APPENDIX B

UNRECOVERED NUCLEAR WEAPONS AND CLASSIFIED COMPONENTS

The information which follows is excerpted from a Joint Department of Defense (DoD)/Department of Energy (DOE) Report on the Histories of Nuclear Weapon Accidents. Accident descriptions are reproduced verbatim from that report. Only minor editorial changes have been made to the introductory material.

Introduction

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 weapons system which could create the risk of an outbreak of war;
- Nuclear detonation;
- Nonnuclear 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; or
- Public hazard, actual or implied.

Following are **unclassified** summaries describing the circumstances surrounding accidents involving nuclear weapons. **Elaboration above and beyond information provided on any incident contained herein must be referred to the appropriate authorities for classification review. (See the NOTES following topics 5.1.1 and 5.1.2.)**

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. The "Scorpion" incident (spring 1968) was added when it was declassified in 1993.

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 only. Only two accidents, those at Palomares, Spain, and Thule, Greenland, resulted in 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:

a. Accidents, particularly those at Palomares and Thule;

b. The rising cost of maintaining SAC bomber force constantly on airborne alert; and

c. 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.

Since the location of a nuclear weapon is classified, it is DoD 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 weapons carriers 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 P-5M aircraft, and the Minuteman I missile.

With some early models of nuclear weapons, it was standard procedure during most operations to keep the 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 high explosives 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 and 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 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; Naval Air Station, 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. 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. Navy, or the Atomic Energy Commission (AEC). 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.

Accidents involving nuclear weapons

February 13, 1950/B-36/Pacific Ocean, off the Coast of British Columbia. The B-36 was en route from Eielson Air Force Base (AFB) to Carswell AFB 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 brief 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.

April 11, 1950/B-29/Manzano Base, New Mexico. The aircraft departed Kirtland AFB at 9:38 p.m. and crashed into a mountain on Manzano Base approximately three minutes later, killing the crew. Detonators were installed in the bomb on board the aircraft. The bomb case was demolished and some high explosive material burned in the gasoline fire. Other pieces of unburned high explosive 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.

July 13, 1950/B-50/Lebanon, Ohio. The B-50 was on a training mission from Biggs AFB, Texas. The aircraft was flying at 7,000 feet on a clear day. The aircraft nosed down and flew into the ground killing four officers and twelve airman. The high explosive portion of the weapon detonated on impact. There was no nuclear capsule aboard this aircraft.

August 5, 1950/B-29/Fairfield-Suisun AFB, California. A B-29 carrying a weapon, but no capsule, experienced two runaway propellers and landing gear retraction difficulties on takeoff from Fairfield-Suisun AFB (now Travis AFB). The aircraft attempted emergency landing, 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.

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.

March 10, 1950/B-47/Mediterranean Sea. The aircraft was one of a flight of four scheduled for nonstop deployment from MacDill AFB 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 a 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.

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 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 AEC. The weapons that were involved were in storage configuration. No capsules of nuclear materials were in the weapons or present in the building.

May 22, 1957/B-36/Kirtland AFB, New Mexico. The aircraft was ferrying a weapon from Biggs AFB, Texas, to Kirtland AFB. At 11:50 a.m. Mountain Standard Time, while approaching Kirtland at an altitude of 1,700 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 0.3 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.

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 en route from Dover AFB, 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 jettisons. 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.

October 11, 1957/B-47/Homestead AFB, Florida. The B-47 departed Homestead AFB shortly after midnight on a deployment mission. Shortly after liftoff one of the 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.

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 or waste 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.

February 5, 1958/B-47/Savannah River, Georgia. The B-47 was on a simulated combat mission that originated at Homestead AFB, 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 AFB, Georgia, with a weapon aboard. Because of the condition of the aircraft, its airspeed could not be reduced enough to ensure a safe landing. Therefore, the decision was made to jettison the Mark 15, Mod 0 weapon rather than expose Hunter AFB 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.

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 AFB, Georgia, as number three aircraft in a flight of four en route to an overseas base. After level off at 15,000 feet, the aircraft accidentally jettisoned an unarmed nuclear weapon which impacted on a sparsely populated area six and one-half 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.

