OFFICE OF THE ASSISTANT TO THE SECRETARY OF DEFENSE
1400 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-1400

PUBLIC AFFAIRS

29 AUG 1994
Ref: 94-F-1475

Mr. Robert Heitmann
[ ]

Dear Mr. Heitmann:

This responds to your June 25, 1994, Freedom of Information Act (FOIA) request pertaining to "an August 5, 1950, accident at Fairfield-Suisun AFB." Your letter, addressed to the "Armed Forces Radiobiology Institute", Bethesda, MD, was referred to this Directorate for FOIA processing. Our July 18 letter, your July 24 letter, and our August 5 interim response, refer.

The Armed Forces Radiobiology Research Institute (AFRRI) provided the enclosed report as responsive to your request. Please refer to item 4 on page 10 of the report. AFRRI advised that their search did not locate any other responsive records.

In regard to the National Archives Form NA 2011 that you described in your July 24 letter: it was indeed sent by error. The form pertains to an entirely different case from another requester.

Also, for your information, we have been advised by the Defense Nuclear Agency (DNA) that they are working on a request from you that is identical to your June 25 letter to us. The DNA Case Number is FOIA 94-078.

Since the chargeable cost of processing this request was under $15.00, there are no assessable fees, in this instance.

Sincerely,

W. M. McDonald
Director
Freedom of Information
and Security Review

Enclosure:
March 1986 AFRRI Report, DoD Nuclear Mishaps

#634

AFRRI SP86-2

AFRRI SPECIAL REPORT

DoD nuclear mishaps

H. L. Reese

DEFENSE NUCLEAR AGENCY
ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE
BETHESDA, MARYLAND 20814-5145

#634

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFRRI SP86-2	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Armed Forces Radiobiology Research Institute 6b. OFFICE SYMBOL (If applicable) AFRRI	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State and ZIP Code) Defense Nuclear Agency Bethesda, MD 20814-5145	7b. ADDRESS (City, State and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Defense Nuclear Agency 8b. OFFICE SYMBOL (If applicable) DNA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State and ZIP Code) Washington, DC 20305	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO.
11. TITLE (Include Security Classification) DoD nuclear mishaps	
12. PERSONAL AUTHOR(S) H. L. Reese	
13a. TYPE OF REPORT Special Report 13b. TIME COVERED FROM ____ TO ____	14. DATE OF REPORT (Yr., Mo., Day) March 1986 15. PAGE COUNT 19
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Nuclear accidents, nuclear weapons mishaps

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report contains a summary of Department of Defense (DoD) nuclear mishaps from 1950 to 1980. The information presented is a collection of material available in the public domain at the time of publication.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☒ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Junith A. Van Deusen	22b. TELEPHONE NUMBER (Include Area Code) (202) 295-3536 22c. OFFICE SYMBOL ADMG

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

The following information concerning U.S. nuclear weapon accidents has been collected from materials released by the Department of Defense (DoD) in 1977, 1980, and 1981, and also from several media references. This publication is intended to be a source document in the course "Medical Effects of Nuclear Weapons," which is sponsored by the Armed Forces Radiobiology Research Institute.

The United States has never had an inadvertent nuclear detonation, even a partial one, despite the very severe stresses imposed on the weapons that might be involved in accidents. All "detonations" reported in the DoD summaries involved only conventional high explosives. Only two accidents, those at Palomares and Thule, resulted in widespread dispersal of nuclear materials.

Nuclear weapons are never carried on training flights. Most of the aircraft accidents described 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;
- 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 DoD policy, normally, to neither confirm nor deny the presence of a nuclear weapon at any specific location. In the case of an accident involving a nuclear weapon, the weapon's presence may or may not be divulged at the time, depending on the possibility of public hazard or alarm. Therefore, for some of the events summarized in this publication, the presence of a nuclear weapon or material may not have been confirmed at the time. Furthermore, due to diplomatic considerations, it is not possible to specify the locations 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 P-5M aircrafts and the Minuteman I Missile.

