By mid-June, neither the Commission nor Congress had agreed to the proposal of revealing the detailed drawings of the Vela Uniform device to the Russians. In mid-June, Reeves notified Betts of his forecast for the Vela Uniform detonations as follows: Orchid in the fall of 1961 (they had already had a dry run); Linen, April 15, 1962; and Crystal, June 1, 1962. Yet in July, Reeves informed Betts that Crystal was only 19 weeks from being ready to fire in U-12e.03a.

While there had been money problems on Vela Uniform through this entire period, apparently the Commission was depending upon a supplemental appropriation to help them out in FY 1962. Vela Uniform had been considered as a two year program to match the political problems, but as far back as January, the ARPA Advisory Committee, headed by Dick Latter, had noted with alarm the intended decrease in money and strongly recommended to ARPA that something be done about it. As the possibility of weapons testing increased toward the latter part of the year, this problem became more serious, especially since ALOO and DMA had started in about June to use some Vela money for weapons test preparation. In early July, DMA (Colonel Anderson) discussed with JCAE the question of parallel efforts on weapons test resumption and the Vela program as planned. The JCAE indicated a strong feeling that the Vela Uniform series be carried out as planned, with foreign observers.

At the end of July, Betts authorized further work on the Linen project, apparently in order to be able to meet the intended shot date the following spring. However, he made it clear, both in July and August, that the shaft should not be backfilled, pending further specific notification, because that would commit the project. By the end of August, H&N estimated that Linen could be ready on May 25, 1962, and that if exploratory drilling of the proposed site were authorized, Lollipop could be ready by January 14, 1963. On August 30, the same day that the Russians announced their decision to resume nuclear testing, Reeves informed DMA of his planning assumptions for Vela Uniform to comply with the funding reduction from $24,000,000 to $10,500,000 for FY 1962. They were: Orchid, 5 kt, tamped in tuff, 10 weeks readiness for a detonation April 15, 1962; Linen, on which work would continue for a detonation date of June 1, 1962; Crystal, on which a 19-week readiness for a detonation on July 15, 1962, would be maintained; and Stingray, where basic construction in U-12e.06 would continue through the fiscal year. As for Lollipop, he would complete the exploration in Area 15 for site suitability and then would need construction authorization. For Shoal, he would conduct an exploratory program. On Porpoise, the five to ten thousand foot 5-kt shot, he assumed no action. On Muslin, he would continue the suspension. As for the off-site shots of project Dribble in the Tatum Dome, he would continue the exploratory program.

With the resumption of testing, Shade, as such, disappeared into history. At the sixth meeting of the ARPA ad hoc group on the detection of nuclear explosions, chaired by Dick Latter, on September 21, 1961, there were the following recommendations:

> The Group reviewed the Vela explosion program in the light of the planned AEC Operation Nougat. The Group concluded that the seismic results obtainable from Operation Nougat should be sufficient to meet the objectives of the proposed Vela Project Shade shots with one possible exception--the deep Porpoise shot. The Group, therefore, recommended that except for Porpoise, Project Shade be discontinued. The need for Porpoise will be reviewed by the Group after seismic data from Operation Nougat are evaluated. The Group recommended that preparations for Project Shoal be continued. The Shoal shot is the only direct comparison of the seimic waves from nuclear explosions with those from earthquakes and, therefore, is vital for an investigation of discrimination techniques. The Group concluded that the original decision that Shoal should be 5-kt nuclear should not be changed.

Shoal was eventually fired, but today (1983) the Linen cavity is still available in

Nevada to anyone who would like to pump it out.

X-Ray Kill Problem, 1961

On March 10, 1961, the Latter brothers (Albert and Richard), Ernest Martinelli, and William McMillan circulated a Rand report they had written that was to cause great controversy and eventually affect the high-altitude program of Dominic appreciably. The report was entitled simply "Some New Considerations Concerning Nuclear Test Ban." (Apparently, Rand did not approve the formal issuance of this report and it is somewhat unclear as to how it got out.) The report made a number of very serious accusations. It started out:

> The United States is seriously considering a nuclear test ban agreement which cannot be adequately controlled. Such an agreement would enable the Soviets to continue their nuclear tests underground and in outer space while the United States would, of course, live up to its commitment. In 1958, at the outset of the test ban talks, it was generally believed that underground nuclear explosions were detectable and nuclear tests in outer space impractical. The facts are now known to be otherwise. In April 1960, hearings before the Joint Congressional Committee on Atomic Energy made it clear that the Soviets can cheat if they want to without fear of the Geneva control system. There is now no essential disagreement among scientific experts on this point irrespective of their views on the desirability of a test ban.

The report brought up the possibility of x-ray kill for incoming nuclear warheads on either side and went into great detail. It envisaged a pack of incoming missiles, including warheads and decoys, on the order of 10 to 15 miles or more in radius, and advised that it might be possible through x-ray damage to the ablation material in the warhead nose cones to achieve a kill radius. [redacted] Ex.(b)(1) [redacted] The report suggested that in the event of an inadequately controlled test ban, which would jeopardize the deterrent strength of the United States, it would be necessary to build a deterrent force even larger and more diversified than we would build without a test ban, and, finally, "In our opinion, the best course is to adhere to the principle of adequately controlled agreements. At the present time, this principle allows us to make an agreement stopping atmospheric tests, some space tests, and underground tests above a threshold."

AFSWC, on April 17, took issue with some of the conclusions of the Rand report, which had the apparent endorsement of John Foster, Edward Teller, and Dave Griggs of the Air Force Scientific Advisory Board. Major Lew Allen* and Lieutenant Paul Hoffman of AFSWC felt that the Rand report had overstated the advantages that the Soviets could gain by clandestine nuclear testing during the uncontrollable test ban, and, in particular, refuted the strong statements made in the original paper that the Soviets could develop an effective antiballistic missile system by secret testing and that the United States could do next to nothing to decrease the present vulnerability of reentry vehicles and complete missile systems. Allen and Hoffman felt that the U.S. could do a great deal to improve present weapons technology in the area of RV vulnerability to nuclear effects, even without nuclear tests, but did comment that:

> The important point is not the testing, but rather that we must continually improve our deterrent capability to survive the Russian defensive capability. In every system which we have examined, the decision regarding possible improvement is not fundamentally affected by lack of nuclear test data at present.

*Lew Allen--Chief of Staff of the Air Force-July 1978 to July 1982.

Ex.(b)(1)

[redacted]

At this same meeting, Wigner wondered if Los Alamos would be willing to interest itself in seriously undertaking theoretical calculations on this question, but Betts made the point that the real problem was to simulate experimentally the pertinent weapon flux levels in the Laboratory. The GAC recommended that more effort should be undertaken on the subject now and Pitzer suggested perhaps 25 to 50 bright people full time. Williams commented that it would be difficult to produce experimentally the necessary x-ray flux, short of an actual nuclear explosion. Libby speculated that whether or not one could kill a hydrogen bomb at three miles or so would need to be derived through actual experimentation. Betts agreed to confer with ARPA on the subject.

Apparently reacting to the Rand report, Wigner asked Seaborg to tell Wiesner the GAC would like Panofsky's opinions. Thus, Panofsky, with DASA assistance, assembled a panel to assess the problem for the White House. The Panel membership was Panofsky, Bethe, George Bing, Hendric Bode, Daniel E. Dustin, Richard Garwin, Conrad Longmire, Herbert Scoville, and Spurgeon Keeny. They concluded that U.S. missiles were vulnerable to rather crude AICBM tactics and that, unfortunately, this factor had not been recognized earlier and had not been a missile system design consideration. Whereas the U.S.S.R. was probably thinking of RVs weighing on the order of 10,000 pounds, unfortunately, the U.S. thinking was in the direction of roughly 1,000-pound RVs, which are very difficult to render invulnerable at short distances. The report* suggested that the U.S. should review its reentry vehicles to determine AICBM hardness requirements.

Panofsky, in a discussion with the General Advisory Committee at Los Alamos on July 13-15, 1961, added that, unfortunately, no agency was looking at this problem in its entirety. He stated that there might possibly be short-term remedies for spallation in nose cones, such as changing materials or using foam layers. He also noted that while it was known that the U.S.S.R. was conducting a vigorous AICBM activity, it was unknown whether or not they planned to use nuclear warheads. Panofsky discussed the other possible AICBM kill mechanisms, such as bomb debris, blast, neutrons, beta rays, and non-nuclear pellets. Libby noted that at the moment, the United States was spending roughly $2,300,000 per year on the subject and raised the question of whether or not more should be spent. Panofsky emphatically agreed that more effort was warranted on the problem. Various possible improvements to decrease vulnerability were mentioned, including addition of decoys or protection with weight made available through increase of yield-to-weight ratios, increase of specific impulse of propellants, reduction of missile range requirements, increase of payload capacity, etc. Later in the meeting, Wigner commented that Bradbury and Brown, asked whether they considered the vulnerability problem to be within their province, gave conflicting answers. As a result of this discussion, the General Advisory Committee advised Glenn Seaborg that:

> **All currently planned U.S. ICBM warheads and reentry vehicles are vulnerable to AICBM destruction by nuclear explosions at ranges much greater than previously anticipated. This is due not to a single kill mechanism but rather to a combination of several effects. In our opinion the currently planned U.S. family of ICBMs is altogether too vulnerable to crude AICBMs and simple tactics.**

*Report of the Ad Hoc Panel on Warhead Vulnerability to the President's Science Advisory Committee, June 20, 1961.

They further commented:

> The recent findings on the vulnerability of our ICBM and the unexplored possibilities of AICBM initiated by the March 10 Rand report point not only to a present military danger, they also raise the question of whether our weapon research has been set up in the way which ensures that no catastrophic surprises are in store for us. If one compares the present situation with that which existed during the Manhattan project, one cannot but deplore the absence of a group of scientists feeling a true responsibility for all aspects of weapons research and its consequences and who devote all their time to these problems. Unless we succeed in establishing such a group of first-rate scientists with an intense and abiding interest in weapons research and the military strength of this country, surprises similar to the present one will recur. Our concern applies not only to nuclear weapons, but to all weapons and to their integration in systems. The recent events show that the present setup is unsatisfactory in view of the fact that even a temporary clear military superiority of our opponents may have permanent effects. We recommend that the AEC should have its weapons laboratories assume the broader responsibility of examination of the entire weapons systems in which its warheads are employed.

