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Projects 36.1 and 36.2

EXPOSURE OF MOBILE HOMES AND EMERGENCY VEHICLES TO NUCLEAR EXPLOSIONS

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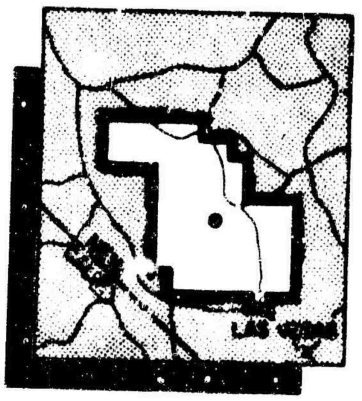

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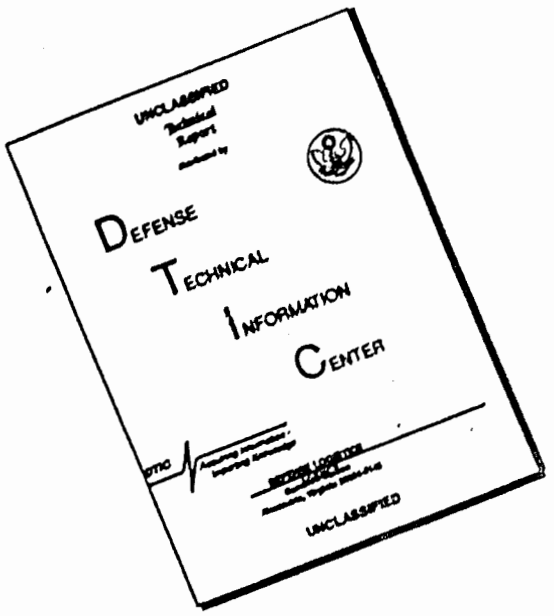

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Report to the Test Director

EXPOSURE OF MOBILE HOMES AND EMERGENCY VEHICLES TO NUCLEAR EXPLOSIONS

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July 1957

ABSTRACT

Experiments were conducted during Operation Teapot to determine the effects of a nuclear explosion on mobile homes at pressure levels which might be expected in the suburbs of a large city and to determine the effects on emergency vehicles and their equipment located at various simulated distances from near Ground Zero to the suburbs of a large city.

Missiles produced by flying glass and the translocation of furniture in the mobile homes are potential hazards to personnel occupying these homes at the time of the blast. Screening or other means of protecting the interior against glass splinters reduces this hazard. By rearrangement of the displaced furniture, clearing up debris, and improvising window coverings, trailers in this area of damage could readily be made habitable.

Emergency vehicles caught in the open near Ground Zero would be completely destroyed. Vehicles in medium- and low-pressure regions would suffer damage, but the vehicles and equipment would probably be operable.

ACKNOWLEDGMENTS

The Program Director and the Project Officer for Project 36.1 wish to express sincere appreciation to the Mobile Home Manufacturers Association (MHMA), Mobilehome Dealers National Association (MDNA), Trailer Coach Association (California) (TCA), and the industry participants (see Appendix A), whose help and cooperation made possible these tests on mobile homes, and to the representatives of these associations:

T. T. Singer of the MDNA, C. T. McCreary of the TCA, G. F. Miles of the MHMA, and L. L. Rantz of the MDNA, who aided in the planning and execution of the experiment.

The Program Director and the Project Officer for Project 36.2 wish to express sincere appreciation to the Edison Electric Institute (EEI), the American Gas Association (AGA), the Fire Apparatus Manufacturers Association (FAMA), the Seagrave Corporation, Seagrave-Hirsch, Inc., the American Telephone & Telegraph Company (AT&T), the Willys Motor Company, and the Federal Civil Defense Administration (FCDA) Rescue Service, whose help and cooperation made possible the tests on emergency vehicles, and to the representatives of these associations (see Appendix B).

A. C. Werden and Russell Berg of EEI, Guy Corfield, G. A. Ruddell, and H. Ferguson of the AGA, J. H. Ruggles, B. F. Gifford, F. E. McGeeny, and R. Moran of the FAMA and Seagrave Corporation, R. P. Lunt of AT&T, I. A. Kessler of Willys, and R. Knight of FCDA, who aided them in the planning and execution of the experiment.

The assistance of R. L. Corsbie of the Atomic Energy Commission and H. L. Goodwin, L. Lieberman, and J. S. Jenner of FCDA is gratefully acknowledged by all personnel of Program 36.

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CHAPTER 1

OBJECTIVES

1.1 GENERAL

Under Program 36, Exposure of Mobile Homes and Emergency Vehicles to Nuclear Explosions, two segments of industry—that which manufactures and sells mobile homes and that which manufactures and uses emergency vehicles—participated with the Federal Civil Defense Administration (FCDA) in exposing representative samples of their equipment to the effects of a nuclear explosion. Knowledge of the effects to be expected from an enemy attack will be useful to industry by pointing out weaknesses of the equipment to be strengthened and will be useful in civil defense in estimating the possible utility of such equipment after an attack.

Civil defense officials have become accustomed to thinking of damage in terms of four zones:

A damage: buildings almost completely destroyed by blast
B damage: most buildings damaged beyond repair
C damage: moderately damaged buildings that must be vacated during repairs
D damage: partially damaged buildings that need not be vacated during repairs

Information derived from Program 36 will be evaluated in terms of these damage zones to enable easy extrapolation to the effects expected from different bomb yields.

1.2 SPECIFIC

1.2.1 Mobile Homes

Mobile homes will be an important resource in the event of a war. This is especially true if our cities are subjected to attack by thermonuclear weapons, leaving large numbers of people homeless and in need of aid. Many of the facilities which might normally be available to care for the homeless or to serve as medical and feeding centers would be severely damaged or destroyed. Trailer parks and trailer dealers are generally located in the suburbs Development of information as to the nature of damage which the trailers might sustain under these conditions and the evaluation of the repairs necessary to make them usable afterwards becomes important.

Two distances from Ground Zero were chosen to simulate low-blast-pressure areas which might be expected in suburban zones.

1.2.2 Emergency Vehicles

Planning for postattack operations by the front-line civil defense services is predicated on the dispersal of men and equipment. Areas outside the potential zone of D damage have been assumed as "safe dispersal locations." According to present civil defense planning assump-

tions, it is expected that the C zone of blast damage will extend to the city limits of the principal city in the critical target area. This would require that emergency equipment would often be without shelter at its dispersal location in the suburban areas of the target cities. It is also expected that some vehicles will be caught at close-in locations because of a surprise attack or heavy traffic.

To show the effects on emergency vehicles and their equipment, test units were placed within the various zones of damage and beyond in the assumed dispersal area.

CHAPTER 2

MOBILE HOMES

2.1 OPERATIONS AND RESULTS

The 17 trailers included in the test program were placed at several distances from Apple II shot, which had a yield approximately 30 per cent greater than nominal [a nominal atomic bomb has an energy release equivalent to 20 kilotons (kt) of TNT]. Nine were located at the 10,500-ft line, seven at the 15,000-ft line, and one at 18,600 ft. The single trailer at 16,000 ft was intended to be in the fall-out zone and was to be part of a decontamination experiment; however, it was not in the actual fall-out area, and this part of the experiment was not performed. Figures 2.1 to 2.3 show positions of the trailers.

Identification of the test units, specifications supplied by the manufacturers, test results, and illustrative photographs before and after the blast follow.

TEST UNIT 1*—VAGABOND

Location: 10,500-ft line, position 4, facing away from the blast.

Description: Over-all length, 35 ft; 1 bedroom; weight, 7850 lb; steel chassis; tandem axles. (See Fig. 2.4.)

Floor: $\frac{5}{8}$-in. plywood covered with standard-gauge linoleum; subfloor, Homosote; floor insulation, Celotex.

Sidewalls: Metal-tubing studding, 1 × 2 in.; 0.040 aluminum exterior covering, fastened to studding by screws and painted; Fiberglas insulation.

Roof: 2 × 4's on 24-in. centers, covered with 0.032 aluminum fastened with screws and painted with Aluminite; Fiberglas insulation.

Windows: There were 19 awning type single-pane windows and 4 double-pane stationary windows of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood $\frac{1}{4}$ in. thick or less; complete with divan, table and chairs, electric refrigerator, apartment-size stove, oil heater installed in a closet, electric water heater, box spring and mattress, flush water closet, steel-porcelain bathtub, steel-porcelain sink, steel-porcelain lavatory, cotton drapes, four venetian blinds, metallic drainage plumbing, and water-supply-line copper tubing with fittings. (See Fig. 2.5.)

* The number of the test unit appears on the side of each mobile home.

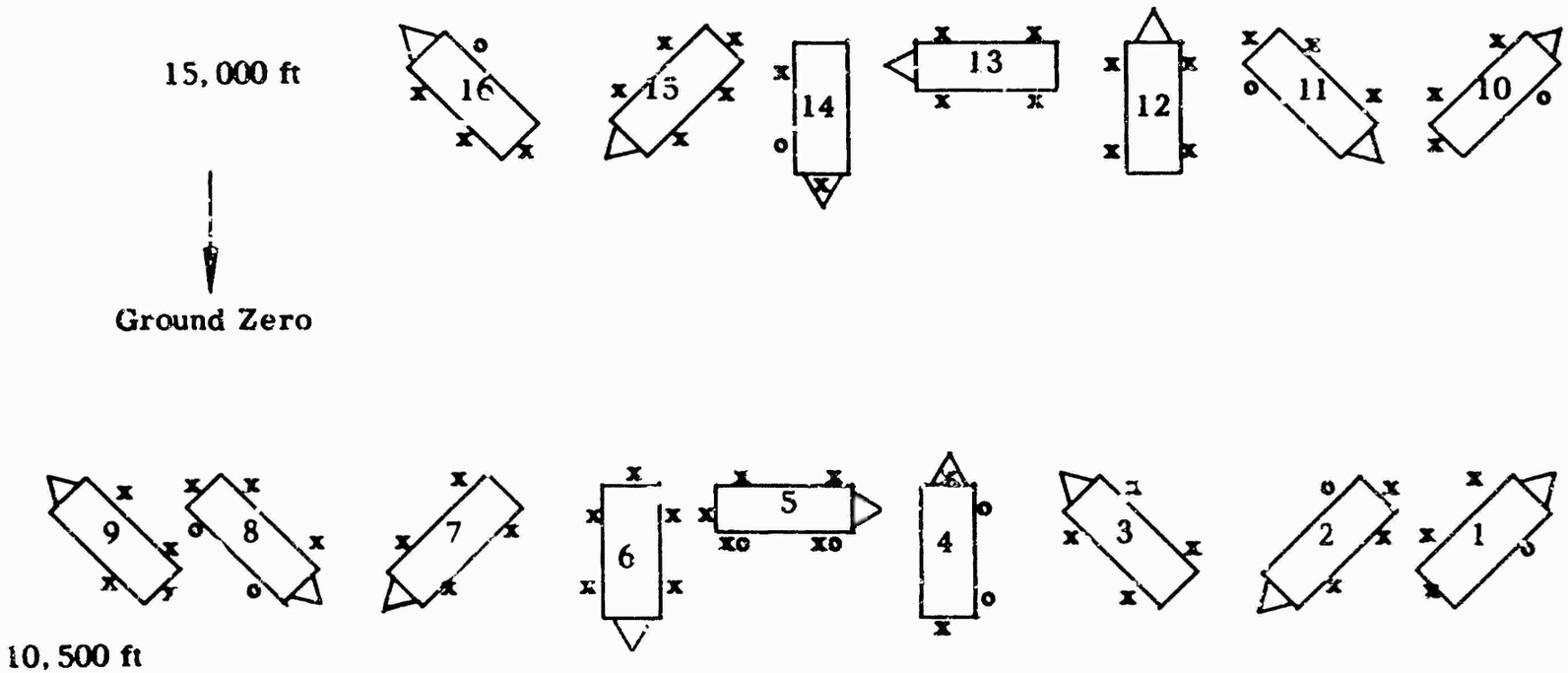

Fig. 2.1 — Trailer positions and orientation. x, window(s) open. o, door open.

