CHAPTER III

RETURN TO TESTING--NEVADA

NTS Readiness Status

As the anticipation of test resumption grew during the months before September 1961, plans were refined and some preliminary schedules were defined. As an example of a short-term program, DMA circulated a plan to the Laboratories and Operations Offices on August 11 (see Table XIII), which suggested 13 device tests to be performed underground at the NTS. The Laboratories were asked to gear their in-house activities to preparing for such a short-term program, if possible, and to maintain the flexibility to modify this program as politics and high-level decisions dictated.

Responses to his August 11 program concept led Betts to the following summary, which was part of an August 17 paper on preparation for test resumption:

> At the present time, there exist two principal tunnel complexes at NTS, with approximately 20,000 feet of tunnel and side drifts for conducting underground tests. Also, there are three small tunnels. In general, LRL experiments would be concentrated in the tunnels. In addition to the tunnel systems, four vertical drilled holes, 500 feet deep, have been prepared in Area 3. These holes are presently suitable for tests having yields up to about 1 kt. In general, LASL experiments would be performed in the vertical holes, although provision has been made for conduct of a 40-kt LASL experiment in the U-12e.03 drift if so required. In addition to the excavation work, cable runs have been installed for Orchid--the proposed initial shot of the Vela Uniform series--consisting of 14 runs of 5,500 feet each . . . The present readiness position for underground tests, if and when it is decided to proceed, is in large part based upon the tunnel complexes begun during previous test operations, the cleaning out and improvement of these tunnels, and to an extent, work performed under the Vela program . . . The present condition of readiness to resume testing permits only a few (perhaps four) of the initial test shots to be done with reasonable assurance that significant diagnostic information could be obtained. There is no assurance that all types of cable required for the experiments are on hand or could be procured in time to meet all portions of the schedule. Based upon the most recent cable procurement action, delays of one to four months (beyond promised deliveries of one to three months) were encountered, and such types of delay must be anticipated . . . In order to allow for unknown factors or unpredictable delays, the initiation of certain actions now which would not unreasonably increase the risk of public disclosure will increase the probability of carrying out the entire short-range test program on the time scale indicated. These actions would include the extension of the current planning effort and the procurement of the necessary cable and additional diagnostic equipment. In addition, the degree of readiness achieved through undertaking these actions may contribute to some reduction in the present schedule proposed.

In the same paper Betts authorized ALOO and the Laboratories to proceed with readiness work consistent with his August 11 letter. (See Chapter II for details of the work authorized.) However, because of the risk of public disclosure, at the end of August no vertical hole drilling was authorized, and cable procurement, soon to become a very critical item, was still only in the planning phase. Actual cable procurement was to be some time off.

TABLE XIII
DEVICE, SITE, AND DIAGNOSTICS READINESS SCHEDULE
SHORT-TERM PROGRAM

Priority	Device	Device Avail. Date	Assumed Sites[a] ("U" indicates tunnel sites)	Site Avail. Date	Site/Diag. Avail. on Present Schedule	Date if Preparation Authorized by Aug. 1
1	Ex.(b)(3)	08/01/61	U-12b.09	Now	A[b]+5 wks	09/05/61
2		09/30/61	U-12b extended	A[b]+8 wks	A+20 wks	12/19/61
3		12/02/61	U-12b extended	A+8 wks	A+22 wks	01/01/61
						Ex.(b)(3)
4		08/01/61	Deepen 500' hole to 800'	A+8 wks	A+10 wks	10/10/61
5		08/01/61	Deepen 500' hole to 1,200'	A+10 wks	A+12 wks	10/24/61
6		08/01/61	Deepen 500' hole to 1,200'	A+10 wks	A+12 wks	10/24/61
7		09/01/61	U-12e.04	Now	A+10 wks	10/10/61
8		09/30/61	U-12e.06 extended and deepened	A+15 wks	A+20 wks	12/19/61
9		08/15/61	U-12e.03b deepened	A+3 wks	A+12 wks	10/24/61
10		10/14/61	U-12e.07 deepened	A+4 wks	A+16 wks	11/21/61
11		08/01/61	250' hole	Now	A+4 wks	08/29/61
12		08/01/61	U-12e.03a	Now	A+8 wks	09/30/61
13		08/01/61	1,200' hole to be dug	A+14 wks	A+20 wks	12/19/61

[a] 1. Tunnels in Area 12 and holes in Area 3.
2. Selection of sites for each device is based on:
   a. Maximum utilization of existing tunnels and holes
   b. Minimum construction effort to accommodate the short-range test program.
   c. Minimum interference with preparation for subsequent shots.
3. As of now, firing sequence will be in order of site and diagnostics readiness.

[b] The letter A stands for the date on which test preparations are authorized.

Real Preparations Begin

The long-sought words from high levels finally came, but only when they were inevitable, on August 31, the day after the Russians announced their intent to resume testing. Betts wrote: "We are authorized to proceed in the readiness program without the unusual security restrictions which have previously applied to our planning efforts in this regard." He also stated that something must be tested as soon as possible, setting September 14 as the target for the first test. He asked the Laboratories to comment on the August 11 short-term test program (Table XIII), coordinating their comments through ALOO within two weeks. Moreover, Betts said that the first test should be Ex.(b)(3) and he stated that meeting the schedule was more important than the diagnostic information to be obtained. Bradbury reacted to this

point on September 1 (before the first Russian test): His Laboratory's "senior staff opinion . . . is unanimous that this procedure appears insane and that for the U.S. to be mousetrapped by the U.S.S.R. into testing before the U.S.S.R. would be a national blunder of the first magnitude." Events quickly overtook this concern.

On September 1, Reeves sent a message to Fred Hohner of the AEC Las Vegas office authorizing that office to proceed immediately with basic construction of U-12e.03a in accordance with Livermore criteria, including extending the drift by approximately 150 feet. Apparently, the construction had not yet begun on the drift extension, and Reeves estimated basic construction would be complete by October 15. On the same day, Hohner sent a message to Carl Taylor of REECo and Frank Hines of H&N, both at Mercury, directing them to proceed immediately, but without causing too much publicity, with activities necessary to prepare the U-3ac hole for LASL use on September 10. Specifically, the hole was to be backfilled from 500-foot depth to about 250 feet and finished for device readiness.

The Russians' first atmospheric detonation in 34 months took place at Semipalatinsk Proving Grounds at 3 a.m. EDT on September 1, signaling the real end of the moratorium. Ex.(b)(3)

All of this occurred before a public Presidential announcement of any U.S. test resumption. What was going on in Washington in these crucial days? In the AEC, discussions among DMA, the Labs, Operations Offices, and contractors were aimed at identifying programs and various means of doing them. Luedecke sent a paper based on some of these discussions to Chairman Seaborg on September 4, setting forth several alternatives to the already-planned short-term testing program. The paper listed the disadvantages and advantages of each alternative. Ex.(b)(3)

Ex.(b)(3)

While these three shots could be completed between September 14 and October 12, doing so would delay subsequent testing because virtually all of the existing cable inventory would be used, leaving little cable for further diagnostic data collection. The second alternative was to test a high-yield device Ex.(b)(3) While this test could be done within a few weeks, there was uncertainty as to its effects on the remainder of the tunnel complex in which it would be fired, and it was felt that an additional four to five weeks should be taken to gain assurance that the device could be fired without jeopardizing the rest of the complex. Further discussion of alternatives addressed various techniques for atmospheric testing, including balloons, either overseas or at the NTS. Atmospheric testing at the NTS was believed to be possible within a few weeks, but the larger yield devices would have to be tested outside the continental United States, requiring an estimated minimum of three months preparation. Luedecke stressed that each of the alternative quick-response programs would cause problems in the long run, and he recommended that the short-range program already planned be implemented so as to permit maximum use of the available facilities and secure adequate diagnostic information.

A letter from AEC Chairman Seaborg to McGeorge Bundy, the President's National Security Advisor, on September 5, disclosed that these alternatives had resulted from discussions several days earlier among Seaborg, the President, and the Secretary of Defense, Robert McNamara. McNamara had asked how the AEC could respond on a "two weeks, four weeks, six weeks schedule" reflecting the first alternative, and, observing that such small shots might not be noted other than by our announcements, he further requested a schedule for an initial shot of high-enough yield to be felt off-site by foreign observers. Seaborg, in his rebuttal to the suggested alternatives, not only repeated Luedecke's list of disadvantages, but added that "the

Soviets have tried hard to picture us to the world as having made continuous preparations for testing . . . to be ready to start at the very first opportunity. They surely would take advantage of any announcement by us of an almost immediate test detonation to further this line." Recommending to Bundy that the test program authorized be the short-range program under preparation since July, he asked that a decision be made on the same day, September 5, to enable the AEC to carry out the first detonation on September 14.

