



THE DEFENSE MONITOR

© 1981 CENTER FOR DEFENSE INFORMATION — WASHINGTON, D.C.

I.S.S.N. #0195-6450

Vol. X, Number 5

U.S. NUCLEAR WEAPONS ACCIDENTS: DANGER IN OUR MIDST

Defense Monitor in Brief

- The Department of Defense has reported thirty-two serious accidents involving U.S. nuclear weapons.
- The Pentagon reports provide interesting and disquieting information about the dangers of nuclear weapons accidents but are incomplete, uneven, and vague.
- Nuclear weapons are located at hundreds of places throughout the U.S. and in foreign countries and are transported frequently from place to place.
- Not all significant mishaps involving nuclear weapons and their components are reported under the current Department of Defense nuclear accident reporting system.
- As the numbers of nuclear weapons increase in the 1980s the risk of nuclear accidents will increase.

U.S. DEPARTMENT OF DEFENSE NUCLEAR WEAPONS ACCIDENTS 1950-1980 INTRODUCTION*

Attached are unclassified summaries describing the circumstances surrounding 32 accidents involving nuclear weapons. Also attached is the Department of Defense (DOD)/Department of Energy (DOE) definition of "accident" used in researching this project.

Twenty-six of these summaries were first released by the Air Force in 1977; another was prepared following the Titan II explosion in Arkansas in September 1980.

There never has been even a partial inadvertent U.S. nuclear detonation despite the very severe stresses imposed upon the weapons involved in these accidents. All "detonations" reported in the summaries involved conventional high explosives (HE) only. Only two accidents, those at Palomares and Thule, resulted in a widespread dispersal of nuclear materials.

Nuclear weapons are never carried on training flights. Most of the aircraft accidents represented here occurred during logistic/ferry missions or airborne alert flights by Strategic Air Command (SAC) aircraft. Airborne alert was terminated in 1968 because of:

- Accidents, particularly those at Palomares and Thule,

- The rising cost of maintaining a portion of the SAC bomber force constantly on airborne alert, and,
- The advent of a responsive and survivable intercontinental ballistic missile force which relieved the manned bomber force of a part of its more time-sensitive responsibilities. (A portion of the SAC force remains on nuclear *ground alert*.)

Since the location of a nuclear weapon is classified defense information, it is Department of Defense policy normally neither to confirm nor deny the presence of nuclear weapons at any specific place. In the case of an accident involving nuclear weapons, their presence may or may not be divulged at the time depending upon the possibility of public hazard or alarm. Therefore, in some of the events summarized here, the fact of the presence of nuclear weapons or materials may not have been confirmed at the time. Furthermore, due to diplomatic considerations, it is not possible to specify the location of the accidents that occurred overseas, except for Palomares and Thule.

Most of the weapon systems involved in these accidents are no longer in the active inventory. Those include the B-29, B-36, B-47, B-50, B-58, C-124, F-100 and

*This is a Department of Defense document. All material in brackets by Center for Defense Information.

P-5M aircraft, and the Minuteman I missile, [BOMARC].

With some early models of nuclear weapons, it was standard procedure during most operations to keep a capsule of nuclear material separate from the weapon for safety purposes. While a weapon with the capsule removed did contain a quantity of natural (not enriched) uranium with an extremely low level of radioactivity, accidental detonation of the HE element would not cause a nuclear detonation or contamination. More modern designs incorporate improved redundant safety features to insure that a nuclear explosion does not occur as the result of an accident.

This list of accidents was compiled by DOD/DOE researchers during December 1980-January 1981. The researchers reviewed all available records of the military services and DOE, applying current definitions to determine if an event warranted categorization as an accident.

For example, one event *not* covered by these narratives was included in a "Chronology of Nuclear Accident Statements," released by DOD in 1968:

"March 18, 1963, Titan (I) Missile Burned in Silo near Moses Lake, Washington."

The researchers found, however, that only a small retrorocket on the missile had accidentally fired. The missile and its warhead were not damaged. That event does not warrant inclusion in a list of accidents involving nuclear weapons.

Another event from the 1968 list, involving a U.S. Navy Terrier missile (January 20, 1966; NAS Mayport, Florida) was not considered to be an accident, but has been categorized as a significant incident. In that incident, a nuclear warhead separated from the missile, and

fell about eight feet [aboard the USS Luce, a guided missile frigate. The event occurred on January 19]. The warhead was dented; no other damage occurred.

The events outlined in the attached narratives involved operational weapons, nuclear materials, aircraft and/or missiles under control of the U.S. Air Force, U.S.

DEPARTMENT OF DEFENSE DEFINITION OF AN ACCIDENT

An "accident involving nuclear weapons" is defined as

- An unexpected event involving nuclear weapons or nuclear weapons components that results in any of the following:
 - Accidental or unauthorized launching, firing, or use, by U.S. forces or supported allied forces, of a nuclear-capable weapon system which could create the risk of an outbreak of war.
 - Nuclear detonation.
 - Non-nuclear detonation or burning of a nuclear weapon or radioactive weapon component, including a fully assembled nuclear weapon, an unassembled nuclear weapon, or a radioactive nuclear weapon component.
 - Radioactive contamination.
 - Seizure, theft, or loss of a nuclear weapon or radioactive nuclear weapon component, including jettisoning.
 - Public hazard, actual or implied.

U.S. Navy Definitions

NUCFLASH	Any accidental or unauthorized incident involving a possible detonation of a nuclear weapon by U.S. forces which could create the risk of nuclear war between the U.S. and the USSR.
BROKEN ARROW	a) The accidental or unauthorized detonation, or possible detonation of a nuclear weapon (other than war risk); b) Non-nuclear detonation or burning of a nuclear weapon; c) Radioactive contamination; d) Seizure, theft, or loss of a nuclear weapon or component (including jettisoning); e) Public hazard, actual or implied.
BENT SPEAR	Any nuclear weapons significant incidents other than nuclear weapon accidents or war risk detonations, actual or possible.
DULL SWORD	Any nuclear weapon incident other than significant incidents.
FADED GIANT	Any nuclear reactor or radiological accidents involving equipment used in connection with naval nuclear reactors or other naval nuclear energy devices while such equipment is under the custody of the Navy.

U.S. Department of the Navy,
Chief of Naval Operations, 15 July 1978

Navy or a DOE predecessor agency, the Atomic Energy Commission. The U.S. Army has never experienced an event serious enough to warrant inclusion in a list of accidents involving nuclear weapons. The U.S. Marine Corps does not have custody of nuclear weapons in peacetime and has experienced no accidents or significant incidents involving them.