1. Airstream
2. Spartan
3. Mid-State Elcar
4. Vagabond
5. Peerless
6. Kit
7. Singer
8. Traveleze
9. Scott
10. Quality Manorette
11. Mon-o-Coach
12. Pacemaker
13. Columbia
14. Aljoa
15. Supreme-Victor
16. Southwestern

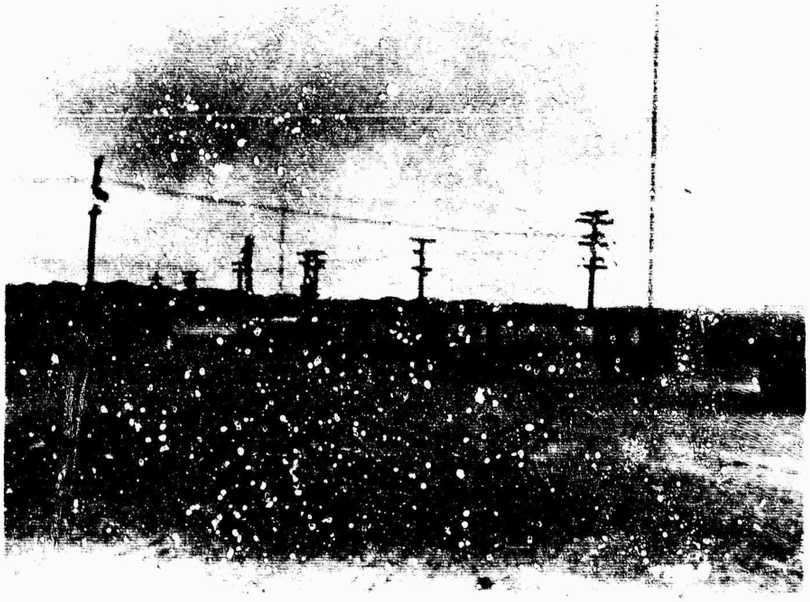

Fig. 2.2—Trailers at 10,500 ft from Ground Zero.

Fig. 2.3—Trailers at 15,000 ft from Ground Zero.

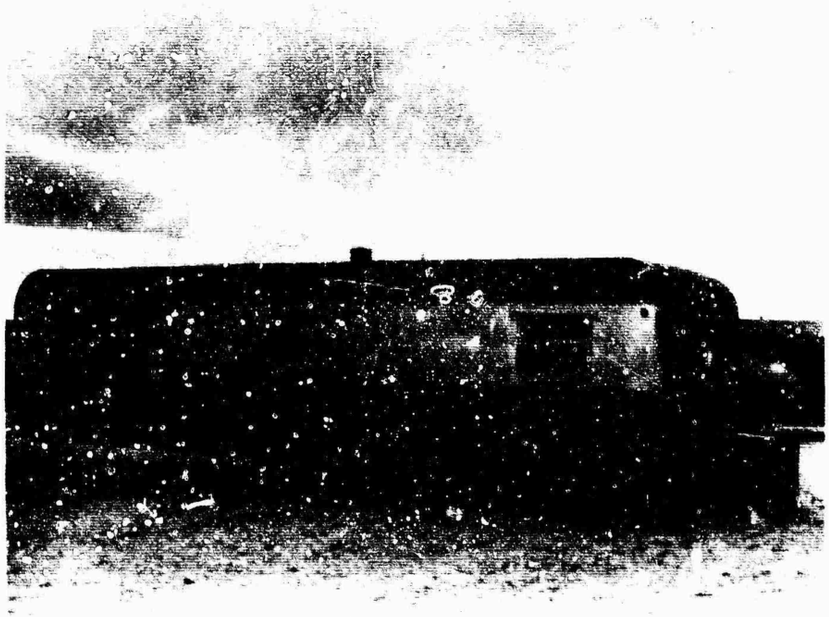

Fig. 2.4—Exterior of Vagabond trailer at 10,500 ft before the blast.

Fig. 2.5—Interior of Vagabond trailer at 10,500 ft before the blast.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Right side dished in; back end dished in; no ruptures on exterior; taillight off; trailer moved forward 12 in.; bent jack stem; front door dished in; no separation of floor and sidewalls. (See Fig. 2.6.)

Interior: Ceiling bulged in slightly; front-door jamb inside torn loose; front overhead mirror broken; screen-door panel torn loose; galley overhead cabinet over stove torn loose; cornice oox on left side of living room off; very little window glass inside; venetian blinds intact; no splits or ruptures in interior sidewalls; kitchen ceiling fixture hanging loose; rear windows, left front picture window, and left bedroom window broken; kitchen cabinets unhurt on both sides; sliding wardrobe door off; bathroom door off; lavatory off wall; all plumbing tight and operable; linen closet torn from bulkhead; rear bathroom bulkhead separated from floor; one tile off bathroom wall; rear wardrobe door off; rear panel molding off; light fixture in rear off; bathroom style off; light-fixture glass and mirror glass in bedroom broken; all side vents undamaged; stove, refrigerator, heater, divan, table and chairs, and beds unhurt. (See Fig. 2.7.)

TEST UNIT 2—PACEMAKER

Location: 15,000-ft line, position 12, facing away from the blast.

Description: Over-all length, 28 ft; 1 bedroom; weight, 5250 lb; steel chassis; single axle.

Floor: $\frac{5}{8}$-in. plywood covered with inlaid linoleum; glass-wool insulation; no subfloor.

Sidewalls: $1\frac{1}{8}$- × $1\frac{5}{8}$-in. and $1\frac{5}{8}$- × $2\frac{1}{4}$-in. wood studding on 16-in. centers, covered with 0.032 aluminum, painted; glass-wool insulation.

Roof: 2 × 5 rafters on 16-in. centers, covered with 28-gauge steel, painted with Aluminite; no subroof; glass-wool insulation.

Windows: There were 9 windows, all single pane, 4 of which were stationary.

Interior Sidewalls and Cabinets: Hardwood plywood $\frac{1}{4}$ in. thick or less; complete with divan, table and chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, box spring and mattress, flush water closet, steel-porcelain bathtub, sink, and lavatory, unlined drapes, 1 metal venetian blind, drainage plumbing part metallic and part plastic, and water-supply-line copper tubing with sweat fittings.

Windows on both sides of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Distorted in rear.

Interior: Slight ceiling bulge in kitchen; kitchen ceiling light fixture hanging loose; television shelf loose; molding off in bathroom; bathroom window broken; no glass inside.

TEST UNIT 3—MID-STATE ELCAR

Location: 10,500-ft line, position 3, side-on to the blast.

Description: Over-all length, 41 ft; 2 bedrooms; weight, 8190 lb; steel box channel chassis; tandem axles.

Floor: Plywood covered with linoleum tile; building-board subfloor; Fiberglas insulation.

Sidewalls: 2 × 2 wood studding on average of 16-in. centers, covered with 0.032 and 0.025 aluminum, painted; Fiberglas insulation.

Roof: 2 × 3's on average of 16-in. centers, covered with 24-gauge steel, painted with aluminum roof coating; Fiberglas insulation.

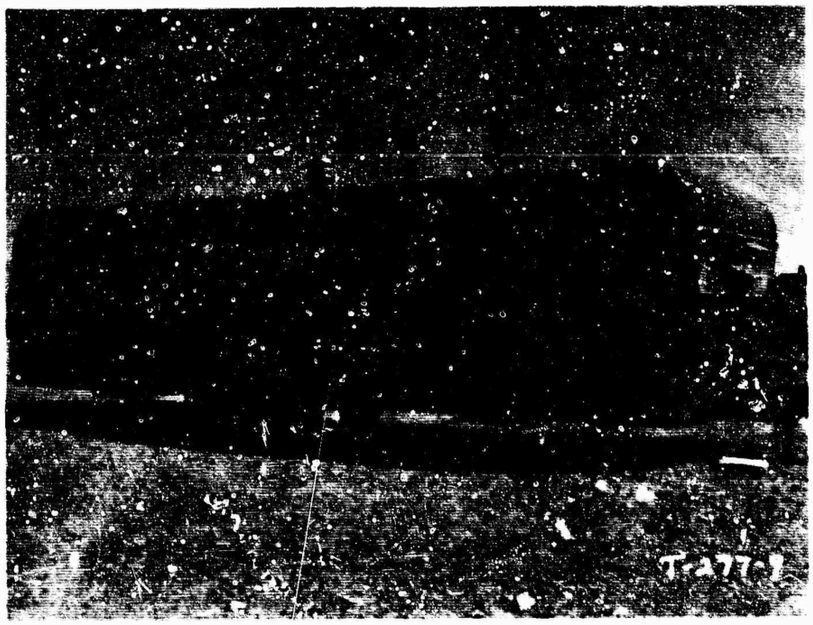

Fig. 2.6—Exterior of Vagabond trailer after the blast.

Fig. 2.7—Interior of Vagabond trailer after the blast.

Windows: There were 18 windows, 4 of which were stationary, with various sizes of single pane.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, wooden table, no chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, and box springs.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Dished in between studding on left side; exterior skin ruptured on left side; bulged out on right side; rear exterior distorted.

Interior: Left-side light fixture over side window torn loose; all molding off; ceiling molding bulged slightly; base shoe off; third panel from front left side separated at seams; Formica galley walls broken; overhead cabinets in galley distorted; panel bulge in center bedroom; center-bedroom overhead cabinets unhurt; bathroom walls broken; toilet broken at base of tank; back-bedroom wall broken, separated, and bulged in about 10 in.; back-bedroom chest of drawers twisted; right side bulged out slightly, no ruptures; panels in wardrobe on right side had nails protruding, indicating an in-and-out movement; all windows on left side broken except left rear bedroom window; front picture window and back window broken; stove, refrigerator, heater, and beds undamaged; table broken; outside vent covering off; glass from picture window in interior; furniture disarranged.

TEST UNIT 4— PEERLESS

Location: 10,500-ft line, position 5, broadside to the blast.

Description: Over-all length, 35 ft; 1 bedroom; weight, 7200 lb; steel chassis; tandem axles.

Floor: ⅝-in. plywood covered with linoleum tile; subfloor, Temlok; Fiberglas insulation.

Sidewalls: 1⅝- × 1¼-in. wood studding on average of 16-in. centers, covered with 0.032 aluminum, painted; Fiberglas insulation.

Roof: 2 × 4 studding on 16-in. centers, covered with 0.032 aluminum, painted with Aluminite; Fiberglas insulation.

Windows: There were 13 windows, all open, consisting of jalousies and standard type single-pane windows.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, dinette table and two chairs, electric refrigerator, apartment-size stove, oil heater installed in a closet, electric water heater, box spring and mattress, flush water closet, steel-porcelain bathtub, lavatory, and sink, drapes throughout, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

All windows and doors of this trailer were open.

Test Results: Chassis, floor, and undercarriage unhurt; tipped on side.

Exterior: Right side dished in, seams ruptured; rear seam also ruptured; roof all right.