Presidential Direction to Prepare

How did President Kennedy reach his decision to resume underground testing? On the day of the first Russian test, buffeted by a variety of recommendations for action or inaction from his many advisors, he declined to announce a test resumption, but made very clear his feeling that he could not refrain much longer. On the 3rd, Kennedy joined with British Prime Minister Macmillan in openly offering Khrushchev an agreement to ban any atmospheric tests that would produce fallout, "pointing out such a pact could rely on existing means of detection and would not require additional controls."* The Russians ignored this and carried out their second and third detonations on September 4 and 5, whereupon Kennedy felt he had no choice but to allow U.S. test resumption underground, which he publicly announced on September 5. At the same time, however, he stated that the atmospheric test ban proposal would remain open until September 9. An interesting insight into Kennedy's personal anguish and resolve over this most important decision is provided by Schlesinger,** who recounts a meeting the same day on other matters with several top advisors, including Adlai Stevenson. Noting his fears that the Soviets might respond to the Kennedy-Macmillan note on an atmospheric test ban by bringing up general and complete disarmament and thereby "scooping" his own disarmament initiative, Kennedy expressed his own personal regret at the decision he had had to make this day: to resume underground testing.

> Kennedy quickly said, "What choice did we have? They had spit in our eye three times. We couldn't possibly sit back and do nothing at all. We had to do this." Stevenson remarked, "But we were ahead in the propaganda battle." Kennedy said, "What does that mean? I don't hear of any windows broken because of the Soviet decision. The neutrals have been terrible. The Russians made two tests after our note calling for a ban on atmospheric testing. Maybe they couldn't have stopped the first, but they could have stopped the second. . . . All this makes Khrushchev look pretty tough. He has had a succession of apparent victories--space, Cuba, the thirteenth of August [the Berlin Wall], though I don't myself regard this as a Soviet victory. He wants to give out the feeling that he has us on the run. The third test was a contemptuous response to our note. . . . Anyway, the decision has been made. I'm not saying that it was the right decision. Who the hell knows? But it is the decision which has been taken."

Pretty clearly, the President made the decision that he had earnestly sought to avoid and he felt very emotional about it. At any rate, the test community, pulling itself together as it raced ahead on an uncertain path, at least had firm direction and permission to do the work that was already in progress.

---

*A. Schlesinger, *A Thousand Days*, page 460.

**Ibid, page 482.

Towards the First Shot

Back in Nevada, at Reeves' request Hohner was coordinating the Livermore and LASL cable requirements in order to expedite a cable purchase which was still not under way in spite of the July and August discussions which had pointed out the urgency. At LASL, trailers were being prepared for shipment to the Test Site within the next day or two, and the radiochemistry group had approved the sampling configuration for the first shot. Ogle informed J-6 that Sandia would do some seismic measurements, that the first shot was to be on the 14th, and that a 625-foot hole for the second shot Ex.(b)(3) was planned as soon as possible but not earlier than October 1. In line with this, work was started to deepen hole U-3ae to 800 feet (it was later used at 630 feet) and to start a 6,000-foot exploratory hole as soon as possible. On the 6th it was decided that the first hole would be backfilled with clean silt for a short distance above the can, followed by sand the remainder of the way up to within five feet of the ground, with a concrete cap on top. On the same day, Ogle requested that the USGS (United States Geological Survey) determine the locations of water tables between 1,000 feet and 6,000 feet depth. Arthur Cox, J-15 group leader, discussed with J-6 the possibility of making yield measurements by hydrodynamic techniques, which would involve drilling satellite holes.

The next day J-6 and H&N worked out a plan for preparing satellite holes up to 12 inches in diameter and emplacing gauges to be used for measurements such as shock time-of-arrival and pressure. The pace was hectic. The J-6 man at NTS reported an immediate need for 10,000 feet of a particular type of cable, to replace one that had been cut by a blade that morning. He also commented that he was "shook about Campbell's apparent order not to raid site 400 [Rover]* for REECo support." He was instructed ". . . to use what was necessary, all if required, but no more."

On September 5 Al Graves, in a letter to Jim Reeves, requested authorization to design a number of facilities for NTS testing in Area 3, including area and shot site layouts; vertically drilled, large-diameter holes of any depth with either concrete or steel casing; new head houses and towers; direct radiochemical sampling systems; coaxial cable feed and placement systems; canister and cable lowering harnesses and hoist arrangements; well backfilling operations and equipment; and new deep hole winches. Graves pointed out several advantages that would accrue by accomplishing design now.

> First, long lead time procurement items will be specified sufficiently to permit orders to be placed early. Second, the overall costs of an operation should be reduced through orderly design and procurement schedules and with a smaller probability of expensive field corrections traditional with crash operations. Third, the time until the completion of a test operation will be reduced by the time spent in design before such an operation is authorized.

In a second letter to Reeves, Graves expressed concern about the very deep test hole required by LASL in Area 3. The letter briefly laid out the need for geologic and other information at great depths and requested that a 6,000-foot core hole be drilled in Area 3 as outlined by J-6 in an attached paper written August 10. Illustrative of the confusion in the first few days, a September 6 message from Betts to Hertford and the Lab Directors stated that "The President has requested that a shot be fired on September 15 and that the following events (Ed. note; not included here) be conducted on an early and frequent schedule, subject to obtaining beneficial technical information. The President was advised that Ex.(b)(3) could be readied by

*"Rover" was the nuclear-rocket program, since defunct.

September 15; please plan accordingly." That same day, perhaps before seeing Betts' message, Hertford sent a message setting out a brief schedule for Reeves and other AEC management personnel and contractors, with information copies to the Laboratories. Reeves' schedule showed the first two events Ex.(b)(3) [redacted] Ex.(b)(3) [redacted] to be performed immediately after the first test. Some clarification of this confusion came in a message from Betts to the Lab Directors, Hertford, and Shute:

> I recognize that some explanation may help to explain my verbal instruction given Sept. 5 to proceed with a test Ex.(b)(3) [redacted] on Sept. 15 in contradiction to the program of testing which was discussed with your representatives at the meeting in Albuquerque on Saturday Ex.(b)(3) [redacted] demand that the first [redacted] The Chairman hoped that yielding on one very early test would take the heat off the program of three events previously planned for a crash effort and discussed in Saturday's meeting. Our major goal was to insist that any tests after the first one can actually achieve the technical results desired by the testing laboratory. This position is now supported at the highest level. We consider the new instructions to be a real victory for our recommendation that we not be forced to do technical experiments before proper instrumentation is available to achieve the desired technical results. It was in this context that we agreed to a Ex.(b)(3) [redacted] test as more or less of a "sacrifice" event in that we knew that we could not obtain all the diagnostic information which we would desire. . . Ex.(b)(3) [redacted] Ex.(b)(3) [redacted] certainly we should go ahead with preparations to carry out that event expeditiously. The date of its firing will be specified from here. It is important for reasons other than technical that Ex.(b)(3) [redacted] must be the first device tested.

The next day Betts informed the same addressees that a Commission letter was going to the President requesting authority for Ex.(b)(3) [redacted] on September 15, informing him that Ex.(b)(3) [redacted] could be ready on the same day,* and requesting authority for that shot. Betts' message contained precisely the same schedule as is shown in Table XIV, dated September 6, and while it did not clarify the origin of the list, it did establish that it was agreed to by DMA within 24 hours of the date given by ALOO.

On September 7, Bradbury sent Betts a message summarizing LASL's plans and philosophy in respect to underground testing. LASL recommended testing as rapidly as NTS facilities allowed, at depths determined by a 475 $W^{1/3}$-feet rule for overburden, where W is the yield in kilotons. Tentatively, LASL planned 12 to 16 tests for the first year, and the specific schedule set forth was essentially the same as that presented in Table XV. Bradbury said that groundwater and seismic effects problems would not be considered until they showed themselves to be problems. Vela Uniform experiments or other effects measurements were to be done on a catch-as-catch-can basis. The weapons testing philosophy, Bradbury felt, should "put maximum effort on immediate improvement or test of stockpile items which might be involved in a real dirty knockdown war-to-win with the U.S.S.R. and on extension of stockpile into small, two-stage areas utilizing smallest possible primary." Finally, it was the LASL opinion that atmospheric testing with balloons, barges, or airdrops was the best and quickest way of making progress and the only practical way of proof testing weapons in excess of 200-kt yield.

On September 7, Dale Nielsen, Livermore Test Group Director, sent Hertford a status report on their preparations for the Antler event. He reported that excavation of U-12e.03a was complete and that diagnostic equipment was being emplaced. The first signal dry run was scheduled for Saturday afternoon (September 9) and the device was to arrive the same day, with the first diagnostic dry run scheduled for September 12. The final and complete dress rehearsal was scheduled for September 14. Livermore expected Antler to be ready, as scheduled, at 10 a.m. on September 15.

*It was, in fact, ready on the 7th of September.

TABLE XIV
SHORT-TERM PROGRAM--TENTATIVE SCHEDULE

Ex.(b)(3)

[redacted]

Ex.(b)(3)

[redacted]

Ex.(b)(3)

[redacted]

On September 8, Joe Sanders, ALOO Director of Logistical Support at Mercury, sent Hertford a status report on preparations for firing the first two events on September 15, noting that the field organization had attained the capability to fire both of them as directed on that day, and giving some details of the status of the

two separate events in the two areas. For the LASL test in Area 3, the items remaining were the arrival of a crane to lower the device and the arrival of the radiochemistry sampling pipe, which was scheduled for installation on Monday, September 11. For the Livermore test in Area 12 the final blasting for the zero room was completed at 9 a.m. on September 8, and final mucking, installation of coax, and connection of tunnel motor generator sets were underway. The stemming material was scheduled to arrive on the 11th of September, with installation to begin after the first successful dry run. As for other site activities and projects, the Command Post and programmatic building had been opened and all the offices were manned; housing would be short during the weapons test periods; and preparations for DOD participation, to be housed in Area 12, were being scheduled on a noninterference basis and within REECo's capability to complete the desired construction.

