POR 6337

OPERATION MINUTE GUN

SHOT MING VASE

INTERIM SUMMARY REPORT

(POR 6337)

NOVEMBER 1969

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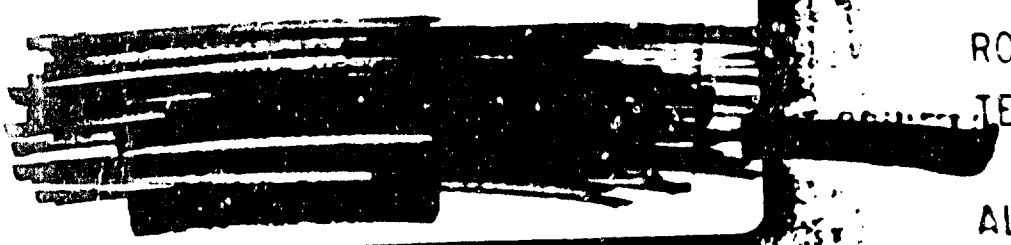

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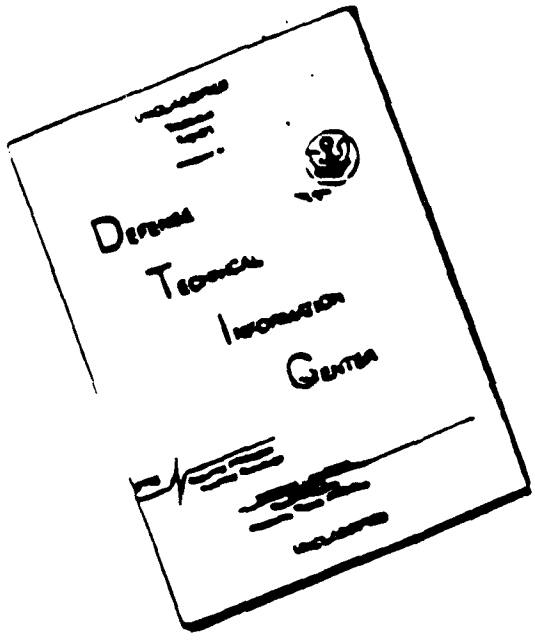

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MING VASE
明朝花瓶

NEVADA TEST SITE

TEST COMMAND
DEFENSE ATOMIC SUPPORT AGENCY
1968

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OPERATION MINUTE GUN

POR 6337
(WT-6337)

SHOT MING VASE

PROJECT OFFICERS' REPORT

MING VASE INTERIM SUMMARY REPORT [redacted]

November 1969

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[redacted]

[redacted]

ABSTRACT

[redacted] NG VASE was a Department of Defense, underground nuclear weapon[redacted] effects test executed at the Nevada Test Site in the U16a.04 tunnel on 20 November 1968. The primary objective of the test was to obtain information on

[redacted]

[redacted] The event was completely contained, and all but a very few instrumentation channels provided data [redacted]

[redacted]

[redacted]

PREFACE

This MING VASE Interim Summary Report was prepared in lieu of the individual Project Officer's Interim Reports (POIRs) traditionally written for each experiment and is in accord with DASA Instruction Number 3000.2, 9 May 1969, Scientific and Technical Information Reports, Weapon Effects Test Event Reports. This consolidated report is intended to provide limited distribution of the preliminary test results. After completion of data analysis, each experimenter, with the possible exception of the AEC laboratories, will prepare, and DASA will publish, a final Project Officer's Report (POR) for general distribution.

This report was written by the Air Force Weapons Laboratory which furnished the Technical Director for MING VASE and by Test Command, DASA which directed the test operation and construction activities. The experimental results presented are based upon brief, written interim summaries furnished by each experimenter at a posttest results meeting held on 21 and 22 January 1969 and on updated information obtained by the Technical Director from the experimenters. The conclusions drawn in this report are those of the authors and have not necessarily been coordinated with nor approved by the experimenters or their agencies.

[redacted]

[redacted]

TABLE OF CONTENTS

[redacted]

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LIST OF TABLES

LIST OF FIGURES

[redacted]

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Page

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CHAPTER 1

INTRODUCTION

[redacted] MING VASE was a Department of Defense, underground nuclear weapon effects test in the Defense Atomic Support Agency's (DASA) MINUTE GUN Series. MINUTE GUN is a series of such tests to provide environments for the examination of the effects [redacted] on military systems, components, and materials. MING VASE [redacted] was executed in a tunnel (U16a.04) at the Atomic Energy Commission's (AEC) Nevada Test Site on 20 November 1968 under existing AEC-DOD agreements.