This period marked the beginning of the transition from the philosophy of neutron kill of incoming missiles to x-ray kill. Obviously, many variations of this were discussed over the coming years.

Vela Sierra, January-August 1961

The Vela Sierra equipment destined for Thule, Greenland, was received at Los Alamos from EG&G during January, was further prepared, and then shipped to Greenland. Prototype fluorescence detection stations operated during February at Fairbanks (Operation Big Moon), and at Thule (Operation Brass Ring). A partial prototype of the direct optical system, prepared by EG&G for LASL test, was received at LASL during February.

The main objectives of Operations Big Moon and Brass Ring were to study natural backgrounds and to ascertain the capabilities of the air fluorescence system in the auroral and polar cap latitudes, and more generally, to carry out an operational evaluation of the "preproduction prototype" air fluorescence equipment constructed by EG&G for LASL. Although the data were not fully reduced by late March, indications were that the aurora did not give optical pulses which would lead to false alarm signals. The prototype check out was considered successful, and the solution or elimination of a rather long list of problems and malfunctions was now possible. Moreover, these experiences made it possible for the Air Force to build an operational station. LASL planned to collect data on the natural background, and then to derive the appropriate conclusions regarding the operational capability of the Geneva-type international system.

By the end of July the set of air fluorescence detection equipment that had been returned from Thule was operational in a room atop the administration building at LASL, largely through the efforts of R. Thompson, an AFTAC noncommissioned officer who had assisted at Thule. Following the completion of modifications being effected by EG&G, another set of instrumentation was utilized for routine observations of natural background during the remainder of the summer. Many serious electronic troubles had turned up in the direct optical system, and were gradually being eliminated.

During August problems of calibration, increase in range, signal recognition, and auroral background were addressed using the prototype systems. LASL and EG&G discussed the need to record world time as an aid to detection, and all concerned agreed that the present design was hopeless for this application. It thus appeared likely that an entirely new version would be required to replace the prototype, but no decision had been reached by mid-August.

Vela Hotel, January-August 1961

LASL continued instrumentation flight tests in early 1961. Proton telescopes, electron scintillation spectrometers, ionization chambers, and other equipment were tested on Atlas and Blue Scout flights.

ARPA published a new Vela Hotel order on January 13, naming a joint technical group to be chaired by ARDC, with representation from AEC and DOD, which would have technical supervisory authority over AEC and DOD portions of the program. Areas of responsibility were defined as follows: AEC would provide detectors, logic systems, and analysis of telemetry; ARDC would provide satellite vehicles, including integration of detectors and logics systems, system assembly and testing, and other items. Thus, the AEC desire to have responsibility for the complete satellite, including the interface with the booster, was not realized.

The conclusions and recommendations of the ARPA ad hoc group on detection of nuclear detonations, chaired by Dr. Richard Latter, were forwarded to General Betts (Director of ARPA) on January 16. Without noting the specifics, the group stated that "the funds available for Vela Hotel are still far below those required for a scientifically desirable program. The group urges that the required funds be released as soon as possible to this program."

The Vela Hotel Joint Planning Team met on February 14 and 15 and recommended that the original March 30, 1960, development plan be followed at a cost of approximately $100,000,000, but they also offered, as an alternative, a detailed discussion of a limited program consistent with current funding limits. This limited program would lead to three launches using the Thor/Able Star/30KS 8,000 booster system launched from the Atlantic Missile Range. LASL/Sandia would have 90 pounds in which to provide a useful payload. The orbit would have an apogee of 50,000 nautical miles and a perigee no less than 30,000 nautical miles, with a 50,000-mile circular orbit preferred. The AEC was asked to have by March 1 a draft payload description for use in making a new development and funding plan to be finalized by March 16. This updated plan, published on March 9, entitled "The Vela Hotel Program, Joint Development Plan (Reduced Scope Plan), ARDC/AEC/NASA" noted that it was in response to ARPA Order No. 102-61, Amendment No. 3, dated December 8, 1960, which provided guidance for a reduced scope program of about $10,000,000. It was proposed that the new program consist of two phases. The first phase would be a group of piggyback and probe experiments, and Phase II would place at least one of three spacecraft into a successful orbit by about 18 months after approval. The program's goal was to gather sufficient satellite data on the space radiation backgrounds to fully define an operational detection system. Based on a program approval from ARPA by April 1961, the Thor carrier system was to be developed to support the launch of satellites to be delivered in May, July, and September of 1962, with launches scheduled for October and December 1962 and February 1963. By mid-March the program had been expanded to the $25,000,000 level.

Dick Taschek reported the status of the instrument development flights to LASL Director Norris Bradbury on April 3, summarizing the program of some 25 flights (on various Atlas launches, 609A rocket probes, Blue Scout Jr. probes, and upcoming NASA Moon and Venus probes) as having had a high degree of success. Flights to the region beyond the radiation belts had not yet been achieved. Planning was now under way for the next series of detector flights in Nike-Cajun rockets. But, during April, the first two attempts to launch balloons in the BLICOS program failed at the Tonopah Test Range in Nevada.

By May the decision had been made to use a launch system (Atlas-Agena) with a much greater lift capability than the Thor system. Although the first flight was now planned not to be before March 1963, each launch could carry two spacecraft plus

additional weight. A meeting of the joint planning group in the near future would address the use of the higher weight capability. The new overall program might involve as many as 12 satellites. The overall DOD funding plan now was $64 million, to be spent through FY 1965. On May 24 General Betts (now Director, DMA) asked Hertford of ALOO, who handled the overall Laboratory funding for Vela Hotel, to review the developmental requirements in accordance with the new plan and submit the AEC requirements. The response from Hertford on May 31 included increased funding requests for Sandia and LASL for FY 1962 and the three years following. For FY 1962, about $3 million total, instead of $2 million as earlier authorized, would be required. ARPA issued an order to Air Force Space Systems Division (SSD, formerly part of AFBMD) during June giving formal approval for the Atlas-Agena concept.

The details of the new Vela Hotel concept were made more definite in a development and funding plan updated in July 1961. The specific goal of the program was still to gather sufficient knowledge of the space radiation background to permit an operational detection system to be fully defined. However, the increased payload capability now allowed each launch to inject (using separate kick rockets) two spacecraft into different 50,000 nautical mile circular orbits. The extra payload weight capability had been used up mostly by the new rocket motors, with a little weight being used by additional payload systems. Each spacecraft would now carry x-ray, gamma ray, and neutron detectors, as well as the equipment to accumulate and store data which were to be transmitted later on ground command. Five launches were planned at three-month intervals beginning in April of 1963.

LASL froze the design of their part of the spacecraft in August, noting that within a few weeks initial negotiations would begin with the spacecraft contractor, to be selected in September. Both LASL and Sandia sent a representative to SSD in Los Angeles for a two-week period to serve as technical advisors in the selection of the contractor.

Plowshare, January-August 1961

The Vela Advisory Group meeting on January 5 and 6, 1961, briefly addressed the mutual usefulness of Vela Uniform and Plowshare detonations. They concluded that the Plowshare Gnome detonation scheduled for fall 1961 was of direct relevance to Vela Uniform and recommended that it be instrumented to the maximum extent feasible without interfering with the overall Vela program. Furthermore, they recommended that Vela Uniform detonations be made available for Plowshare experiments, provided such experiments didn't interfere in a major way with Vela.

A new Plowshare project, known as Wagon, was explained in a document entitled "Technical Director's Concept of Project Wagon (Danny Boy)," first published on January 14, 1961, and updated in March. The objectives of the test would be to learn more about the cratering capabilities of buried nuclear explosives, the characteristics of seismic shock and airblast, and the amount and distribution of radioactivity, among other things. The tentative plan was to detonate a 1-kt nuclear device in basalt 200 feet below the surface at the NTS. The area most nearly satisfying the criteria was the Buckboard site in Area 18, where Sandia had carried out high-explosive cratering tests the previous summer. Clifford M. Bacigalupi of Livermore would be the technical director. A flexible schedule was laid out which would allow the detonation to take place about six months after authorization to proceed.

The Livermore mid-year program letter of January 18 from Harold Brown noted the detrimental effect on the Plowshare Program of the political considerations that forbade nuclear detonations. However, it was also noted that Vela experiments such as Cowboy were contributing data for Plowshare. At this time, Gnome, the only firmly

projected nuclear Plowshare test, was planned for August of 1961, only seven months away.

On February 2, 1961, John J. McCloy sent the Commission a paper covering the issues of the nuclear test ban negotiations and requesting their considerations and comment. He recommended that the U.S. now indicate that it was prepared to drop the requirement that Plowshare tests be performed from a stockpile of devices placed under international surveillance before the treaty entered into force, but wherein the internals of the devices would not be subject to inspection. The requirement was to be replaced with a proposal for "disclosure of devices and their blueprints by the testing country and an agreed upper limit on the number of shots by a single party in an agreed period of time."

Some indication of future Plowshare activity was given by the Commission's FY 1962 budget discussions in the meeting of February 8, 1961. A proposed increase of $7.9 million would provide $4.9 million for site preparation and construction for Project Chariot in Alaska to meet a shot schedule in the spring of 1962, $3 million for site preparation and construction for developing and field testing nuclear explosives (Project Ditchdigger) in Nevada, and initial site preparation for an experiment intended to study very high pressure effects on chemical reactions. While it was emphasized that funding was dependent upon receiving Presidential approval for resuming nuclear detonations, the Department of State had expressed interest at a National Security Council meeting on January 18 in developing the canal construction possibilities of Plowshare. While this lent some impetus to carrying out Project Chariot, Commissioner Graham hesitated to move forward with Chariot without confirming its desirability with the Administration. Mr. Kelly of the Plowshare Advisory Committee noted that the Chariot tests could be carried out only in the spring because of weather and biological conditions, and if, after preparations, it were delayed from its spring of 1962 firing date, it should be held in readiness for later use. Commissioner Wilson suggested that the funds be included in the FY 1962 budget amendment, with a decision to be made later about the desirability of a 1962 firing date. Mr. Kelly, noting that the firing date for Gnome was not to be set until after site preparation, suggested that a similar path could be utilized for Chariot. Further discussion among the three Commission members (Wilson, Olson, and Graham, the acting chairman), which included the questions of safety and radioactive contamination, led to a decision to defer consideration of this budget request.