Interior: Entire right side bulged in and ruptured at seams; all cabinets torn loose; left side intact; ceiling bulged slightly, most molding off; all windows broken except rear window; living room and dinette ceiling fixtures down; appliances, bathroom and kitchen fixtures, and plumbing unhurt; table broken, all other furniture undamaged; very little glass inside.

A considerable amount of the above damage was partly due to tipping over.

TEST UNIT 5—SUPREME-VICTOR

Location: 15,000-ft line, position 15, side-on to the blast.

Description: No construction information available.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Left side dished in between studs.

Interior: Front overhead mirror broken; overhead cabinets in dinette area torn loose; panel in wardrobe ruptured; left-side screen frames twisted; window-frame center bar bent; center-bedroom overhead loose from bulkhead; kitchen ceiling light hanging loose; back-door frame torn loose; left-side wardrobe loose from sidewall; rear right-side bedroom venetian blinds down; screen frames out; no glass inside; P trap loose; left rear, left rear side, right rear side dinette, and living-room picture windows broken.

TEST UNIT 6—SOUTHWESTERN

Location: 15,000-ft line, position 16, side-on to the blast.

Description: Over-all length, 35 ft; double decker; 2½ bedrooms; weight, 9550 lb; steel chassis; tandem axles. (See Fig. 2.8.)

Floor: ⅝-in. plywood covered with inlaid linoleum tile; ½-in. Celotex subfloor; Silvercote insulation.

Sidewalls: 2 × 2 and 2 × 4 wood studding on 16-in. centers or less, covered with 0.032 aluminum, painted; Silvercote insulation.

Roof: 2 × 4 wood rafters on 24-in. centers, covered with 26-gauge galvanized steel, painted with rubber-base aluminum coating.

Windows: There were 16 windows, jalousie and standard type, single pane; all could be opened.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, table and chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, box springs and mattresses, flush water closet, steel-porcelain bathtub and sink, vitreous-china lavatory, 5 venetian blinds, traverse drapes on all windows, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

All left-side windows, rear window, and front door of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Back end slightly distorted. (See Fig. 2.9.)

Interior: All doors of overhead cabinets in kitchen and living areas down; ceiling molding in kitchen down; kitchen overhead cabinets pulled from the ceiling and wall; front-wardrobe bulkhead dished in; fluorescent tube in kitchen broken (the only broken glass in the trailer); panel doors of sink cabinet out; thermostat loose on the wall; lavatory torn loose from wall in bathroom; toilet tank broken; all plumbing intact; front-bedroom bulkhead dished in; overhead cabinet upstairs loose from the ceiling; venetian blinds off; both upstairs and downstairs window frames pulled loose; three pieces of glass broken in jalousie windows and glass outside trailer; entrance-hall light hanging loose. (See Figs. 2.10 and 2.11.

TEST UNIT 7—QUALITY MANORETTE

Location: 15,000-ft line, position 10, side-on to the blast.

Description: Over-all length, 35 ft; 1 bedroom; weight, 6850 lb; steel box chassis; tandem axles.

Floor: ¾-in. plywood covered with linoleum tile; subfloor, ½-in. asphalt-impregnated Celotex; 1½-in. Fiberglas-batt insulation.

Fig. 2.8—Exterior of Southwestern trailer at 15,000 ft before the blast.

Fig. 2.9—Exterior of Southwestern trailer at 15,000 ft after the blast.

Fig. 2.10—Interior of Southwestern trailer after the blast.

Fig. 2.11—Interior of Southwestern trailer after the blast.

Sidewalls: 2 × 2 wood studding on 24-in. centers, covered with 0.032 aluminum, painted; insulation, 1½-in. semirigid Fiberglas batts.

Roof: 2 × 4 wood rafters on 16-in. centers, covered with 5/16-in. fir sheathing and 0.025 aluminum, unpainted.

Windows: There were 16 windows, 3 of which were stationary, of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, table, no chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, box spring and mattress, flush water closet, steel-porcelain bathtub, lavatory, and sink, 3 venetian blinds, drapes, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

All windows on the left side and rear and the front door of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Right rear behind the back door and the back of the front door dished in, pulled out of Pittsburg seam.

Interior: Right panel bulged in, no rupture; rear-wardrobe style broken; right rear window, one pane of right lower window, and three panes of window front of door broken; kitchen light fixture hanging loose; wardrobe overhead dished in and split; oil-heater door off; venetian blinds in kitchen and bedroom down; no glass inside trailer.

TEST UNIT 8—MON-O-COACH

Location: 15,000-ft line, position 11, side-on to the blast.

Description: Over-all length, 41 ft; 1 bedroom; weight, 7950 lb; aluminum extruded chassis; tandem axles.

Floor: Aluminum extrusion covered with linoleum tile; aluminum-sheet subfloor; insulation of Fiberglas with aluminum-foil vapor barrier.

Sidewalls: Aluminum extrusions on 12- to 24-in. centers, covered with 0.048 aluminum, riveted, painted, with a bare feature strip; insulation, Fiberglas with aluminum foil, 2 in. thick.

Roof: Exterior aluminum rafters spaced on 12- and 16-in. centers, covered with 0.032 aluminum, riveted, painted; insulation, Fiberglas with aluminum-foil vapor barrier, 2 in. thick.

Windows: There were 33 windows, some of which were stationary, of single-strength glass.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, no table or chairs, electric refrigerator, divided oven and range cooking facilities, gas heater of the Moduflow type heating system, butane water heater, flush water closet, steel-porcelain bathtub and sink, vitreous-china lavatory, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

The back windows on the left side and the rear door of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: No distortion.

Interior: Rear-wardrobe style loose; some tile in bathroom off; kitchen light fixture hanging loose; front picture windows, two lower side windows, left front casement, second and third casements, and bedroom picture window broken; bedroom venetian blinds down; no glass inside trailer.

TEST UNIT 9—COLUMBIA

Location: 15,000-ft line, position 13, broadside to the blast.

Description: Over-all length, 29 ft; 2 bedrooms; weight 6080 lb; steel chassis; tandem axles. (See Fig. 2.12.)

Floor: $\frac{5}{8}$-in plywood covered with standard-gauge linoleum; asphalt-impregnated Celotex subfloor; insulation, Silvercel type B Fiberglas blanket.

Sidewalls: $1\frac{1}{8}$- × 2-in. wood studding on 16-in. centers, covered with formed 0.030 aluminum, painted; insulation, Silvercel type B Fiberglas, plus Silvercote reflective paper.

Roof: 2 × 4 wood rafters on 24-in. centers; subroof, $\frac{1}{2}$-in. Simpson board, covered with 0.032 aluminum, painted with Aluminite; insulation, T.W.F. Fiberglas batts.

Windows: There were 13 windows, all casement and awning type, of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood $\frac{3}{16}$ in. thick; complete with divan, gate-leg table, no chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, 1 box spring and 3 mattresses, flush water closet, steel-porcelain bathtub and sink, vitreous-china lavatory, metallic drainage plumbing, water-supply-line copper tubing with sweat fittings.

All windows on both sides of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Slight distortion on left side. (See Fig. 2.13.)

Interior: Style in center wardrobe broken; one piece of molding in living room bulged; heater door off; kitchen venetian blind off; left-side rear panel by window in bedroom split; lower right front window, lower kitchen window, and bedroom left-side window broken; no glass inside trailer. (See Figs. 2.14 and 2.15.)

TEST UNIT 10—KIT

Location: 10,500-ft line, position 8, head-on to the blast.

Description: Over-all length, 35 ft; 2 bedrooms; weight, 6240 lb; steel chassis; tandem axles. (See Fig. 2.16.)

Floor: $\frac{1}{2}$-in. plywood covered with linoleum tile; subfloor of $\frac{1}{2}$-in. asphalt-impregnated Celotex; insulation, $\frac{3}{4}$-in. Fiberglas.

Sidewalls: 2 × 2 studding on 16-in. centers, covered with 0.025 die-formed aluminum of "Panelized Floating Walls," with only the trim painted; $\frac{3}{4}$-in. Fiberglas insulation.

Roof: 2 × 3 rafters on 16-in. centers; subroof of 16 rows equally spaced longitudinally, $\frac{1}{4}$-in. lath covered with 26-gauge galvanized steel, not painted; insulation, $\frac{3}{4}$-in. Fiberglas.

Windows: There were 15 windows, some of which were stationary, of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood $\frac{1}{4}$ in. thick or less; complete with divan, table and chairs, electric refrigerator, apartment-size stove, oil heater, electric water heater, 1 box spring and 3 mattresses, flush water closet, steel-porcelain bathtub and sink, vitreous-china lavatory, 7 metal venetian blinds, drapes on all windows, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

This trailer had windows on both sides and rear open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged. Trailer was moved back 18 in.

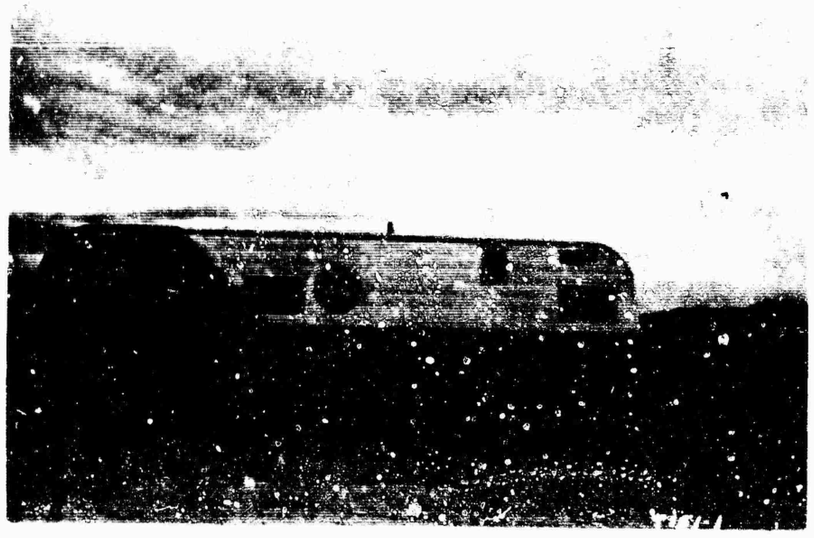

Fig. 2.12—Exterior of Columbia trailer at 15,000 ft before the blast.

Fig. 2.13—Exterior of Columbia trailer at 15,000 ft after the blast.

Fig. 2.14—Interior of Columbia trailer after the blast.

Fig. 2.15—Interior of Columbia trailer after the blast.

Exterior: Left lower panel partially out of channel; two panels on left lower side out of channel approximately 3 ft; overhang in front dished in; no rupture in roof; panel over left front window out of channel the length of the window; panels below taillight and below roof curve in rear out of channel. These panels out of channel could be easily and quickly repaired without tools. (See Fig. 2.17.)

Interior: Interior ceiling panels by the front door split; front shelf above daveno torn loose; front panel bulged; mirror and cabinet separated; furniture disarranged; bathroom bulkhead bulged in; toilet tank broken; wardrobe bulkheads torn loose slightly; all light fixtures intact; stove moved about 2 in.; refrigerator, heater, divan, table and chairs, beds, and stove undamaged; 2 front picture windows, right front side picture window, left front side casement window, left kitchen picture window, center left lower and left rear windows, right rear lower window, and right dinette lower window were broken; mirror in bedroom off the wall, not broken. (See Figs. 2.18 and 2.19.)

TEST UNIT 11—ALJOA

Location: 15,000-ft line, position 14, facing head-on to the blast.