[redacted]

[redacted]

[redacted]

Several additional experiments were included in MING VASE on a space-available basis to obtain materials and structural response data applicable to components of these and other weapons systems [redacted]

[redacted]

[redacted]

A comprehensive program was included in MING VASE to provide environmental parameters for the experimenters to allow correlation of the effects observed in the test with predictions based upon laboratory experiment and analytical calculations. Several organizations provided either active or passive measurements [redacted] Additionally, the performance of the stemming and containment system and temperature, pressure, and ground shock environments were obtained.

[redacted]

[redacted]

uncertainties in output and effects calculations.

[redacted] MING VASE was conducted under the direction of Headquarters, DASA through its implementing agency, Test Command, DASA. Supervision of the technical aspects of MING VASE was performed by the Technical Director and his staff provided by the Air Force Weapons Laboratory. The experiments were designed and fielded by the various participating agencies and their supporting contractors. The experimental facility was provided, under contract, by Test Command, DASA who also planned and directed major field construction activities performed by the AEC's test site contractors.

[redacted] This report presents a brief description of the MING VASE configuration, experimental program, and chronology prior to presenting a summary of the results of each of the experiments. Conclusions and recommendations with regard to the experiments and test facility also are included.

[redacted]

CHAPTER 2

GENERAL TEST DESCRIPTION [redacted]

2.1 TEST FACILITY [redacted]

[redacted] The underground test bed facility constructed for the MING VASE event consisted of the (1) tunnel complex, (2) the horizontal line-of-sight pipe, and (3) the stemming, containment, and the experiment protection plan.

2.1.1 TUNNEL COMPLEX [redacted]

[redacted] (1) Shot MING VASE was constructed and executed in the .04 drift, U16a tunnel, Area 16, Nevada Test Site. Figure 2.1 is the U16a Tunnel Layout and shows the main features of the entire complex. Figure 2.2 is the as-built U16a.04 Drift and Alcove Plan and also gives the details of the stemming and containment plan. The device location or working point (WP) was Scientific Station 0, Nevada State Coordinates N822,869.21, E634,377.61 at an elevation of 5434.70 feet. This gave a vertical cover of 1010 feet above the WP and a slant range to the nearest surface of 960 feet.

[redacted] (2) Two side drifts were mined as indicated in Figure 2.2: one 110-foot drift at the WP orthogonal to the a.04 drift for Sandia Project 8.43 and the second, a 212 foot drift, which was first used for pipe assembly and then as a

[redacted]

[redacted]

[redacted]

instrument alcove in which GE Project 8.82 located its two Integrated Recording Packages (IRPs). Other alcoves, also indicated in Figure 2.2, were mined to give access to the test chamber and to provide space for controls, equipme diagnostics experiments, etc.

[redacted] (3) Administrative and instrumentation trailers were all located on the portal, there being no mesa trailer park. The signal, control, and power cables were routed out the 16a.04 drift through the Overburden Plug (OBP) in a grouted trench, out the 16a drift through grouted and polymer-stemmed conduits at the Gas Seal Door (GSD) to the portal. Gas seals were installed on all multi-conductor cables at the OBP and the GSD. From the portal, cables were routed to trailers, the Forward Control Point (FCP), and a few pair continued from the FCP to CP-1 carrying RAMS information.

[redacted] (4) The event was fired from the FCP approximately 1.8 miles northeast from the portal. Here were located the Los Alamos Scientific Laboratories (LASL) Control Van (No. 007), the DOD Monitor Trailer, and a trailer in which RAMS and geophone data were received and monitored postshot. As indicated, the latter information was paralled back to CP-1 over the existing 25-pair cable for the AEC Test Manager's information..