Two days later the Commissioners and Seaborg, Chairman-designate, met with the Plowshare Advisory Committee. Spofford English, chairman of the Committee, began with a discussion of the Ditchdigger project which the Committee strongly favored. Aside from its most obvious usefulness as an excavation tool, it would also produce a large amount of heavy nuclides such as californium. The development of this type of device was absolutely necessary, said English, to minimize problems of radioactive contamination from large-scale detonations and, moreover, could yield information in unknown areas of basic chemical and nuclear reactions. Further discussion of Ditchdigger addressed the problems of designating such tests as weapons development; research in chemical reactions under extreme pressures; and that information on fission fractionation and radioactive contamination which could be obtained from developmental experiments. The Committee recommended unanimously that Chariot should proceed to a spring 1962 test, expressing confidence that it could be conducted safely. This confidence was based on results from the Chariot bioenvironmental survey program and on estimates of the amount of radioactive products which would be released. The AEC General Manager, Alvin Luedecke, expressed the opinion that it would not be wise to commit FY 1961 funds until it was indicated that the program could proceed in FY 1962. In regard to the overall Plowshare program, Mr. Abelson of the Plowshare Advisory Committee reiterated the Committee conclusion that, in the

context of the AEC's total research effort, Plowshare held the greatest promise for dramatic breakthrough in areas now totally unknown. Mr. English stated that the Committee wished to see additional funds provided for measurements on Vela Uniform tests that would be useful to the Plowshare program and that would provide data not obtainable otherwise. He estimated that the required funding increment was approximately twice the budget for high-explosive experiments. Mr. Seaborg, however, noted that plans to do additional measurements on the Vela shots might lead to the suggestion that there was a U.S. effort to circumvent the weapons test moratorium, thus overshadowing the primary purpose of the seismic tests. Discussion of Project Gnome, scheduled for November 1961, addressed the possibility that the explosion would create surface fissures which would allow venting of radioactive material. To minimize this problem, the depth of burial could be increased (from 1,200 feet) or the yield could be decreased. It was decided that in order to stay within the budget, the yield should be reduced from 10 to 5 kt and it was agreed that a reduction would not appreciably affect the anticipated results.

In response to a State Department proposal that the U.S. unilaterally disclose Vela device designs to the Russians, the AEC staff pointed out to Mr. Adrian Fisher, McCloy's deputy, their reluctance to agree to that approach because of its possible adverse effect on the Plowshare program, an effect which could arise because the Plowshare devices might involve weapon concepts and device improvements (although specifically for Plowshare) that we would not wish to disclose to the Russians. Commissioner Wilson felt that revealing the Ditchdigger device design to the Russians would be a significant revelation of advanced design techniques to which he was opposed. He felt that Plowshare would fail if, in order to keep those designs from the Russians, the required tests were not conducted. He stressed that he could not agree to giving up the advantages of Plowshare in order to gain an illusory test cessation agreement with the U.S.S.R. Commissioner Graham, on the other hand, feeling that the Commission's past reluctance to alter its position on design disclosure had weakened its position in the public eyes, expressed concern over the Commission position that Plowshare was for peaceful purposes, but information and designs were being withheld for national defense reasons. He further suggested that the Commission consider open demonstrations. After more discussion, and in spite of the opinion of one or two of the Commissioners, the AEC staff remained convinced that, whereas revealing device design and allowing internal inspection was acceptable for seismic research (in particular, the Mark XI), that procedure was not acceptable for the Plowshare devices. Discussion seemed to indicate this position would not change until Congressional attitude on the subject was clear.

On February 16 the new President, John Kennedy, met with the AEC Commissioners at Germantown. During the meeting the subject of Plowshare came up, and the minutes of that meeting include the following:

> **The Plowshare program for the use of nuclear detonations for peaceful purposes was a program of great interest to the Commission, Mr. Seaborg said, and one which at the moment is making little progress. Mr. Wiesner remarked it is clear that the use of nuclear detonations for peaceful purposes offered great possibilities and test cessation should not preclude the many benefits such a program could bring to the world. The problems here are, of course, how to use nuclear devices for these purposes and still disprove any accusations that they were being used for weapons development purposes, a difficulty posed by the fact that advanced weapons, which cannot be shown, will be used. He thought this subject was a matter of such importance that it would be useful to set up a (special) briefing for the President on the Plowshare program.**

Nevertheless, when the Geneva talks resumed on March 21, Ambassador Dean announced that the U.S. was now willing to accept the same safeguards for both Plowshare and seismic explosions, meaning that U.S. nuclear devices to be used would be

open to Soviet inspection and that we would require the same of any devices they intended to use for nuclear experiments. Dean acknowledged to the conference that this would limit the U.S. Plowshare program to use of obsolete devices. He outlined some of the objectives of the Plowshare program as follows:

a. Developing techniques for major earth-moving enterprises, such as the construction of harbors or canals;
b. Using peaceful detonations to break up rock, regulate the underground flow of water, and to make it possible to recover petroleum from shale deposits in the United States and tar sands in Canada; and
c. Exploring the possibility of producing heat and power economically and of producing isotopes and chemical reactions for use in many peaceful pursuits.

On the other hand, he said, we did not agree to the one-for-one stipulation of the Russians' February 1959 counterproposal on peaceful detonations, requesting them to withdraw this demand so that either side could carry out a Plowshare-type program and not suffer a veto because the other side simply refused to do any tests of their own.

On May 17, 1961, Livermore published the "Technical Director's Operations Plan, Continuing Chemical Explosive Experiment at NTS," also known as Project Rowboat. In this project, a series of multiple, simultaneous, high-explosive detonations, were to be carried out in June 1961 in Area 10 at the NTS, on the western edge of the Stagecoach area. Area 10 was chosen because of the similarity in geology to sites which had been used earlier for gathering data on seismic signals and cratering characteristics. The project, carried out under the technical direction of Livermore (Clifford Bacigalupi), included eight different tests, each consisting of several (three to six) simultaneous high-explosive detonations buried from 12 to 18 feet deep.

On May 31 the Commission discussed revisions to the Plowshare program resulting from the new Geneva policy on safeguards and device design disclosure. General Betts noted that there was no obsolete device of the proper yield for the Chariot experiment. When it was proposed that the feasibility of redesigning the experiment be investigated, Commissioner Wilson suggested that this be delayed for a month or two in case the Geneva talks reached a point or a conclusion that would make such a redesign unnecessary. After discussions covering public information policy, budget distribution, and program revision, the Commission approved a revised program which included implementation of a broader and more informative public information policy; continuation of R&D at a slightly reduced level; and reorientation of the projects so as to prepare Gnome for firing in FY 62, to defer further work on Ditchdigger and Limestone, and to support, at reduced levels, the Chariot bioenvironmental survey work and the Wagon preparations.

The next meeting of the Plowshare Advisory Committee was held at Los Alamos on June 7 and 8. The committee was not surprised that the current budget requests were still not being fulfilled, but felt that several factors, especially the international situation, made it prudent to have substantial plans on hand for specific projects which could be prosecuted rapidly "as soon as the situation is clarified." Moreover, the Committee pointed out that substantial funds would be needed immediately if the international situation were to allow pursuit of the Plowshare projects. Specifically, if further device development became possible, the Committee would recommend that such work receive first priority and funds be provided immediately to pursue this avenue so as to attain the least possible radioactive contamination from detonations. Noting the unfortunate fact that much of what had been accomplished was classified, they suggested the classification rules be modified to permit some public understanding of these device possibilities. In addition to the clean device concept for Ditchdigger they also encouraged research directed to this end by other means. They expressed their desire to make use of these developments on Project Chariot.

Other items in Chariot discussions included the preliminary conclusion by Livermore that a scaled-down experiment which could be done with a "disclosable" device was less desirable than waiting for Chariot to be done properly. The special subcommittee on Project Chariot made their interim report and concluded that more information, analyses, and studies were required regarding the bioenvironmental and safety aspects of the project. Among the other subjects discussed by the Committee were Project Gnome (the Committee urged that the experiment be carried out on schedule), Project Wagon, nuclear explosions for various kinds of scientific research, and the AEC's recently adopted public information policy (which the Committee endorsed and urged be implemented immediately).

In June and July 1961 there was discussion of alternatives to continuing the moratorium. An announcement of U.S. test resumption underground could be made in various ways. The Geneva delegation warned that any ban on atmospheric testing must be carefully worded to protect our intent and potential needs for Plowshare cratering shots.

The AEC's preparations for the Gnome event near Carlsbad, New Mexico, became publicly known in July when a couple of newspaper articles and exchanges with the AEC brought out the fact that this test, "for purely peaceful scientific research," had progressed to the stage where it could, if authority were given, be performed in December 1961. Project Gnome, which was actually carried out on December 10, after test resumption, will be discussed in greater detail in Chapter III.

Additional bioenvironmental studies for Project Chariot had been carried out during 1961, but the earliest date being considered for that test was the spring of 1963. A project named Coach was also being planned at Livermore. Coach, using a several kiloton nuclear explosive especially designed to produce a high neutron flux, was intended to study the possibility of the production of neutron-rich isotopes of known trans-plutonic elements and of elements heavier than those yet discovered. Reuse of the Gnome site was being considered for Coach.

In an effort to gather Plowshare-related data from nuclear tests performed in the past, soils (and where possible, plants and animals) from the environs of Teapot Ess in 1955, Buster-Jangle in 1951, Rainier in 1957, and Blanca and Logan in 1958 were studied.

Plowshare-type activities were put under a new division in AEC headquarters--the Division of Peaceful Nuclear Explosives (DPNE)--during 1961.

Deep Space, January-August 1961

DASA's request for authorization to proceed with the Advanced System for Weapons Test (ASWT) was stalled by Herbert York (DDR&E) on February 22, 1961, pending further policy guidance expected within the next six weeks. York also deferred a decision on whether the operation should be planned for a remote site or the Atlantic Missile Range, noting that the Assistant Director for Ranges and Space Group Support had indicated no overriding technical reasons for not performing the ASWT tests from AMR. However, York noted that the decision would ultimately have to be made at a national level.