To the best of our knowledge, this list is complete. Reporting requirements varied among the Services, particularly in the earlier period covered by these narratives, so it is possible but not likely that an earlier accident has gone unreported here. *All later events*, however, have been evaluated and are included if they fall within the established definition of an accident.

DEPARTMENT OF DEFENSE SUMMARIES OF ACCIDENTS INVOLVING US NUCLEAR WEAPONS 1950-1980*

No. 1, February 13, 1950/B-36/Pacific Ocean, off Coast of British Columbia

The B-36 was enroute from Eielson Air Force Base, [near Fairbanks, Alaska] to Carswell Air Force Base [Fort Worth, Texas] on a simulated combat profile mission. The weapon aboard the aircraft had a dummy capsule installed. After six hours of flight, the aircraft developed serious mechanical difficulties, making it necessary to shut down three engines. The aircraft was at 12,000 feet altitude. Icing conditions complicated the emergency and level flight could not be maintained. The aircraft headed out over the Pacific Ocean and dropped the weapon from 8,000 feet. A bright flash occurred on impact, followed by a sound and shock wave. Only the weapon's high explosive material detonated. The aircraft was then flown over Princess Royal Island where the crew bailed out. The aircraft wreckage was later found on Vancouver Island.

CDI: Sixteen crewmen and one passenger parachuted safely and were rescued. An accompanying B-36 flew safely to Carswell Air Force Base. No mention is made of an attempt to recover the nuclear weapon and presumably it is still in the ocean. As early as 1950 nuclear weapons were carried to and from Alaska. The B-36 was operational from 1948-1959 and 325 were built.

No. 2, April 11, 1950/B-29/Manzano Base, New Mexico

Aircraft departed Kirtland Air Force Base [Albuquerque, N.M.] at 9:38 p.m. and crashed into a mountain on Manzano Base approximately three minutes later killing the crew [of thirteen]. Detonators were installed in the bomb on board the aircraft. The bomb case was demolished and some high explosive (HE) material burned in the gasoline fire. Other pieces of unburned HE were scattered throughout the wreckage. Four spare detonators in their carrying case were recovered undamaged. There were no contamination or recovery problems. The recovered components of the weapon were returned to the Atomic Energy Commission. Both the weapon and the capsule of

nuclear material were on board the aircraft but the capsule was not inserted for safety reasons. A nuclear detonation was not possible.

CDI: The *New York Times* reported the B-29 crashed in a "remote secret area of Sandia Special Weapons Base . . . and burned, shooting up flames visible for fifteen miles." Manzano Mountain was used as a "dead storage" site where outmoded weapons were stored. The B-29 was the United States' first nuclear delivery aircraft and comprised the majority of our strategic bomber force through 1952. The *Enola Gay* was a B-29 which dropped the bomb on Hiroshima. By June 1948 only 32 B-29s were modified to deliver nuclear weapons. All were assigned to the 509th Bomb Group. The B-29 was operational from 1943-1954; 3970 were built.

No. 3, July 13, 1950/B-50/Lebanon, Ohio

The B-50 was on a training mission from Biggs Air Force Base, [El Paso,] Texas. The aircraft was flying at 7,000 feet on a clear day. Aircraft nosed down and flew into the ground killing four officers and twelve airmen. The high explosive portion of the weapon aboard detonated on impact. There was no nuclear capsule aboard the aircraft.

CDI: The explosion was heard over a radius of 25 miles and made a crater 25 feet deep and 200 feet square. The B-50 was an improved derivative of the B-29 with the same general appearance. It was operational from 1948-1953 and 370 were built.

No. 4, August 5, 1950/B-29/Fairfield-Suisun Air Force Base, [Fairfield,] California

A B-29 carrying a weapon, but no capsule, experienced two runaway propellers and landing gear retraction difficulties on takeoff from Fairfield-Suisun Air Force Base (now Travis Air Force Base). The aircraft attempted an emergency landing and crashed and burned. The fire was fought for 12-15 minutes before the weapon's high explosive material detonated. Nineteen crew members and rescue personnel were killed in the crash and/or the resulting detonation, including General Travis.

CDI: The aircraft crashed near a trailer camp occupied by 200 service families. The explosion of 10-12 500 lb.

* All material in brackets by Center for Defense Information.

conventional explosive bombs shattered more than half of the fifty automobiles and trailers, blasted a crater 20 yards across and six feet deep and was felt 30 miles away. The fire could be seen for 65 miles. There were also 60 people hurt.

No. 5, November 10, 1950/B-50/Over Water, Outside United States

Because of an in-flight aircraft emergency, a weapon containing no capsule of nuclear material was jettisoned over water from an altitude of 10,500 feet. A high-explosive detonation was observed.

CDI: There is no record of recovery of this nuclear weapon.

No. 6, March 10, 1956/B-47/Mediterranean Sea

The aircraft was one of a flight of four scheduled for non-stop deployment from MacDill Air Force Base [Tampa, Fla.] to an overseas air base. Take-off from MacDill and first refueling were normal. The second refueling point was over the Mediterranean Sea. In preparation for this, the flight penetrated solid cloud formation to descend to the refueling level of 14,000 feet. Base of the clouds was 14,500 feet and visibility was poor. The aircraft, carrying two nuclear capsules in carrying cases, never made contact with the tanker. An extensive search failed to locate any traces of the missing aircraft or crew. No weapons were aboard the aircraft, only two capsules of nuclear weapons material in carrying cases. A nuclear detonation was not possible.

CDI: This disappearance of the B-47, its crew, and nuclear weapons material was assumed to be an accident. The B-47 was America's first jet bomber and was operational from 1951-1965. Faster than its predecessors, it lacked the range to reach the Soviet Union from the U.S. and thus bases were established in England and French Morocco in 1950-51. 2060 B-47s were built.

No. 7, July 27, 1956/B-47/Overseas Base

A B-47 aircraft with no weapons aboard was on a routine training mission making a touch and go landing when the aircraft suddenly went out of control and slid off the runway, crashing into a storage igloo containing several nuclear weapons. The bombs did not burn or detonate. There were no contamination or cleanup problems. The damaged weapons and components were returned to the Atomic Energy Commission. The weapons that were involved were in storage configuration. No capsules of nuclear materials were in the weapons or present in the building.