[redacted]

[redacted]

[redacted]

2.1.2 HORIZONTAL LINE-OF-SIGHT PIPE (HLOS) [redacted]

[redacted] (1) The HLOS pipe was a [redacted] The features of the facility are shown in Figure 2.3. The HE machine, muffler, Tunnel and Pipe Seals (TAPS) No. 2 and No. 1, Sample Protection Systems (SPSs) No. 2 and No. 1, and the Debris Scoop were all conventional items used on previous events and require no discussion. [redacted] Test Chamber 2 (TC2) was installed after the HLOS pipe was completely installed. [redacted] The guaranteed exposure envelope at each of these chambers is shown in Figure 2.4. [redacted]

[redacted]

(2) Because of the limiting dimensions of the GSD [redacted] was necessary to assemble several pieces underground in the assembly drift. These were TAPS No. 1, the debris scoop, the pipe section between SS 7+47 and SS 7+90, and TC No. 1.

2.1.3 STEMMING CONTAINMENT, AND EXPERIMENT PROTECTION PLA[redacted]

(1) The details are depicted in Figure 2.2 and tabulated in Table 2.1. The details of the zero room and th[redacted] re shown in Figure 2.9.

(2) Although the plan is a standard one, some remarks are in order. [redacted]

[redacted]

[redacted]

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[redacted]

[redacted]

2.2 EXPERIMENTAL PROGRAM

The experiments which were conducted in MING VASE can be placed in the following three categories: the primary effects experiments, the secondary effects and phenomenology experiments, and diagnostic measurements. These experiments and their objectives are briefly presented in this section of the report. Their results are discussed in Chapter 3.

2.2.1 Primary Effects Experiments

(1) [redacted] The objectives were to: (a) [redacted] and (b) obtain data to verify the analysis and prediction techniques employed to establish their performance in this environment. [redacted]

[redacted]

[redacted] Recording of the pressure measurements on material samples was accomplished in a trailer at the portal. The [redacted] measurements were recorded with magnetic tape recorders (Integrated Recording Packages - IRPs) located in a tunnel alcove outside the overburden plug and approximately 850 feet from the experiments.

(2) Project 8.83 was the [redacted] experiment fielded by AVCO [redacted]

[redacted]

[redacted]

were instrumented with accelerometers and displacement gages. Active and passive materials samples were included all stations to fulfill the remainder of the [redacted] objectives. Pressure profile or passive impulse measurements were made on many of these samples.

[redacted] 2.2.2 Secondary Effects and Phenomenology Experiments

(1) Project 8.31 was a passive experiment performed by the Lawrence Radiation Laboratory (LRL) [redacted]

[redacted]

[redacted]

(2) Project 8.43 was a basic phenomenology experiment performed by Sandia Corporation. [redacted]

(3) Project 8.44 was a passive exposure of materials samples [redacted] It was performed by Sandia Corporation to determine effects on various [redacted] materials [redacted] Momentum measurements were made with honeycomb crush material behind some of the samples and with torsion bar gages.

(4) Project 8.60 was conducted by Lockheed

Pages 21-23 are deleted

[redacted]

[redacted]

[redacted]

2.2.3 Diagnostic Measurements ([redacted])

[redacted] (1) Project 8.51 by LASL included three types of measurements: [redacted]

[redacted] (2) Project 8.52 was primarily a calorimeter experiment performed by LRL. A total of 50 active and 12 passive calorimeters of several designs were placed at the [redacted] station. Data from a portion of these were telemetered to CP1 for recording and rapid analysis in addition to being recorded in the portal trailer park. LRL also fielded a passive pinhole camera experiment to document the source intensity variations.

[redacted] (3) [redacted]

[redacted] (4) Project 8.54 by the Naval Radiological

[redacted]

[redacted]

[redacted]

Defense Laboratory (NRDL) also was a [redacted] dosimeter experiment. It was located at the [redacted] station and employed many filtered LiF powder samples for dose measurements. Two additional types of materials were included to evaluate new dosimetry techniques.

[redacted] (5) Project 8.55 was performed by Stanford Research Institute (SRI) and included three separate experiments: [redacted] a filterfluorescer experiment, two multichannel calorimeter experiments, and a pinhole camera experiment. All were installed in pipes extending from the rear of the test chamber.

[redacted] (6) Project 9.62 by SRI included a large variety of measurements to provide data relative to the performance of the stemming and containment design. These included shock wave time-of-arrival measurements and temperature, pressure, and earth and pipe motion data. The transducers were located at various places in the stemming, in and on the pipe, and in the tunnel.