In another important message to Betts on testing philosophy on September 9, Bradbury further explained LASL's opinion (incorrect, as it turned out) that it would prove somewhere between impractical and impossible to test at much beyond 100 kt underground because of the need for adequate containment, groundwater problems, and seismic effects. Bradbury said that LASL was not convinced at this point that good yield measurements could be made on underground tests because of the appreciable thermonuclear contribution (also to prove incorrect). In spite of this, he said, "If the yield measurement problem can be surmounted, it is probable that underground testing up to 100 kt or so can do everything except air effects experiments that can be done in the air." He added that in addition to the yield flexibility offered by atmospheric testing, as well as the capability to make better measurements, the time factors seemed to favor atmospheric testing because things could certainly be done more rapidly. In spite of the negative view of the relative advantages of testing in these two regimes, this is probably as generous a view of the future of underground testing as Bradbury had yet openly stated.

From Newman's (J-6) notes, the LASL plan on September 8 showed canister delivery from LASL to the NTS in time for a September 14 Ex.(b)(3) October 1. The high level of activity led to a mad scramble for cabling, connectors, and "Crosby clamps." Rea Blossom (J-6 at the NTS), reported to Newman that the drill rigs would be in place on the night of the 12th, and that EG&G planned a dry run of their diagnostic and firing equipment on the evening of the 8th. In discussion of the 6,000-foot core hole, to be positioned one-half mile west of instrument bunker (alpha station) 3-300, Blossom asked Newman if the so-called "Hi-Vac" system would be okay for recovery drilling in the event of a shot at this depth, and Newman told him "Yes, if debris can be contained and personnel protected." Newman had also checked that day with George Cowan, head of LASL's radiochemistry group, as to whether the "Orchid" hardware would be satisfactory for a possible test in U-12e.03b and Cowan said that it would be fine if that shot were done earlier than Orchid. The potential Orchid test referred to was one which DMA had asked LASL to consider, Ex.(b)(3) in U-12e.03b in late December. Ogle met with Westervelt and Hoerlin on the possibility of Orchid in that period, and replied to Betts that this could be done but the overburden was 300 feet short of that required for containment by a 450 $W^{1/3}$ rule. LASL had been planning that shot for a 2,000-foot hole during the week of January 14, 1962. At the end of his notes, Newman gave the first indication of a new date for the first shot, noting that Art Cox had met with Bradbury, who had revealed that the first shot date was now September 15. LASL could, in fact, have been ready to fire its first shot on the 10th or 11th.

Khrushchev finally replied on September 9 to the Kennedy-Macmillan proposal, saying that a limited test ban would permit the West to improve their weapons by underground testing, for which they had been preparing, and that the Russians would

not agree to such a "dishonest deal."

In addition to the LASL and Livermore discussions on underground and atmospheric testing, Hertford told Betts of his conclusion that--given certain assumptions--one or two atmospheric tests could be quickly staged at the NTS without too much consideration for public opinion because of the attitude of the people in that geographical area, among other things.

On September 9, Reeves, the NTS Test Manager, published the operations order for Nougat, the nickname given to these underground tests. The organizational structures to conduct these underground tests included the following key personnel, in addition to Reeves: Air Force Colonel Leo Kiley, military deputy; Alvin Graves, scientific advisor; Roger Batzel, alternate scientific advisor; Dale Nielsen, Livermore test group director; Lieutenant Colonel John Kodis (DASA), DOD test group director; and William Ogle, LASL test group director. (DOD involvement in NTS field testing was the responsibility of the Weapons Effects Test (WET) section of Field Command, Defense Atomic Support Agency, headed by Colonel Kiley.)

On September 6, representatives of ARPA and WET had met in Washington to discuss the impact on Vela Uniform of the projected usage of NTS tunnels for weapons tests and to define any necessary revision of Vela Uniform program plans. Betts sent a message on September 9 to the AEC organizations, ARPA, DASA, and the Air Force, giving proposed plans for continuation of Vela Uniform work as resources became available, based on working in conjunction with the weapons testing program and without undue interference with it. On that same day, in a message to Hertford at ALOO, Betts emphasized that first priority was now to go to weapons testing and that the following instructions applied to Vela Uniform events: Shoal and Porpoise were to be placed in an inactive status; Linen was canceled; the Orchid goals could be fulfilled by the Livermore Ex.(b)(3) test; Stingray and Lollipop requests could be fulfilled by the Livermore test and Hardhat, respectively; Crystal and Muslin requests would be partly addressed Ex.(b)(3) the Plowshare Gnome shot was now being planned to include Vela Uniform objectives; and the use of Area 3 for Vela Uniform purposes should be investigated since this would give information on a new medium.

Meanwhile, back at the NTS, Ogle's diary records that he came upon Jerry Tatom at 8 a.m. on September 9 placidly surveying his nice, neat zero area with a big smile on his face. Some hours later, at 3 p.m., 100 people were milling around the area in the dust. The next day, the alpha/reaction history rack and the device canister were joined together by 3 p.m., and dry runs continued well into the evening to determine whether the scheduled work could proceed. Discussions with USGS on September 10 led to a decision to put the first 2,000-foot hole close to Well 7, where the water table was at considerable depth. There was also a tentative decision to drill a 6,000-foot hole in granite monolith approximately two miles northeast of Area 15, where the geologists were confident (but not positive) there would be no water problem. Ogle concluded that this "obviously means that a portable alpha station is necessary."

A September 11 memorandum from Hertford to Reeves specifically appointed Reeves Test Manager for Operation Nougat and redelegated to Reeves the authority given to Hertford by DMA. In this role, Hertford told Reeves that he should report directly to the Director of DMA for operational matters pertaining to Nougat. However, for normal administrative actions he would continue to be responsible to Hertford. Among the specific directives given to Reeves as Test Manager, in addition to his overall responsibility for the operation and for meeting the technical needs of the AEC Laboratories and the DOD, was the responsibility to emplace the devices so that "as far as can be predicted within existing experience and capabilities, containment of the nuclear detonation" would be ensured. Specific rad-safe criteria to be met by the Test Manager were also laid out, including ensuring that external whole-body

radiation exposure to persons off the NTS would not exceed 3.9 rem* for any calendar year. Reeves was to designate September 5 as the effective date for the commencement of the operational period of Nougat. As of September 11, only three shots Ex.(b)(3) Ex.(b)(3) had been authorized for execution. The specific schedule attached by Hertford (given earlier as Table XIV) was established on September 6, although the memo does not clarify how it was to be accomplished.

On September 11, Jim Reeves authorized Bill Ogle to emplace the Ex.(b)(3) device.

Presidential Approval to Resume Testing

The President made his decision for test authorizations on September 11 or 12. He specifically approved the first three events, with the Livermore event first on September 15 for the political reasons cited earlier (external visibility), and the LASL event on September 16 since he did not want two tests done on the same day. This latter point was not made clear until late on the 12th of September. That morning LASL had lowered their device canister to the bottom of the emplacement hole and, after a discussion with Bradbury, decided not to backfill until the last minute in case there was trouble. It was that afternoon that Bradbury got word from the President that LASL couldn't fire until the 16th: in Ogle's words "Bradbury was hopping mad."

Minutes of the AEC meetings indicate that the Commission did not discuss test resumption in any detail until their September 13 meeting, during which Betts briefed the Commission on the President's decisions and the proposed short-range program of 15 tests to be done by mid-February 1962. Betts also presented a suggested draft of the request to the President for authorization to expend the special nuclear material for the first 15 tests, should the Commission approve the short-term program. Discussion of uncertainties about the 15 tests led to a decision to clarify the letter to the President, requesting permission for the Commission to make minor program changes as they deemed necessary, without new Presidential authority. In discussion of the forthcoming (September 14) Congressional hearings on the pros and cons of underground and atmospheric testing, Mr. Ink (AEC staff) opined that the question would arise of U.S. gains or losses vis-a-vis the Soviets should we restrict ourselves to underground testing. Betts noted that underground testing was approximately twice as expensive as atmospheric testing and that although the U.S. would be limited in the size of weapons it could test underground, he felt that tests of devices with yields in the megaton range would not be precluded. The possibility of a third kind of testing, underground testing that would not be fully contained but would have controlled venting, was also briefly discussed. Betts informed the Commission that preliminary discussions with ARPA, AFTAC, and DASA made it appear that major portions of the planned Vela Uniform data could be acquired by instrumenting the planned Nougat series. However, with the possible exception of the DOD Hardhat test, Vela participation would be on a noninterference basis. Chairman Seaborg said that nongovernment U.S. seismic stations would not be alerted for the first test and probably would not be able to detect the second test, but would probably be prepared for the third shot. He requested that appropriate seismologists be invited to participate in a seismic research program beginning with the third test. As for budgets, Betts estimated AEC costs for the planned series of 15 tests at $35 million, with an additional $20 million in costs and $18 million in commitments for FY 1962 preparations aimed at an FY 1963 program. An example of such preparation would be $6

*Roentgens-equivalent-man, a measure of biological dose.

million required immediately for necessary engineering and surveys of a new tunnel complex and deep holes for high-yield tests. Thus, the total requirement for FY 1962 testing was estimated to exceed $80 million. Congress, he said, was making available $30 million, and since it was not clear that the $30 million would be sufficient to conduct tests through February 1962, approval should be given for DMA to reprogram funds on an interim basis. The objectives as stated by Betts for the first 15 tests would include improvement in yield-to-weight ratio in tactical and strategic weapons; examination of effects, including warhead kill mechanisms for ABM systems and "hardness" estimates for underground missile sites; and examination of the effects of U.S. warhead vulnerability vis-a-vis enemy ABM systems. After this discussion the Commission approved, with certain minor changes, the 15-shot program and the special nuclear material request to the President. They noted that the procedures for informing the President of program changes would be discussed between the Chairman and the President and that, after Presidential approval, the JCAE would be informed of the test plans by letter, and a directive to the General Manager to carry out the Nougat program would be issued. It was also noted that supplemental funding from Congress would be requested to support testing beyond the first 15 tests and for additional preparations for subsequent testing.