Description: Over-all length, 16 ft 9 in.; travel trailer; weight, 2190 lb; steel chassis; single axle. (See Fig. 2.20.)

Floor: ½-in. plywood covered with linoleum; subfloor, surface board; Fiberglas insulation.

Sidewalls: 1¼- × 1⅝-in. wood studding on maximum 21-in. centers, covered with 0.032 aluminum, painted; Fiberglas insulation.

Roof: 1½- × 1⅝-in. rafters on maximum 18-in. centers, covered with 0.025 aluminum, not painted; Fiberglas insulation.

Windows: There were 7 windows of various sizes, all single pane.

Interior Sidewalls and Cabinets: Hardwood plywood 1 in. thick or less; complete with plastic dinette seats, 1 table, electric refrigerator, apartment-size range, no space heater, no water heater, 1 mattress, no toilet, bathtub, or lavatory, steel-porcelain sink, 6 metal venetian blinds with valance curtains on all windows, metallic drainage plumbing, and water-supply-line copper tubing with sweat-fitted connections.

Front, rear, and left-side windows, as well as the door, of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged; trailer had been moved back 8 in.

Exterior: Slight distortion in front. (See Fig. 2.21.)

Interior: Dinette table down, with leg broken off; ceiling molding bulged down left front side; rear left bedroom venetian blind down; front left lower window cracked. (See Figs. 2.22 and 2.23.)

TEST UNIT 12—SPARTAN

Location: 10,500-ft line, position 2, facing side-on to the blast.

Description: Over-all length, 42 ft 10 in.; two-bedroom model; weight, 8600 lb; steel chassis; tandem axles. (See Fig. 2.24.)

Floor: ⅝-in. plywood covered with linoleum tile; aluminum subfloor; Fiberglas and reflective insulation.

Sidewalls: 1¾-in. U-channel aluminum on 16-in. centers, covered with 0.032 38 ¾ hard aluminum, not painted; Fiberglas and reflective insulation.

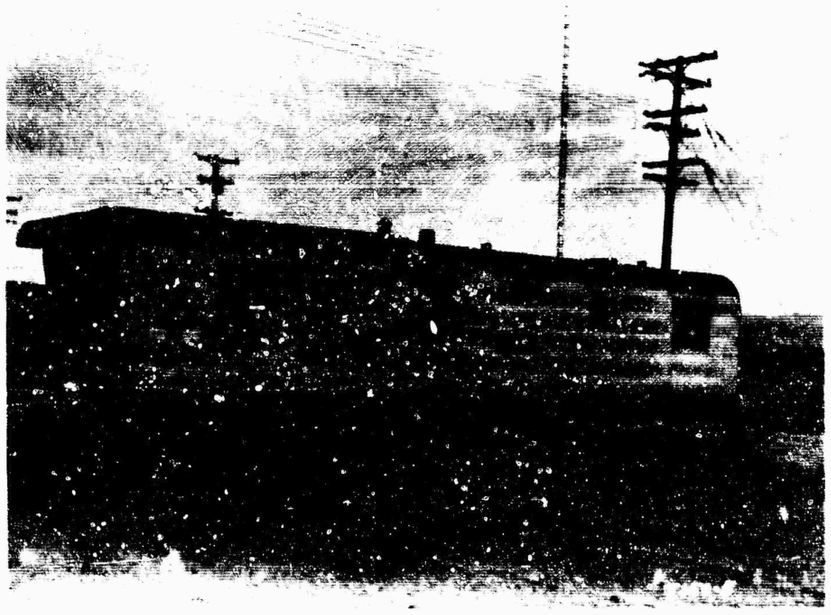

Fig. 2.16—Exterior of Kit trailer at 10,500 ft before the blast.

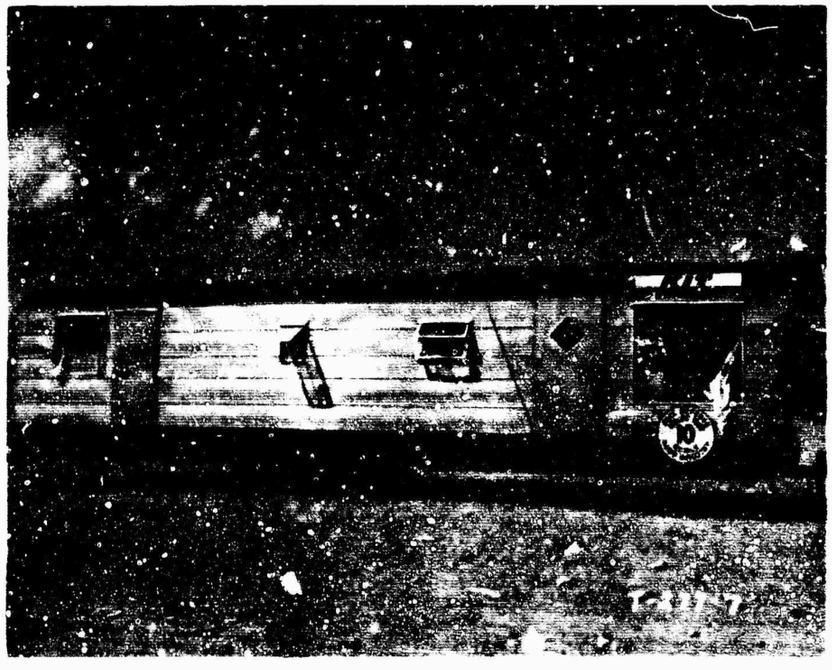

Fig. 2.17—Exterior of Kit trailer at 10,500 ft after the blast.

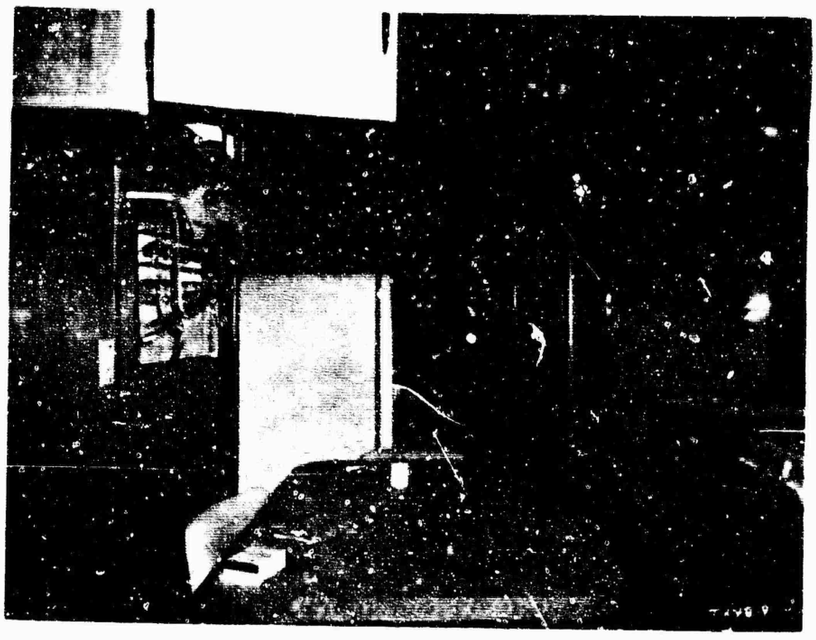

Fig. 2.18—Interior of Kit trailer after the blast.

Fig. 2.19—Interior of Kit trailer after the blast.

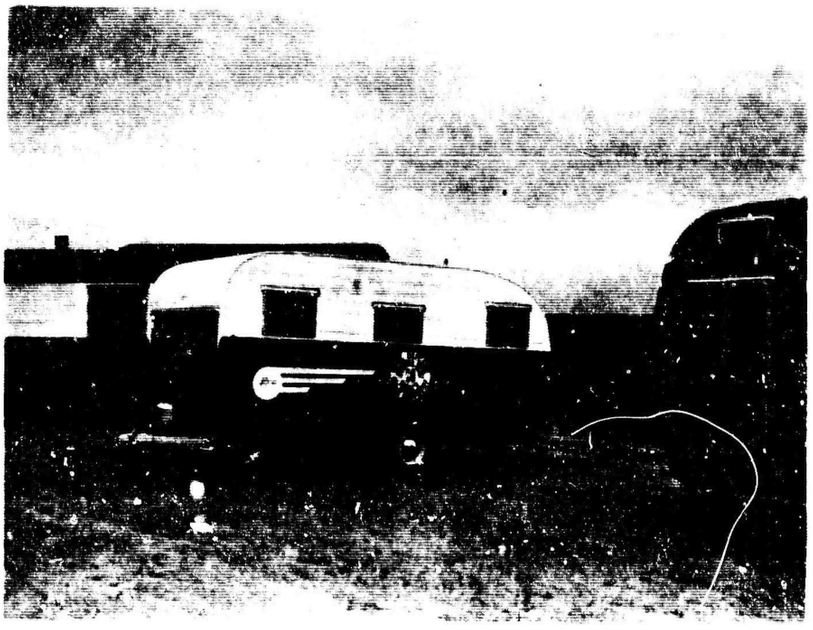

Fig. 2.20—Exterior of Aljoa trailer at 15,000 ft before the blast.

Fig. 2.21—Exterior of Aljoa trailer at 15,000 ft after the blast.

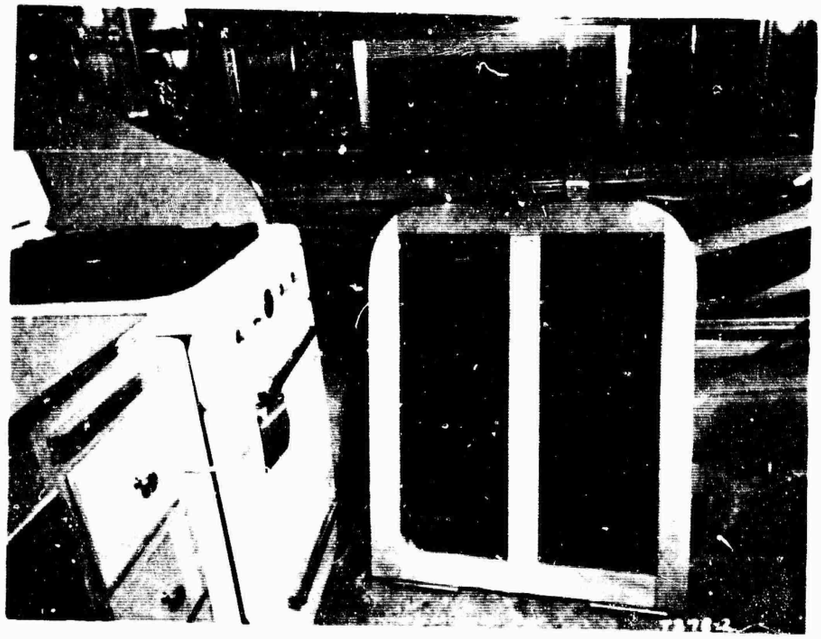

Fig. 2.22—Interior of Aljoa trailer after the blast.