At the meeting of the AEC General Advisory Committee toward the end of April it was recommended that plans be made for exoatmospheric tests. In the subsequent AEC discussions on a capability for such testing, Betts reminded Luedecke that the AEC had participated with the Air Force in a joint feasibility study and proposal, published on August 29, 1960, (Advanced System for Weapons Test) which described a plan for outer space testing with a lead time of 18 to 24 months, and that he didn't plan, for the time being, to initiate any more studies.

A May 12 letter from Sandia to General Betts forwarded a Sandia report, No. SC-4575 (WD), entitled, "A System for Weapons Development Tests in Space."

On June 22 the Chief of DASA sent to the Joint Chiefs of Staff a "review of nuclear test plans" which had a number of sections on DOD needs for various types of weapons effects tests in various environments. That review showed that two years would be required to develop a space testing capability and perhaps additional time would be needed to develop instrumentation for obtaining worthwhile effects data.

In providing the details of outer space test readiness to the Commission on June 27, General Betts gave a brief background of the earlier studies for outer space test capability which led to the ASWT report in 1960. He stated that the first test would be for calibration, and would use Ex.(b)(3) [redacted] The first tests would utilize diagnostic capsules and measure yield (by x-rays) and time interval. The cost for a five-launch program would be about $40 million if a U.S. launch site were used or about $100 million if overseas launch facilities had to be built. The latter method would require about two years before first launch, whereas utilizing an existing U.S. launch site might allow a test within about 18 months.

On June 30 DASA sent a copy of the ASWT study to the DOD Office of International Security Affairs to be forwarded to the Disarmament Administration (USDA) for study.

Following their meeting at Los Alamos on July 13 through 15, 1961, the General Advisory Committee summarized their comments and recommendations in a July 19 letter to Chairman Seaborg. Feeling that "preparations for resumption of nuclear testing are seriously inadequate," the Committee recommended various activities to increase AEC readiness, including preparation of plans and equipment for outer space nuclear tests on an urgent time scale. "Nonnuclear tests of such facilities could be undertaken even during the moratorium."

On August 7 Colonel Anderson of the DMA test office sent a memo to Chairman Seaborg which included estimated costs per test for various types of test methods. For the outer space method it was estimated that with the ASWT system the first test would cost about $100 million and each shot thereafter would be $10 to $15 million.

On the same day General Betts sent a message to Los Alamos and Livermore asking them to look at the use of outer space testing for various weapons test requirements and, assuming that underground testing would also be permitted, to address the advantages and disadvantages of the two methods. In the replies from Foster on August 24 and Bradbury on August 30, both stressed the high cost and tremendous effort involved in developing such a capability. The safety problems to be overcome were emphasized and the advantages (high-yield testing and measurement of certain types of effects which were not possible underground) were also stated. However, the flavor was certainly that neither laboratory would recommend developing the capability at that time, but Bradbury did point to the engineering studies that had been done in the past by Sandia on such a method. In discussions within LASL, Harold Agnew told the Weapons Working Group on August 8 that J-Division had advised Sandia to base their outer space testing proposal Ex.(b)(3) [redacted] In discussions within J-Division, Ogle suggested to Graves that the large potential safety problems with exo-atmospheric testing were such that deep space test planning (with the exception of the delivery system) should not be pursued by LASL until the proper effort could be put into it.

Domestic and International Political Developments, January-August 1961

The year 1961 opened with numerous changes in the key personnel filling high-

level government positions. Ambassador Arthur H. Dean, Kennedy's newly appointed chief of the U.S. delegation at the Geneva test ban talks, later recalled in his book, *Test Ban and Disarmament*, that the test ban talks were in recess while the status quo was being fully analyzed in the the early days of the Kennedy administration (which began on January 20, 1961) and a comprehensive "new" approach at Geneva was being formulated.

> By the end of 1960 it was hard to know how to draw the balance (of basis for hope or despair in the test ban talks). On the other hand, agreement had been reached on a preamble, 17 articles and 2 annexes of a draft treaty for a comprehensive test ban, including 1 article which recognised the principle of international inspection. On the other hand, the diplomatic atmosphere had deteriorated markedly since the collapse of the summit conference in May 1960 after the U-2 incident.

President Kennedy solicited the full spectrum of scientific and political opinions and "ultimately decided, in part on the basis of the report in February-March 1961 of a special committee under Dr. Fisk, and after a favorable recommendation by the National Security Council, that it would be to our national advantage to work for a comprehensive test ban treaty."* Kennedy, in his first State of the Union message on January 29, requested a "reasonable delay" in the Geneva talks, stating that we intended "to resume negotiations prepared to reach a final agreement." The rethinking of our Geneva position and hard looks at the potential weapons status and development potential for both the U.S. and U.S.S.R., in or out of a test moratorium, were evident early in the administration.

In late January, the "disarmament study group," chaired by Dr. James Fisk and reporting to Mr. John J. McCloy, the President's new disarmament advisor, undertook a study on the potential weapon developments possible in both the U.S. and U.S.S.R. under various hypothetical testing scenarios. The context of this study was intended to update the "McRae Report on Weapons Testing."

During late January and February a series of discussions on the Soviet weapon program, facilities, and test capabilities took place between the weapons laboratories, Ex.(b)(1) and the AEC. Starbird noted at the January 28 Commission meeting that the Fisk panel was addressing five major problem areas as follows:

a. The capabilities of the present Geneva system to monitor a nuclear test agreement.
b. The estimated capabilities of a revised Geneva System, after extensive research and development, including Project Vela.
c. The probable gains to the United States from conducting various types of nuclear tests.
d. The probable gains to the U.S.S.R. from conducting various types of nuclear tests.
e. A comparison of the relative gains to each side in terms of improved weapons systems.

The Commission was anxious to be informed of deliberations of subgroups in which Starbird, Carson Mark, Harold Brown and others were participating, in order to be prepared for upcoming discussions with the Joint Committee on Atomic Energy. However, reports of those deliberations indicated vastly differing opinions on the various questions with no predictions of what conclusions would result.

In early February 1961 McCloy informed the commission of the major issues still open at Geneva and presented strawman recommendations as to what positions the U.S. might take on such issues as safeguards for seismic research and Plowshare detonations, composition of the control commission, and on-site inspection quotas for their

*Arthur H. Dean, *Test Ban and Disarmament: The Path of Negotiation*, New York and London: Harper & Row, 1966, pages 6, 87, 88.

use in formulating instructions to the Geneva delegation before resumption of talks on March 21. At the March 1 Commission meeting General Betts reviewed that part of the Fisk panel's report dealing with the capabilities of the AFTAC detection system, the capabilities of the Geneva system proposed by the U.S., estimated improvements of the Geneva system, the present status of nuclear weapons technology, potential future weapons developments in the U.S., U.K. and U.S.S.R., and the cost necessary to evade the proposed Geneva system.

> General Betts said members of the panel generally agreed that underground and high-altitude testing could be conducted without detection if adequate steps were taken to conceal it. He stated the cost would vary with the steps taken to avoid detection of underground tests. He stated there was little agreement among the members of the panel on the cost of the clandestine high-altitude testing, even though the panel noted the U.S.S.R. possessed rocket systems with a high thrust potential suitable for testing at high altitudes in the megaton range.

There was wide disagreement over what further weapons development might be possible by various types of testing.

Dr. Jerome Wiesner, the President's new science advisor, had participated in former Commissioner Murray's campaign exchange with the Presidential candidates the previous fall. In earlier newspaper articles he had criticized the technical preparation by the American delegations to various conferences, including the test ban talks, and opined that the U.S. "has generaly been ultraconservative in the inspection requirements it places upon any system." He seemed to feel that inspection systems of a wide variety would be possible and that a monitoring system could be developed that would be deemed adequate to monitor any degree of disarmament, "though its acceptability is by no means certain." He had also been recently quoted as stating, "I know of no reason for resuming testing immediately. My own view is that the U.S. cannot let any single thing hinder the negotiations." Thus, his statements and positions gave the overall feeling that the U.S. had not been earnest in exploring any and all avenues toward arms control, disarmament, inspection, and related issues.

After three months of behind-the-scenes discussion, Ambassador Dean opened the Geneva talks by stating a U.S. position which was new on several items. Among other things the U.S. offered to reduce the number of detection control posts in each country (e.g., from 21 to 19 in Russia), to accept an 11-state treaty control commission with East-West parity (four western, four Soviet bloc, and three neutrals), to allow Soviet inspection (with Congressional/AEC concurrence) of U.S. nuclear devices to be used in the Vela Uniform and Plowshare programs, and to agree on a total high-altitude test ban and the necessary technical equipment for control.

Ambassador Tsarapkin of the Soviet Union, in turn, stated a new U.S.S.R. position by withdrawing agreement for a single administrator (of the control commission) and proposing a three-man executive (one Soviet, one West, and one neutral). This plan, to become known as the Troika, coupled with the Soviet demands for unanimity on major control commission action, was tantamount to a Soviet veto on such things as on-site inspections. Tsarapkin also raised the question of French nuclear tests for the first time in the Geneva negotiations, accusing the U.S. and U.K. of prolonging the talks in order to give their NATO ally time to conduct these tests, and implying that France might be testing for the U.S. and U.K.

The impact of the exchange in Geneva after the long recess was expressed in Ambassador Dean's own words, who said that the Soviets had:

> . . . set back our hopes by introducing . . . a "Troika" proposal that would have stultified the operation of the proposed international control organ. Since a similar arrangement had already been discussed by the U.S. and U.K. in 1958 and rejected, and since even the Soviet Union had assented to an alternative approach, the Soviet reversion to an abandoned position did not make for immediate optimism.

Dean labeled the "Troika" proposal as unacceptable on March 30 in Geneva, and President Kennedy publicly stated his discouragement over this Soviet proposal in a news conference on April 21. Expectations of rapid action toward a treaty under the new administration were short-lived because of the harder, uncompromising Soviet position.

Nevertheless, the U.S. and the U.K. tabled a new "comprehensive" treaty on April 18 calling for the following conditions:

a. Ban on tests everywhere except underground tests producing seismic signals less than magnitude 4.75.
b. Voluntary three-year moratorium (renewable annually thereafter) on underground tests below magnitude 4.75 pending perfection of techniques for detecting small underground tests.
c. Up to 20 on-site inspections annually in the territory of each of the three powers. Inspection teams would not include nationals of the country inspected, except as observers.
d. Direction of the treaty control commission by a single administrator acceptable to all three powers.