After a hiatus of more than two years, the Nevada Test Site Planning Board held a meeting at the Test Site on September 13. They had plenty to talk about, as indicated by the agenda (Table XVI). Reporting to Jim Reeves, the NTS Test Manager, and chaired by Al Graves of LASL, the membership included Bill Ogle of LASL; Duane Sewell and Roger Batzel of Livermore; Leo Kiley of Field Command-DASA; Robert Corsbie of Headquarters, AEC, Civil Effects Test Office; John Eckhart of Sandia; and Bob Miller of ALOO (Secretary).

Early on, Colonel Anderson of DMA, in response to a question about the decision on which tests to do on which days, stated that these decisions had come straight from the President and probably had some political basis. In subsequent discussions, the Board considered the shots proposed by the various agencies and developed a schedule of events including a short-term program of 15 tests running through February as well as a mid-term program extending into September of 1962 (Table XV). They recommended that Presidential approval for the special nuclear material to be expended in Nougat be in gross figures rather than related to specific events. LASL stated that after the first four events they were basing their planned activity on a concept of two events per month. Device readiness would influence the schedule, as well as site readiness. In addition to the weapons test program, it was felt that two Plowshare events per year could be accommodated in side-drifts of the U-12b, e, or g tunnels as a rather small addition to the schedules, and that the Plowshare "Wagon" event could be accommodated in Area 18. As for DOD experiments other than Hardhat and Marshmallow, the philosophy was now that they would not be considered in an integrated fashion by the Planning Board, but would be approved in Washington and integrated into the schedules at the field level. Lengthy discussion addressed the question of where to carry out LASL's Ex.(b)(3) test. It was agreed that U-12e.03b would be returned to Livermore and should not be used for a large shot, but that one of the other large-shot sites in the tunnels (e.07 or e.06) might be available if it turned out the Ex.(b)(3) [redacted]

In addressing the Vela Uniform program, it was decided that the Linen site (U-12b.07) would now be designated as a low-yield weapons test site, Vela Uniform programs would be integrated on a noninterference basis with other tests, and the DOD Test Group Director would work with each Laboratory Test Group Director to coordinate Vela Uniform activities. The group decided that any needed "care and feeding" of the

8 million pounds of high explosives stored at the Test Site for Linen was the responsibility of the ALOO office of field operations (OFO). It was noted that, as stored, the HE was not an immediate safety problem, but since it was not to be used for Linen, it should eventually be disposed of, perhaps being used in the DOD Groundhog program (which might utilize up to one and a half million pounds) or by various other potential customers.

TABLE XVI
AGENDA
MEETING OF NTS PLANNING BOARD
September 13, 1961

1. Review DMA-LASL proposed events and schedule. If possible, integrate LRL items.
2. Consider DOD proposed list of experiments.
3. What constitutes the short-term program?
4. Consider and recommend emplacement of LASL Ex.(b)(3) -U-12e.03b or deep-hole Area 3.
5. What, if any, policy is recommended for integrating the Vela Uniform program?
6. Consider disposition of HE (Area 2)-8,000,000 pounds.
7. Consider immediate and longer range list of support facilities required at NTS.
8. Consider possible mid-term program from standpoint of devices and possible sites.
9. Consider possible long-term program from standpoint of possible required facilities.
10. What can be done now to implement 8 and 9 above.
11. What impact, if any, does Gnome (readiness December 10) have on technical capability?

The Board considered a number of specific items concerning NTS support facilities which would be the responsibility of Reeves' office. These included (a) improvements in housing, administrative laboratory space, and recreational facilities, and (b) augmentation of the labor force as soon as possible so as to establish a 40-hour workweek for the crafts and allow a 6- to 7-day workweek for specified areas when required to meet schedules.

After consideration of the mid-term program, shown in the second part of Table XVII, The Board recommended (a) immediate action to construct G tunnel for tests beginning in late spring or early summer 1962, (b) continuation of deep hole exploration for LASL high-yield events, including immediate engineering geology assistance and expansion of the long-range hydrological program (including possibly eight deep holes as part of the groundwater studies) to provide engineering data for high-yield test facilities, and (c) immediate initiation of studies and activities addressing the feasibility, site, costs, and schedules for a "Christmas Tree" facility, which both Livermore and LASL would share, should it prove feasible. It was further recommended that the NTS support organization be prepared to provide (a) mining crews to extend the U-12b complex, mine drifts, and shafts in the U-12 complex, to mine a new U-12g complex, to tunnel or drill a vertical shaft in dolomite, and to carry out postshot exploration in the Hardhat tunnel; (b) drilling crews to carry out Area 3 exploration and emplacement; (c) LASL deep hole exploration; (d) postshot exploration of Hardhat; (e) exploration of the Christmas Tree concept; (f) deep hole drilling for the hydrological program; and (g) drilling of many small diagnostic holes both horizontally and vertically.

TABLE XVII
NTS PLANNING BOARD RECOMMENDED SCHEDULE OF EVENTS
OPERATION NOUGAT

Ex.(b)(3)	Sponsor	Nickname	Ex.(b)(3)	Location	"R" Date
	LRL	Antler		U-12e.03a	09/15/61
	LASL	Shrew		Area 3 (250')(3ac)	09/16/61
	LASL			Area 2 (800')(3ae)	10/01/61
	LRL	Chena		U-12b.09	10/10/61
	LASL			Area 3 (500')(3ag)	10/15/61
	LASL			Area 3 (1200')(3ah)	11/01/61
	LASL			Area 3 (1200')(3ai)	11/15/61
	LASL			Area 3 (1200')(3aj)	12/01/61
	LRL			U-12e.03b	12/15/61
	LASL			Area 3 (2000')(3am)	Early Dec.
	LRL	Jordan		U-12e.02a	01/15/62
	DOD	Hardhat		U-15a	Early Jan.
	LASL			Area 3 (800')	01/62
	LRL	Eel		U-12e.04	02/01/62
	LASL			Area 3 (1200')	02/11/62
	LRL				
	Laboratory Determination				
	Laboratory Determination				

Midterm Program
(All devices, yields, locations, and "R" dates very tentative)

Ex.(b)(3)			Ex.(b)(3)		
	LRL	Yellowstone		U-12e.07	05/62
	LRL			To be assigned	Spring 62
	LRL	Pecos		U-12e.08	Mid-03/62
	LRL			New 12e site	03/62
	LASL			To be assigned	03/62
	LASL			To be assigned	04/62
	LRL	Yukon		U-12e.06	04/62
	LASL			Area 3	05/62
	LASL			Area 3	06/62
	DOD	Marshmallow		U-12e.01 or G	06/62
	LRL			New U-12b	06/62
	LASL			Area 2	07/62
	LRL			New U-12b	08/62
	LASL			To be assigned	
	LASL			To be assigned	09/62

Other NTS Events

LRL		To be announced	
LRL		To be announced	
LRL		To be announced	
LRL	Wagon	To be announced	