CDI: The crash occurred at Lakenheath Royal Air Force Station, 20 miles northeast of Cambridge, England. The plane was part of the 307th Bombardment Wing and had recently come from Lincoln Air Force Base, Neb-

raska. As part of what was called "Operation Reflex," B-47 bombers were regularly rotated, usually on a 90-day basis, to bases in the United Kingdom and North Africa. In the storage igloo were three Mark 6 nuclear bombs, each 12 feet long and 6 feet in diameter. Each bomb had about 8000 lbs. of TNT as part of its trigger mechanism. The blazing jet fuel did not ignite the TNT and was extinguished by the base fire fighters. The four crewmen were killed. "It is possible that a part of Eastern England would have become a desert" had the TNT exploded and showered radioactive materials over a wide area, said a now retired Air Force general who was in the U.K. at the time. "It was a combination of tremendous heroism, good fortune and the will of God," said a former Air Force officer who was on the scene.

It is not clear when American nuclear weapons were first deployed to Europe. The process went through several stages. In early July 1950 President Truman approved the stockpiling of non-nuclear components at forward bases in England. On December 6, 1950, President Truman endorsed the Joint Chiefs' request that non-nuclear components of atomic bombs be stocked on board the aircraft carrier, USS Franklin Roosevelt, stationed in the Mediterranean.

No. 8, May 22, 1957/B-36/Kirtland Air Force Base, New Mexico

The aircraft was ferrying a weapon from Biggs Air Force Base, Texas, to Kirtland Air Force Base. At 11:50 a.m. Mountain Standard Time, while approaching Kirtland at an altitude of 1700 feet, the weapon dropped from the bomb bay taking the bomb bay doors with it. Weapon parachutes were deployed but apparently did not fully retard the fall because of the low altitude. The impact point was approximately 4.5 miles south of the Kirtland control tower and .3 miles west of the Sandia Base reservation. The high explosive material detonated, completely destroying the weapon and making a crater approximately 25 feet in diameter and 12 feet deep. Fragments and debris were scattered as far as one mile from the impact point. The release mechanism locking pin was being removed at the time of release. (It was standard procedure at that time that the locking pin be removed during takeoff and landing to allow for emergency jettison of the weapon if necessary.) Recovery and cleanup operations were conducted by Field Command, Armed Forces Special Weapons Project. Radiological survey of the area disclosed no radioactivity beyond the lip of the crater at which point the level was 0.5 milliroentgens. There were no health or safety problems. Both the weapon and capsule were on board the aircraft but the capsule was not inserted for safety reasons. A nuclear detonation was not possible.

CDI: In a *New York Times* report of the 1968 list of accidents, there is mention of a B-36 bomber dropping

an atomic bomb near Kirtland Air Force Base in 1956 that was publicly reported. Either a similar event did occur in 1956 or it has been confused with this event.

Inadvertent Explosion

"Nuclear weapons are designed with great care to explode only when deliberately armed and fired. Nevertheless, there is always a possibility that, as a result of accidental circumstances, an explosion will take place inadvertently. Although all conceivable precautions are taken to prevent them, such accidents might occur in areas where weapons are assembled and stored, during the course of loading and transportation on the ground, or when actually in the delivery vehicle, e.g., an airplane or a missile."

Atomic Energy Commission/Department of Defense
The Effects of Nuclear Weapons
1962

No. 9, July 28, 1957/C-124/Atlantic Ocean

Two weapons were jettisoned from a C-124 aircraft on July 28 off the east coast of the United States. There were three weapons and one nuclear capsule aboard the aircraft at the time. Nuclear components were not installed in the weapons. The C-124 aircraft was enroute from Dover Air Force Base, Delaware when a loss of power from number one and two engines was experienced. Maximum power was applied to the remaining engines; however, level flight could not be maintained. At this point, the decision was made to jettison cargo in the interest of safety of the aircraft and crew. The first weapon was jettisoned at 4,500 feet altitude. The second weapon was jettisoned at approximately 2,500 feet altitude. No detonation occurred from either weapon. Both weapons are presumed to have been damaged from impact with the ocean surface. Both weapons are presumed to have submerged almost instantly. The ocean varies in depth in the area of the jettisonings. The C-124 landed at an airfield in the vicinity of Atlantic City, New Jersey, with the remaining weapon and the nuclear capsule aboard. A search for the weapons or debris had negative results.

CDI: Three of the 32 accidents occurred while transporting nuclear weapons from one place to another, using the C-124 "Globemaster" transport. In this instance weapons and a nuclear capsule were being taken to Europe. The weapons were jettisoned within an area 100 miles southeast of the Naval Air Station, Pomona, N.J. where the aircraft landed. The two weapons are still presumably in the area, somewhere east of Rehobeth

Beach, Delaware, Cape May and Wildwood, N.J. Plutonium-239, an isotope used to fuel atomic bombs has a half-life of 24,400 years and remains poisonous for at least half a million years.

No. 10, October 11, 1957/B-47/Homestead Air Force Base, [Homestead,] Florida

The B-47 departed Homestead Air Force Base shortly after midnight on a deployment mission. Shortly after liftoff one of aircraft's outrigger tires exploded. The aircraft crashed in an uninhabited area approximately 3,800 feet from the end of the runway. The aircraft was carrying one weapon in ferry configuration in the bomb bay and one nuclear capsule in a carrying case in the crew compartment. The weapon was enveloped in flames which burned and smoldered for approximately four hours after which time it was cooled with water. Two low order high explosive detonations occurred during the burning. The nuclear capsule and its carrying case were recovered intact and only slightly damaged by heat. Approximately one-half of the weapon remained. All major components were damaged but were identifiable and accounted for.

CDI: Four crewmen were killed.

No. 11, January 31, 1958/B-47/Overseas Base

A B-47 with one weapon in strike configuration was making a simulated takeoff during an exercise alert. When the aircraft reached approximately 30 knots on the runway, the left rear wheel casting failed. The tail struck the runway and a fuel tank ruptured. The aircraft caught fire and burned for seven hours. Firemen fought the fire for the allotted ten minutes fire fighting time for high explosive contents of that weapon, then evacuated the area. The high explosive did not detonate, but there was some contamination in the immediate area of the crash. After the wreckage and the asphalt beneath it were removed and the runway washed down, no contamination was detected. One fire truck and one fireman's clothing showed slight alpha contamination until washed. Following the accident, exercise alerts were temporarily suspended and B-47 wheels were checked for defects.

CDI: The crash might have taken place at a U.S. air base in Sidi Slimane, French Morocco. An earlier Air Force document reported, "Contamination of the wreckage was high, but that of the surrounding area was low." The *New York Times* of June 8, 1960 mentions a nuclear weapons accident having occurred "at a United States field near Tripoli, Libya," but gives no date.