The next day Ambassador Tsarapkin rejected the Western treaty proposal, reiterating the Soviet "politically determined" limit of three on-site inspections annually and the demand for Russian representation on any team inspecting the U.S.S.R. The Russians cited the recent actions of U.N. Secretary-General Dag Hammarskjold in the Congo as the basis for their demand of a Troika administrative council rather than a single administrator.

While the above mentioned action was going on in Geneva, back home the U.S. Disarmament Administration set up the "Consultative Group on Nuclear Armaments" chaired by Harvey Brooks of the USDA, to discuss steps that could be taken toward a disarmament agreement with Russia, a subject that was related to the test ban talks. Members included, among others, Norris Bradbury and John Foster. A letter from Bradbury to Brooks on April 28 contains these interesting comments:

> 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 steps toward disarmament (e.g., stopping production of fissionable material for weapons) might seem to them worth more real effort.

Bradbury felt that such steps would not create an unacceptable national security risk.

The Brooks panel had asked a group known as the Perkins panel to work out the details of the U.S. position along with formulation of the advantages and disadvantages of various positions. The panel did agree on certain recommendations, e.g., cutting off the production of fissionable materials for weapons use, but it warned against tying any of the conditions too closely to the existing unmonitored test ban. Specifically,

> The U.S. should push vigorously for a resolution of the present test ban negotiations in order to retain its freedom of action in regard to testing in the absence of a satisfactory agreement on an adequate control system . . . the West should be prepared to exploit fully the political initiative it has acquired in world opinion through the change in the Soviet position on the control administration. Two of the key issues unresolved . . .are an adequate control system . . .and an impartial administration for the international control organisation. A solution to these issues must be in sight before there can be hope for meaningful progress in any of the disarmament measures known to us. . . . The U.S. should be prepared to initiate unilateral underground nuclear tests for purposes of seismic improvement on short notice . . . the U.S. should be prepared to initiate a well-planned series of underground weapons tests . . . the panel urges a reexamination of our present preparations for resumption of testing . . .

After the Soviet's words in March about French testing, the French performed their fourth (and last for some time) atmospheric test in the Sahara on April 25. Ambassador Tsarapkin then stated that further French testing would make agreement on test cessation impossible and that continuance of French tests "places the Soviet Union in a situation which may compel it to resume" nuclear tests.

Back in Geneva April 28 was a milestone in that it was the 300th meeting since the beginning in late 1958, and the statements of the two sides were particularly telling. Dean was quite pessimistic and talked of a future of innumerable meetings, saying: "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 responded, stating that the U.S. and U.K. statements had given "the death knell of our conference." He made it clear that the Soviets were not going to back down from their "Troika" proposal and claimed that the West wanted to wreck the negotiations and shift the blame to the other side. Several days later, on May 5, Kennedy made another public statement citing the "Troika" proposal as unacceptable.

On May 16 John McCloy sent to Chairman Seaborg a communication entitled "Memorandum on Future United States Policy Regarding Negotiations With the Soviets on the Test Ban." McCloy's paper, which he proposed be discussed at the meeting of the Principals on May 22, included:

> It now appears clear that the intent of the Soviet negotiators at Geneva is to avoid a prompt conclusion on test ban agreement. . . . According to Ambassador Dean, the indications are that the Soviet Union will not take the responsibility of breaking off negotiations, but will drag them along to a time when they might be merged into the comprehensive disarmament negotiations now set for July 31, 1961. Ambassador Dean's estimate is that the Soviets are trying to put the U.S. in a position in which it goes into the July 31 talks with the present uncontrolled moratorium still in effect, a position which would make it increasingly difficult for the United States to exercise its freedom of action with respect to the resumption of testing. This difficulty might be intensified by the agreement to begin discussion with the U.S.S.R. sometime in mid-June concerning the conduct of these negotiations.

After going into possible Soviet motivations for their position and suggesting ways to resolve some of the problems, the paper continued:

> . . .decision should be made now so that a course of action can be planned before the scheduled resumption of the comprehensive disarmament negotiations on July 31, 1961, and the beginning of discussions with the U.S.S.R. in mid-June. Two questions must be decided: Should the U.S., sometime in June or July of 1961, indicate that it is preparing to resume nuclear tests? Should the U.S. actually detonate a nuclear device prior to July 31, 1961, and if so, what sort of nuclear device should be detonated?

Further discussion addressed the type of detonation and the arguments for and against test resumption.

On May 29 the U.S. and U.K. did make a significant compromise by changing their position on annual inspection quotas from 20 down to 12, that quota to be achieved at a ratio of one inspection for every five eligible seismic events. The Russians rejected this "sliding scale" proposal on May 31, saying that an acceptable number would have to be determined politically, not technically.

The Vienna summit talks between Kennedy and Khrushchev, requested by Kennedy in February, took place on June 3 and 4. One of the topics of discussion was the almost hopeless test ban question. The results matched the expectations. Kennedy told Khrushchev that the U.S. Senate would never approve a test ban treaty with a Soviet veto such as the Troika provided. Khrushchev answered that the Soviets would only drop the Troika proposal if the test ban matter would now be included under talks for

complete disarmament. Khrushchev had argued in Geneva that the Soviets couldn't accept controls which they considered equivalent to espionage. "Kennedy suggested that if the controls turned out really to threaten Soviet security, the Soviet Union retained the right to abrogate the treaty." Kennedy also informed Khrushchev that combining the test ban with disarmament discussions would cause the uninspected moratorium to continue for several more years and noted that the American people were already concerned over the protracted uninspected moratorium on testing. Kennedy's public statement after the summit, on June 6, was that hopes for an end to nuclear testing had "been struck a serious blow."

The Soviets made their Vienna memorandum more firm on June 12 by presenting the conditions at Geneva. In essence they issued an ultimatum to the West that either the Troika and three inspection quota proposals be accepted or the test ban issue be merged with general disarmament discussions. Ambassador Dean immediately rejected the Soviet proposals as an attempt to "dictate" to the conference.

The U.S. formally warned the Russians on June 17, in an aide-memoire, that the security of the free world did not permit an indefinite continuation of the U.S. test suspension "without the certainty that the Soviet Union had likewise stopped its testing." The U.S. said that combining test ban with disarmament talks was unacceptable and called on the Soviets to reach, with the West, an effective test ban without delay.

On June 20 Ambassador Dean was recalled to Washington and replaced by his deputy, Charles Stelle, as an expression of the U.S. belief that the talks were hopelessly deadlocked.

The Soviets answered the June 17 U.S. aide-memoire in early July, again stating that a way out of the deadlock should be sought by joining this issue with complete disarmament. The Americans formally replied on July 15 with no change in their positions, almost pleading with the Soviets to change their stand and allow the talks to move on towards a treaty with effective controls. On the same day the U.S. and U.K. jointly placed an item on the agenda for the coming 16th General Assembly of the U.N. (scheduled to convene in September) entitled "The Urgent Need for a Treaty to Ban Nuclear Weapons Tests Under Effective International Control."

The administration had been under pressure from various quarters right from the inauguration to break the deadlock at Geneva.

As early as February, the Joint Chiefs of Staff had urged the President to resume testing if agreement were not reached within 60 days of negotiations. The Joint Chiefs favored atmospheric testing. The Department of Defense, though, would have limited the resumption to underground testing. There were also pressures from Congress, especially from the JCAE, from the press, and from public opinion. A Gallup poll in July 1961 showed more than 2 to 1 public support for the United States unilaterally resuming testing.*

On June 14 the Chairman of the JCAE, Representative Chet Holifield, appealed to the President to announce "within a few weeks" U.S. plans to resume testing and concurrently continue the Geneva talks. Holifield noted a suggestion that had been more and more frequently heard since 1960, namely, that the Russians might be conducting secret tests.

On June 12 the Commissioners heard a special briefing on the Geneva talks by Wilmot Hess, who had been in attendance there for eight weeks. It was Hess's opinion that if the U.S. was going to resume testing, the testing should begin before the

*A. Schlesinger, *A Thousand Days*, page 370.

commencement of the disarmament negotiations on July 31. Chairman Seaborg stated that it would be extremely difficult to prepare for nuclear tests prior to August 1. Hess also reported some observations from Vincent Baker, a member of the U.S. Geneva delegation, who had gone to Geneva as an advisor during the summit meetings. Part of Baker's report had been on conversations at Geneva between Secretary of State Rusk and Soviet Foreign Minister Gromyko.

> Mr. Gromyko admitted the "Troika" principle did imply a veto power. When Mr. Gromyko asked Mr. Rusk if he thought the Russians were conducting nuclear testing, Mr. Rusk said this was difficult to know and that a negative proposition was always difficult to prove. Mr. Gromyko said the Soviets are convinced the Americans do not believe the Russians are testing nuclear weapons.

In recalling the visit of Representative Holifield and Senator Hickenlooper of the JCAE to Geneva (May 24 and 29, 1961), Hess stated that:

> Ex.(b)(1) [redacted]

Hess also commented on a telegram which the Geneva delegation had received from the State Department, which included a draft of a letter from Mr. McCloy to the President, containing the following points for the delegation's comments:

> (1) The U.S. should resume nuclear testing because of the current unenforced moratorium; (2) the decision to resume testing should be preceded by a specific announcement a short time before the first test; (3) a general statement should be made by the U.S., possibly in concert with the U.K. and France, opposing atmospheric tests; (4) Mr. Arthur Dean should be recalled from the conference after a reasonable period of time, to emphasize the U.S. intention to place the conference on a lower priority basis; (5) the test ban conference should be merged with the general disarmament conference to begin in August; and (6) the U.S. should publish a statement at the time of test resumption that any nuclear test conducted by the U. S. would not result in a world health hazard.

In this atmosphere of heightened possibility of test resumption, the Committee of Principals met on June 16. At that meeting AEC Chairman Seaborg agreed to collaborate with Secretary of Defense McNamara to prepare a paper on weapons testing. The detailed planning and preparations requested by the AEC to prepare for testing, discussed by the Commmission on June 20 and also discussed at the meeting of the Joint Committee on Atomic Energy the next day, were based on a different basic assumption than that of the DOD's parallel efforts. That is, the AEC was assuming the President would announce that preparations for underground testing were under way, whereas the DOD was assuming that no announcement would be made and that the preparations would be done in the present climate.