[redacted] (7) Project 9.64 performed temperature and pressure measurements just inside the OBP and the GSD. Gulf General Atomic designed the transducers to provide the measurements in an adverse environment such as would occur if complete

[redacted]

[redacted]

containment were not obtained.

[redacted] (8) Project 9.70, LMSC, in addition to providing the LOS pipe and associated hardware, serviced and monitored the vacuum system and the TAPS and SPS closures. Additionally, a television camera was mounted outside and behind the test chamber to observe the motion of the test chamber and any other phenomena during and after the event.

2.3 Event Chronology [redacted]

(1) [redacted] The planning and preparation for MING VASE, originally called DOUBLE BARREL and renamed in August, 1967, began in early 1967 with a proposed Readiness Date of October, 1967. MING VASE also experienced the usual pains associated with planning the experiments and the readiness date as evidenced by the following sequence of dates promugated at various times as the MING VASE Readiness Date: October, 1967; March, 1968; April, 1968; late May, 1968; 16 October 1968; and 20 November 1968.

(2) Figure 2.10, MING VASE Master Summary Plan, shows in broad detail the construction and fielding phases, while Figure 2.11 depicts the detailed sequence of activities in the 1-year period November 1967 to November 1968. Chronological details are covered in these two figures and will not be repeated. Some comments, however, are in order.

[redacted]

(3) [redacted] Construction Station 2760 (the end) was reached in the U16a.04 drift on 24 May 67. Once the point was reached, efforts were then directed toward tailoring the drift for the event and construction of the facility. [redacted] A first look at the delay required by this change resulted in a 6 June 1968 readiness date. However, in January, 1968 it became evident that the problems of mounting the [redacted] in the test chamber and the problem associated with source would not be easily solved. Therefore, the Test Group Director recommended and Hq, DASA approved in February, 1968 a leapfrog of the Hudson Seal and Ming Vase Readiness Dates. To maintain an 8-week period to allow experimenters common to both events to turn around, a date of 16 October 1968 was scheduled. The final adjustment was made in June 1968 when Hudson Seal required a delay of 5 weeks to 23 September 1968. This resulted in a MING VASE Readiness Date of 19 November 1968. The event was executed on 20 November after a 1-day weather delay.

(4) Events on shot day proceeded calmly on schedule. There were no holds during the 15-minute countdown. The reentry and recovery of experiments are discussed in Chapter

[redacted]

[redacted]

[redacted]

3. All experiments were recovered by 3 December 1968 and shipped from NTS by 6 December. Reentry into the pipe through TAPS No. 1 and to just beyond TAPS No. 2 continued into January 1969. These investigations were completed, then all remaining equipment removed from the tunnel, and finally the operations were secured on 17 January 1969.

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[redacted]

[redacted]

CHAPTER 3

RESULTS SUMMARY

[redacted] MING VASE was executed at 1000:00.031 PST on 20 November 1968. All monitors indicated proper device, closure, and experiment functioning during and after the countdown. The indicated shot time vacuum was approximately [redacted] although the gage indications may have been somewhat high. The stemming and containment system completely contained the detonation. Initial radiation readings from the Remote Area Monitoring System (RAMS) indicated only neutron activation in the LOS pipe drift. All RAMS outside the OBP read background. A definite geophone indication of cavity collapse occurred at H+2 hours. No physical damage was observed in the trailer park. Tunnel ventilation commenced at about H+3 hours on both sides of the OBP. The GSD was opened at H+6 hours to aid ventilation. Ventilation air sampling indicated no radioactive material; however, carbon monoxide in the pipe drift was indicated as expected. The GE IRP tapes and LRL and SRI pinhole camera films were recovered on D+1.

[redacted] Reentry through the OBP on D+1 and subsequent examination of the LOS pipe and drift revealed the following:

[redacted]

[redacted]

(1) Except for slight tunnel floor heave at the portal side of the [redacted] (SS 575) no tunnel damage was observed outside the collapse region between TAPS 2 and SPS 2.

(2) Some telescoping of the LOS pipe and lateral and radial displacement of the rails and ties were observed adjacent to the debris scoop forward of test chamber 1 (Figure 3.1). Evidence of radial displacement also was found at the test chamber rear support.