No. 12, February 5, 1958/B-47 Savannah River, Georgia

The B-47 was on a simulated combat mission that

originated at Homestead Air Force Base, Florida. While near Savannah, Georgia, the B-47 had a mid-air collision at 3:30 a.m. with an F-86 aircraft. Following the collision the B-47 attempted three times to land at Hunter Air Force Base, Georgia, with a weapon aboard. Because of the condition of the aircraft, its airspeed could not be reduced enough to insure a safe landing. Therefore, the decision was made to jettison the weapon rather than expose Hunter Air Force Base to the possibility of a high explosive detonation. A nuclear detonation was not possible since the nuclear capsule was not aboard the aircraft. The weapon was jettisoned into the water several miles from the mouth of the Savannah River (Georgia) in Wassaw Sound off Tybee Beach. The precise weapon impact point is unknown. The weapon was dropped from an altitude of approximately 7,200 feet at an aircraft speed of 180-190 knots. No detonation occurred. After jettison the B-47 landed safely. A three square mile area was searched using a ship with divers and underwater demolition team technicians using Galvanic drag and hand-held sonar devices. The weapon was not found. The search was terminated April 16, 1958. The weapon was considered to be irretrievably lost.

CDI: Some accounts of nuclear weapons accidents list a February 12, 1958 accident involving a B-47 off Savannah, Georgia. An earlier DOD narrative was more precise on where it landed. "The best estimate," they say, "was determined to be 31 degrees 54' 15" North, 80 degrees 54' 54" West."

No. 13, March 11, 1958/B-47/Florence, South Carolina

On March 11, 1958 at 3:53 p.m. Eastern Standard Time, a B-47E departed Hunter Air Force Base, Georgia as number three aircraft in a flight of four enroute to an overseas base. After level off at 15,000 feet, the aircraft accidentally jettisoned an unarmed nuclear weapon which impacted in a sparsely populated area 6-1/2 miles east of Florence, South Carolina. The bomb's high explosive material exploded on impact. The detonation caused property damage and several injuries on the ground. The aircraft returned to base without further incident. No capsule of nuclear materials was aboard the B-47 or installed in the weapon.

CDI: Accounts of this widely reported accident describe the bomb falling in the garden of the home of Mr. Walter Gregg in Mars Bluff, S.C. The high explosive detonation virtually destroyed his house creating a crater 50-70 feet in diameter and 25-30 feet deep. It caused minor injuries to Mr. Gregg and five members of his family, and additionally damaged five other houses and a church. The clean-up effort required several days. Air Force personnel recovered hundreds of pieces of bomb fragments that were carried off as souvenirs by local

residents. The inhabitants of Mars Bluff were examined for several months to see if they had been exposed to any radiation. Five months later the Gregg family was awarded \$54,000 from the Air Force. After this accident Air Force crews were ordered to "lock in" nuclear bombs. This reduced the possibility of accidental drops but increased the hazards if the plane crashed.

Triggering a Nuclear Exchange

"The explosion of a nuclear device by accident—mechanical or human—could be a disaster for the United States, for its allies, and for its enemies. If one of these devices accidentally exploded, I would hope that both sides had sufficient means of verification and control to prevent the accident from triggering a nuclear exchange. But we cannot be certain that this would be the case."

John T. McNaughton
Assistant Secretary of Defense
1962

No. 14, November 4, 1958/B-47/Dyess Air Force Base [Abilene,] Texas

A B-47 caught fire on take-off. Three crew members successfully ejected; one was killed when the aircraft crashed from an altitude of 1,500 feet. One nuclear weapon was on board when the aircraft crashed. The resultant detonation of the high explosive made a crater 35 feet in diameter and six feet deep. Nuclear materials were recovered near the crash site.

No. 15, November 26, 1958/B-47/Chennault Air Force Base [Lake Charles,] Louisiana [now closed]

A B-47 caught fire on the ground. The single nuclear weapon on board was destroyed by the fire. Contamination was limited to the immediate vicinity of the weapon residue within the aircraft wreckage.

CDI: This is the eighth and last acknowledged B-47 accident, making it the most accident-prone of the nuclear-capable systems reported.

No. 16, January 18, 1959/F-100/Pacific Base

The aircraft was parked on a reveted hardstand in ground alert configuration. The external load consisted of a weapon on the left intermediate station and three fuel tanks (both inboard stations and the right intermediate station.) When the starter button was depressed during a practice alert, an explosion and fire occurred when the external fuel tanks inadvertently jettisoned. Fire trucks at the scene put out the fire in about seven minutes. The capsule was not in the vicinity of the aircraft and

was not involved in the accident. There were no contamination or cleanup problems.

CDI: During the late 1950s and early 1960s the F-100 Super Sabre served as a primary interceptor. The F-100 could carry nuclear capable air-to-air missiles. In 1959 the United States had bases in the Pacific on Okinawa, in the Philippines, Taiwan, South Korea and Thailand. 2,294 F-100s of all types were produced.

No. 17, July 6, 1959/C-124/Barksdale Air Force Base [Bossier City,] Louisiana

A C-124 on a nuclear logistics movement mission crashed on take-off. The aircraft was destroyed by fire which also destroyed one weapon. No nuclear or high explosive detonation occurred—safety devices functioned as designed. Limited contamination was present over a very small area immediately below the destroyed weapon. This contamination did not hamper rescue or fire fighting operations.

No. 18, September 25, 1959/P-5M/Off Whidbey Island, Washington

A U.S. Navy P-5M aircraft ditched in Puget Sound off Whidbey Island, Washington. It was carrying an unarmed nuclear antisubmarine weapon containing no nuclear material. The weapon was not recovered.

CDI: The crew of ten was rescued. The prime mission of the P-5M was anti-submarine warfare. Weapons used for this purpose include nuclear depth charges which have an explosive power of 5-10 kilotons (one kiloton equals 1,000 tons of TNT). The bomb dropped on Hiroshima has been estimated to have been 13.5 kilotons.

No. 19, October 15, 1959/B-52/KC-135/Hardinsburg, Kentucky

The B-52 departed Columbus Air Force Base, Mississippi at 2:30 p.m. Central Standard Time, October 15, 1959. This aircraft assumed the #2 position in a flight of two. The KC-135 departed Columbus Air Force Base at 5:33 p.m. CST as the #2 tanker aircraft in a flight of two scheduled to refuel the B-52. Rendezvous for refueling was accomplished in the vicinity of Hardinsburg, Kentucky at 32,000 feet. It was night, weather was clear, and there was no turbulence. Shortly after the B-52 began refueling from the KC-135, the two aircraft collided. The instructor pilot and pilot of the B-52 ejected, followed by the electronic warfare officer and the radar navigator. The co-pilot, navigator, instructor navigator, and tail gunner failed to leave the B-52. All four crewmembers in the KC-135 were fatally injured. The B-52's two unarmed nuclear weapons were recovered intact. One had been partially burned but this did not result in the disper-

sion of any nuclear material or other contamination.