Another expression of the pressures on President Kennedy appears in Theodore Sorensen's book, *Kennedy*:*

> Ever since he had taken office, Kennedy had been pressured to authorize a resumption of U.S. testing. Renewed American testing, according to the military and the Teller wing of the scientific community, was indispensable to

*Theodore C. Sorensen, *Kennedy*, Harper & Row, New York, 1965, pages 617 ff.

> the development of new nuclear weapons. It would provide a necessary hedge against the possibility that the Soviets were secretly testing underground. The Joint Chiefs urged him in February to resume testing if no agreement could be reached after 60 days of negotiations. . . . They were for atmospheric testing; the Defense Department was for underground testing; the State Department was for putting off a decision; and a variety of nuclear scientists said that no agreement was in sight, the moratorium had dangerously slowed our technical progress and the U.S. should test while continuing to talk. Similar pressures came from various parts of the Congress and press. Dr. Teller maintained publicly that the Soviets had been testing underground steadily since the moratorium began. . .

At the end of July, Khrushchev told McCloy that he was under strong pressure to test, especially from his scientists, and that the Berlin crisis had increased the pressure. He had been successful thus far, he said, in holding off the decision, but the more the U.S. intensified its threats of war, the more arguments it gave those in the Soviet Union who wanted to resume. His scientists favored a 100-megaton bomb as the most economical and, though they already had the rockets to lift it, the bomb itself needed to be tested. He had cheered his scientists, he said, by telling them that the U.S. would resume testing and thus release them to try out their own bomb.*

The September 1961 issue of the *Bulletin of Atomic Scientists* cited related statements made during the summer as follows:

- President Kennedy--Unless the Soviet Union becomes more cooperative, the U.S. "will probably have to begin testing--not right away, but sometime in the future."
- Seaborg---There is not convincing evidence that the Russians have been testing, and most American scientists think it unlikely.
- Hubert H. Humphrey-- The U.S. should not resume testing immediately: "The Soviet Union wishes to drive us into nuclear testing so that she may freely test."
- Henry M. Jackson, Chairman of the Military Applications Subcommittee of the Joint Committee on Atomic Energy--"we are running the serious risk of being outstripped in weapons technology tests. The possibility----- calls for immediate action for resumption of testing."

Another opinion was:

- Commissioner Robert Wilson (7/5/61) to Seaborg--The matter of overriding importance to the nation's safety----is the resumption at the earliest possible moment of underground weapons testing.

The President addressed the problem by appointing a special scientific panel tasked to review the problem of detecting and identifying nuclear explosions as well as to address the question of what we knew and whether we could know if the Soviets had been conducting clandestine tests. The panel, announced by Kennedy on June 28, 1961, was chaired by Prof. Panofsky and known as the "Nuclear Test" or "Panofsky" Panel. The members of the Committee, other than Panofsky, included Bethe, Bradbury, Fisk, and Foster. On July 14 Hans Bethe circulated a draft report which included:

> The general conclusion reached by the Panel is that none of the specific weapons tests are of such urgency from the technical and military point of view that a delay in reaching a formal decision would be critical. The panel also believes that the Soviets may be under considerable pressure to resume nuclear testing in order to develop a mobile strategic deterrent. On the other hand, the Panel feels that in the absence of adequate progress toward a satisfactory treaty, it would be undesirable to let those parts of modern weapons technology dependent on testing stagnate while all other fields of military development proceed unhampered. Specifically, the Panel believes

*A. Schlesinger, *A Thousand Days*, pages 452 ff.

> that it would be technically unwise to permit the moratorium to proceed indefinitely even for an additional period comparable to that already lapsed. As an overall conclusion, the Panel believes that political rather than technical considerations should determine decisions concerning the resumption of nuclear tests in the near future.

Norris Bradbury and Carson Mark wrote separately on the subject to Presidental advisor Wiesner on July 17. Neither believed that the Russians had been secretly testing and Mark felt that if they had, the rather low yields attainable could not have permitted important changes in strategic capabilities. Neither felt that there was a strong military urgency to resume weapons testing. They still did not see any great potential advances if tests were resumed; perhaps a factor of two increase in yield per pound of higher-yield weapons and some increase in efficiency for smaller weapons. Neither saw the development of a neutron bomb as likely. They saw substantial gains possible by high-altitude effects and vulnerability tests, but neither felt that there was overriding importance to early testing in these areas since the other side was equally limited by their ignorance.

On July 28 the Secretary of Defense sent to Mr. McCloy a recommendation that the Committee of Principals propose to the President that the U.S. initiate weapons test preparation.

On August 9 the Russians restated their unchanging position in a note to the U.S. which said in part:

> It is evident that the efforts of the U.S. are aimed mainly at actually legalizing the holding of tests in any agreement, if such was signed, and creating an International Control Agency which would be a pliant tool in the hands of the Western powers and would be used by their general staff to collect required intelligence.

They further stated that the Western position made it impossible for the Soviets to sign an agreement and that the West would have to bear responsibility for that.

The Panofsky Panel on Nuclear Testing met with both President Kennedy and the National Security Council early in August 1961 to report the results of their deliberations. Among their conclusions were:

> It was feasible for the Soviet Union to have conducted secret tests, that there was no evidence that it had done so (or had not done so), and that there was no urgent technical need for immediate resumption by the United States. Oddly enough, the Livermore scientists, who a year earlier had discoursed most eloquently on the ease and convenience for the Soviet Union of testing in secret cavities underground, were now most insistent in proclaiming the inadequacy of underground testing for the U.S. and demanding that we go into the atmosphere as soon as possible. Foster argued vigorously to the President that immediate resumption was necessary in order to develop the neutron bomb. . . .The President remarked that he had understood that atmospheric testing was not indicated for the neutron bomb for at least another 18 months.*

President Kennedy was not convinced of the advantages to be gained by unilaterally resuming testing. He posed the hypothetical situation that the Soviets were not clandestinely testing, and that the U.S. resuming testing underground would result in the Soviets resuming testing in the atmosphere. He asked each Panel member if he would favor unilateral underground test resumption under the hypothetical situation. Panofsky answered no, Foster answered yes, and Bradbury answered no, adding that the Soviets could overtake us if they tested in the atmosphere while we restricted

*A. Schlesinger, *A Thousand Days*.

ourselves to underground testing. Following this exchange, McCloy noted the coming meeting of the U.N. General Assembly, feeling that the decision on test resumption could be postponed to the first of the year without impairing national security. Schlesinger* wrote:

> I came away with the feeling that, while there was no irresistible short-run case for resumption, everyone regarded a return at least to underground testing as inevitable in the long run if the Russians continued to reject the treaty. Kennedy wrote Macmillan early in August that he was still reviewing the evidence, but was not very hopeful that it would be possible to wait much beyond the first of the year. If we did resume, it would be underground, unless and until the Soviets resumed atmospheric tests.

Kennedy mentioned to Macmillan the idea of trying once again for a limited test ban agreement. Ambassador Dean resisted any retreat from pushing for a comprehensive treaty and:

> When the matter was brought to the President, he readily came up with a compromise--that Dean should fight for the whole treaty in Geneva, but, if nothing happened, we would come out for the limited ban later. In mid-August the President concluded that when Dean returned from Geneva and DOD had completed its review of weapon requirements, the AEC might announce contingency preparations for underground testing, though this would not mean that we had actually decided to resume tests.

The Warsaw Pact nations met in Moscow on August 13 and 14 and accused NATO of using Berlin as an espionage center. Furthermore, they proposed that East Germany "establish such an order on the borders of West Berlin which would securely block the way for subversive activities against the socialist camp countries" until a German Peace Treaty was concluded. Acting on this statement, East Germany then closed 68 of 80 crossing points along the intracity border to traffic from east to west and moved tanks to the borders to enforce the closures. Calling the incident a threat to world peace, the United States, the United Kingdom, and France, on August 17, condemned the closing of the Berlin border and called on the Russians to end the harassment. On August 18 President Kennedy ordered reinforcements for the U.S. garrison in West Berlin.

Theodore Sorensen's view of what happened during August is that:

> Finally, early in August, despite a new recommendation from Maxwell Taylor and the Chiefs that testing be resumed immediately, he (the President) decided to order preparations for underground tests but not actually to resume them until it was absolutely clear--not only to him, but to the world--that he had done everything possible to obtain a treaty, that the Soviets had not bargained in good faith or really wanted such a treaty, and that the security of the free world required this country to test.

In a further effort to break the deadlock in Geneva, President Kennedy made one last attempt at negotiations by having the chief negotiator, Ambassador Dean, return to the talks at the end of August to present another U.S. proposal. On August 28, Ambassador Dean offered two possible new treaty proposals, the first of which was a slight modification of the April 18 version. The second proposal was more far-reaching in that it offered not a threshold but a comprehensive test ban under which it might be possible to reduce or even eliminate the threshold immediately upon signing the treaty. In order to reach these latter positions, it would be necessary to reexamine the technical aspects, and such a step might be possible by increasing the number of control posts or the number of on-site inspections, as well as by

*A. Schlesinger, *A Thousand Days*, page 459.

making other technical improvements in the control system. The Soviets gave an immediate response that was totally unyielding, stating that a test ban agreement might have played a useful role as a first step toward disarmament sometime in the past 2 1/2 to 3 years, but that now the Soviet Union could only regard control measures as a screen for Western intelligence operations, and that now the test ban question could be solved "only in conjunction with that of disarmament." The next day, in Russia, an announcement was made that in light of growing international tensions and the Western military threat, Russia had decided to extend the service of certain of their soldiers who had been due for release from active duty.

On August 28 the Soviets broadcast an aircraft warning to stay out of a designated area over Siberia, an indication that they were preparing for atmospheric testing. Their actual announcement came on August 30 in a radio broadcast. The Soviet government denounced the Western arms and military buildup, saying that the West was "resorting to threats . . .to unleash war as a countermeasure to the conclusion of a peace treaty (Soviet) with the German Democratic Republic." Thus, the Soviets had:

> Made a decision to carry out experimental explosions of nuclear weapons. . . . It is an open secret that the U.S. is standing at the threshold of carrying out underground nuclear explosions and only waits for the first suitable pretext to start.