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

MANAGEMENT OF THE NUCLEAR WEAPON STOCKPILE

The management of nuclear weapons is shared by the Department of Energy (DOE) and DoD. The Secretary of Energy and the Secretary of Defense are directly responsible to the President, who retains the sole authority for weapons employment. DOE, as successor of the Atomic Energy Commission, is responsible for all research, development, test, and production of nuclear weapons. DOE is the only Government agency that is authorized by statute to engage in these activities. By law, DOE is required also to control and account for all active nuclear material, including the U.S. stockpile of war-reserve nuclear weapons. These weapons have been entrusted to DoD for employment readiness in case the President orders their use in the interest of national security. Ownership, however, is retained by DOE.

To carry out these responsibilities, the DOE organization includes a network of Government-owned laboratories, plants, and test sites in nine states, all operated by private industry or institutions under Government contract. There are three design and development laboratories, manufacturing facilities, and a field test capability.

At the policy level, DOE's Division of Military Applications (DMA) interfaces with DoD's Military Liaison Committee (MLC). DMA is DOE's primary liaison with DoD, and it provides major program guidance and direction for weapons research and development directly to the weapons laboratories. The Defense Nuclear Agency (DNA) provides some elements of the DoD liaison function with DOE. DNA is a joint service agency under the Joint Chiefs of Staff, with headquarters in Washington, DC, and its operating unit, Field Command, Defense Nuclear Agency, located in Albuquerque, New Mexico.

The MLC Chairman is the Assistant to the Secretary of Defense for Atomic Energy, and is responsible for management and control policies for all nuclear weapon functions within DoD. MLC consists of two senior officers from each Service, with the DNA Director and DOE's DMA Director acting as observers. The DoD nuclear weapon program and requirements are provided to DOE through MLC.

WEAPON SAFETY CONCEPTS

Since DOE designs, develops, and produces all nuclear weapons, it is primarily responsible for the safety features and devices within the weapons. DoD is responsible for safe and secure operations external to the weapon. Considerable overlap and interaction exist, with DoD participating in weapon design (for familiarity and to coordinate requirements) and DOE assisting in the development of safety rules for operating the total nuclear weapon system.

To understand the philosophy of nuclear weapon safety, it is important to first understand the basic nuclear physics involved. Unlike conventional explosives that derive their sensitive properties from their basic chemical makeup, a nuclear device must be specifically designed to bring about an explosion. To obtain a nuclear reaction or explosion through fission, an amount of active material sufficient to produce a continuous, self-sustaining nuclear reaction must be assembled so that a "supercritical mass" can be attained. One technique used to achieve a supercritical mass is called "implosion." In contrast to the outward burst of an explosion, implosion is an inward compression. In a nuclear weapon, high explosive surrounds the nuclear material. A simultaneous firing of detonators mounted on the surface of the high explosive produces a shock wave that compresses the nuclear material. The important feature is the simultaneous firing of the detonators and control of the shock wave to achieve symmetrical compression of the nuclear material, and thus attain a supercritical mass.

The implosion process used to detonate a nuclear weapon, by its very nature, has a built-in safety feature. If the high explosive detonates at any single point for any reason, including fire or shock as a result of an accident, there would be no symmetrical implosion. The shock wave moving from a single point on the high-explosive surface would explode and destroy the device. This would release and perhaps scatter the active material, but would not result in a nuclear explosion.

In our latest weapons, a new, insensitive high explosive is used, which is extremely stable and will not explode on impact or in a fire. This will dramatically reduce the possibility of nuclear materials being scattered in an accident.

The current DOE safety-design concept packages the weapon-detonation subsystem into an "exclusion region." This feature follows a design philosophy intended to prevent undesired electrical energy from reaching the nuclear weapon detonator system. Included in this concept is a series of "weak links" and "strong links" to obtain predictably safe responses in abnormal environments such as fire, deep water, lightning, cruising impacts, or impact from high-velocity projectiles. The strong links are open switches that close only when the proper signals are received. The weak links are elements vital to the operation of the detonator system. These links are packaged together so that both strong and weak links experience the same environment. Safety is achieved in abnormal environments because the vital components (weak links) are designed to fail first, destroying the detonator system, before the open switches (strong links) can possibly fail to a closed position.

Associated with the exclusion region concept is the design of the strong links to respond only to unique signals. These open switches will not respond to the weapon system's electrical power sources, which might become connected through short circuits during an accident. The unique signals required can be generated by the weapon system only when intended by the human operator.