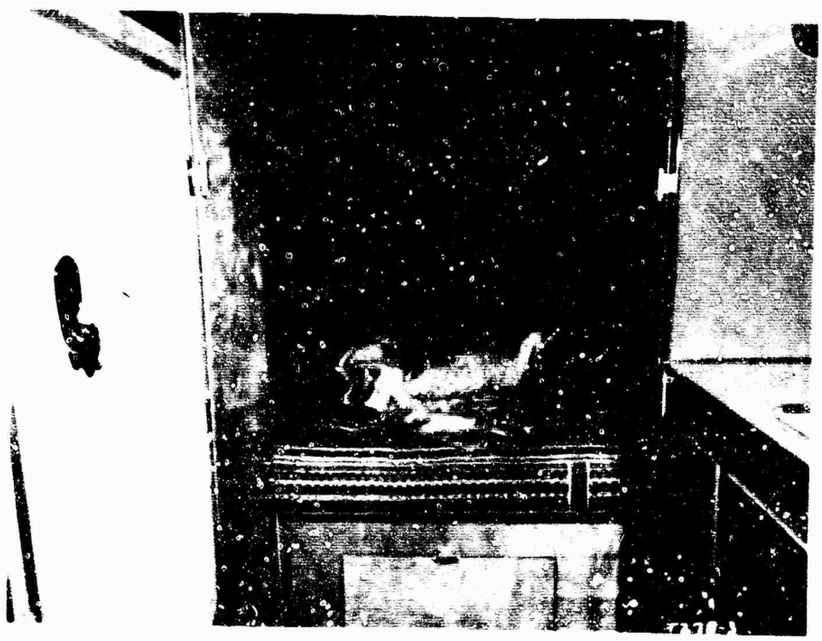

Fig. 2.23—Interior of Aljoa trailer after the blast.

Fig. 2.24—Exterior of Spartan trailer at 10,500 ft before the blast.

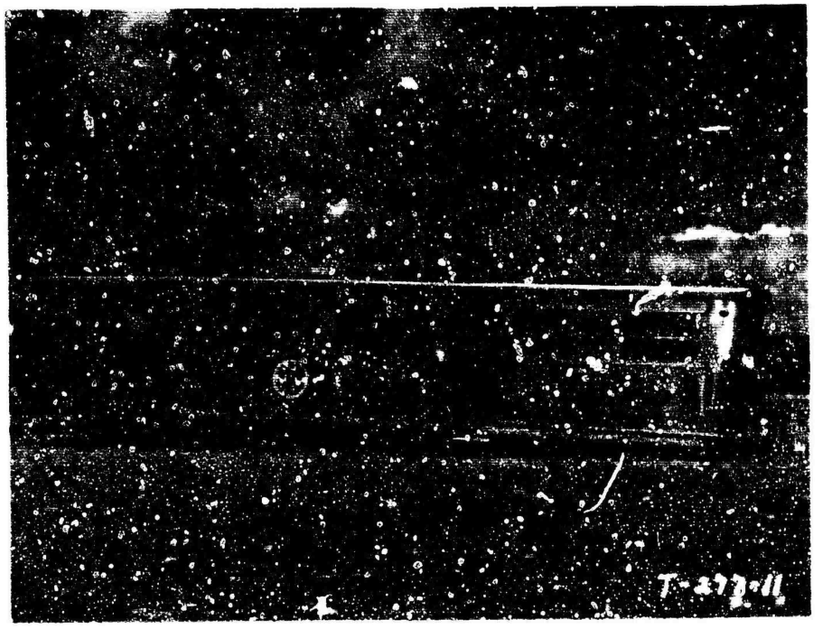

Fig. 2.25—Exterior of Spartan trailer at 10,500 ft after the blast.

Roof: 5-in. U-channel aluminum on 16-in. centers, covered with 0.032 aluminum, not painted; Fiberglas and reflective insulation.

Windows: There were 15 windows, 2 of which were Plexiglas; some were stationary and some could be opened; various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with divan, table and chairs, electric refrigerator, oil heater, apartment-size range, electric water heater, 2 box springs and mattresses, flush water closet, steel-porcelain bathtub, lavatory, and sink, drapes on all windows, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

Left-side windows and rear window of this trailer were open, as well as rear door.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged; trailer moved 2 ft, causing hitch stem to break.

Exterior: Front end dished in about 8 in.; left side dished in about 8 in. at living-room window; entire length of left side of trailer distorted; minor rupture of front roof, dented about 4 in.; no distortion of back and right side. (See Fig. 2.25.)

Interior: Front-bedroom left-side panel bulged in; front panels bulged in, some separation; living-room panels on left side bulged in; living-room window frame on left side torn loose; ceiling panels bulged down, no rupture; living-room end of galley ruptured on wall; galley overhead door styles broken; bottom of overhead cabinet broken; no damage to cabinets on right side; back-bedroom chest of drawers broken; left-side panel in bedroom bulged; window frame broken; all front windows and all windows on left side except kitchen window broken; right-side rear window broken; plumbing undamaged; light fixture in living room broken, glass in living room; divan, table and chairs, stove, refrigerator, and heater undamaged; all vent plates on left side down. (See Figs. 2.26 and 2.27.)

TEST UNIT 13— TRAVELEZE

Location: 10,500-ft line, position 8, facing side-on to the blast.

Description: Over-all length, 22 ft; travel type trailer; weight, 3400 lb; steel chassis; single axle.

Floor: ⅝-in. plywood covered with light-weight linoleum; subfloor, ½-in. asphalt-coated Celotex; ½-in. Fiberglas insulation.

Sidewalls: 1 × 2 studding on 22-in. centers, covered with 0.030 3S H16 aluminum, partly painted; ½-in. Fiberglas with aluminum reflective insulation.

Roofs: 2 × 2 rafters spaced on 48-in. centers, covered with 0.030 aluminum, no paint; ½-in. Fiberglas with aluminum reflective insulation.

Windows: There were 10 windows, some of which were stationary, of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood 3/16 in. thick; complete with divan, drop-leaf table, electric refrigerator, apartment-size stove, gas heater, electric water heater, 1 box spring, 1 mattress, flush water closet, no bathtub, steel-porcelain lavatory and sink, no venetian blinds, drapes on all windows, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

Rear and left-side windows of this trailer were open, as well as both doors.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Slight distortion on front and sides, no ruptures; studding in sidewall from right rear to back door broken.

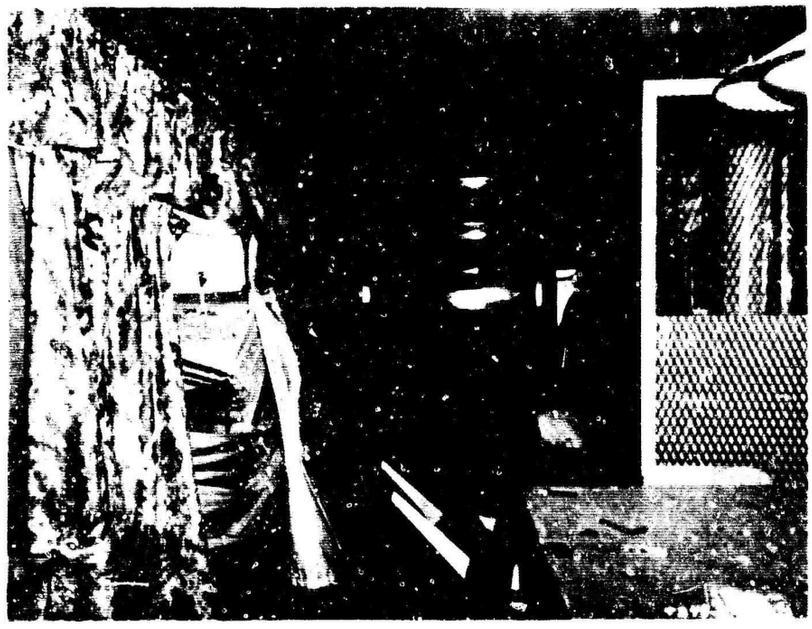

Fig. 2.26—Interior of Spartan trailer after the blast.

Fig. 2.27—Interior of Spartan trailer after the blast.

Interior: Interior roof-rib front split, no panel ruptures; interior overhead cabinets not broken; wardrobe and bathroom doors broken; ceiling fixture in living room hanging loose; front stationary picture windows, right-side windows, except picture window right front side, broken; no glass inside; stove top disarranged; plumbing undamaged; lavatory torn from wall; refrigerator, heater, divan, and beds unhurt.

TEST UNIT 15—AIRSTREAM

Location: 10,500-ft line, position 1, facing side-on to the blast.

Description: Over-all length, 22 ft; travel type trailer; weight, 2700 lb; steel chassis; single axle.

Floor: Plywood covered with linoleum; aluminum subfloor; Fiberglas insulation.

Sidewalls: 1½- × ¾-in. aluminum-channel studding on approximately 24-in. centers, covered with 0.032 aluminum, riveted, no paint; Fiberglas insulation.

Roof: 1½- × ¾-in. aluminum channel on approximately 24-in. centers, covered with 0.032 aluminum, riveted, no paint; Fiberglas insulation.

Windows: There were 7 windows of various sizes, all of which were open.

Interior Sidewalls and Cabinets: The interior covering was of aluminum, painted, except for the washroom, which was bulkheaded with plywood; complete with dinette cushions, twin beds, 1 table, no chairs, electric refrigerator, a wheel-housing type range, gas heater (panel-ray type), no toilet in bathroom, steel-porcelain lavatory and sink, no venetian blinds, drapes on all windows, plastic drainage plumbing, and water-supply-line copper tubing with fittings.

Rear and left-side windows, as well as the door, of this trailer were open.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Small dent over back windows, no ruptures.

Interior: Interior sidewall and cabinets, small bulge in rear but no ruptures; washroom bulkheads broken from the sidewall and the dinette; rear window right side and the lower pane of the front window broken; drapes and rods off some of the windows; roof ventilators broken; no glass inside; plumbing unhurt; no damage to table, refrigerator, stove, or heater.

TEST UNIT 16—USED TRAILER (SCOTT)

Location: 10,500-ft line, position 9, facing side-on to the blast.

Description: Used 1947 model; over-all length, 20 ft; 1 bedroom; weight, 2700 lb; Masonite exterior; full specifications of construction not available.

Test Results: Chassis, subfloor, and undercarriage, including tires, not damaged.

Exterior: Rear left side broken beyond back door, no other ruptures; pivoted 18 in.

Interior: Interior roof ribs split; ceiling panel split; sidewall by left front window split; knickknack shelf torn off; overhead cabinets separated from wall; window frames on left side torn from wall, glass out; all windows (except door and right front) broken; rear-wardrobe door split; very little glass inside; support rail of left sidewall split.

TEST UNITS 17 AND 18

These were withdrawn from the program and were not included in the test.

TEST UNIT 19—USED TRAILER (SINGER)

Location: 10,500-ft line, position 7, facing side-on to the blast.

Description: Over-all length, 17 ft; travel type trailer; weight, 2180 lb; steel chassis; single axle. (See Fig. 2.28.)

Floor: Plywood covered with linoleum; subfloor, Firtex; Fiberglas insulation.

Sidewalls: 1 × 2 wood studding on 18-in. centers, covered with 0.032 aluminum, painted; Fiberglas insulation.

Roof: 1 × 2 wood rafters on 18-in. centers, covered with 0.032 aluminum, not painted; Fiberglas insulation.

Windows: There were 12 windows, 2 of which were stationary, of various sizes.

Interior Sidewalls and Cabinets: Hardwood plywood ¼ in. thick or less; complete with dinette cushions, dinette table and chairs, a General Chef combination unit of refrigerator, sink, and three-burner cookstove, no heater, no water heater, 1 box spring and mattress combination, no toilet, bathtub, lavatory, or sink, metallic drainage plumbing, and water-supply-line copper tubing with fittings.

All windows on both sides of this trailer were open.

Test Results: This trailer tipped over on its side; chassis, subfloor, and undercarriage, including tires, undamaged.