Further, the announcement noted that France had "conducted explosions of nuclear devices one after another," while the Soviet Union had refrained and that this would have put the U.S.S.R.:

> . . .in an unequal position as compared with the U.S., Britain, France, and other countries which are their partners in one military bloc.

The announcement also referred to the Soviet's arsenal of device-carrying rockets and designs for superpowerful (as great as 100 megatons) bombs.

When handed the information from the Russian test resumption announcement, Kennedy's

> . . . first reaction is unprintable. It was one of personal anger at the Soviets for deceiving him and at himself for believing them, for their tests had obviously been under secret preparation even before Geneva and throughout the Geneva negotiations. His second reaction was one of deep disappointment--deeper, I believe, than that caused by other Soviet action during his tenure.*

The Soviet announcement was publicly condemned over the next day or so by the United States, India, Japan, the United Kingdom, France, and West Germany, among others.

Ex.(b)(1)

[redacted]

*T. Sorensen, *Kennedy*, page 619.

Ex.(b)(1)

[redacted]

New Test Planning, Mid-1961

Reeves' May 10 meeting (previously discussed) to begin a new readiness plan seems to mark an upturn in readiness interest and actions throughout most of the test system. LRL had been pressing for increased readiness-to-test effort all the time, but the real reason for the upturn was probably the fact that the Russians at Geneva had turned down President Kennedy's first attempt at tabling a complete treaty; they still insisted on the Troika, which Kennedy had branded on May 5th as unacceptable. The GAC had written to the Commission on May 2:

> The possibility of a breakup of the Geneva negotiations requires that the AEC be ready to resume weapons testing. We have had weapons development arrested for 30 months, and we should be prepared to initiate tests as soon as possible after the date on which permission might be given by the President. The underground technique in Nevada should be used first, and a program for this technique should be carried to within a few days of firing time.

On May 5 Seaborg had written to McCloy, the President's advisor on disarmament, that in the event the President should find it necessary in the light of the Test Ban Conference situation to decide that the United States must resume nuclear detonations and should make such announcement,

> The AEC recommends that . . . the U.S. begin underground detonations for the Vela Uniform seismic research program and resume nuclear weapons testing underground. . . . We believe that it would also be desirable to reserve the right to carry out, in the future, tests in other environments which would not produce worldwide fallout.

Seaborg then gave his recommendation for immediate nuclear weapons tests. [redacted]

Ex.(b)(3)

[redacted]

Ex.(b)(3)

[redacted]

Betts informed the Laboratories on May 11 of the contents of the Seaborg to McCloy letter, to which Bradbury responded vehemently on May 18th:

> Unfortunately, we do not entirely understand the basis on which the potential list of experiments was selected and, therefore, find it impossible to concur that the list proposed which involves only one LASL device (at that, apparently only on an alternative basis) is satisfactory or acceptable.

After noting that the optimum listing of potential nuclear weapons tests depends upon a number of factors, such as the length of time that testing is expected to continue, the political importance of resuming testing as soon as possible, the amount of preparation that DMA would allow, and the ground rules regarding containment, he remarked that LASL had five devices on the shelf for immediate tests, if the facilities permitted.

> All that would keep them from being tested at approximately two-week intervals is lack of suitable facilities. This could be remedied by the following immediate steps: (a) procurement of suitable coax cable and other necessary electronics gear for alpha measurements by EG&G (six weeks to three months); (b) deepening existing holes to 800 feet and 1,200 feet (eight weeks and twelve weeks); (c) agreement that existing tunnel and hole facilities are for general AEC use and not the exclusive property of one laboratory. LASL is procuring, within its own facilities, suitable containing canisters for these experiments on a 30-day available basis. In brief, we are doing everything we can to get ready for testing short of getting ready for testing in Nevada!

He remarked that the devices listed did not reflect the longer-range interests of the Laboratory, but were important in that they could be done first. He went on:

> In general, we would regret seeing ourselves limping along "ten weeks after authorization," "six months after authorization," "one year after authorization" and so on if what has been so widely described as the urgent need of returning to testing is correct. There seems to be enough things going on in connection with Vela Uniform or Plowshare that it ought to be possible to deepen a few holes and get some electronics ready under this convenient umbrella. Why are we being so difficult about the situation--now and a year from now? It should also be obvious to you in light of all the foregoing and in light of LASL's past and future stockpile contribution that we strongly object to your selection and division of tests. Taking any individual test series you will find out that appreciably more practical and stockpileable weapons have resulted from the tests conducted by the LASL than any other Laboratory. For all the reasons given we will not be able to support your suggested program when reviewed by the Commission or the Congress.

The same day, May 18, Betts asked Foster and Bradbury to work together on the designation of the most needed tests and to consider joint use of the NTS resources wherever it might be appropriate. Futhermore, he directed Hertford on May 23 to retain his mining capability, charging it to Vela Uniform on a nominal five-day workweek schedule, even though some of the work would be applied to maintenance of NTS weapons test readiness.

On May 19 Los Alamos working groups came to a number of conclusions concerning the canister design, including provisions for alpha and prompt sampling. On May 23 Ogle sent Bradbury the test division suggestions for the five-shot program on the basis that underground testing might be requested at any time but would cease on October 15. He discussed options for the moratorium ending June 15 or July 15. In both cases the use of a tunnel site would be necessary and the data would be minimal.

On May 20 Chuck Violet of LRL gave Reeves the list of desired improvements in the Area 12 tunnel complex, including the amount of work it would entail for the tunneling crews. Foster answered Betts on May 26, giving his proposed shot list and ready dates, with the very earliest being a minimum diagnostics test possible on June 22. He also requested information on whether planning would be for a definite window or indefinite period.

On May 25, in commenting on the minutes of the March inter-Laboratory meeting, Betts stated:

> However, we must be careful not to permit ourselves or our thinking to become too completely "conditioned" to a "no-test" environment. When and if the moratorium is lifted, as there is at least a reasonable chance that it will be, I would like to see us work out a more deliberate and orderly overall pattern within which we should conduct our future weapon development program.

On the same day Betts reviewed the situation for Luedecke, stating that device availability was not pacing so much as site availability, diagnostics, cable procurement and installation, and contractor technical support. He recommended instituting procurement action, construction, and scientific installations as required, and asked for concurrence. In order to achieve an underground readiness posture of a few days, it would be necessary to have a detailed plan of laboratory and field activities; long lead-time purchases; major construction of holes and tunnels; and a substantial increase in spending. Betts commented that:

> Any disclosure of such activities might indicate the U.S. is not negotiating in good faith at Geneva. In-house (quiet and less extensive) preparation seems to give readiness of a few weeks.

All of this fussing resulted in a coordinated program which was sent, on May 26, from Hertford to Betts. Hertford noted that LASL wished to use the 15a granite hole at a depth of 950 feet, to deepen one of their 500-foot holes to 800 feet and one to 1,200 feet, and to ream out the 15b hole to a diameter of 36 inches, at a total cost of $455,000. The LRL proposed program would have some ten different projects and would cost about $2,500,000. Hertford recommended that the LASL program be authorized in its entirety and that the question of the assignment to LASL of the b.03 tunnel site and the 15a complex be included in discusssions at a general program meeting to be called by DMA. This meeting, which he requested, would include ALOO, LASL, LRL, DASA, and DMA representatives,and would establish the appropriate priorities for test preparations. On June 1, after talking with Seaborg, Luedecke okayed the proposed limited actions, but emphasized that care should be exercised to minimize the number of people involved.

At the June 1 meeting of the LASL Weapon Working Group, as further preparation for NTS testing, [redacted] Ex.(b)(3) [redacted] Charles Browne discussed the prompt sampling techniques to be used on Orchid, compared them with the Livermore system, and pointed out other underground sampling possibilities suggested by investigation of the melt from some of the 1958 underground Livermore shots.

On June 9 Reeves arranged to get the details of the LASL hole proposals to H&N for a feasibility study and issued authorization to bill this work to the Vela Uniform program. He went on to authorize REECo, on June 15, to begin work as soon as possible on the LRL tunnels and to also bill the work to the Vela program.

The Principals agreed on June 16 that Seaborg and McNamara would prepare a paper on nuclear weapons testing. To assist in the preparation of that paper, Betts sent to Luedecke on June 20 a paper

> . . . to determine the advance preparations for underground nuclear weapons tests required to improve the Atomic Energy Commission's capability to respond promptly to a Presidential directive to resume nuclear weapons testing.

He commented on several aspects of test preparation as follows:

- NPG test readiness was presently inadequate to begin testing on short notice,
- In accordance with the directive from Luedecke on June 1, limited actions were being undertaken,

- The June 20 proposed test list had been coordinated with all agencies and contractors except the DOD.
- He requested immediate diversion of $3,000,000 from Vela Uniform to begin construction.
- He recommended against public announcement of test preparations.
- He recommended that diagnostic equipment procurement and installation be initiated, the most critical requirement being coax cable.
- He recommended that DMA and the DOD develop a long-range test plan.

The total cost of the short-range program, if conducted, would be $25,000,000 to $30,000,000 above current funds. The shots would be fired only when there was assurance that radioactivity would be limited to the Nevada Test Site if venting occurred. The proposed short-range test program, in possible order of detonation, was as shown in Table XII.

Betts appended a list giving the yield, description, and purpose of each of the devices in the proposed short range program along with a map showing test site availability. As he had commented to Foster the day before, there was no consideration of low-altitude atmospheric shots, underground shots that might vent, or Plowshare shots. On the same day, with Foster and Bradbury present, the Commission discussed and generally approved the DMA plan, evincing also great interest in the Owl concept.

During June Reeves raised the question of whether or not Vela Uniform preparations should be pursued independently of weapons testing. He requested a code name for the operation. Betts continued to stress that confidentiality was important and stated that he could see no quiet way to drill the vertical holes for LASL. (JTF-7 was discontinued on June 30.)