Nuclear weapons also contain environment-sensing devices that prevent firing of the detonators unless the required environment is experienced. The devices include such items as

- Pullout cables that maintain an open circuit until the cable is physically pulled from the weapon upon release from the aircraft;
- Accelerometers that maintain open circuits until they sense the acceleration or deceleration for a required period of time, as would be produced by a rocket motor or a retarding parachute;
- Barometric switch devices that remain open until they sense the pressure differential that is anticipated in desired release conditions;
- Timers that maintain open switches for a specific time interval after weapon release;

- Electromechanical switches that remain open until a positive action is taken by a human operator.

These safety features and others are designed into the weapon with stringent quality and reliability controls by DoD.

The DoD Safety Program is based on four nuclear safety standards. The standards require that, in the design, development, and employment of a nuclear weapon system, there be positive measures to

- Prevent jettisoned weapons or weapons involved in accidents or incidents from producing a nuclear yield;

- Prevent deliberate prearming, arming, launching, firing, or releasing of nuclear weapons except upon execution of emergency war orders or when directed by competent authority;

- Prevent inadvertent prearming, arming, launching, firing, or releasing of nuclear weapons;

- Ensure adequate security of nuclear weapons.

To satisfy these DoD nuclear safety standards, the Safety Program addresses safety-design engineering for each nuclear weapon system, its logistic and operational environment, and the human factors involved in the maintenance and operation of the weapon system. The various considerations of the program are listed below to give a perspective of their relationships and a feeling for the extent of the Safety Program. The program considerations include

- Requirements and design guidance for safety considerations in nuclear weapon system development;

- Safety engineering evaluation and formal certification before the system can be used with a nuclear weapon;

- Nuclear safety analysis and certification of all computer programs developed for use in the control of the nuclear weapon system;

- Engineering, operational, and logistic studies and reviews of the complete weapon system and its intended environment from storage to target, resulting in weapon system safety rules that prescribe authorized procedures and impose limitations for operation of the nuclear weapon system;

- Approved technical data and maintenance procedures that must be precisely followed in the operation or maintenance of the nuclear weapon system;

- Engineering evaluation and safety certification of all equipment used in the maintenance, movement, and operation of the nuclear weapon system;

- Reporting and analysis of accidents, incidents, and deficiencies that involve the nuclear weapon system, support equipment, and procedures;

- Safing and sealing of critical nuclear weapon system switches;

- Evaluation of all personnel associated with the nuclear weapon system to ensure their emotional stability and proper security clearance before being authorized access to a nuclear weapon, nuclear weapon system, or nuclear command and control facility;

- A "two-man" or "no lone zone" concept around the nuclear weapon and the nuclear weapon system;

- An inspection system to monitor compliance not only with the four DoD safety standards but also with all nuclear safety rules and technical data in all operations involving a nuclear weapon or nuclear weapon system.

In addition to the safety devices contained within the nuclear weapon, the weapon carrier contains devices that prevent prearming or release unless intended. Examples of these devices are

- Dual switches that force two-man consent for both prearm and launch (or release);

- Intent switches that prevent a prearm signal until manually closed by the human operators;

- A unique signal generator, activated by the prearm intent switch, that produces the unique signal required by the weapon's strong links described earlier;

- Intent switches that prevent a nuclear weapon release signal until manually closed by the human operators (separate from the prearm switches);

- Arm-inhibit switches that require a "good guidance" signal from the missile guidance system before warhead arming can occur;

- In-flight reversible mechanical locks on the weapon carriage rack that physically prevent weapon release until electrically activated by the human operators;

- A monitor system to provide the operator the arm/safe status of the nuclear weapon and lock/unlock status of the carriage rack.

Devices such as these prevented weapon arming in the Goldsboro and Palomares accidents. In early bomb racks such as those involved in the accidents at Kirtland Air Force Base, New Mexico, and at Florence, South Carolina, one means to prevent inadvertent release was the insertion of safety pins in the carriage rack. These pins were removed during takeoff and landing to permit emergency jettison. When the safety pins were removed, however, a single failure in the rack could cause an inadvertent release of the nuclear weapon, as shown by these accidents.

