Reeves, among others, the following:

> a. The U.S. would, without Soviet help, deliver the device to the test organization at the test site.
> b. On-site control of the device: keys to storage locations, zero station, etc., should rest with AEC custodians and Soviet observers; seals and locks would be fixed as mutually agreed; stationing of Soviet armed guards was "unthinkable."
> c. Other details of Soviet coverage of intra-site device movement, access to other NTS (or whatever site) areas, limiting permissible areas and procedures for Soviet specialists setting up their instruments, and the important problem of effectively controlling the contact of Soviet with U.S. personnel would have to be considered. (The co-mingling of Soviets and U.S. personnel and assuring limited passage of information was called "a very serious hazard.")