Exterior: Some distortion of left side; dents in rear roof, no ruptures. (See Fig. 2.29.)

Interior: Ceiling molding off; ruptured panel above back window; butane light globe broken; wardrobe and overhead cabinet split slightly; table off wall; dinette cushion—wood assembly torn from wall and floor; all windows except front and right front side broken. (See Figs. 2.30 and 2.31.)

TEST UNIT 20—USED TRAILER

Location: Approximately 16,000 ft; position, fall-out area; facing head-on to the blast.

Description: Over-all length, 27 ft; 1 bedroom; weight, 4985 lb; used 1948 model; Masonite exterior; complete specifications unknown.

Test Results: Front window broken.

2.2 CONCLUSIONS

The damage sustained by the mobile homes (trailer coaches) in Project 36.1 was comparatively minor in nature. Some coaches sustained more damage than others, although they were at the same pressure area. This was due to the different methods of construction, types of fastening, gauge and design of die-formed metal, spacing of studding, and the use of different-size windows. There was little or no glass inside some trailers despite the fact that their windows were broken. This was observed especially when the screen insert wire was on the inside of the window, preventing the glass from flying as missiles into the interior. On the smaller windows screening was even more effective.

Fig. 2.28—Exterior of used trailer at 10,500 ft before the blast.

Fig. 2.29—Exterior of used trailer at 10,500 ft after the blast.

Fig. 2.30—Interior of used trailer at 10,500 ft after the blast.

Fig. 2.31—Interior of used trailer at 10,500 ft after the blast.

All trailers could have been made habitable after an emergency by boarding up the windows that were broken, rearranging the furniture, and making temporary repairs to the cabinets and wardrobes. Most plumbing, gas lines, and appliances were in usable condition.

The results of Project 36.1 indicate that mobile homes could be an appreciable asset to a community as emergency housing in the event of an atomic attack. This is predicated on the basis that most mobile homes are normally located in the suburban areas beyond which overpressures from the enemy bomb would be no greater than about 1.7 psi, or those experienced by the trailers on the Apple II shot.

2.3 RECOMMENDATIONS

The information contained in this report should be made available to the mobile home industry for use in improving the construction and design of mobile homes.

A permanent committee representing the mobile home industry should be appointed to serve as liaison with the Federal Civil Defense Administration.

The mobile home industry should be allowed to participate in future suitable atomic tests to evaluate the results of design and construction improvements.

CHAPTER 3

EMERGENCY VEHICLES

3.1 OPERATIONS AND RESULTS

Eleven emergency vehicles were included in the test program of Project 36.2 on the Apple II shot. One was at 1470 ft, two were at 4700 ft, two were at 10,500 ft, and six were at 15,000 ft from Ground Zero. Identification of the vehicles, descriptions, test results, and illustrative photographs follow.

CUSTOMERS' GAS SERVICE TRUCK

Location: 15,000-ft line, facing Ground Zero.

Type: 1948 Chevrolet, 1½-ton pickup. (See Fig. 3.1.)

Equipment. Gas meters, repair parts, appliances, and testing and repair instruments.

Test Results: No damage to vehicle or equipment.

HEAVY-DUTY GAS REPAIR TRUCK

Location: 15,000-ft line, broadside to Ground Zero.

Type: 2-ton cab-over. (See Fig. 3.2.)

Equipment: Emergency lighting equipment, portable water pump, air-compressor earth tamper, oxyacetylene welding equipment, full set of construction and repair tools, and two-way radio.

Test Results: The side window was shattered, and the window and frame to the rear of the air compartment were knocked out. There was no damage to tools or equipment. This truck would have been available for emergency operation. (See Figs. 3.3 and 3.4.)

EARTH-BORING MACHINE

Location: 4700-ft line, broadside to Ground Zero.

Type: 1947 Dodge, 2½-ton flat-bed. (See Fig. 3.5.)

Equipment: Jaques earth-boring machine bolted to truck bed.

Test Results: This truck was overturned. The roof of the cab was dished in, and the door on the side of the truck facing the blast was badly damaged. The earth-boring machine was knocked loose from the truck and was on its side. Later this truck was pulled into an upright position and driven from its location. Operating condition of the earth-boring machine was not determined. (See Fig. 3.6.)

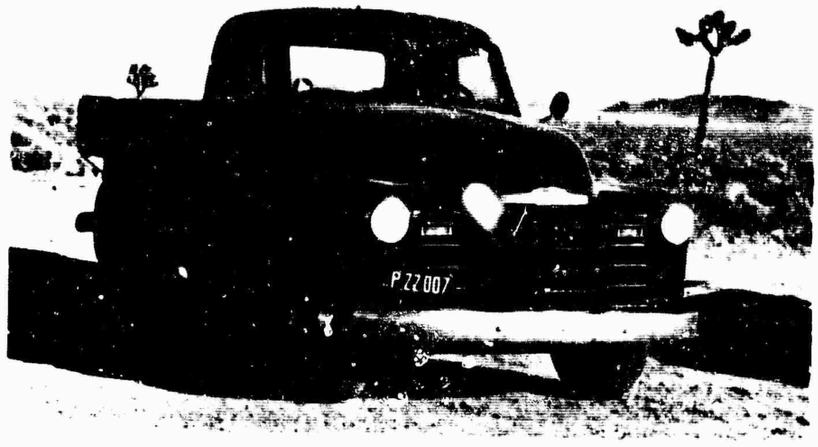

Fig. 3.1—Gas service truck at 15,000 ft.

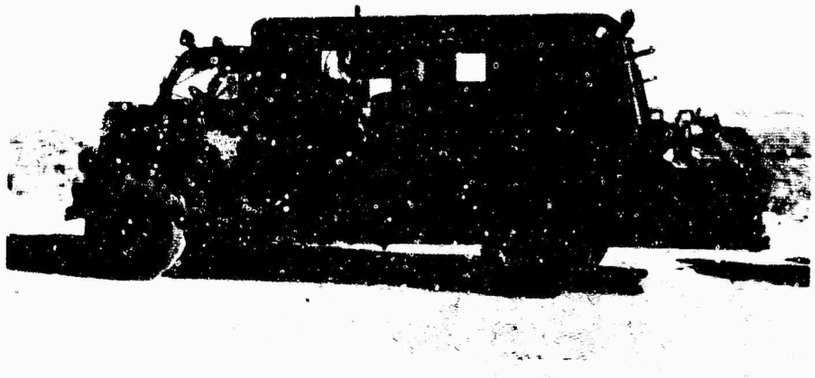

Fig. 3.2—Heavy-duty gas repair truck at 15,000 ft before the blast.

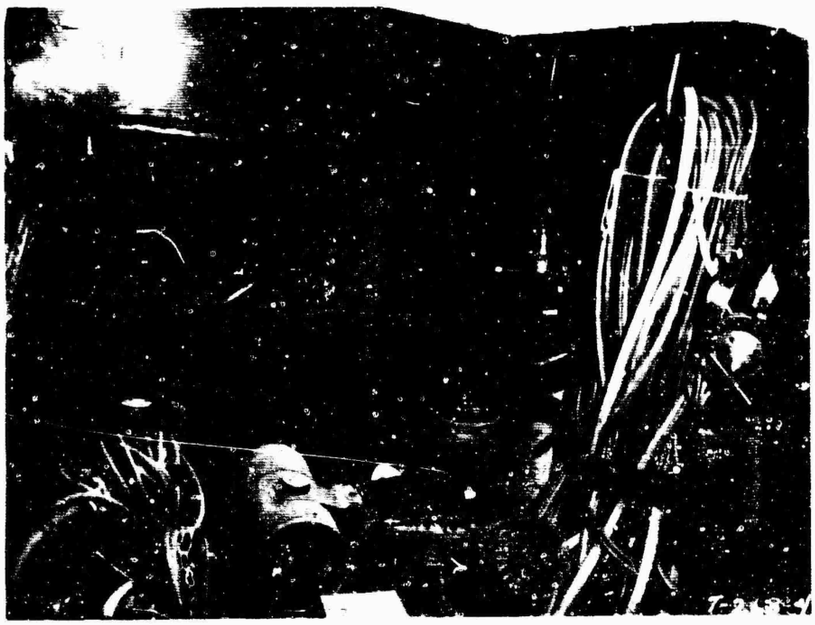

Fig. 3.3—Dislodged window and frame of heavy-duty gas repair truck.

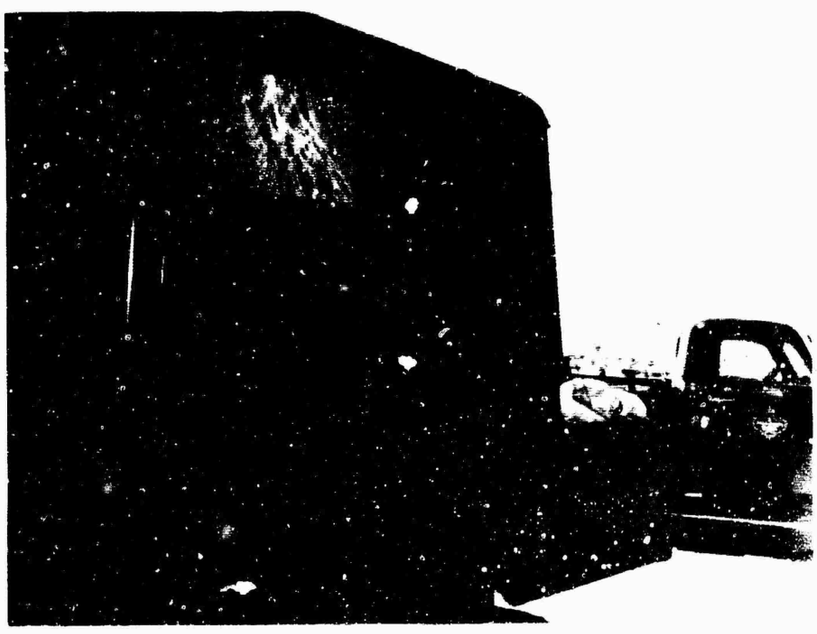

Fig. 3.4—Shattered side window of heavy-duty gas repair truck.

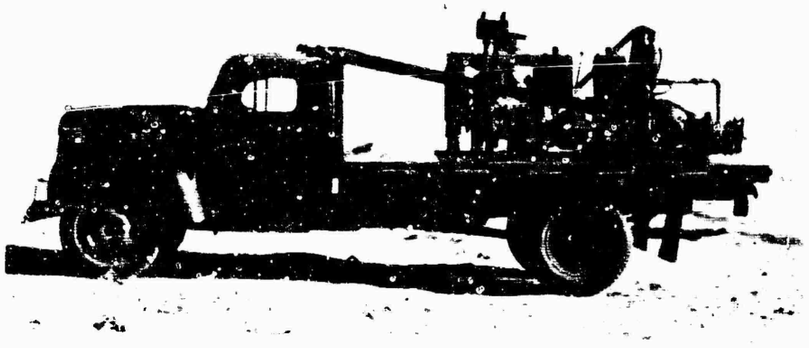

Fig. 3.5—Truck with earth-boring machine at 4700 ft before the blast.

Fig. 3.6—Truck on side with earth-boring machine dislodged.

HEAVY-DUTY ELECTRICAL LINE TRUCK

Location: 4700-ft line, facing Ground Zero.

Type: 1947 International, 3-ton special body. (See Fig. 3.7.)

Equipment: Double winch and boom; standard tools and equipment.