November 4, 1958/B-47/Dyess AFB, 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.

November 26, 1958/B-47/Chennault AFB, Louisiana. 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.

January 18, 1959/F-100/ Pacific Base. The aircraft was parked on a revetted 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.

July 6, 1959/C-124/Barksdale AFB, 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.

September 25, 1959/P-5M/Pacific Ocean off Washington/Oregon Coast. A U.S. Navy P-5M aircraft assigned to Naval Air Station Whidbey Island, Washington, crashed in the Pacific Ocean about 100 miles west of the Washington/Oregon border. It was carrying an unarmed nuclear antisubmarine weapon which contained no nuclear material. The weapon was not recovered.

October 15, 1959/B-52/KC-135/Hardinsburg, Kentucky. The B-52 departed Columbus AFB, Mississippi, at 2:30 p.m. Central Standard Time, October 15, 1959. This aircraft assumed the number 2 position in a flight of two. The KC-135 departed Columbus AFB at 5:33 p.m. Central Standard Time as the number 2 tanker aircraft in a flight of two scheduled to refuel the B-52s. Rendezvous for refueling was accomplished in the vicinity of Hardinsberg, 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-52s two unarmed nuclear weapons were recovered intact. One had been partially burned but this did not result in the dispersion of any nuclear material or other contamination.

June 7, 1960/BOMARC/McGuire AFB, 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 in 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.

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's 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.

March 14, 1961/B-52/Yuba City, California. A B-52 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 from 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.

November 13, 1963/Atomic Energy Commission Storage Igloo/Medina Base, Texas. An explosion involving 123,000 pounds of high explosive components of nuclear weapons caused minor injuries to three AEC employees. There was little contamination from the nuclear components stored elsewhere in the building. The components were from obsolete weapons being disassembled.

January 13, 1964/B-52/Cumberland, Maryland. A B-52D was en route from Westover AFB, Massachusetts, to its home base at Turner AFB, Georgia. The crash occurred approximately 17 miles southwest of Cumberland, Maryland. The aircraft was carrying two weapons. Both weapons were in tactical ferry configuration (no mechanical or electrical connection 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 square yards. The weather during this recovery and cleanup 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.

December 5, 1964/Land-Based Guided Missile (LGM) (Minuteman I Intercontinental Ballistic Missile)/Ellsworth AFB, South Dakota. The LGM 30B Minuteman I missile was on strategic alert at Launch Facility (LF) L-02, Ellsworth AFB, South Dakota. Two airmen were dispatched to the LF to repair 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 fuzing/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.

December 8, 1964/B-58/Bunker Hill (Now Grissom) AFB, Indiana. Strategic Air Command 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 slide 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.

October 11, 1965/C-124/Wright-Patterson AFB, 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 ordnance disposal and firefighting personnel, and was removed by normal cleaning.

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.

January 17, 1966/B-52/KC-135/Palomares, Spain. The B-52 and KC-135 collided during a routine high altitude air refueling operation. Both aircraft crashed near Palomares, Spain. Four of the eleven crew members 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 1,400 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 cleanup operation.

January 21, 1968/B-52/Thule, Greenland. A B-52 from Plattsburgh AFB, New York, crashed and burned some seven miles southwest of the runway at Thule Air Force Base, Greenland, while approaching the base to land. Six of the seven crew members 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 operations.

Spring 1968/At Sea, Atlantic. When USS SCORPION (SSN 589) sank in 1968, there were two Mk 45 ASTOR torpedoes with nuclear warheads aboard. The warheads were low-yield tactical nuclear weapons. The special nuclear material (plutonium and highly enriched uranium) from the warheads has not been recovered. It can be assumed with certainty that the integrity of the weapons was compromised due to sea pressure and that the weapons were exposed to seawater immediately after the sinking. Periodic monitoring of sea water, marine life and sediment from the wreck site has not detected plutonium in excess of that expected from fallout from past atmospheric weapons testing nor uranium in excess of natural background concentrations. No significant environmental impact is expected.

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 AFB, the missile's main support base. About eight and one-half 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 U.S. Air Force personnel were injured. The missile's reentry vehicle, which contained the nuclear warhead, was recovered intact. There was no radioactive contamination.