CDI: The B-52 entered service in June 1955 and continues to be the primary aircraft for the strategic bomber force. In 1959, the United States reached its peak bomber strength of 1,366 B-47s and 488 B-52s. In the early 1960s, as much as 15% of the B-52 force (50-70 planes) was placed on airborne alert, in the air at all times armed and ready for attack. At that time B-52s carried from 1-4 nuclear bombs with yields between 1 and 24 megatons (one megaton equals 1,000,000 tons of TNT). The present strategic bomber force includes 316 B-52s and 60 FB-111s.

No. 20, June 7, 1960/BOMARC/McGuire Air Force Base, [near Trenton,] New Jersey

A BOMARC air defense missile in ready storage condition (permitting launch in two minutes) was destroyed by explosion and fire after a high pressure helium tank exploded and ruptured the missile's fuel tanks. The warhead was also destroyed by the fire although the high explosive did not detonate. Nuclear safety devices acted as designed. Contamination was restricted to an area immediately beneath the weapon and an adjacent elongated area approximately 100 feet long, caused by drain-off of firefighting water.

CDI: The BOMARC missile was one of 56 housed at the 46th Air Defense Missile Squadron in Jackson Township, N.J., ten miles east of McGuire Air Force Base. Each missile was housed in a separate concrete and steel shelter. The BOMARC had earned a reputation as a dangerous weapon system. The *New York Times* reported the 47-foot missile "melted under an intense blaze fed by its 100-pound detonator of TNT . . . The atomic warhead apparently dropped into the molten mass that was left of the missile, which burned for forty-five minutes." The radiation "had been caused when thoriated magnesium metal which forms part of the weapon, caught fire, . . . the metal, already radioactive, becomes highly radioactive when it is burned."

No. 21, January 24, 1961/B-52/Goldsboro, North Carolina

During a B-52 airborne alert mission structural failure of the right wing resulted in two weapons separating from the aircraft during aircraft breakup at 2,000—10,000 feet altitude. One bomb parachute deployed and the weapon received little impact damage. The other bomb fell free and broke apart upon impact. No explosion occurred. Five of the eight crew members survived. A portion of one weapon, containing uranium, could not be recovered despite excavation in the waterlogged farmland to a depth of 50 feet. The Air Force subsequently purchased an easement requiring permission for anyone to dig there. There is no detectable radiation and no hazard in the area.

CDI: This report does not adequately convey the potential seriousness of the accident. The two weapons were 24 megaton nuclear bombs. Combined, they had the equivalent explosive power of 3,700 Hiroshima bombs. All of the bombs dropped on Japan and Germany in World War II totaled 2.2 megatons. The Office of Technology Assessment's study, *The Effects of Nuclear War*, calculated that a 25 megaton air burst on Detroit would result in 1.8 million fatalities and 1.3 million injuries. Upon recovering the intact bomb it was discovered, as Daniel Ellsberg has said, that "five of the six safety devices had failed." "Only a single switch," said nuclear physicist Ralph E. Lapp, "prevented the bomb from detonating and spreading fire and destruction over a wide area." This accident occurred four days after John F. Kennedy became President. He was told, according to *Newsweek*, that, "there had been more than 60 accidents involving nuclear weapons," since World War II, "including two cases in which nuclear-tipped anti-aircraft missiles were actually launched by inadvertence." As a result of the Goldsboro accident many new safety devices were placed on U.S. nuclear weapons and the Soviets were encouraged to do the same.

No. 22, March 14, 1961/B-52/Yuba City, California

A B-52 [from Mather Air Force Base near Sacramento] experienced failure of the crew compartment pressurization system forcing descent to 10,000 feet altitude. Increased fuel consumption caused fuel exhaustion before rendezvous with a tanker aircraft. The crew bailed out at 10,000 feet except for the aircraft commander who stayed with the aircraft to 4,000 feet, steering the plane away from a populated area. The two nuclear weapons on board were torn from the aircraft on ground impact. The high explosive did not detonate. Safety devices worked as designed and there was no nuclear contamination.

CDI: The crew of eight survived though a fireman died extinguishing the fire. The nuclear weapons involved could have been either the free fall bombs located in the interior bomb bay compartment or "Hound Dog" (AGM-28B) air-to-ground missiles which are carried in pairs beneath the wings of B-52s. The Hound Dog was a stand-off nuclear-tipped strategic missile with a range of 500-600 miles. It was inertially guided and powered by a turbo jet, air-breathing engine and had a warhead of about one megaton. It was first assigned to SAC in late 1959, and was part of the Air Force's nuclear inventory until it was phased out in 1977.

By July 1961, SAC had increased the percentage of the bomber force on 15-minute ground alert from approximately 33% to 50%.

No. 23, November 13, 1963/Atomic Energy Commission Storage Igloo/Medina Base, [San Antonio,] Texas

An explosion involving 123,000 lbs. of high explo-

Nothing Infallible

"Some day there will be an accidental explosion of a nuclear weapon, a pure accident, which has nothing whatsoever to do with military or political plans, intentions, or operations. The human mind cannot construct something that is infallible. Accordingly, the laws of probability virtually guarantee such an accident—not because the United States is relaxing any of the conscientious precautions designed to prevent one, or because the Soviet Union is necessarily getting more careless with warheads, but simply because sheer numbers of weapons are increasing. . . . Nuclear weapons will surely spread throughout the world. They may become available in international trade: even that is not to be excluded. With thousands of nuclear weapons in existence, the danger of a nuclear accident in the world is unquestionably increasing."

Oskar Morgenstern
The Question of National Defense

sive components of nuclear weapons caused minor injuries to three Atomic Energy Commission employees. There was little contamination from the nuclear components stored elsewhere in the building. The components were from obsolete weapons being disassembled.

CDI: While three employees were dismantling the high-explosive component of a nuclear bomb it began burning spontaneously, setting off the larger amount of high explosives. Three other accounts of accidents (as well as this one) involving components of nuclear weapons were supplied to Dr. Joel Larus of New York University by the AEC on January 12, 1966:

Hamburg, New York (January 4, 1958) . . . An eastbound Nickel Plate railroad freight train was derailed, and five cars carrying "AEC classified material" were involved in the accident. According to the report there was no damage to the material and no injury to AEC personnel escorting the shipment.