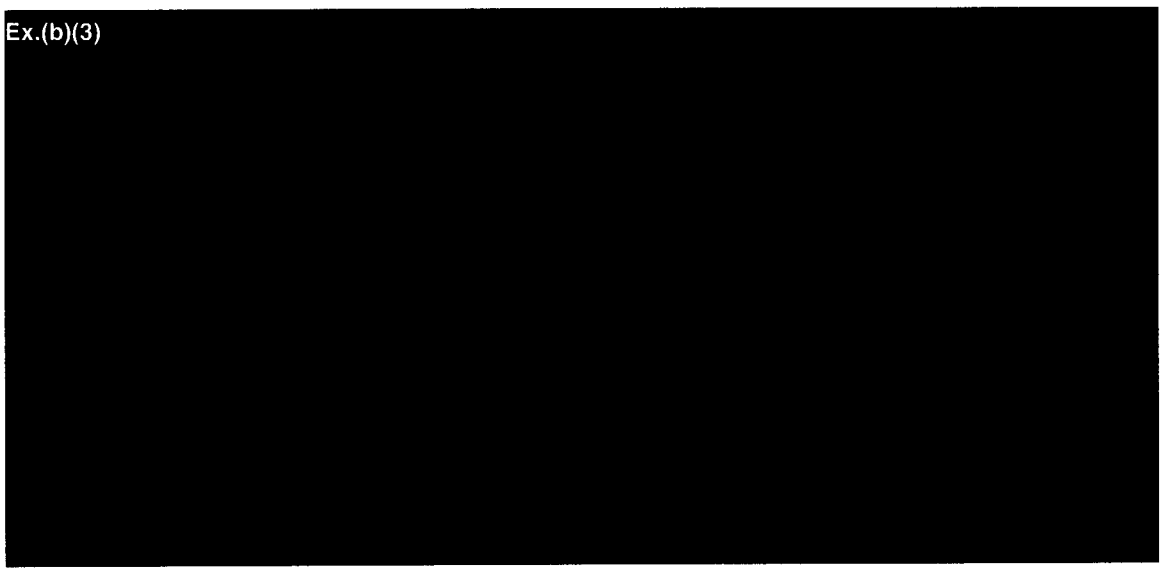
Other Events Which May Affect NTS Schedules

LRL	Gnome	Ex.(b)(3)	Carlsbad	12/61

In addressing a possible long-term program and facilities to support it, the Board concluded that there was a valid and urgent need for an underground high-yield shot facility, that expanded support facilities for both technical and support personnel were required, and that a continuing program of three or more shots per month would be assumed for the indefinite future. The Board concluded that the Plowshare Gnome event would not have a major impact upon weapons testing except in the availability of technical personnel, a problem which could be resolved by adjustments in scheduling.

The group estimated that the total cost of the construction projects at the Test Site would be $6 million, the cost of those items recommended for immediate action being about $1,750,000.

The LASL diagnostics planned for the underground tests at this time (before the first tests) were alpha and yield measurements for both single- and two-stage devices, radiochemistry for single-stage devices, and time interval measurements for two-stage devices. Livermore, in a September 12 message from the Director, John Foster, to Betts, described plans to do alpha, high-explosive transit time, and pin measurements on the first test, as well as radiochemical yield determination. The types and descriptions of Livermore diagnostics planned for underground tests upon test resumption are listed as follows in a January 12, 1962, message from Sewell to Betts:



On the 13th and 14th of September, Ogle and the DASA staff discussed LASL radchem sampling needs for LASL shots. LASL wanted samplers available to monitor the underground shots but did not want to make a formal request since, of course, they were not supposed to vent any radioactivity. Some of these samplers (B-57s) were off in Australia and Colonel Kiley was worried about the rest of the planes being sent there, which might lead to unavailability of samplers in the event of U.S. atmospheric testing. Ogle noted in his diary that the B-57 people were willing and, in fact, anxious to fly a sampler on the LASL underground tests and that Kiley agreed to provide one for the first shot, after which future usage could be debated. Final considerations regarding firing Antler were discussed by the Antler Advisory Panel at the CP at 4 p.m. on the 14th of September. The Panel consisted of Al Graves, Chairman; Roger Batzel, Alternate Chairman; Clint Maupin, Orin Stopinski, O. Placak, Gordon Dunning, Gary Higgins, and P. W. Allen. Dale Nielsen presented the containment figures, and concluded that the probability of any measureable off-site fallout was

extremely small. The Panel recommended to Jim Reeves, the Test Manager, that the device be detonated as scheduled.

Underground Testing Resumes

The Livermore Antler test of their Ex.(b)(3) device occurred in location U-12c.03a at 10 a.m. PDT on September 15, 1961. Unfortunately, large-scale venting began at the tunnel portal several minutes after the event, leading to loss of virtually all the Livermore data. This development was to prove indicative of the problems with tunnel containment for some time.

General Betts sent a personal message to Hertford, Bradbury, Foster, and Schwartz on September 15 expressing his gratitude to each of their organizations for their response during the preparation period. He stated that, since August 31,

> DMA has had occasion to request a large quantity of information from all of you. Without exception, I can say that you have accepted my requests fully within the spirit in which given and your cooperation, both with respect to timing and with respect to substantive information, has been exceedingly gratifying. Also, you have been on top of the problem and have volunteered much information, in addition to the specific requests from DMA, which has been most helpful and beneficial. I know that this has meant a lot of work from, for each (Ed. note: from and for each . . .) of you individually, and for your organizations. I wish to take this opportunity to thank you for your help during this particularly trying period.

On September 16, LASL fired its first post-moratorium test, Shrew Ex.(b)(3) in the U-3ac vertical hole, which LASL preferred over tunnel emplacement. Although it could have been performed as early as the 10th or 11th, as a result of political decisions noted earlier, it was the second test in the series, one day after the Livermore tunnel test.

Ogle reported on the first two underground tests at a LASL WWG meeting on the 19th of September. The Livermore Antler test Ex.(b)(3) was fired at a point 1,760 feet below the surface. Alpha detectors were placed in the tunnel about 1,000 feet from the device. Not long after the detonation, radioactive debris began to escape from the tunnel entrance, from the ground above the device, and from a point above the end of one of the other tunnels. Later, a highly contaminated stream of water flowed from the tunnel entrance. The entire tunnel system, along with the alpha gear, had to be abandoned temporarily and recovery of the data was not expected. Speculation was that water, which was initially lying directly above the blast, drained into the blast cavity, vaporized, and was subsequently dispersed as radioactive steam. The LASL Shrew test Ex.(b)(3) was fired in a vertical hole 330 feet deep which was backfilled with sand except for a sampling pipe leading to the radiochemical sampling pots. Containment was such that no particulate matter was found at the surface, but some air samples about 30 feet from the hole indicated seven mR per hour and one filter paper from the B-57 that did air sampling gave a count of about 20 mR per hour. Indications were that this activity resulted mostly from gaseous fission fragments.

Ogle also reported on the LASL schedule: Ex.(b)(3) had been interchanged so that the latter test would be performed first in a vertical hole at the same depth as Shrew, Ex.(b)(3) and with the same instrumentation. The present drilling capability would allow a shot approximately every other week. He reported that the water table was at 1,600 feet depth, which would place the Ex.(b)(3) shot below water level, necessitating moving it to another location farther north. He also noted that arrangements had been made for core drilling in an area containing a granite bed extending horizontally for about six miles and suggested

that the area offered promise as a site for very deep waterproof holes which might prove satisfactory for yields as large as one and a half megatons.

Other WWG discussion led to a significantly modified schedule. [redacted] Ex.(b)(3) [redacted] These would be held for possible atmospheric testing, presumably by airdrop over either the EPG or the ocean. Estimated delivery dates were six and eight weeks, respectively. At the next WWG meeting on September 27, Harold Agnew presented the newly-received, revised underground schedule for Nougat (Table XVIII), which reflected the LASL changes.

TABLE XVIII
REVISED NOUGAT SCHEDULE
September 27, 1961

Ex.(b)(3) [redacted]

On September 22, Ogle sent to Reeves a brief description of the results of the first LASL underground event, Shrew. Quoting extensively from the summary:

> It was detonated at a depth underground of about 325 feet inside a buried canister 32.5 feet long. The canister was placed at the bottom of a 36-inch diameter hole lined with steel 1/2-inch thick. The hole was filled with sand above the canister to about 7 feet below ground surface at which point the filling became concrete. A radiochemical sampling system, basically consisting of 2-inch diameter pipe, came up from the device through the sand and turned to feed sampling pots on the surface whence it went into one of the old Hardtack shot holes used as a dump hole.
>
> The shot was detonated at 12:45 p.m., September 16, 1961. No immediate effects were noted; however, remote control radiation monitors indicated high radiation levels above ground. Early rad-safe surveys in the first half hour after the shot showed that practically all radiation was associated with the portion of the sampling system that is above ground. Radiation levels as high as 10,000 R per hour at a meter were reported as associated with one of the sampling collector pods. A B-57 sampler aircraft made four passes downwind from the hole and reported no activity. However, upon return to the field, it was found that the filter papers were at about 20 mR

per hour. At the same time, it was discovered that the filter papers in the air samplers placed some 30 feet from the hole on the surface of the ground read 7 mR per hour. The pulse-height analysis of the radiation from those filter papers showed that they had collected gaseous fission fragments such as xenon, krypton, or other elements with gaseous precursors. No statement can be made at the moment as to what proportion of the gaseous fission fragments reached the air, but data were obtained that will allow a later statement on the subject. No particulate radioactive material was noted on the surface of the ground even immediately adjacent to the hole. Thus, it seems proper to conclude that the particulate radioactive material from the detonation was completely contained; that there was some leakage of gaseous fission fragments, probably percolating right through the dirt; and that the radiation observed above ground around ground zero was almost entirely due to active material that was contained in the sampling system.

Since the sampling system was so hot, only small samples could be obtained from it. Laboratory analysis shows these were highly fractionated; however, it is expected that the sample to be obtained by taking all that is contained in one of the sampling pots will be moderately satisfactory. The samples will be recovered about September 23. Preliminary results from those samples indicate that the device went about as expected, but no precise yield can be quoted at this time. The alpha system operated properly and the results are close to those predicted.