(3) The pipe was not ruptured outside of TAPS 1. The wire mesh around the pipe where it ruptured just forward of TAPS 1 caught considerable large debris (timber, rock, etc.) preventing it from entering the pipe (Figure 3.2). The pipe also must have ruptured forward of TAPS 2 as evidenced by considerable sand in the TAPS 2 shroud (Figure 3.3).

(4) The TAPS 1 door was down and latched, confirming monitor indications of closure (at +1.077 seconds, Figure 3.4). The door did not provide a gas seal since insufficient pressures were developed forward of it to seat the door [redacted] The TAPS 2 door was down; however, it could not be determined if it had fallen due to ground shock damage to the uplatch or due to the bolt firing

[redacted]

[redacted]

(monitors were lost at ground shock time).

(5) Both SPS boxes closed properly confirming the monitors (Figure 3.5). Several shrapnel craters and holes were found in the SPS 2 doors (Figure 3.6). None were found on the SPS 1 doors (Figure 3.7).

(6) [redacted] (Figure 3.8).

(7) No obvious damage [redacted] was observed in either test chamber (Figures 3.9 and 3.10). All experiments were still hanging. The black soot found covering many experiments principally in TC 1 has been ascribed to SPS HE burn products. [redacted]

(8) In general, little debris was found in the pipe, test chambers, or debris scoop. The debris recovered outside of TAPS 1 has been identified as: sand from the stemming region, plywood slivers and small bits of thin steel from the SPS HE system, an 8-inch piece of wire from the mesh forward of TAPS 1, and a hexcel crush block from the TAPS 1 door latch. A piece of 1/4-inch thick crumpled steel found between TAPS 2 and SPS 2 was originally part of a LOS pipe section forward of TAPS 2 (Figure 3.11).

[redacted]

[redacted]

(9) Carbon soot deposit was found on most of the TV camera face plate. The TV system performed well for approximately 1 second, at which time the view was obscured by flying dust. When the dust cleared about 4 hours later the soot obscured about 75 percent of the field of view. With the remote camera controls, the unobscured camera field could be used to view the whole test chamber area.

Preliminary examination of the major test items was accomplished in situ. Experiment recovery took place during the week of 2 December 1968.

The SRI stemming and containment diagnostics (Project 9.62) generally indicated lower pressures in the LOS pipe than measured on previous tests. The pipe and air gap pressures and earth shock measurements are consistent with the degree of containment observed. A more detailed discussion of the results of these measurements is contained in Appendix A.

The Project 9.64 hardened temperature and pressure measurements indicated an ambient environment inside both the GSD and CSP. [redacted] has been ascribed to ground shock effects on a water tube protecting the transducer. This water protection technique has been found to be unnecessary and will be eliminated in

[redacted]

[redacted]

the future.

[redacted] On 21 and 22 January 1969 (D+62 and 63), a MING VASE meeting was held to provide an opportunity for diagnosticians and effects experimenters to present and discuss the results of their analyses completed to date. This section of the report represents the Technical Director's interpretation of experimental results based on information provided at that meeting and subsequently furnished reports.

[redacted] The reader must recognize, therefore, that <u>the results described herein are not final, and the conclusions tentatively drawn are subject to revision</u> at such time as the data are completely analyzed and appropriate evaluations of possible systems implications are completed.

3.1 [redacted]

[redacted]

Pages 47-67 deleted

[redacted]

[redacted]

[redacted]

Figure 3.1 [redacted] Lateral and radial deflections of rail under the Debris Scoop (DASA CR 353-05-WES-65) [redacted]

[redacted]

Figure 3.2 [redacted] (DASA 353-10-WES-65)

[redacted]