Winslow, Arizona (November 4, 1961) . . . A trailer truck caught fire while carrying a small amount of radioactive material. There was no contamination resulting from the fire.

Marietta, Georgia (December 3, 1962) . . . A Louisville and Nashville train was derailed while carrying nuclear weapons components. The material was not damaged, but three couriers were injured.

Accidents of this sort probably happen more frequently than reported. In December 1980 a Department of Energy trailer carrying plutonium overturned on icy roads on Interstate 25 near Fort Collins, Colorado, on its way from Richland, Washington, to Los Alamos, New Mexico. Each year hundreds of nuclear convoys travel millions of miles on U.S. highways. Even when there is

no accident, exposure over a period of years to radioactive material by certain Department of Energy couriers and privately contracted transporters and personnel may be carcinogenic. It has been estimated that nearly 120,000 persons have access to U.S. nuclear weapons and weapons-grade fissionable material. A study on the hazards of low level, intrinsic radiation inherent in nuclear weapons is being conducted by the Defense Nuclear Agency and will be released in 1982.

The weapons work at Medina was phased out in 1966 and consolidated with production activities in the Pantex, Texas (near Amarillo) and Burlington, Iowa, final assembly plants.

No. 24, January 13, 1964/B-52/Cumberland, Maryland

A B-52D was enroute from Westover Air Force Base, [Chicopee Falls,] Massachusetts, to its home base at Turner Air Force Base, [Albany] Georgia. The crash occurred approximately 17 miles SW of Cumberland, Maryland. The aircraft was carrying two weapons. Both weapons were in a tactical ferry configuration (no mechanical or electrical connections had been made to the aircraft and the safing switches were in the "SAFE" position). Prior to the crash, the pilot had requested a change of altitude because of severe air turbulence at 29,500 feet. The aircraft was cleared to climb to 33,000 feet. During the climb, the aircraft encountered violent air turbulence and aircraft structural failure subsequently occurred. Of the five aircrew members, only the pilot and co-pilot survived. The gunner and navigator ejected but died of exposure to sub-zero temperatures after successfully reaching the ground. The radar navigator did not eject and died upon aircraft impact. The crash site was an isolated mountainous and wooded area. The site had 14 inches of new snow covering the aircraft wreckage which was scattered over an area of approximately 100 yards square. The weather during the recovery and clean-up operation involved extreme cold and gusty winds. Both weapons remained in the aircraft until it crashed and were relatively intact in the approximate center of the wreckage area.

No. 25, December 5, 1964/LGM 30B (Minuteman ICBM)/Ellsworth Air Force Base, [Rapid City,] South Dakota

The LGM 30B Minuteman I missile was on strategic alert at Launch Facility (LF) L-02, Ellsworth Air Force Base, South Dakota. Two airmen were dispatched to the LF to repair the inner zone (IZ) security system. In the midst of their checkout of the IZ system, one retrorocket in the spacer below the Reentry Vehicle (RV) fired, causing the RV to fall about 75 feet to the floor of the silo. When the RV struck the bottom of the silo, the arming and

fusing/altitude control subsystem containing the batteries was torn loose, thus removing all sources of power from the RV. The RV structure received considerable damage. All safety devices operated properly in that they did not sense the proper sequence of events to allow arming the warhead. There was no detonation or radioactive contamination.

CDI: The Minuteman I was a three stage intercontinental ballistic missile carrying a one megaton warhead. The first missiles became operational in November 1962. Throughout the 1960s and 1970s they were gradually replaced by Minutemen IIs and IIIs. The Office of Technology Assessment study calculated that a one megaton surface burst in Detroit would cause 70 square miles of property destruction, a quarter of a million fatalities, and half a million injuries.

No. 26, December 8, 1964/B-58/Bunker Hill (Now Grissom) Air Force Base, [Peru,] Indiana

SAC aircraft were taxiing during an exercise alert. As one B-58 reached a position directly behind the aircraft on the runway ahead of it, the aircraft ahead brought advanced power. As a result of the combination of the jet blast from the aircraft ahead, the icy runway surface conditions, and the power applied to the aircraft while attempting to turn onto the runway, control was lost and the aircraft slid off the left hand side of the taxiway. The left main landing gear passed over a flush mounted taxiway light fixture and 10 feet further along in its travel, grazed the left edge of a concrete light base. Ten feet further, the left main landing gear struck a concrete electrical manhole box, and the aircraft caught on fire. When the aircraft came to rest, all three crew members aboard began abandoning the aircraft. The aircraft commander and defensive systems operator egressed with only minor injuries. The navigator ejected in his escape capsule, which impacted 548 feet from the aircraft. He did not survive. Portions of the five nuclear weapons on board burned; contamination was limited to the immediate area of the crash and was subsequently removed.

CDI: The B-58 supersonic bomber was operational from 1960-69 and 104 were built.

No. 27, October 11, 1965/C-124/Wright-Patterson Air Force Base [near Dayton,] Ohio

The aircraft was being refueled in preparation for a routine logistics mission when a fire occurred at the aft end of the refueling trailer. The fuselage of the aircraft, containing only components of nuclear weapons and a dummy training unit, was destroyed by the fire. There were no casualties. The resultant radiation hazard was minimal. Minor contamination was found on the aircraft,

cargo and clothing of explosive ordinance disposal and fire fighting personnel, and was removed by normal cleaning.

No. 28, December 5, 1965/A-4/At Sea, Pacific

An A-4 aircraft loaded with one nuclear weapon rolled off the elevator of a U.S. aircraft carrier and fell into the sea. The pilot, aircraft, and weapon were lost. The incident occurred more than 500 miles from land.

CDI: The A-4 is a lightweight attack bomber. The weapon may have been a B-43 nuclear bomb.

No. 29, January 17, 1966/B-52/KC-135/Palomares, Spain

The B-52 and the KC-135 collided during a routine high altitude air refueling operation. Both aircraft crashed near Palomares, Spain. Four of the eleven crewmembers survived. The B-52 carried four nuclear weapons. One was recovered on the ground, and one was recovered from the sea, on April 7, after extensive search and recovery efforts. Two of the weapons' high explosive materials exploded on impact with the ground, releasing some radioactive materials. Approximately 1400 tons of slightly contaminated soil and vegetation were removed to the United States for storage at an approved site. Representatives of the Spanish government monitored the clean-up operation.