A cockpit-controlled, in-flight, reversible lock is now required which, when locked, prevents inadvertent weapon release even though the normal release force is applied. This design allows safe takeoff and landing with the rack in the locked position. The device is designed to fail to the locked position, and also requires an independent positioning of intent switches by two crew members in multiplace aircraft before the rack holding the weapon can be unlocked.

RADIOACTIVE MATERIALS IN NUCLEAR WEAPON ACCIDENTS

Nuclear weapons contain three principal types of radioactive materials: plutonium, uranium, and tritium. Other types of radioactive materials may also be present in lesser and varying amounts, depending on the type and age of the weapon. For accidental contamination, the initial public health risks and protective/corrective actions are the same as those for contamination by particles of plutonium, uranium, and tritium (see below).

The risks to the public from radioactive contamination caused by a nuclear weapon accident are <u>not</u> like fallout from a nuclear bomb blast, and are <u>not</u> like contamination from a major nuclear power plant accident. However, contamination from a nuclear weapon accident could be serious and could require both immediate and long-term protective and corrective cleanup measures. The potential harm to the public and the environment can be controlled best by an effective response to the accident and by providing the public with timely information and instructions about protection from contamination.

Public instructions and appropriate actions will depend on the severity of the accident, the type of material involved, and the length of time between occurrence of the accident and initiation of protective action.

ACCIDENT SEVERITY FACTORS

If nuclear weapons are involved in an accident and the condition of the weapon is not known, the potential for contamination must be assumed. Besides the immediate response around the accident site, protective measures (possible evacuation) for the general public may be necessary within 1 day.

Instructions on basic protective measures should allow time to respond to the accident, to determine the condition of the weapon, and to disseminate supplementary information and instructions to the public.

If damage to a nuclear weapon is known but the weapon is still structurally intact, any potential contamination would be limited to the immediate area of the accident site, and would probably be of very short duration (a few minutes). Keeping the public clear of the accident site and providing information to relieve unwarranted fears (prevent panic) should be sufficient for public protection.

If a nuclear weapon accident results in severe structural damage (scattering of small chunks of the warhead), fire (melting and burning of the warhead), or detonation of the conventional (chemical) high explosive, then more widespread contamination is probable and larger scale protective actions will be necessary. In this case, information and instructions provided to the public will depend on the type of radioactive material and the time since the accident.

PLUTONIUM

Contamination by plutonium particles dispersed by conventional (chemical) explosion or burning of a weapon would pose the most serious health hazard to the public, and could impact the environment over a wide area.

Plutonium is both a poison and a radiation hazard. The radiation given off consists of "alpha particles" (like very fast moving helium atoms), which do not have sufficient energy to penetrate buildings, most clothing, or even the outer skin. Therefore, short-term exposure (up to a few days) to contamination outside of the body will pose only a small health risk.

Plutonium radiation is considered a serious health risk if small "dust-like" pieces are inhaled or ingested and remain as deposits in the body. Even a very small quantity (equivalent to a single piece of dust) inside the body could cause concern as a health risk over the long term. No immediate "radiation sickness" symptoms are expected from this type of contamination.

Unless it is possible to immediately (within minutes) evacuate the area around the accident site and several miles downwind, the best initial public response will probably be to stop outside activity, seek shelter in well-sealed buildings (with little or no use of outside air for heating or cooling), and delay evacuation until the dust cloud has passed and particles have had time to settle out of the air. Besides being medically sound, this procedure will reduce casualties that result from panic and will least affect the critical and essential services.

Any evacuation of the public that does take place must be in a controlled manner, thereby reducing the risk of resuspension of the contaminant and the risk of collateral injury to the civilian population. Any person evacuating an area should breathe through a filter (such as a common dust mask or even several layers of a wet handkerchief), and move with care to avoid stirring up the dust. If resources and time permit, evacuation should include the use of protective outer clothing that can be cleaned for reuse or discarded.

The best direction and timing for travel can be specified for population centers or zones in the area. Factors such as population density, transportation, and facilities in the contaminated area must be considered in deciding whether and when to move the public out of an area.