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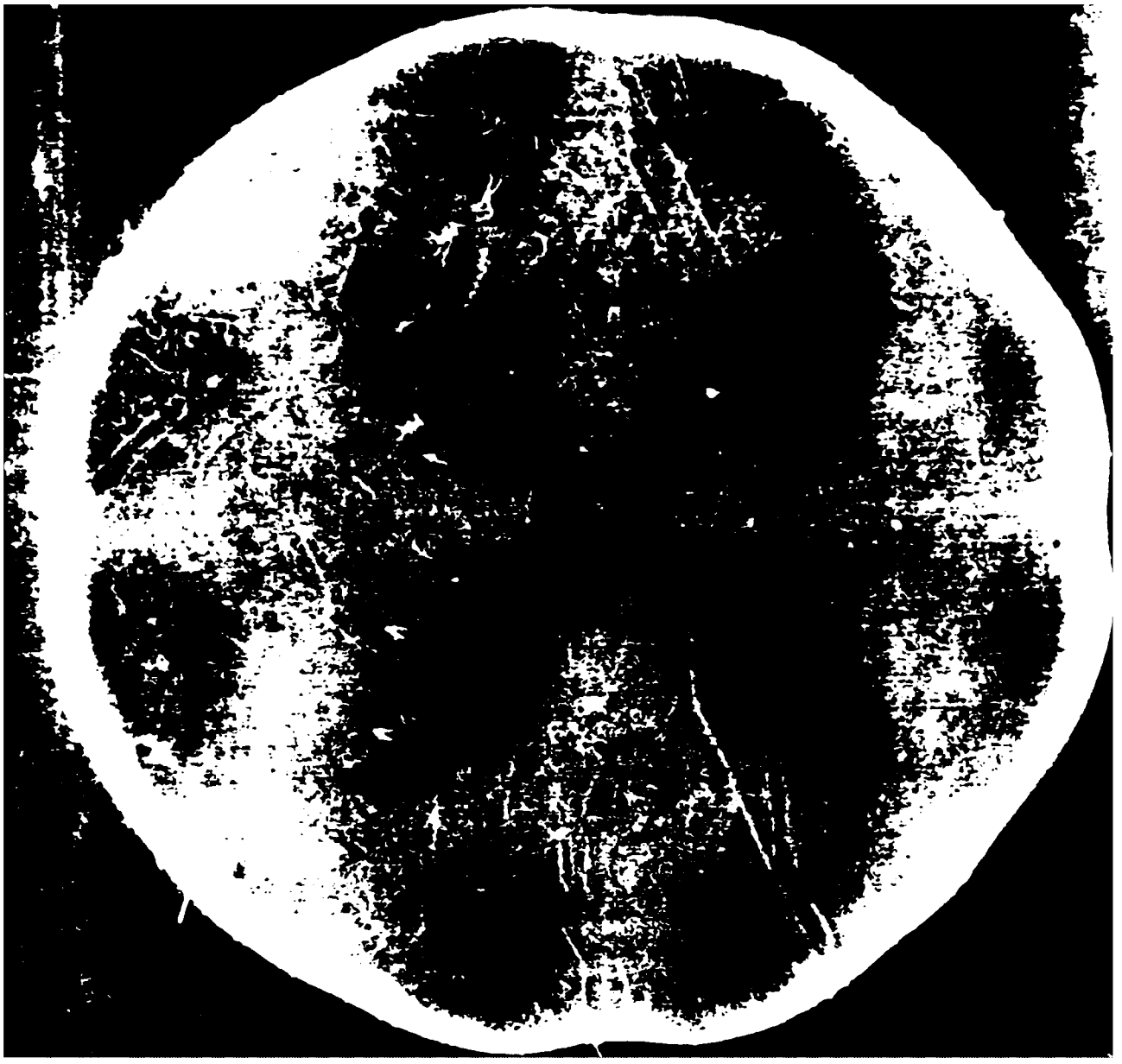