CDI: The DOD summary is a typically low-key account of the most well-publicized nuclear accident which resulted in what has been described as "the most expensive, intensive, harrowing and feverish underwater search for a man-made object in world history." The B-52 was returning to Seymour Johnson Air Force Base at Goldsboro, North Carolina, after flying the southern route of the SAC air alert missions (code-named "Chrome Dome"). It was attempting its third refueling of the mission with a KC-135 tanker from the American base at Morón, in southwestern Spain, near Sevilla. Although the official report of the cause of the accident was not released to the public, it is believed that while attempting to dock at 30,000 ft. above the Spanish coast, the nozzle of the tanker's boom, which was supposed to hook up with the B-52's orifice, struck the bomber, ripping open the B-52 along its spine and causing aerodynamic stress which snapped the bomber into pieces. Flames spurted through both planes and the KC-135's 40,000 gallons of jet fuel ignited, killing its four crew members almost immediately. Four of the seven crew members of the B-52 managed to eject and parachute to safety.

As the two planes, worth \$11,000,000 and weighing loaded nearly 800,000 lbs., crashed and burned, wreckage fell across an area of land and water of about 100 square miles. Of the four H-bombs (believed to be in

Accidental Nuclear War

"Despite the most elaborate precautions, it is conceivable that technical malfunction or human failure, a misinterpreted incident or unauthorized action, could trigger a nuclear disaster or nuclear war."

Introduction of U.S.-Soviet Treaty
U.S. Arms Control and Disarmament
Agency
September 1971

the 20-25 megaton range) aboard, one fell to earth and remained relatively intact, two scattered plutonium widely over the fields of Palomares when their high explosive material detonated, and one fell into the ocean. For the next three months the village was turned upside down as the search, decontamination and removal operation began. Estimates for the amount of radioactive soil and vegetation removed to the nuclear dumping site at Aiken, South Carolina, range up to 1,750 tons.

The weapon that sank in the Mediterranean caused the greatest problem. Its recovery required the assembly of a naval task force, including a small armada of miniature research submarines, scuba teams, sonar experts, nuclear weapons engineers, oceanic photographers, and hundreds of sailors aboard ships of the Sixth Fleet which were called in to seal the area. It took two weeks for the midget sub "Alvin" to sight the bomb, entangled in its parachute 12 miles off Palomares on a 70 degree slope at a depth of 2,500 feet. After a series of failed attempts, the bomb was finally recovered on April 7, dented but intact, with no known radiation leakage. The Palomares search took about eighty days and required the services of 3,000 Navy personnel and 33 Navy vessels, not counting ships, planes and people used to move equipment to the site. By 1969, a U.S. Commission had settled 522 claims by Palomares residents totalling \$600,000. It also gave the town of Palomares the gift of a desalting plant, which cost about \$200,000 to build.

No. 30, January 21, 1968/B-52/Thule, Greenland

A B-52 from Plattsburgh Air Force Base, New York, crashed and burned some seven miles southwest of the runway at Thule Air Base, Greenland, while approaching the base to land. Six of the seven crewmembers survived. The bomber carried four nuclear weapons, all of which were destroyed by fire. Some radioactive contamination occurred in the area of the crash, which was on the sea ice. Some 237,000 cubic feet of contaminated ice, snow and water, with crash debris, were removed to an approved storage site in the United States over the

course of a four-month operation. Although an unknown amount of contamination was dispersed by the crash, environmental sampling showed normal readings in the area after the cleanup was completed. Representatives of the Danish government monitored the cleanup operation.

CDI: The B-52 was flying the Arctic Circle route as part of the continuous airborne alert operation, "Chrome Dome," involving anywhere from 6 to 50 B-52s. A fire broke out in the navigator's compartment and was soon out of control, spreading smoke throughout the plane. The pilot headed the bomber towards Thule Air Base, located about 700 miles above the Arctic Circle on the northwestern Greenland coast, to attempt an emergency landing. The seven crew members had to eject when the plane was at about 8-9,000 feet and about four miles south of the runway. Six of the crew members parachuted to safety with only slight injuries while one, the co-pilot, died. After it was abandoned, the plane did a 180 degree turn and crashed onto the ice of North Star Bay seven and one-half miles southwest of Thule, whereupon it skidded across the ice in flames and exploded. It is believed that the high explosives in the outer coverings of the four 1.1 megaton H-Bombs aboard detonated, releasing radiation from the plutonium in the bombs and causing fires which destroyed all four. Wreckage of the plane was widely scattered in an area about 300 yards on either side of the plane's path, much of it in "cigarette box-sized" pieces.

A team of 70 Air Force and civilian specialists were flown in to monitor radiation and search for debris and the bombs, soon followed by the Navy's special team which had worked at Palomares. The bombs' parts were discovered about ten days later on the snow within 1,000 feet of the path of the plane.

A massive collection and removal effort began. The contaminated ice and crash debris were removed to the United States, the bomb debris to the AEC Pantex plant at Amarillo, Texas, where the bombs had been manufactured. A few days after the crash, Secretary of Defense McNamara ordered the removal of nuclear weapons from planes on airborne alert. The alerts were later curtailed and then suspended altogether.

The government of Denmark, which owns Greenland and prohibits nuclear weapons on or over their territory, issued a strong protest. There were large demonstrations throughout Denmark against the U.S. and its base at Thule. Costs of the crash, clean-up and compensation ran into the millions of dollars.

No. 31, Spring 1968/At Sea, Atlantic Details remain classified.

CDI: The accident probably refers to the nuclear powered attack submarine USS Scorpion. The Scorpion was last heard from on May 21, 1968. It was returning to Norfolk, Va. after a three-month training exercise with the Sixth Fleet in the Mediterranean. It sank 400-450 miles southwest of the Azores. Initial suspicion that the

Soviets were somehow involved was allayed when the research ship Mizar photographed the wreckage lying at 10,000 feet on the sea floor. A Navy seven-man court of inquiry met for eleven weeks and heard 90 witnesses. They found "No evidence of any kind to suggest foul play or sabotage," and that the "certain cause of the loss of the Scorpion cannot be ascertained from evidence now available." Ninety-nine men were lost. The nuclear weapons aboard may have been either SUBROC or ASTOR, or both. SUBROC, first deployed in 1965, is an anti-submarine missile and nuclear depth charge. Attack submarines normally carry 4-6 SUBROCs, which have a range of 25-30 miles and high explosive power. ASTOR is the nuclear version of the MK45 torpedo which went into service around 1960 and has low explosive power.