I should like to comment that a great deal of credit is due to the AEC and its subcontractors, Reynolds and EG&G. The support we were furnished during the critical two weeks before this shot was outstanding and clearly made the detonation possible on that date.

Thus, after the first two underground tests of the new series in which each Laboratory was attempting complete containment of radioactivity, the technique using a tunnel drift in volcanic tuff had failed to achieve containment, destroying most of the data and rendering the tunnel complex unusable for some time. The technique using a vertical hole in alluvium had contained satisfactorily. Now, having achieved the politically desired early resumption of testing, the Laboratories could devote a little more attention to the real problems facing them, some of which were how to contain, how to get the best diagnostic information, how to improve drilling and tunneling, how to integrate Vela Uniform measurements with the ongoing test program, and how to perform high-yield tests underground. They might also investigate the problems of water table location and water contamination, development of the Christmas Tree concept, and possible acceleration of weapons development by atmospheric testing at the NTS, etc.

The specific objectives of the first two U.S. shots are of interest and are contained in a discussion of the AEC's General Advisory Committee on October 19 through 21. [redacted]

Ex.(b)(3) [redacted]

Operation Nougat

In a September 19 message, Bradbury informed General Betts that LASL felt it advisable to interchange the Ex.(b)(3) [redacted] Ex.(b)(3) [redacted] The reason was the lack of experience with the containment depth-of-burial rules and a desire to gather more confidence by performing the lower yield Ex.(b)(3) [redacted] test first. The containment design for the [redacted] shot was thought to be very conservative at the planned depth Ex.(b)(3) [redacted] Furthermore, there would be a fairly trivial venting problem if the [redacted] shot should turn out to be inadequately contained.

On September 20 Betts notified the Laboratories and Operations Offices that verbal approval for Nougat had been received from the President and that confirming written approval would be provided to the field when such was received. Betts emphasized another point in this message; namely that the President:

> . . .is most, repeat most, anxious to accelerate time scale of this program. This expressed wish could stem from understandable impatience reacting to impact of very high rate of testing being carried out by U.S.S.R. However, interest in acceleration might also stem from concern that international, as well as local, pressures will build up over next few months and force cessation of testing. Accordingly, my previous instructions reference deliberate pace that could be sustained indefinitely must be modified to request that pace over next few months be maximum attainable in light of device, diagnostics, and site limitations. Accordingly, have your staff review program again to determine what steps can be taken to accelerate the schedule as now planned, perhaps introducing greater risk with respect to getting adequate results from each test.

Betts said he would meet with all of the addressees' representatives at Mercury on September 28 to thoroughly review the program and revise it as appropriate.

Norris Bradbury replied to Betts on September 21 concerning the possibility of accelerating the LASL program, describing what had been learned about underground testing to date, and suggesting how that foreshadowed the future of that technique. As for the only LASL test to date, he said:

> Ex.(b)(3) The actual curve has some funny business towards the end which is probably either electronics or some effect of surrounding material causing neutron backscatter. We obtained very large radiochemical samples which are very badly fractionated, mixed up with solids and partially dissolved and condensed water vapor, and which are going to be really tough, a really tough and long mess to unscramble. There is a real question in my mind as to whether the effort involved Ex.(b)(3)

Furthermore, on the present schedule, and particularly if the schedule were accelerated, "these samples are just going to pile up, any short-lived stuff that might have been helpful will disappear, and the problem will simply get worse. We are not arguing one way or the other, but hope people at high levels or any other levels are not kidding themselves about this aspect of life." In this same message Bradbury made some detailed arguments about quick-response atmospheric airdrops, noting that the Air Force ought to be able to drop Ex.(b)(3) very quickly, within one week, and also setting forth the fact that Sandia and LASL were already "working like beavers" to get some (drop) cases, Ex.(b)(3) which could be done in about two months. One of Bradbury's final comments was that "the local quipsters are making the remark that the Russians will bury us in our own holes."

Expanded Testing Considered

In addition to underground testing, there were a number of parallel discussions going on about other testing possibilities, both self-initiated by certain agencies and in response to Washington requests. Very soon after the Russian test resumption the discussions about how to test more quickly in Nevada, as well as overseas, led to the question of atmospheric tests in Nevada. On September 13, Mr. S. P. Schwartz, President of Sandia Laboratories, advised General Betts that Sandia could provide tethered balloons at the Eniwetok Proving Ground and the Nevada Test Site. On a crash schedule Sandia could prepare an Eniwetok program to carry a 1,000-pound

payload to 5,000 feet in about 90 days, and with the equipment stockpiled at the Nevada Test Site, could lift 2,000 pounds to about 1,500 feet within about three weeks. He also pointed out that LASL had developed a balloon-borne diagnostic Pinex capability during the moratorium. On the 21st of September Reeves informed the Labs that at the NTS there were four 4-foot shot cabs and one 6-foot cab, and Sandia was authorized to increase this inventory; there were six balloons that would carry 2,000-pound payloads to 1,500 feet, four balloons limited to 700 feet altitude, and five partial reels of cab control cable, limited in length to a maximum altitude of 1,000 feet unless spliced; helium trailers; and anemometers. Authorization was given to procure additional cab control cables and to rehabilitate the balloon areas in Frenchman Flat, Area 7, and Area 9. On the same day, Reeves asked LASL, Livermore, and ALOO to submit cost estimates by October 12 for various weapons test program segments, namely, (a) the possibility of developing a balloon contingency for both NTS and EPG, (b) work needed in the g tunnel complex, (c) Christmas Tree preliminary engineering, (d) site evaluation and geological exploration, (e) feasibility studies of (1) extension of main tunnel b, (2) exploration for deep holes for the LASL weapons program, and (3) the hydrological program; and (f) weapons and other related items for supporting each planned event. He also requested completion of event location plans for both Nougat and the so-called midterm program to begin after April 1962 (see Table XIX). Livermore, at this time, had used one tunnel location, which contaminated substantial parts of the tunnel, but they were projecting 10 more tunnel shots through the following August.

The September 21 Reeves memo on cost estimates was modified on September 30, as a result of the September 27 and 28 Planning Board meeting. The requested estimates for NTS work now included the following: shift of the event in dolomite to the midterm program; tunnel preparation for i, j, and k; preparation to emplace a 10-kt device in Area 3 as a possible added event; reentry and decontamination of underground facilities; coaxial cable procurement; a temporary power facility in Area 12; equipment; and assumption of Area 18 as the new location for the DOD Marshmallow event shown previously to be located in U-12e.01 or g. Regarding the balloon contingency program, Reeves noted that preparations were already under way for a contingency program in which five LASL events and one Livermore event would be switched to this method of execution, and he directed Sandia to develop an aerodynamic balloon capability at the NTS. EG&G was to furnish estimates for the following work: Area 7 alpha system; relocation of U-12e alpha system to i, j, and k tunnels; development of alpha systems for U-12e and U-12g; other activities addressing overseas testing; and expansion of the alpha detector inventory.

A September 25 message from Betts to Hertford requested a detailed proposal including a schedule and cost estimate for testing with balloons at either the NTS or EPG, but prohibited procurement of additional balloons or any flying of the balloons for the time being.

In one of the myriad of communiques between Bradbury and Washington on various possible atmospheric programs and justifications, etc., on September 25 Bradbury concluded another LASL shot list with the following quote: "After listening to highest authority's excellent speech before the United Nations this morning, we find it hard to see how all the foregoing can be other than an exercise for the student. Nevertheless, . . ."

The NTS Planning Board met on September 27 to prepare for a meeting with General Betts on the following day. Betts had asked the test community how the testing pace could be accelerated over the next few months to the maximum attainable test rate consistent with device, diagnostics, and site limitations. The Planning Board addressed three questions raised by Betts, namely, What acceleration is possible, utilizing existing underground sites? What acceleration is possible by resumption of

TABLE XIX
NOUGAT
September 21, 1961

Location	Sponsor	Ex.(b)(3)	"R" Date
U-12e.03a	LRL		09/15/61
U-3ac (250')	LASL		09/16/61
U-3ag (500')	LASL		10/01/61
U-12b.09	LRL		10/10/61
U-3ae (800')	LASL		10/15/61
U-3ah (1200')	LASL		11/01/61
U-3ai (1200')	LASL		11/15/61
U-3aj (1200')	LRL		12/01/61
U-12e.03b	LRL		12/15/61
U-3am (2000')	LASL		Early December
U-12e.02a	LRL		01/15/62
U-3 (800')	LASL		01/62
U-12e.04	LRL		02/01/62
U-3 (1200')	LASL		02/11/62
Dolomite	LRL		04/62

Note: The Hardhat event, 5.0 kt, in U-15a, is included in both Vela Uniform and Weapons Test Programs.

Midterm Program
(All devices, yields, locations, and "R" dates very tentative.)