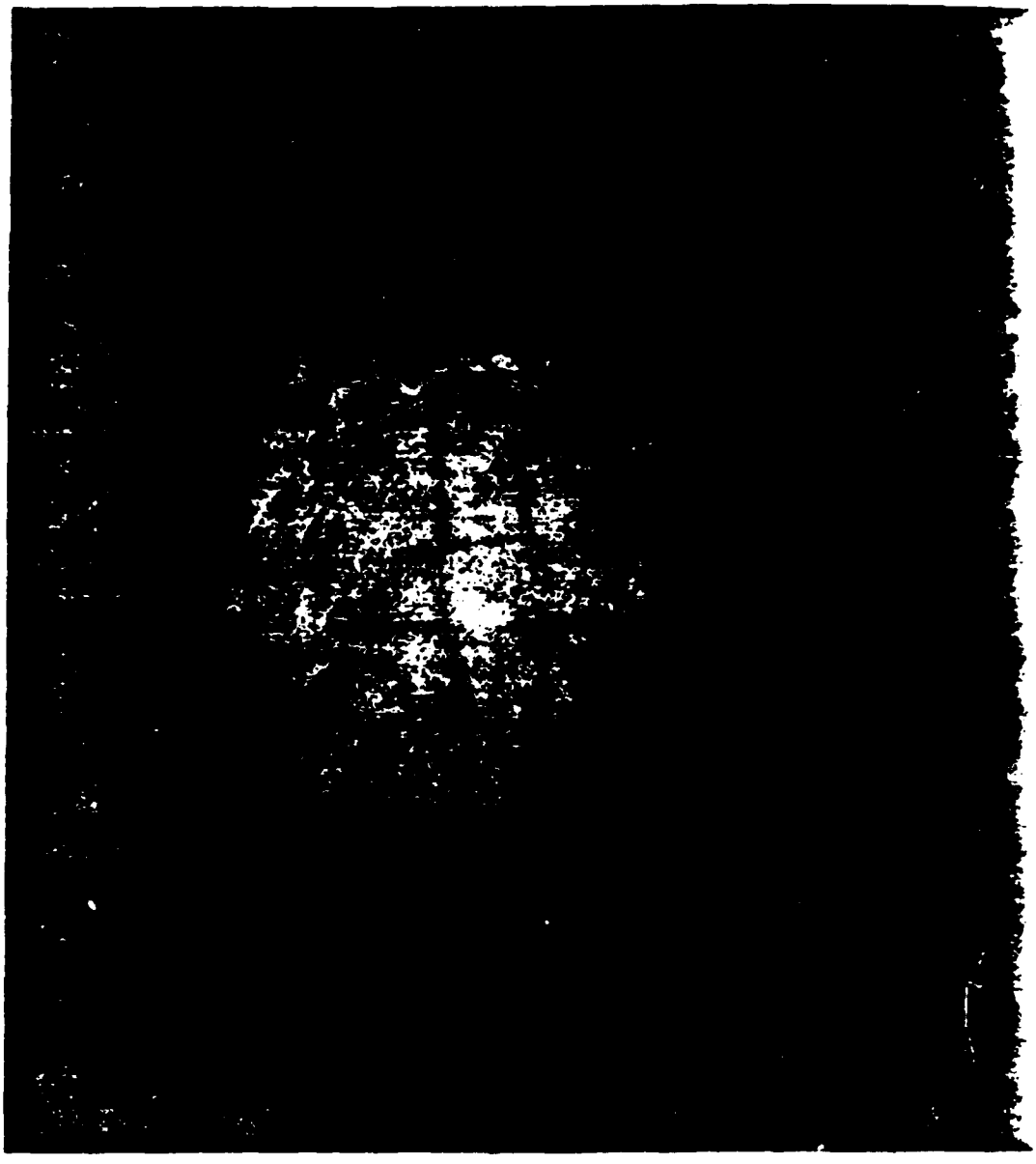

Figure 3.15 [redacted] Image from SRI 0.061-mm diameter pinhole film [redacted]

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[redacted]

CHAPTER 4

CONCLUSIONS AND LESSONS LEARNED[redacted]

4.1 EXPERIMENTAL[redacted]

[redacted] The primary effects experiments, and, with only one possible exception (Project 8.71), all the secondary effects and phenomenology experiments achieved their objectives on MING VASE. A review of the recorded data indicated that only 2 out of the 400 scope channels and none of the nearly 400 tape channels were lost. While subsequent examination of these data records has uncovered some channels which recorded unintelligible data, the actual data percentage yield from MING VASE is probably the highest ever attained on a major event.

[redacted] Reiteration and discussion of the preliminary conclusions of the [redacted] experiments appear appropriate at this point.

[redacted]

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[redacted]

[redacted]

4.2 TEST FACILITY [redacted]

[redacted]

The stemming and containment design employed for MING VASE was completely successful in containing the detonation. While the secondary containment provided by the TAPS may not have been required, [redacted]

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[redacted]

[redacted]

[redacted]

(U) Several convenience features have been incorporated in subsequent events based on the MING VASE experience. At each test chamber there are now (1) a telephone jack to allow use of a telephone inside the test chamber, (2) ports for a power connection to make available power and lights inside the chamber, and (3) feedthrough connector ports have been extended to allow increasing the radius of curvature of the jumper cables inside the chamber and to lessen the strain on connectors.

(U) Notwithstanding the minor problems discussed above, MING VASE has to be considered one of the most troublefree, ideal environments from an experimental standpoint.