Test Results: The windshield was shattered and blown to the floor of the cab. Both doors were slightly dished in, one-half of the motor hood was blown away, and one tool-compartment door was dished in. There was no damage to tools or equipment. The truck was driven from its location and would have been available for emergency operations. (See Fig. 3.8.)

LIGHT-DUTY ELECTRICAL SERVICE TRUCK

Location: 10,500-ft line, facing Ground Zero.

Type: 1946 Studebaker, 1½-ton light-duty service truck. (See Fig. 3.9.)

Equipment: Fully equipped with ladders, meters, rope, blankets, body belts, saws, gloves, helmets, cable, and hand tools.

Test Results: The windshield was shattered. The rear window of the cab and two side windows on the truck were cracked; one side panel was dished in. Tools and equipment were not damaged. This vehicle would have been available for emergency operations. (See Fig. 3.10.)

TELEPHONE COMPANY INSTALLERS' SERVICE TRUCK

Location: 15,000-ft line, facing Ground Zero.

Type: 1947 Ford, 1-ton pickup. (See Fig. 3.11.)

Equipment: Full complement of telephone-installation equipment, including overhead-mounted ladders.

Test Results: No damage to vehicle or equipment.

TELEPHONE COMPANY INSTALLERS' SERVICE TRUCK

Location: 15,000-ft line, broadside to Ground Zero.

Type: 1947 Chevrolet, 1-ton pickup. (See Fig. 3.12.)

Equipment: Full complement of telephone-installation equipment, including overhead-mounted ladders.

Test Results: No damage to vehicle or equipment.

AERIAL-LADDER TRUCK (FIRE APPARATUS)

Location: 10,500-ft line, broadside to Ground Zero.

Type: 75-ft aerial-ladder truck. (See Fig. 3.13.)

Equipment: 75-ft wooden aerial ladder, full complement of wooden ground ladders, and one section of 2½-in. cotton-jacket fire hose.

Test Results: The hood was slightly dished in, but there was no damage to tools or equipment. The aerial ladder was operable, and the vehicle was driven from the Test Site. This equipment would have been available for emergency operations.

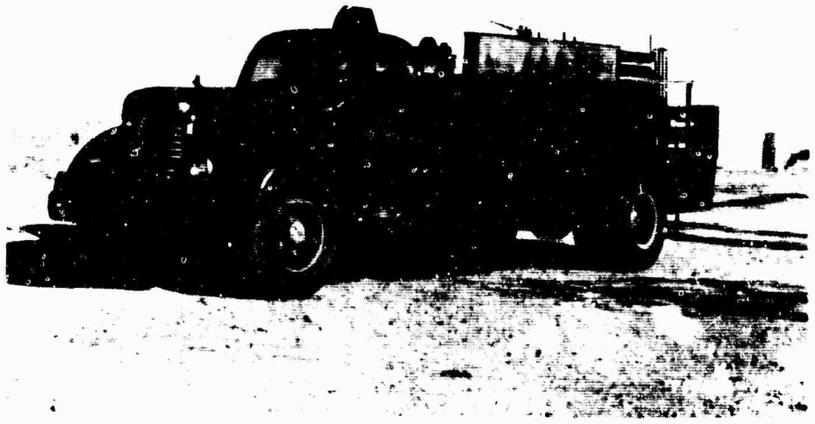

Fig. 3.7—Heavy-duty line truck at 4700 ft before the blast.

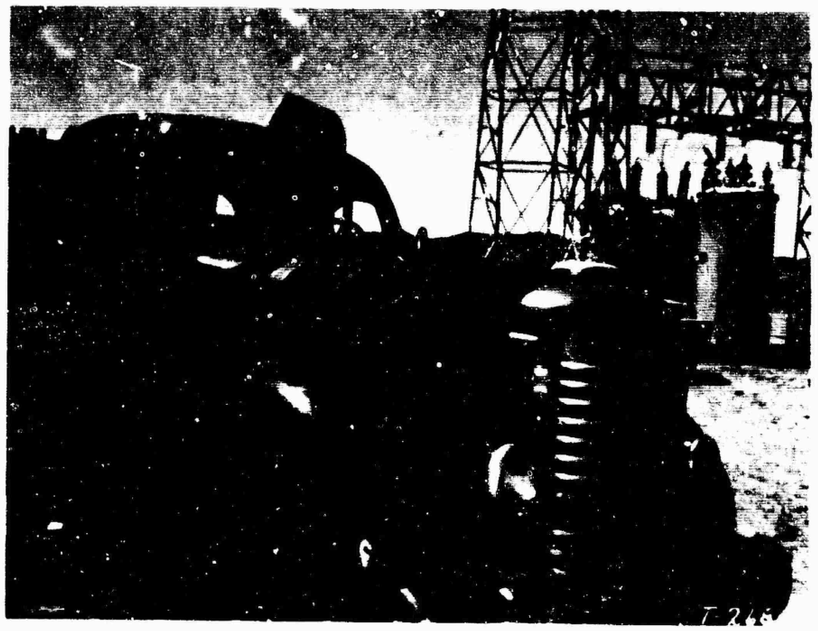

Fig. 3.8—Windshield and hood blown away from heavy-duty line truck.

Fig. 3.9—Light-duty electrical service truck at 10,500 ft before the blast.

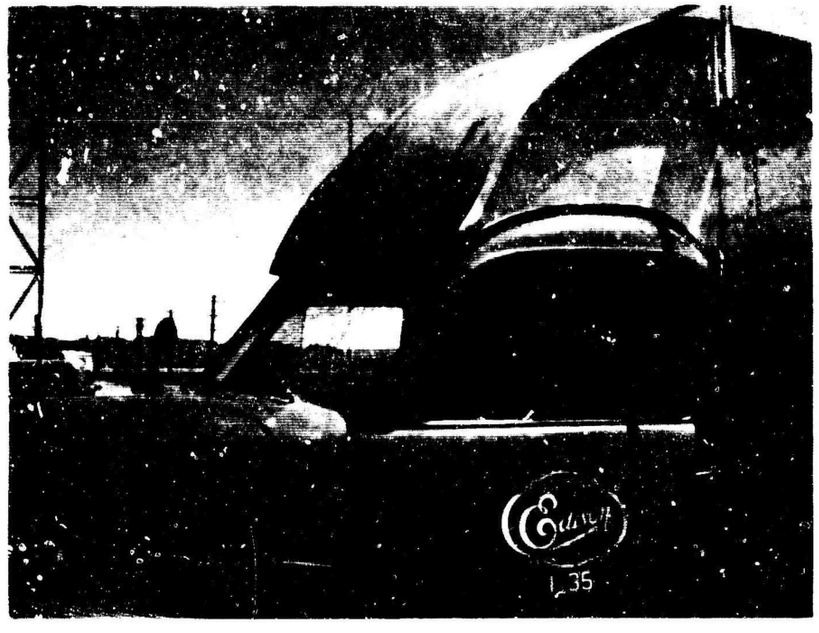

Fig. 3.10—Shattered glass in light-duty electrical service truck.

Fig. 3.11—Telephone service truck facing Ground Zero at 15,000 ft.

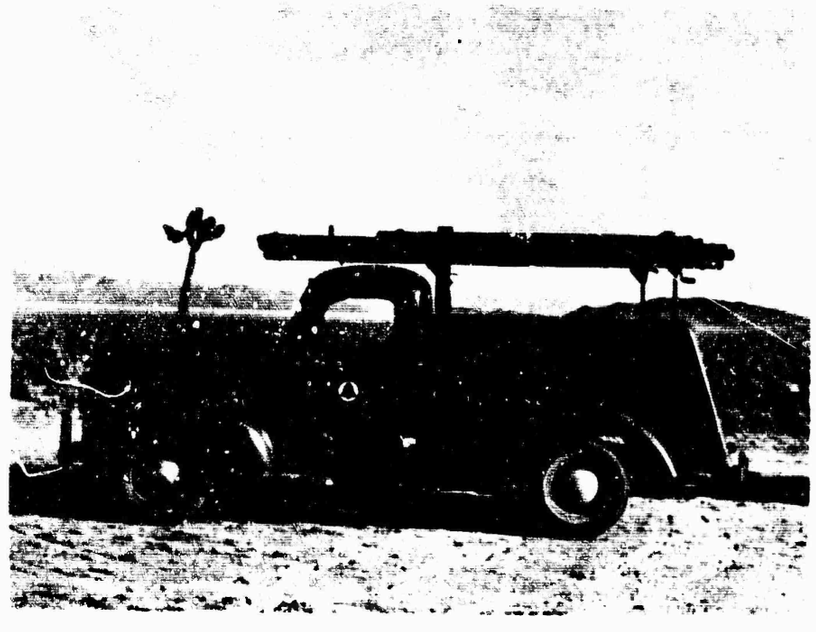

Fig. 3.12—Telephone installers' truck broadside to Ground Zero at 15,000 ft.

Fig. 3.13 — Hook and ladder truck at 10,500 ft before the blast.

FIRE DEPARTMENT PUMPER

Location: 15,000-ft line, broadside to Ground Zero.

Type: 1923 Seagrave, 1000 gal/min pumper. (See Fig. 3.14.)

Equipment: 1½- and 2½-in. cotton-jacket fire hose in hose bed; one section of 2½-in. cotton-jacket and one section of 2½-in. cotton-dacron-jacket fire hose connected to outlets of pumper on blast side.

Test Results: The two access panels on the side of the truck were dislodged, and the floor boards were displaced, but there was no other damage to the vehicle or equipment. This vehicle was driven from the Test Site and would have been available for emergency operations.

JEEP FIRE APPARATUS

Location: 15,000-ft line, facing Ground Zero.

Type: Jeep fire engine. (See Fig. 3.15.)

Equipment: Fully equipped with fire hose, ladders, tools, and equipment with water-tank trailer.

Test Results: No damage to vehicle or equipment.

RESCUE TRUCK

Location: 1470-ft line, broadside to Ground Zero.

Type: 1946 Dodge with rescue-truck body. (See Fig. 3.16.)

Equipment: None.

Test Results: Only one wheel and part of an axle were found after the blast. (See Fig. 3.17.)

Fig. 3.14—Fire department pumper at 15,000 ft before the blast.

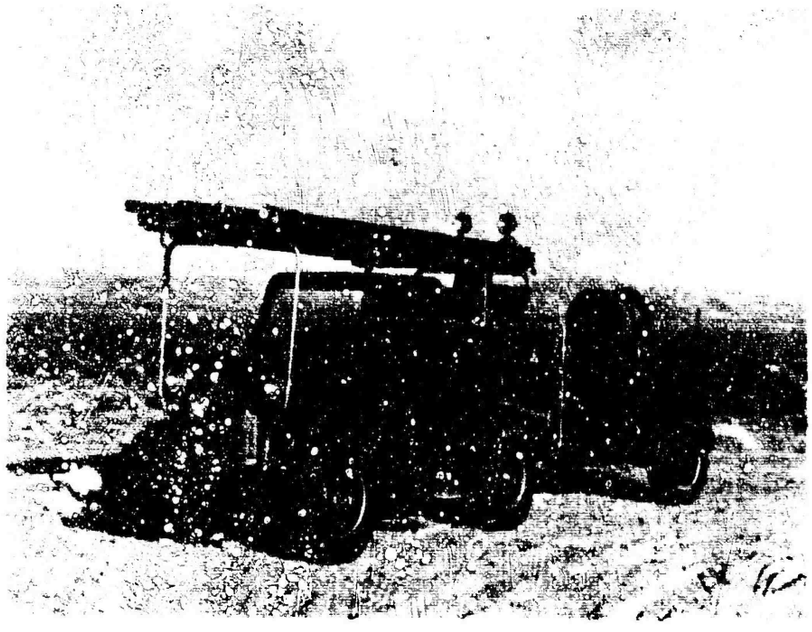

Fig. 3.15—Jeep fire engine at 15,000 ft before the blast.