Whether evacuation is immediate or delayed, panic of the population may result in some injury, death, or property damage. Every effort should be made to state the problem in a way that will inform the public, keep the problem in context, and avoid confusion.

The determination of cleanup requirements and techniques will involve extensive surveys and coordination with experts in several government agencies (Federal Emergency Management Agency, Environmental Protection Agency, DOE, DoD, etc.). Cleanup efforts may extend over several months, and monitoring requirements over several years.

URANIUM

Contamination by uranium fragments or small particles dispersed by a conventional (chemical) explosion or by the burning of a weapon is primarily a chemical health hazard (heavy metal poison similar to the lead poisoning associated with some paints), not a radiological hazard. The short-term risk to health occurs only if a relatively large quantity of uranium is deposited inside the body by inhaling or ingesting the dust. A short-term public hazard from radiation (alpha particles) from uranium is very unlikely. Determination of any long-term radiation (or chemical) hazard will require detailed and extensive surveys.

It is unlikely that uranium contamination, even though dispersed over a wide area, would add significantly to the overall exposure that man normally receives from radioactive materials found in most environments.

TRITIUM

The radiation given off by tritium is a low-energy "beta particle," which is stopped by the outer layers of skin. Thus external exposure is not a hazard. Contamination by tritium gas would pose a health hazard only in a closed or confined space. Tritium released by a weapons accident will dissipate and be diluted so rapidly in open air that no internal hazard would result. Monitoring (air sampling) of the immediate site of the accident is sufficient to assure prevention of exposure to accident-response personnel. Tritium from a weapons accident will not affect the public or the environment.

CLEANUP AFTER A NUCLEAR WEAPON ACCIDENT

An accident that causes a nuclear weapon to structurally break apart, burn, or chemically detonate will contaminate an area of indeterminate size with potentially hazardous materials. These materials may include plutonium, uranium, or high explosive.

The cleanup of explosive and chemical hazards will be relatively straightforward, but the decontamination of any radioactive materials will depend on technically sophisticated surveys and risk assessments.

DETERMINATION OF CONTAMINATION LEVEL

An initial estimate of the size and shape of the contaminated area and of the level of contamination within the area can be provided within a few hours by computer models. This information can be used to determine the actions necessary to protect the public and the scope of the cleanup problem. Then the determination of actual cleanup requirements and preferred techniques will depend on the material involved, field survey measurements of actual contamination levels, and careful assessment of any associated potential health risk.

Cleanup requirements may be minimized if contamination levels are low, or if the contaminating material is trapped and therefore not a hazard to plants, animals, or man. If contamination levels are high and/or the material is a health risk to man, then cleanup requirements may be quite stringent over an extensive area. The cleanup of scattered plutonium would probably present the greatest difficulty.

THE CLEANUP PROCESS

If initial estimates of the contamination level and subsequent field survey measurements indicate radiological contamination in the soil above a screening level of 0.2 microcuries/square meter (or above 1 fCi/m^3), then a careful assessment of health risks is necessary and cleanup may be necessary. Below this screening level, cleanup actions may not be necessary.

SUMMARY OF ACCIDENTS INVOLVING U.S. NUCLEAR WEAPONS, 1950-1980

An "accident involving a nuclear weapon" may be defined as an unexpected event involving a nuclear weapon or nuclear weapon 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 that 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;
- Seizure, theft, or loss, including jettison, of a nuclear weapon or radioactive nuclear weapon component;
- Public hazard, actual or implied.

Accidents involving U.S. nuclear weapons from 1950 to 1980 are summarized in the following paragraphs.

1. <u>13 February 1950 / B-36 / Pacific Ocean, Off Coast of British Columbia</u>

A B-36 aircraft was en route from Eielson AFB to Carswell AFB on a simulated combat profile mission. The weapon aboard the aircraft had a dummy capsule installed. After 6 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 into the ocean. A bright flash occurred on impact, followed by a sound wave and a 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.

2. <u>11 April 1950 / B-29 / Manzano Base, New Mexico</u>

A B-29 aircraft departed Kirtland AFB at 9:38 p.m. and approximately 3 minutes later crashed into a mountain on Manzano Base, 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. Contamination did not occur, and there were no recovery problems. The recovered components of the weapon were returned to the Atomic Energy Commission. The capsule of nuclear material was on board the aircraft but had not been inserted into the weapon for safety reasons. A nuclear detonation was not possible.