[redacted]

[redacted]

[redacted]

APPENDIX A

SRI STEMMING AND CONTAINMENT DIAGNOSTICS [redacted]

[redacted] The following is taken verbatim from Reference 2.

"SCENARIO OF EVENTS AND DISCUSSION OF DATA:

PRESSURE

[redacted]

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[redacted]

[redacted]

[redacted]

COMPARISON WITH PREDICTIONS

In Figures A.1 and A.2 peak values of the radial, vertical, and transverse accelerations and particle velocities at various ground ranges (adjusted for baseline shifts if any) are shown compared with predictions. The prediction curves are taken from DASA-1285 for Rainier Mesa tuff. It has been noted by others that the tuff in Area 16 has less water content than that in Area 12 and that this would have the effect of greater attenuation of the earth shock. The time of arrivals as a function of ground range are shown plotted in Figure A.3. No prediction of velocity was made before the event; however, it will be noted that the seismic velocity is much lower than than observed on other events in Area 12, which is another indication of the difference in the character of the rock in which MING VASE was placed."

(U) The data upon which Figures A.1, A.2, and A.3 are based are displayed in Figures A.4, A.5, and A.6.

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[redacted]

[redacted]

APPENDIX B

PROJECT OFFICER REPORTS [redacted]

1. [redacted] The requirement for submitting a POR has been cancelled for the following project agencies:

Project 8.53 Moleculon Research Corporation - Passive Diagnostics

Project 8.71 [redacted]

Project 9.64 Gulf General Atomic - Long Time Tunnel Environment Measurements

]. [redacted] The following reports have been published by the AEC Laboratory indicated reporting their work on MING VASE, and no DASA POR will be published reporting the work covered.

Project 8.43 L. B. Neely, Organization 9126, "Instrumentation Report, Sandia's Participation on MING VASE [redacted];" SC-DR-69-284, June, 1969; Sandia Laboratories Albuquerque, New Mexico, [redacted]

Project 8.44 James L. Rea, Organization 9114, "MING VAST Preliminary Post-Test Report[redacted]; RS 3410/1461, SC-DR-69-66, January 1969; Sandia Laboratories, Albuquerque, New

[redacted]

[redacted]

Mexico; [redacted]

Project 8.51 D. W. Bergen and R. R. Fullwood, "Neutron Experiments on MING VASE [redacted]", LA-4135, November 6, 1969; Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico; [redacted]

Project 8.91 W. D. Benedick, "Neutron Irradiation Effects on Sandia Quartz Gages [redacted]", RS 3410/1447, SC-WD-69-300, June ,1969; Sandia Laboratories, Albuquerque, New Mexico; [redacted]

3. [redacted] It is anticipated that the AEC Laboratory indicated will furnish a report to Test Command, DASA to be published as a DASA POR.

Project 8.31 Lawrence Radiation Laboratory - Phenomenology Experiments

Project 8.43 Sandia Laboratories, Albuquerque - "Blow-off Experiment"

Project 8.52 Lawrence Radiation Laboratory - Output Diagnostics

4. [redacted] The following agencies have already submitted reports to Test Command, DASA to be published as a DASA POR.

Project	Agency	POR Number	Status
8.54	USNRDL	6322	Accepted for Publication
8.55	SRI	6323	Accepted for Publication
8.60	LMSC-NSPO	6324	Returned for Rewrite
8.70	GE [redacted]	6325	Tech Director Review
8.82	GE [redacted]	6327	Tech Director Review
8.85	KN=SAFSCOM	6330	Accepted for Publication
8.86	[redacted]	6331	Returned for Rewrite
8.88	[redacted]	6333	Accepted for Publication
9.62	SRI	6335	Accepted for Publication
9.70	LMSC	6336	Accepted for Publication

5. [redacted] It is anticipated that these reports will be received by Test Command, DASA to be published as a DASA POR.

Project	Agency	POR NUMBER
[redacted]		
8.89	AFWL	6334

[redacted]

REFERENCES

1. Letter [redacted] WLRFU, Air Force Weapons Laboratory, 2 May 1969, subject: MING VASE Environment [redacted]

2. C. T. Vincent, SHOT MING VASE, Project Officer's Report, Project 9.62, DASA POR 6335, "Stemming and Containment Diagnostics", to be published.

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[redacted]