Fig. 3.16—Rescue truck at 1470 ft before the blast.

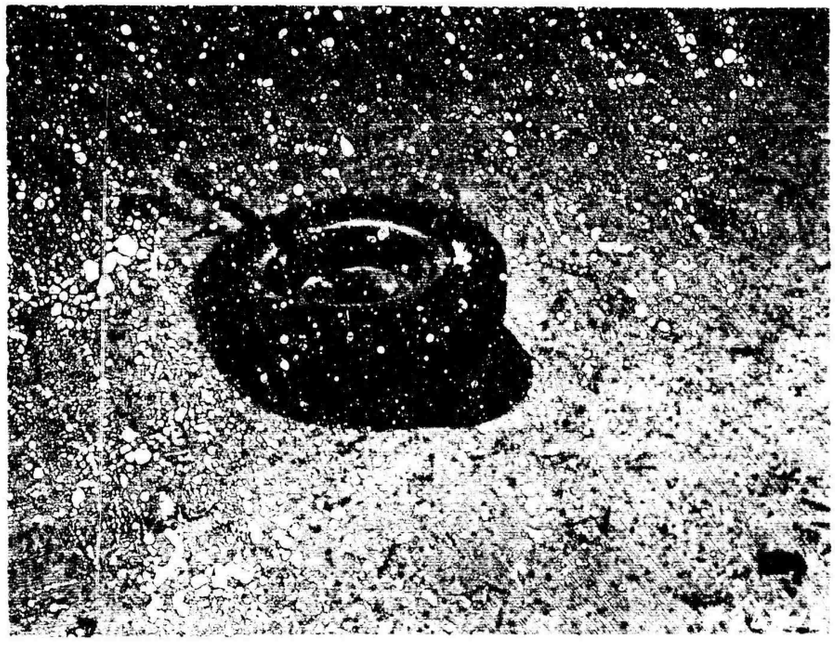

Fig. 3.17—Remains of rescue truck after the blast.

3.2 CONCLUSIONS

The results of the exposure of emergency vehicles and their equipment to the Apple II test emphasize that vehicles designed for disaster operations are substantially constructed and that the tools and equipment are protected from low-blast effects by the design of the truck body, or when adequately housed in compartments with protective doors.

The only equipment seriously damaged outside the very high pressure range was the earth-boring machine.

It is apparent that dispersed vehicles will suffer less damage if they are placed head-on to the blast.

This test substantiated the Federal Civil Defense Administration (FCDA) recommendation that the minimum safe dispersal area for emergency vehicles is just outside the D zone.

Test results indicate that emergency vehicles that survive within the B and C zones would be difficult to remove from these zones because of debris and other obstacles.

3.3 RECOMMENDATIONS

Further studies should be made of the blast and thermal effects on other emergency equipment and materials, these results to be used in planning future changes in design for protection of men and emergency equipment.

The unclassified pertinent material in all Civil Effects Test Group reports should be made available to the makers and users of emergency vehicles and equipment.

A small representative committee should be set up by each participating service to evaluate the test reports and recommend to their particular service such changes as may be indicated and to work with the FCDA on future test programs.

Serious consideration should be given to changing the design of emergency vehicles to enable them to operate more effectively under postattack conditions, such as:

1. Greater vehicle clearance
2. Improved angle of approach and departure
3. Better protection to tools and equipment by enclosing the vehicle or by additional closed compartments
4. Larger water tanks on fire equipment for fire fighting and decontamination use
5. Some type of selective four-wheel drive

CHAPTER 4

APPLICATION OF TEST RESULTS

The test results of Program 36 demonstrate the effects of a nuclear explosion of a particular yield on trailer coaches and emergency vehicles located at particular distances from Ground Zero of a shot with a yield approximately 50 per cent greater than nominal. Through the use of scaling laws published in "The Effects of Atomic Weapons" and presented in graphic form in Fig. 4.1, these results can be applied to different-size bombs and different distances

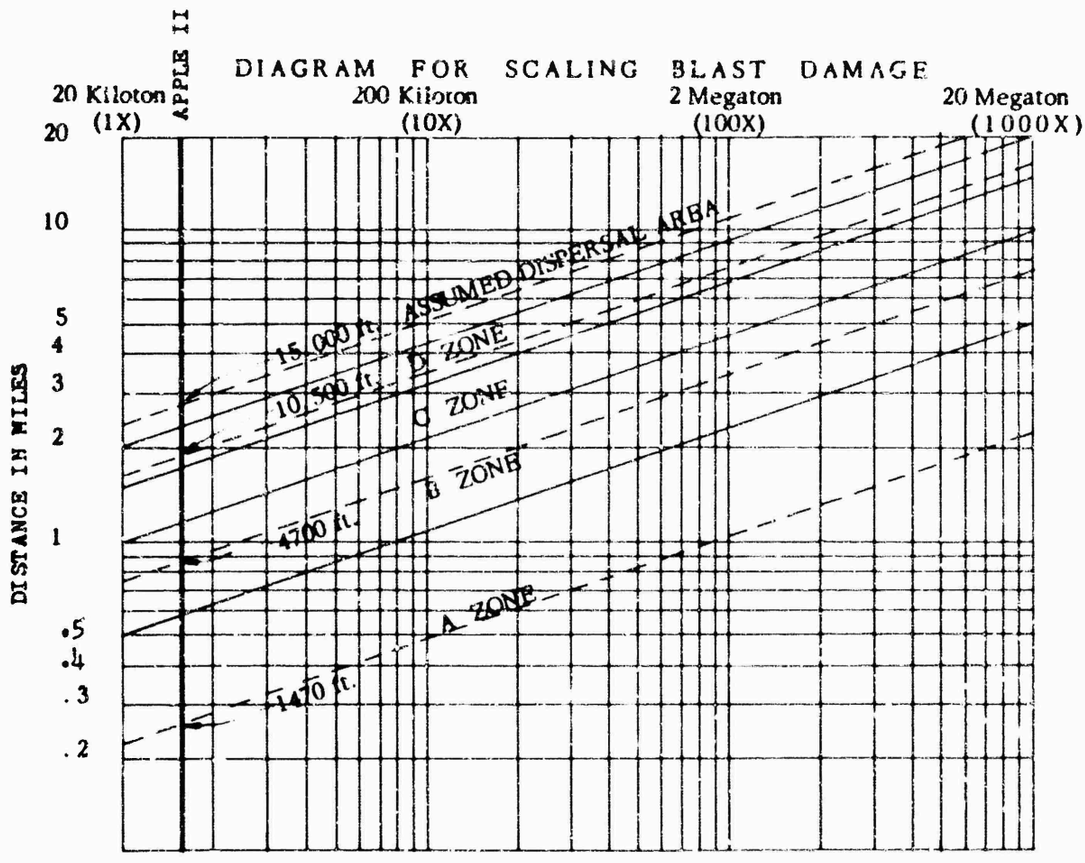

Fig. 4.1 — Range of damage as a function of bomb yield.

from Ground Zero. Several examples of scaling are given. The following assumptions are made:

1. That the distance for a particular degree of blast damage varies with the cube root of the ratio of bomb yields. (This is a good assumption and is quite adequate for planning purposes.)

2. That the areas of the cities in question are circular, with the radii of the circles equal to the square roots of the actual city areas divided by π. (This is not a particularly good assumption, and any city applying the results of the Program 36 experiment would probably be able to choose a more suitable geometric figure. However, for purposes of illustration this assumption is adequate.)

3. That the enemy will employ a bomb which will cause C damage, extending to the city limits of the principal city in the critical target area, i.e., the C ring of damage will extend a distance equal to the radius of the circle of item 2 above.

4. That the city in question is a relatively flat plain and no substantial shielding is provided by hills and valleys or other obstructions. (This assumption varies from poor to good, depending on the city or the parts of the city being studied.)

Chicago has an area of 207.5 square miles. This area would be included in a circle of 8.1 miles radius. By assuming that a bomb used on Chicago would cause C damage to 8.1 miles from Ground Zero, the bomb size from the curve of Fig. 4.1 is seen to be approximately 3.1 megatons (Mt). Under this condition the damage occurring at the various distances from Ground Zero in Apple II shot would occur as shown in Table 4.1. By this procedure the comparable-

Table 4.1—DISTANCE FROM GROUND ZERO WHERE DAMAGE COMPARABLE TO APPLE II DAMAGE WOULD OCCUR

Apple II		Miles from Ground Zero				
Ft	Miles	Detroit	Indianapolis	Flint	Los Angeles	Chicago
1,470	0.3	1.0	0.7	0.5	1.9	1.3
4,700	0.9	3.4	2.1	1.5	6.1	4.1
10,500	2.0	7.5	4.8	3.5	14.0	9.1
15,000	2.8	10.5	6.8	5.0	19.5	13.0

damage distances are worked out for other cities. Detroit, with an area of 139.6 square miles (equivalent radius, 6.7 miles), would require a 1.7-Mt bomb. Indianapolis, with an area of 55.2 square miles (equivalent radius, 4.2 miles), would require a bomb size of 0.44 Mt. Flint, with an area of 29.3 square miles (equivalent radius, 3.1 miles), would require a bomb size of 0.17 Mt. Los Angeles, with an area of 460 square miles (equivalent radius, 12.1 miles), would require a bomb of 10.6 Mt. By reference to a map and assuming Ground Zero, damages of the types resulting from the relatively small bomb detonated at the Nevada Test Site may be translated to the types and locations of damage which might be expected under an actual enemy attack.

APPENDIX A

COMPANIES PARTICIPATING IN TRAILER TESTS

	Test unit
Airstream Trailers, Inc., Los Angeles, Calif.	15
Spartan Aircraft Co., Tulsa, Okla.	12
Mid-State Corp., Bourbon, Ind.	3
Vagabond Coach Mfg. Co., New Hudson, Mich.	1
Peerless Mfg. Co., Fort Wayne, Ind.	4
Kit Mfg. Co., Long Beach, Calif.	10
D. T. Singer, Trailer Sales, Salt Lake City, Utah	19
Traveleze Trailer Co., Sun Valley, Calif.	13
Scott Trailer Mart, Las Vegas, Nev.	16
Quality Trailer Co., Wisconsin	7
Mon-o-Coach Corp., Louisville, Ky.	8
Pacemaker Trailer Co., Elkhart, Ind.	2
Columbia Trailer Co., Van Nuys, Calif.	9
Aljoa–Modernistic Industries, Gardena, Calif.	11
Supreme-Victor, Chicago, Ill.	5
Southwestern Mobile Homes, Inc., Grand Saline, Tex.	6
Hawks Trailer Sales, Rochester, N. Y.	20

APPENDIX B

PARTICIPANTS AND EQUIPMENT IN EMERGENCY-VEHICLE TESTS

American Gas Association
- Customers' gas service truck
- Heavy-duty gas repair truck

Edison Electric Institute
- Earth-boring machine
- Heavy-duty line truck
- Light-duty service truck

American Telephone & Telegraph Company
- Two installers' service trucks

Fire Apparatus Manufacturers Association

Seagrave Corporation
- Aerial-ladder truck

Seagrave-Hirsch, Inc.
- Fire department pumper

Willys Motor Company
- Jeep fire engine

FCDA Rescue Service improvised rescue truck