In parallel with these AEC actions DASA was reviewing its nuclear test plans. In a letter of June 22 to the Joint Chiefs, Admiral Courtney Shands, for the Chief, DASA, noted that planning for weapons testing in the atmosphere and underwater had been stopped in January 1960 and, thus, no detailed plans could be given to carry out their needs in those media, but he pointed out that many of the military effects needs, such as radar blackout, kill mechanism, kill radii of defensive warheads, and

TABLE XII
POST-MORATORIUM TEST PROGRAM PROPOSAL

Device	Laboratory	Time Required after Authorization (weeks)
Ex.(b)(3)		

effects of electromagnetic pulses on weapons systems, would be difficult to accomplish underground. He listed the two underground tests for which some work had been done:

- Marshmallow was to be Ex.(b)(3) effects, and had a 12- to 18-month readiness that might be reduced to 9 to 12 months on a crash basis,
- Hardhat (formerly called Lollipop) was to be a 5-kt detonation underground in granite at the NPG to study effects Ex.(b)(3) and had a readiness time of 4 to 5 months.

He emphasized that worldwide fallout from past tests had not produced a biological hazard, and stated that the testing philosophy of the United States should allow tests to be conducted in any environment for which information is required, taking care to ensure that local fallout does not occur over inhabited areas. He also suggested:

- A 2-kt balloon shot at 115,000 feet to study blast measurements and energy partition at high altitude, with readiness of 12 months;
- Four to six shots at altitudes from 25 to 1,000 kilometers with yields in the range of 250 kilotons to 1 megaton to study the D region blackout, fireball effects, x-ray effects, magnetic containment of trapped particles, and kill radii of warheads, with a readiness time of about two years;
- A series of three to five tests of low yield to study underwater and water surface effects, readiness time approximately two years;
- A series of three to four tests of fractional kt devices to accurately measure local fallout of low-yield weapons over large land mass, study low-yield blast phenomena, and hardened target response in high-pressure regions, with a readiness time of about 18 months.

Finally, he recommended a weapons development series similar to that from the Laboratories with emphasis on the Owl, stating: "When actual test devices are available for tests, this program should take priority over all others."

On July 8 a group of reporters toured the Nevada Test Site and published stories stating that work was progressing on two tunnel complexes designed for underground nuclear tests. Thus, on July 12, Johnny Foster said to Betts:

> In view of the recent publicity regarding testing readiness, I believe that we should reexamine the status of the basic and scientific construction at NTS, giving particular attention to those items which would materially improve our immediate readiness posture. Inasmuch as the AEC public information activities at NTS have resulted in extensive press reference to readiness construction at the site, I believe that we should reduce our sensitivity with regard to these matters, etc.

On the same day Captain Brady of the DMA Test Office opined to Betts that this was simply more of the same kind of pressure that LRL had kept on DMA for the past two years, but that he didn't feel that scientific construction or installations should be agreed to at this time without first seeking top-level guidance, which had to this point only imposed restrictions on the things that Foster had proposed. Betts replied to Foster more gently on July 31, regretting that the recommendations could not be implemented and stating that DMA was continually examining the readiness posture and updating their information; but at the moment, their guidance was to do nothing which could be picked up by the press.

In mid-July Jim Carothers of Livermore introduced the "Christmas Tree" concept. This concept would produce a massive underground testing area centered around a deep, vertical shaft. Off from the shaft, at various depths, would go tunnels, the lengths of the tunnels being roughly proportional to depth, hence, the words

"Christmas Tree." At the ends of the short, upper-level tunnels, small detonations could be contained, whereas large detonations would have to be at the ends of the lower-level, long tunnels which had appreciable overburden. Carothers' design in concept would allow detonations with yields up to 200 kilotons. He pointed out a possible area for this facility in the vicinity of Pahute Mesa where there was apparently at least 4,000 feet of tuff lying above the NTS water table, and requested that Reeves direct the USGS to immediately begin geophysical work in that region to produce the proper mapping. A week later, on July 20, he had refined the design to five working levels that would allow detonations of 5 kilotons, 20 kilotons, 50 kilotons, 100 kilotons, and 200 kilotons maximum yields, respectively, and suggested that the one facility, costing $25 M in construction alone, should be capable of handling over 60 detonations on each level. LRL had contacted USGS to determine whether a suitable site for such a facility existed within NTS. Reeves took the proposal seriously and transmitted it to DMA for consideration. LASL objected strenuously, feeling that this proposal would use up all the engineering effort available and require much more money than was available, and fearing that any accident, if this system were used, could do away with the usefulness of the whole, expensive array. By late August the USGS had made plans to carry out aerial geologic mapping and seismic refraction surveys in connection with the concept.

In mid-July Bob Newman of LASL requested that H&N study the possibility of casing Area 3 holes with concrete instead of steel. The result was that the holes could be cased with steel for about two-thirds the cost of concrete and would be done in 60% of the time of the cement-sheathed case.

At the GAC meeting of July 13 and 14 the AEC proposed list of weapons tests was discussed. Norman Ramsey commented:

> **It is absolutely essential that the U.S. be prepared to conduct a first-rate test program. This would include the digging of holes, and also the placement of devices in those holes if there should be an advantage in doing that. Even if this activity should become known to the world, the Geneva negotiations would not be hampered, since the activity would simply convey a measure of restlessness.**

Libby complained that the Ex.(b)(3) had been placed in inactive status ever since it was completed three years ago. Hearing the discussion of the health of the Laboratories, Wigner pointed out that Los Alamos was apparently losing interest in weapons research. The committee agreed to recommend to the AEC that both Laboratories should be reminded that their primary mission was, and would continue indefinitely to be, weapons research, and that future support would depend largely on successes in the weapon field.

Betts continued to stall on any large obvious effort, but also continued to worry about the problem. In late July he asked Hertford for a detailed breakdown of the cables installed in tunnels and requested a quiet review of the current test readiness posture, including device availability, diagnostic instrumentation readiness, and the detailed construction requirements for the short-range test program.

On July 20 and 21 DASA briefed the newly formed McMillan panel on their tentative nuclear weapons effects tests, including an extensive list of shots addressing electromagnetic phenomena, fallout, and nuclear and thermal effects. The list was forwarded to DDR&E on August 3.

By July 25 H&N had completed their estimates of the time required to activate the holes requested by LASL, including 15a and 15b. The time and cost were somewhat higher than previously estimated.

In early August Colonel Anderson of DMA informed Chairman Seaborg of the estimated costs for various kinds of nuclear detonations. He gave $2,000,000 to $4,000,000 per shot for underground tests, including both AEC and DOD costs; above

ground NTS shots about $1,500,000 per shot; above ground Eniwetok shots about $3,500,000 per shot, and outer space testing at $100,000,000 for the first shot and $10,000,000 to $15,000,000 for each shot thereafter. On August 7 Betts asked the Laboratories to propose a program for testing in outer space.

On August 11 Betts informed the Laboratory Directors and Operations Office Managers of the present status of the proposed nuclear test program, requesting that his paper be treated in the strictest confidence and that distribution be held to an absolute minimum. He commented on the possible advances that could be made by testing in the fields of weapon vulnerability, fusion and fission-fusion weapons, high yield-to-weight ratio strategic weapons, pure fusion weapons, and unforeseen discoveries. Basic program guidelines were divided into three categories: a short-term program, a medium-term program, and a long-term program. Short-term was defined as six months utilizing underground sites, but the long-term program might include deep space also. He also commented that the DOD Hardhat test would be included in the short-term program and Marshmallow in the medium-term program. [redacted]

Ex.(b)(3)

On August 8 Foster requested that Betts authorize stockpiling of cables at the factory if it could not be arranged to have them delivered to NPG. Reeves made a similar request the next day. On August 13 Systems Command Headquarters asked General McCorkle of AFSWC for his recommendation concerning the effective date of discontinuance of the 4950th Test Group. The dam began to leak a little on August 17 when Betts authorized ALOO and the nuclear laboratories to proceed with readiness work, the cost not to exceed $3,000,000, which would be funded from Vela Uniform money. Work would follow the guidelines of the August 11 letter. He specifically authorized construction on the Ex.(b)(3) site in U-12b.06 and completion of the work Ex.(b)(3) U-12e.03a. He authorized construction of an alpha system for LASL to the tune of $160,000, and also authorized ALOO to initiate procurement of $1,300,000 worth of cable, stating that this procurement action should be carefully handled because of the somewhat greater possibility of speculation and public disclosure. He then asked for any further suggestions that the testers might have on test planning. He listed what he saw as the possible risks of public disclosure for activities that might occur. It is clear that at this time there was simply a decision to take a little more risk, but there was certainly no conviction that we would immediately begin testing.

On August 30 the Russians announced their intent to resume testing.

The Moratorium Ends

Thus the moratorium ended, 34 months after its beginning. In those 34 months the U.S. had disbanded its organization for conducting overseas tests and essentially dismantled the site for so doing. A great number of carefully thought-out plans on how future overseas tests should be conducted were left. The AEC had convinced itself that further testing in the atmosphere would not be allowed. Following the growing conviction that underground testing was the thing of the future, some eight or ten sites capable of handling full-scale nuclear detonations had been constructed in Nevada under the guise of readiness, Vela Uniform, or weapons effects. Because of

the growing introduction of efforts other than weapons tests to the Nevada Test Site, for example, Rover, Pluto, Plowshare cratering, and Vela Uniform, the NTS organization maintained appreciable strength; kept its contractors working, a radsafe and weather organization going, a timing and firing system operating; and, in general, maintained those capabilities necessary for testing. Unfortunately for weapon development testing the money for site construction during the moratorium was spent in the wrong place, that is, on tunnels instead of vertical holes. However, that experience was invaluable to the DOD as the beginning of development of those techniques later used for underground effects tests.

In a similar fashion, the Laboratories had, under one guise or another, retained sufficient test personnel to be able to respond quickly and even to advance the technological state of the art. Most of the old testing hands had somehow weathered the storm and stuck through that thirty four months.

Even though contractor effort at the Nevada Proving Ground was not enough to keep all of their people with test experience, some of the contractors, notably H&N and EG&G, managed to hold on to their old testing hands by using them elsewhere in their organizations.

Summation of 1961 Through August

Nineteen sixty one saw a new Administration with renewed hope that its new initiatives would result in Nuclear Test Ban agreement with the Soviets. It took about a month of negotiation for the new administration to realize that they had been overly optimistic, but Kennedy held on to his fading hopes until perhaps mid-August. In spite of the growth of conversation and "what if" questions during the year, very little real work was done on physical preparations to test until the Russians resumed testing, but the growing effort on test planning in the previous six months made the actual return to testing in September feasible.