		Ex.(b)(3)	
U-12e.07	LRL		05/62
To Be Assigned	LRL		Spring 1962
U-12e.08	LRL		Mid-March 1962
To Be Assigned	LASL		03/62
To Be Assigned	LASL		04/62
U-12e.06	LRL		04/62
Area 3	LASL		05/62
Area 3	LASL		06/62
U-12e.01 or G	DOD		06/62
New U-12b Site	LRL		06/62
Area 2 U	LASL		07/62
New U-12b Site	LRL		08/62
To Be Assigned	LASL		09/62
To Be Assigned	LASL		09/62

atmospheric testing at the NTS? What can be done in Pacific operations (airdrops, balloons, barges, etc.)? The Board reached the following very briefly stated answers for the first two questions on their first day of meeting. First, "The conclusion reached was that no acceleration was possible; further, that the present schedule was optimistic;" second, "The conclusion reached was that approximately five LASL events could be accelerated. The LRL events are device-limited, and balloon detonation would not accelerate the schedule." Later discussion about Pacific operations led to conclusions that two airdrops could be accomplished within two weeks; that a short-term air drop program with ground-based diagnostics could be ready in 2 1/2 to 3 months; that a continuing program would require six to nine months; and that a test

of the Nike-Zeus (Thor vehicle) could be ready in six months at Johnston Island. In more detail, the Planning Board's discussions of the underground program focused first on preparations and limitations of various sites. The U-12e tunnel, which, prior to the Antler event, had been projected for seven events extending through the following June, was now contaminated. Decontamination work was proceeding at a rate of about 100 feet per day, consistent with a 3R exposure limit for the tunnel crews. The current exposure rate was 700-800 mR per day, thus limiting workers to about three days of work. Nevertheless, since U-12e provided the only high-yield site (up to 100 kt), the Board wanted all possible actions taken to restore it to operation. Steps were also being taken to add other sites for weapons tests. The i, j, and k tunnels, which were planned as safety shot tunnels, were now all to be extended, beginning in October and November, so as to have a capability for tests Ex.(b)(3) The Board determined that the requirements for drill rigs must be reevaluated by the users. The DOD Marshmallow event which had been planned for U-12e.01 would have to be moved. The DASA representatives said that moving it to a new tunnel, U-12g, was unsatisfactory because of seismic interference from the weapons tests, the pipe alignment requiring about 4 1/2 months without disturbance from other shots. Thus, a new tunnel site would have to be selected and the DOD did not feel that a June 26, 1962, readiness date was feasible.

In addition to shot sites, cabling was a major problem, especially because of planned usage in U-12-i, -j, and -k tunnels and in the Gnome event. Furthermore, LASL, in requiring a new tunnel or deep hole for the Ex.(b)(3) strained the cable requirements even more. The Board noted that Phelps-Dodge, the vendor at that time, was now running at maximum capacity, and foreign sources might be necessary.

Turning to atmospheric contingencies, the Board addressed the balloon capability, Sandia reporting an inventory of ten balloons, six with a capability of 5,000-pound payloads and four with a capability of 2,500-pound payloads, all to an altitude of 1,500 feet. They noted that the average expenditure on Hardtack was 1.5 balloons per shot. Areas 7 and 9 were now ready, they reported, but Frenchman Flat would require power, cable, and general overhaul. Cable was on hand or on order. Sandia said that they could support a shot within two weeks of authorization and if that were granted they could attain a seven-day readiness provided there was authorization for procurement of additional balloons (four- to six-week lead time) and for recruitment and training of balloon crews. LASL stated that they could have five devices ready on seven- to ten-day intervals for balloon testing. Livermore said that they were device-limited to a two-shot program and they preferred tunnels (if available) for the short-range program because of the diagnostics required.

The Board listed several EG&G actions for which EG&G had provided cost estimates; namely, establishing an alpha system for Area 7; moving the U-12e system to i, j, and k; and developing additional alpha systems for U-12e and U-12g.

The Board discussed and made several recommendations on capabilities needed at the Test Site for the Air Force, the Public Health Service, and the Weather Bureau. In these discussions, the use of towers for NTS atmospheric testing was not ruled out, but it was noted that balloons were preferred unless maximum diagnostics were required and adequate time were available.

The Board also discussed, at length, possible overseas atmospheric testing requirements, methods, and alternatives. Attached to the minutes were several detailed schedules: the one covering the Nevada underground and balloon programs is shown as Table XX.

The proposed LASL program of atmospheric tests was also discussed by Agnew at a meeting of the LASL Weapons Working Group on September 27. The proposal included balloon shots at the NTS, which would start immediately and continue with tests at 7- to 10-day intervals. Beginning with the Ex.(b)(3) on October 1, the series would

then include Ex.(b)(3) [redacted]. At the same meeting, George Cowan reported on the results of the sampling pot technique used on Shrew. Of the four pots used, it was found that three did not throttle properly due to the high velocity of the sample. The gamma spectra of samples from the fourth pot looked normal, but processing was going slowly. Good results were expected, eventually.

TABLE XX
TENTATIVE SCHEDULE
NTS PLANNING BOARD MEETING
September 27, 1961

Ex.(b)(3) [redacted]	Sponsor/ Nickname	Ex.(b)(3) [redacted]	Location 09/25/61	NTSO[a] Plng. "R" Date	DMA Aprvd. Date	Balloon Date[b]
	LRL/Antler		U-12.03a	09/15	09/15	
	LASL/Shrew		3ac	09/16	09/16	
	LASL		3ae	10/15	10/15	Oct. 10-15
	LRL/Chena		U-12b.09	10/10	10/10	
	LASL		3ag-500'	10/01	1-/01	
	LASL		3ah-1200'	11/01	Early Nov.	Early Oct.
	LASL		3ai-1200'	11/15	Mid-Nov.	Oct.
	LASL		3au-1200'	12/01	Mid-Dec.	Oct.-Nov.
	LRL/Gnome		Carlsbad	12/10	12/10	
	LRL/Feather		U-12e.03b[i]	12/15	Mid-Dec.	
	LASL		3am-2000'[k]	Early Dec.	Mid-Jan.	
	LRL/Jordan		U-12e.02a[m]	01/15/62	Mid-Jan.	
	DOD/Hardhat		U-15a	Early Jan.	Early Jan.	
	LASL		Area 3-1800'	Jan.	Mid-Feb.	Oct.-Nov.
	LRL/Eel		U-12e.04	02/01	Early Feb.	
	LASL		Area 3-1200'	02/11	Mid-Feb.	Dec.
	U.K.		Open	Open		Oct.

[a] NTS Office of the ALOO Office of Test Operations.
[b] Date if balloon operations accelerated.
[c] Detonated 9/15/61.
[d] Detonated 9/16/61.

Ex.(b)(3) [redacted]

Vela Uniform Reorientation

On September 15 DASA Headquarters directed Field Command to make whatever changes were needed so that current Vela objectives were achieved by getting data from the Antler, Eel, and Yukon events, and to gather close-in surface motion data from the Jordan, Pecos, and Chena events using funding allocated for Crystal.

Beginning on Nougat, the overall DOD management of the Vela Uniform measurements became the responsibility of the DASA Continental Test Organization (CTO). In parallel with these DOD changes, and as reported in the September 26, 1961, Planning Directive Number VU-9-9-61, the AEC Vela Uniform program was to be pursued, but, in particular, the DOD would be performing measurements on underground tests whenever possible. That directive set out briefly the technical projects including the following general areas:

> Earth motion measurements, such as particle motion studies and strong-motion seismic measurements, sponsored by DASA.
>
> Electromagnetic measurements, such as earth current measurements and surface EM measurements, sponsored by AFTAC.
>
> On-site inspection projects, such as vertical surveys of explosion sites, inspection of vegetation damage, and aftershock and subsidence measurements, sponsored by AFTAC.
>
> Seismic measurements, sponsored by AFTAC.

Some mix of these projects was pursued on all of the underground tests, beginning with Antler on September 15.

Nougat Continuation/Impact on Labs

Both Laboratory directors addressed correspondence to General Betts at the end of September, discussing the impact of the weapons test resumption on their Lab's programs and projecting supplemental funding needed to meet the anticipated future demands. Norris Bradbury, on September 29, wrote that from 80 to 100 additional people were needed in the weapons programs, with about half required from internal transfers immediately and the other half needed in the next 12 months. A very rough estimate of the increase in LASL weapons program costs would be about one and one-half million dollars in FY 1962 and two and one-half million dollars in FY 1963. Bradbury was attempting to meet all of the weapons program needs while not severely impacting the Rover and other reactor programs. From Livermore, Foster wrote to Betts on September 30, noting that in underground testing,

> In increasing our rate of progress, it is extremely important to increase the number of both the small- and large-yield underground facilities. Operational plans must assure sufficient facilities so that the temporary loss of any one of them will not materially slow the program. We are presently designing a high-yield "Christmas Tree" facility, and construction of an additional low-yield complex (G tunnel) has been started.

As for Livermore expansion, Foster requested a variety of items, including authority to expand four Livermore buildings, to increase the Laboratory manpower by 590 people by the end of Fiscal Year 1963, and to increase funding by 16% in FY 1962 and 44.6% for FY 1963 over the existing budget of $49.1 million.