3. 13 July 1950 / B-50 / Lebanon, Ohio

A B-50 aircraft was on a training mission from Biggs AFB, Texas, flying at 7,000 feet on a clear day. The aircraft nosed down and flew into the ground, killing 4 officers and 12 airmen. The high-explosive portion of the weapon aboard detonated on impact. There was no nuclear capsule aboard the aircraft.

4. 5 August 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 an emergency landing, crashed, and burned. Fire was fought for 12-15 minutes before the weapon's high-explosive material detonated. Nineteen crew members and rescue personnel, including General Travis, were killed in the crash or the resulting detonation.

5. 10 November 1950 / B-50 / Over Water, Outside the United States

Because of an inflight 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.

6. 10 March 1956 / 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. The takeoff from MacDill and the first refueling were normal. The second refueling point was over the Mediterranean Sea. In preparation, the flight penetrated solid cloud formation to descend to the refueling level of 14,000 feet. The base of the clouds was 14,500 feet, and visibility was poor. The aircraft never made contact with the tanker. An extensive search failed to locate any trace of the missing aircraft or crew. No weapons were aboard the aircraft, only two capsules of nuclear weapon material in carrying cases. A nuclear detonation was not possible.

7. 27 July 1956 / B-47 / Overseas Base

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

8. <u>22 May 1957 / B-36 / Kirtland AFB, New Mexico</u>

The B-36 aircraft was ferrying a weapon from Biggs AFB, Texas, to Kirtland AFB. At 11:50 a.m., MST, as the aircraft approached 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 .3 mile 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 1 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, to remove the locking pin during takeoff and landing, to allow emergency jettison of the weapon if necessary.) The 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. A nuclear capsule was on board the aircraft but had not been inserted into the weapon for safety reasons. A nuclear detonation was not possible.

9. <u>28 July 1957 / C-124 / Atlantic Ocean</u>

Two weapons were jettisoned from a C-124 aircraft off the east coast of the United States. The C-124 aircraft was en route from Dover AFB, Delaware, when a loss of power from the number one and number two engines was experienced. Maximum power was applied to the remaining engines, but level flight could not be maintained. At this point, the decision was made to jettison cargo in the interest of safety of the crew and aircraft. Three weapons and one nuclear capsule were aboard the aircraft, and nuclear components had not been installed in the weapons. 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, and 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.

10. <u>11 October 1957 / B-47 / Homestead AFB, Florida</u>

The B-47 departed Homestead AFB shortly after midnight on a deployment mission. Shortly after lift-off, 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, and it burned and smoldered for approximately 4 hours, at 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.

11. 31 January 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 7 hours. Firemen fought the fire for the allotted 10-minute fire-fighting time for the high-explosive contents of that weapon, and then evacuated the area. The high explosive did not detonate, but some contamination did occur in the immediate area of the crash. No contamination was detected after removal of the wreckage and the asphalt beneath it and after washing down of the runway. One fire truck and one fireman's clothing showed slight alpha contamination before washing. Following the accident, exercise alerts were temporarily suspended and B-47 wheels were checked for defects.

12. 5 February 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 with an F-86 aircraft at 3:30 a.m. Following the collision, the B-47, with a weapon aboard, attempted to land three times at Hunter AFB, Georgia. 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 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 impact point of the weapon 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 3-square-mile area was searched by divers and underwater demolition team technicians using galvanic drag and hand-held sonar devices. The weapon was not found. The search was terminated on 16 April 1958. The weapon was considered to be irretrievably lost.

13. 11 March 1958 / B-47 / Florence, South Carolina

At 3:53 p.m., EST, 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 that impacted in a sparsely populated area 6.5 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 the base without further incident. No capsule of nuclear materials was aboard the B-47 or installed in the weapon.

14. 4 November 1958 / B-47 / Dyess AFB, Texas

A B-47 caught fire on takeoff. 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 6 feet deep. Nuclear materials were recovered near the crash site.

15. 26 November 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.