No. 32, September 19, 1980/Titan II ICBM/ Damascus, Arkansas

During routine maintenance in a Titan II silo, an Air Force repairman dropped a heavy wrench socket, which rolled off a work platform and fell toward the bottom of the silo. The socket bounced and struck the missile, causing a leak from a pressurized fuel tank. The missile complex and the surrounding area were evacuated and a team of specialists was called in from Little Rock Air Force Base, the missile's main support base. About 8½ hours after the initial puncture, fuel vapors within the silo ignited and exploded. The explosion fatally injured one member of the team. Twenty-one other USAF personnel were injured. The missile's re-entry vehicle, which contained a nuclear warhead, was recovered intact. There was no radioactive contamination.

CDI: The explosion of the volatile fuel blew off the 740 ton silo door of reinforced concrete and steel and catapulted the warhead 600 feet. The 54 liquid-fueled Titan II missiles have been operational since 1963. It is estimated that Titan II ICBMs carry a 9 megaton warhead. The Office of Technology Assessment study estimated that a 9 megaton airburst on Leningrad would result in 2.4 million fatalities and 1.1 million injuries. With age, the seals on the missiles are corroding, increasing the number of leaks. The worst missile accident occurred in Searcy, Arkansas on August 9, 1965 when a fire in a Titan II silo killed 53. The Air Force has disclosed that between 1975 and 1979 there have been 125 accidents at Titan sites in Arkansas, Arizona and Kansas. From March 1979 to September 1980 there were ten other leaks and accidents at Arkansas Titan sites. On August 24, 1978 at a Titan site in Rock, Kansas, two airmen were killed and thirty others injured when they were exposed to deadly oxidizer gas. The silo at Damascus, Arkansas will be filled in with gravel while that at Rock, Kansas is being refurbished and is planned to be operational in September 1982.

CDI CONCLUSIONS

- The Department of Defense report on nuclear weapons accidents is a clear warning of the continuing danger of nuclear accidents.
- The variety of nuclear weapons accidents which have occurred in the past and the increased numbers of nuclear weapons suggest that more accidents and perhaps more serious accidents will occur in the future.
- A General Accounting Office or other governmental organization investigation is needed to identify major risks and preventive measures in order to reduce the possibility of accidents in the future.
- Development and promulgation of U.S. government plans for handling emergencies arising from nuclear weapons accidents could reduce civilian casualties in areas where nuclear weapons are stored or handled.

For single copy of this issue, send \$1.00, 10 or more copies, 50¢ each. CDI receives no funds from government or from military contractors. The Center is financed solely by voluntary tax-deductible contributions mailed to Fund for Peace, 122 Maryland Avenue, N.E., Washington, D.C. 20002. Attention: Admiral La Rocque.

THE STAFF

Director:

Rear Admiral Gene R. La Rocque
U.S. Navy (Ret.)

Associate Directors:

Rear Admiral Eugene J. Carroll Jr.
U.S. Navy (Ret.)
Major General William T. Fairbourn
U.S.M.C. (Ret.)

Assistant Director:

Dr. Barry Schneider

Research Director:

David T. Johnson

Media Director:

Arthur L. Kanegis

Senior Staff:

Lt. Col. John H. Buchanan U.S.M.C.
(Ret.)

*Dr. Robert S. Norris

Stephen D. Goose

Evelyn S. Labriola

Patricia G. Anderson

Richard Fieldhouse

*Thomas K. Longstreth

Charolatt Goodwin

Gladis Shaw

Consultants:

James J. Treiros, Economist

Research Interns:

Chris Evans (Columbia)

Hedi Gerstman (Smith)

Cynthia Packard (Yale)

Kathy Wood (Dartmouth College)

Woody Young (Brown)

Alice Zuckertrod (Princeton)

*Principal Analysts This Issue

Doris E. Bato—Cos Cob, Conn.

Arthur D. Berlioz, Jr.—Captain USNR

(ret.); former Vice-President,

Allen-Hollander Co., New York, N.Y.

Hon. Jonathan B. Bingham—Member

of Congress, New York, N.Y.

Benjamin V. Cohen—Former Advisor to

President Franklin D. Roosevelt,

Washington, D.C.

James E. Compton—President, J.R.

Compton Development Company; Board of

Trustees, Experiment in International

Living, Los Gatos, Calif.

Colonel James A. Donovan, USMC

(Ret.), Author, former publisher *Journal of*

the Armed Forces, Atlanta, Ga.

Charles H. Dyson—Chairman of the

Board, Dyson-Kleiser Corporation, New

York, N.Y.

Seth M. Glickenhau—Investment

Broker, New York, N.Y.

Copyright © 1981 by the Center for Defense Information. All rights reserved. Center for Defense Information encourages quotation of any of the material herein without permission, provided the Center is credited. The Center requests a copy of any such use.

BOARD OF ADVISORS

Dr. James D. Head—President, Strategy

Development Company, Friesland, Mich.

Susan W. Horowitz—New York, N.Y.

Alan F. Kay—Businessman, Author,

Weston, Mass.

Eugene M. Lang—President, REFAC

Technology Development Corporation,

New York, N.Y.

Thomas B. Morgan—Author and Editor,

New York, N.Y.

Stewart Mott—Philanthropist, New

York, N.Y.

Paul Newman—Motion Pictures, Los

Angeles Calif.

Jubal Parton—Oil Producer & Cattle

Rancher, Madison, Texas

Dr. Martha B. Pate—Educator, New

York, N.Y.

Lawrence S. Phillips—President,

Phillips-Van Heusen Corporation, New

York, N.Y.

Rudolph S. Rasin—President, The Rasin

Corporation, Chicago, Ill.

Dr. Karl C. Ravensall—Former Director,

Asian Division (Systems Analysis), Office

of Secretary of Defense, Washington, D.C.

John Rockwood—Publisher, Chicago,

Ill.

Albert M. Rosenhaus—Vice President,

Metro-Goldwyn Mayer, Marina del Rey,

Calif.

Robert P. Schaus—Metallurgical

Engineer, International Consultant for

Industrial Development, Chicago, Ill.

Alfred P. Slaner—Former President,

Kayser-Roth Corp., New York, N.Y.

Herbert Scoville, Jr.—Former Deputy

Director, Central Intelligence Agency,

Washington, D.C.

Philip A. Struss—Partner, Neuberger

and Berman, Members, New York Stock

Exchange, New York, N.Y.

Michael Tennenbaum—Investment

Banker, Los Angeles, Calif.

Harold Wilkens—Chairman of the Board,

Factory Equipment Corporation, Los

Angeles, Calif.

Abraham Wilson—Attorney, Partner,

Kadel, Wilson and Potts, New York, N.Y.



Center for Defense Information
122 Maryland Avenue NE
Washington DC 20002
202 543-0400

NON-PROFIT ORG.

US POSTAGE

PAID

Washington, D.C.

Permit No. 45490