LASL was projecting a possible firing schedule of two tests per month, as indicated by the proposed shot schedule circulated by Ogle on September 30. Following Ex.(b)(3) (the Boomer event) on October 1, five events were scheduled: October 15, November 1 and 15, and December 1 and 15. A brief description of Boomer was

given by Al Graves at the Boomer weather briefing on September 30. The hole used was U-3aa, approximately 340 feet deep, with the canister about 40 feet long. The hole was backfilled with sand to about 10 feet from the top and then filled with concrete, a configuration almost identical to Shrew. "The radiochemical pots on this device are set in concrete boxes which have 1-foot concrete lids. The pots and radchem parts are 6 feet underground and backfilled."

On the day that Boomer was detonated (October 1), General Betts reported to the Commission the success of the test, noting that there had been no venting. In view of this he inquired as to the advisability of announcing the test and the Commission agreed not to make a public announcement at that time. As it turned out, they never did.

General Betts reported at an MLC meeting on October 3 on the progress of Nougat, remarking in connection with the Antler contamination problems:

> They are now working back into the tunnel, washing down the walls, and mucking out the result.... Hope is that if they get past the Antler site, they will get into an uncontaminated area and to the other sites. One month delay in tunnel use is foreseen. Have put crews on other tunnels originally intended for safety tests. These tunnels may be raised Ex.(b)(3) Are building up their drill capability. Now have 15 drill rigs, some of which are for radchem sampling but 5 of them are 36-inch affairs. LASL says they are not limited by drill capability.

Later in the meeting, in a discussion of the factors limiting various testing techniques, Betts reported that the three words limiting acceleration of the underground program were "cable, device, and site."

The magnitude of the cable procurement problem is illustrated by an October 5 memo from Jim Reeves discussing an October 2 meeting which concluded that contamination of facilities, delays in construction, and other factors could seriously affect the cable requirements. Reeves appointed W. R. Hickey of the AEC as chairman of a committee to review periodically this situation. The other representatives included Don Shuster of Sandia and Bob Newman of LASL. The three Test Group Directors (Ogle, Nielsen, and Kodis) were asked to collect their cable requirements for testing through the end of February 1962 and provide these to Hickey by October 15.

An October 6 message from Jane Hall, LASL Assistant Director, to Lieutenant Colonel Haney of DASA, briefly summarized the origin of the various components of LASL devices. All high-explosive components came from the Iowa Ordnance Plant at Burlington, Iowa, with minor exceptions. All firing sets were provided by LASL Group GMX-7, again with minor exceptions. All zippers were provided by Sandia, zero racks for the devices were provided by LASL/EG&G, and the canisters were prepared by LASL. Final assembly of the pit in the HE was performed at LASL. All gas reservoirs were obtained from Savannah River Plant (SRP) and the nuclear materials were obtained from Rocky Flats, LASL, and Oak Ridge (Y-12).

On October 7, AEC Chairman Seaborg, in a letter to President Kennedy, noted that the underground test program must be supplemented by atmospheric testing if nuclear testing was to be accelerated and increased in scope.

As of October 9, while the U.S. had detonated three very small devices underground, the Russians had fired 24 devices in several different locations with a yield totaling Ex.(b)(1) On that day Deputy Secretary of Defense Gilpatric wrote a letter to the President which included new recommendations for atmospheric and other types of testing and stated:

> Though a limited amount of valuable data can be secured from the current underground test series with low-yield devices, it is being obtained at a relatively slow pace as is characteristic of underground testing. It may also be emphasized that testing underground can neither provide all the effects data necessary to satisfy defense

> requirements outlined above nor permit the most rapid and full exploration of high-yield weapon technology by the Atomic Energy Commission Laboratories. If it is desired to accelerate the present schedule of operations at the Nevada Test Site significantly, it will be necessary to use balloon techniques.

He then set out several specific device tests scheduled for underground detonation and suggested how they could be accelerated by one or two or more months, given a balloon technique. Finally, he recommended that the DOD and AEC be authorized to prepare for atmospheric testing at the NTS, among other locations.

On October 10, in a letter with a similar goal from Chairman Seaborg to President Kennedy, Seaborg referred to the earlier recommendations for preparation for low-yield atmospheric tests in Nevada conveyed jointly by Secretary Gilpatric and Seaborg on September 20. He noted that the quickest way to accelerate the U.S. test program would be to do some of the Nougat tests one to two months ahead of the current schedule by:

> Using tethered balloons at the Nevada Test. . . . Balloons are on hand. Rehabilitation of the ground handling equipment and training of the crews are the pacing factors of the steps required to achieve readiness; these steps will take from 10 days to 2 weeks. Sampling aircraft and diagnostic equipment can be ready within the same time frame. An advance of as much as 4 or 5 months in the schedule for some of the tests in the follow-on program enclosed with my letter of September 19, 1961, could also be accomplished by use of the balloon technique. Toward the latter part of this program, testing could be conducted much more rapidly if not inhibited by the lengthy process of preparing underground sites. The cost of balloon tests is appreciably less than of those conducted underground, or those utilizing towers, but there is some sacrifice in the technical information attainable.

On October 10 DASA informed George Bing, who was then working on Vela Uniform with ARPA, of the tunnel problems at the NTS, noting that the contamination levels within the U-12e tunnel now promised to "forestall any further events in U-12e for several months. Consequently, to the best of our knowledge, the AEC is planning to open up four additional tunnels tentatively known as g, i, j, and k." While this information was part of a discussion of the Vela Uniform participation in NTS testing, it gave new information on the delay caused by the contamination from the Antler event.

The second Livermore test (and the fourth in Nougat), Chena, was detonated on October 10 at 10:00 a.m. in tunnel U-12b.09. Thirty minutes after the event it was reported from Mercury that containment had been achieved inasmuch as radiation stations in the main tunnel, at the portal, in the near vicinity of the portal, and on the mesa were reading background radiation only. However, only a few minutes later radioactive gas started coming from the stack (directly above the zero room), indicating that the cavity had collapsed, and at one hour past the detonation the reading at that location only was 2 R per hour. Preliminary indications from remote tunnel indicators were that damage in the tunnel was confined to the b.09 drift, although this was only shortly after the shot and there had, of course, been no thorough examination of damage. Reentry of the tunnel was to commence the next day. A few hours later, according to the H-plus 6-hour advisory, the radiation detectors in an area extending 200 feet from the tunnel portal indicated an exposure rate of 10 R per hour. Preliminary indications were that the yield was within the expected range. Ultimately four working days were needed for decontamination and rehabilitation prior to any further construction in the b tunnel.

An October 12 memorandum to Al Graves from the radiochemistry group reported briefly on the results of radiochemical sampling and yield determination on the first two LASL underground events. Both events had exhibited extensive fractionation in pipe samples, and while the phenomenon was not a surprise, "It is greater than had

been expected." Analysis based on the samples available had led to a wide variation of yield, depending upon what isotope was considered in the arithmetic. Various arguments were made to decrease the variance of the calculated yield, but as yet there was still confusion and the results were inconsistent. The radiochemists hoped that the core samples obtained from drillback would yield more reasonable results, as had been the case in previous experience, but the desired core samples were not yet in sight. In summary, they noted: "The chief point in this memorandum is that our experience with prompt sampling for radiochemistry on underground tests has, to date, been unfavorable."

The Boomer rad-chem results were also discussed at the October 12 LASL WWG meeting. It was suggested that the sample pipe probably closed early, giving rise to samples of much different appearance than those obtained from Shrew. In addition, the Boomer sample pots did not contain liquids as was the case with Shrew. However, the Boomer samples were even more highly fractionated. For both events the blower system on the surface collected activity due only to rare gases and their daughters. This observation was interpreted to imply that on the Shrew test the blower system was sampling krypton and xenon that had come up through the sand, but that on Boomer all blowers received the same sample coming largely from the dump hole.

In an October 12 letter from Newman and Ogle to Reeves, LASL proposed to find a more suitable shot area for deep tests than the NTS. Two types of sites were suggested as meeting the requirement for the firing of large devices without introducing contamination into a usable aquifer; namely; (1) an area which contains no underground water or (2) an area in which the underlying soil or rock is so impermeable as to preclude movement of contaminated water into a usable aquifer. LASL would have preferred the entirely dry area and suggested some guidelines as to what areas might be studied. What they were requesting was a search of the literature followed by appropriate reports which would include maps of interest with subsurface contour maps and drawings of area lithology.

Possibility of British Device Test

Another pertinent subject began in parallel about this time. The British, now that the U.S. had resumed testing, were becoming interested themselves in a test or two for their own weapon developments. [redacted]

Ex.(b)(1)

Ex.(b)(3)

[redacted]

Ex.(b)(3)

Ex.(b)(1)
Ex.(b)(3)

Ex.(b)(1)
Ex.(b)(3)

Further Consideration of Expanded Testing

A message from Reeves to the NTS Planning Board on October 13 noted an October 18 meeting to discuss the DOD Hardhat event and requested that the Board also be prepared to provide criteria and justification for resumption of atmospheric testing at the NTS utilizing balloons. Reeves wanted a list of devices to be tested, a recommended schedule, justification for the method, requirements for helium, and assessment of the impact of this method on NTS support facilities. Further, Field Command was asked to submit detailed plans and justifications for effects tests that would require atmospheric detonation.

*See Chapter IV.