16. 18 January 1959 / F-100 / Pacific Base

The aircraft was parked on a revetted hardstand in ground alter 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 alter, an explosion and fire occurred when the external fuel tanks inadvertently jettisoned. Fire trucks at the scene put out the fire in about 7 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.

17. 6 July 1959 / C-124 / Barksdale AFB, Louisiana

A C-124 on a nuclear logistics movement mission crashed on takeoff. The aircraft was destroyed by fire, which also destroyed one weapon. No nuclear or high-explosive detonation occurred; safety devices had 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.

18. 25 September 1959 / P-5M / Pacific Ocean Off the Washington 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 containing no nuclear material. The weapon was not recovered.

19. 15 October 1959 / B-52 / KC-135 / Hardinsburg, Kentucky

The B-52 departed Columbus AFB, Mississippi, at 2:00 p.m., CST. The aircraft assumed the number two position in a flight of two. The KC-135 departed Columbus AFB at 5:33 p.m., CST, as the number two tanker aircraft in a flight of two scheduled to refuel the B-52's. Rendezvous for refueling was accomplished in the vicinity of Hardinsburg, Kentucky, at 32,000 feet. It was night; the weather was clear, with 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 copilot, navigator, instructor navigator, and tail gunner failed to leave the B-52. All four crew members in the KC-135 were fatally injured. The B-52's two unarmed nuclear weapons were recovered intact. One had been partially burned, but did not result in dispersion of nuclear material or other contamination.

20. 7 June 1960 / BOMARC / McGuire AFB, New Jersey

A BOMARC air defense missile in ready storage condition (permitting launch in 2 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 functioned 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 fire-fighting water.

21. 24 January 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. 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. No detectable radiation and no hazard exist in the area.

22. 14 March 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 and steered 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 to prevent nuclear contamination.

23. 13 November 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 Atomic Energy Commission employees. There was little contamination from the nuclear components, which were stored elsewhere in the building. The components were from the disassembly of obsolete weapons.

24. 13 January 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, which 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). Before 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 then occurred. Of the five air-crew members, only the pilot and copilot survived. The gunner and navigator ejected, but died of exposure to subzero 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 14 inches of new snow covered the aircraft wreckage, which was scattered over an area of approximately 100 square yards. The weather during the 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.

25. <u>5 December 1964 / LGM 30B (Minuteman ICBM) / Ellsworth AFB, South Dakota</u>

The LGM 30B Minuteman I missile was on strategic alert at Launch Facility L-02, Ellsworth AFB, South Dakota. Two airmen were dispatched to the Launch Facility to repair the inner zone security system. In the midst of their checkout of the inner zone 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.

26. <u>8 December 1964 / B-58 / Bunker Hill (now Grissom) AFB, Indiana</u>

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 side of the taxiway. The left main landing gear passed over a flush-mounted taxiway light fixture, and 10 feet farther along in its travel, grazed the left edge of a concrete light base. After another 10 feet, 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 abandoned 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 nuclear weapon on board burned. Contamination was limited to the immediate area of the crash and was subsequently removed.

27. <u>11 October 1965 / C-124 / Wright-Patterson AFB, Ohio</u>

The C-124 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 fire-fighting personnel, and was removed by normal cleaning.

28. <u>5 December 1965 / A-4 / Pacific Ocean</u>

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.

29. 17 January 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 crew members survived. The B-52 carried four nuclear weapons. One was recovered on the ground, and one was recovered from the sea on 7 April 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 cleanup operation.

30. 21 January 1968 / B-52 / Thule, Greenland

A B-52 from Plattsburgh AFB, New York, crashed and burned approximately 7 miles southwest of the runway at Thule AB, 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, water, and crash debris were removed to an approved storage site in the United States over the course of a 4-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.

31. Spring 1968 / Atlantic Ocean

Details remain classified.

32. 19 September 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 8.5 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 reentry vehicle, which contained a nuclear warhead, was recovered intact. There was no radioactive contamination.

> **NOTE:** The events outlined here 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 (the DOE predecessor agency). The U.S. Army has never experienced an event classified as an accident involving nuclear weapons. The U.S. Marine Corps does not have custody of nuclear weapons in peacetime, and has not experienced an accident involving them.