HOST BASE SUPPORT

COL G. S. DRESSER
Commander
Thule AFB, Greenland

TO many people Friday the 13th signifies a day of ill omen. But to U.S. Air Force and Danish officials at Thule Air Base, Greenland, Friday, 13 September 1968 was a day of elation.

The last of 600 containers of low-level radioactive residue from Project Crested Ice were loaded aboard a U.S. Navy cargo ship for transport to the United States.

Air Force and Danish officials watched as a giant 150-ton crane hoisted the last 25,000-gallon container of debris, melted snow, and ice from the pier to the deck of the U.S. Navy Ship MARINE FIDDLER. Danish stevedores guided the tank to its resting place on deck and secured it with cables.

For the personnel at Thule this final act completed a difficult, painstaking task which had begun many months earlier when a B-52 bomber caught fire and plummeted to the frozen surface of Wholstenholme Fjord, 8 miles from Thule.

Except for the base air traffic controllers and a limited number of staff members, personnel at Thule were completely unaware of the drama taking place in the pitch-black sky overhead. The impact shattered the arctic stillness of that Sunday afternoon, rocking the base's concrete weighted buildings perched on pilings above the permafrost. Then someone spotted flames out on the bay ice toward Saunders Island. The Base Command Post flashed a message to Headquarters, United States Air Force, of an accident near the Aerospace Defense Command (ADC) installation at the top of the world. At one of Thule's mammoth black hangars, a stranger walked in and asked to use a telephone; he was Maj Alfred J. DeMario, a member of the bomber's crew. Major DeMario called the Command Post and reported to Col Paul D. Copher, acting base commander, that the bomber was carrying a crew of seven, at least six of them had ejected over the base area and that the huge stratofortress was carrying four unarmed nuclear weapons.

Within 10 minutes of Major DeMario's phone call, Capt John M. Haug, a pilot on the B-52, called in from another hangar. This confirmed Major DeMario's statement that the crew had ejected over the base. The Command Post dispatched an ambulance to pick up both men and take them to the dispensary where they were treated for bruises, abrasions, and chills.

The Command Post had been activated at 4:50 p.m. when it was notified of the plane crash, but until Major DeMario called no one had any idea if the crew had bailed out, where they had bailed out, or if they had gone down with the plane. Now the Command Post staff had a point of reference. All off-duty security police were recalled over the base-wide public address system and also over Radio 1425, Thule's Armed Forces radio and television affiliate station. Twenty-one security policemen split into seven teams and began searching the base and the roads leading to the various military sites in the hills above the main installation. All tenant units at sites in the 20-mile radius of the installation sent out patrols to search for the remaining members of the bomber's crew.

All personnel were instructed to report the sighting of strange lights or signals to the Base Command Post. It was imperative to find any survivor quickly. The temperature was a -23°F, the wind was blowing at 9 knots with a chill factor of 5. Exposed human flesh would freeze in 2 minutes.

Telephones in the Command Post were ringing constantly now. Someone reported sighting lights on South Mountain. More flashing lights were seen on the ice toward the wreck. Ground rescue personnel, driving trackmasters and two HH-43 helicopters assigned to Detachment 18, Eastern Air Rescue and Recovery Center, Military Airlift Command, investigated each report. Snow removal called to report that they had picked up another survivor near the base dump. He was SSgt Calvin Snapp, a gunner aboard the downed aircraft. An hour and 15 minutes had gone by since the plane crashed into the frozen bay.

Colonel Copher, on advice from Aerospace Defense Command Post at Ent Air Force Base, Colorado, dispatched four security policemen to the crash scene with ground rescue personnel. They were instructed to stay 2,000 feet from the wreck. A helicopter hovered overhead at 1,900 feet and reported the impact had broken the ice. In spite of the heat of the burning wreckage the 3-foot thick ice had refrozen within minutes after the impact. The equivalent temperature was -50°.

Helicopter pilots (in Pedro II) spotted two parachutes and two ejection seats on the ice 3 miles out in the bay and began following the footprints leading away from them. A radiological monitoring team checked the shorelines from the base dump to the foot of Mount Dundas for radiation, but obtained negative readings. A security police team searching the southern slopes of South Mountain, 5 miles west of the base, found two more survivors walking toward the installation. Maj Frank F. Hopkins had a broken arm and Capt Richard E. Marx suffered from cuts and bruises. Pedro II evacuated the two to the dispensary.

By 9:00 p.m., aircraft from numerous Air Force bases in the United States were en route to Thule. A C-97 left Pease Air Force Base, New Hampshire, and a C-130 departed Sondrestrom Air Base, Greenland, with signal flares aboard. A C-130 also from Pease with two investigating teams aboard stopped at Goose Bay, Labrador, to pick up two pilots. An Explosive Ordnance Disposal Team and an information officer, dispatched by the ADC's Command Post at Ent Air Force Base, Colorado, were airborne. A Strategic Air Command Disaster Control Team under the command of Maj Gen R. O. Hunziker, Strategic Air Command Director of Materiel, took off from Offutt Air Force Base, Nebraska. During the next few days more than 700 military personnel, American and Danish scientists, and newsmen representing 72 different news media in North America and Europe would deplane at Thule.

At 1:30 p.m. Monday, 20 hours after the crash, searchers rescued the remaining survivor. Capt Curtis R. Criss was found wrapped in his parachute near South Mountain. Weak and suffering from a dislocated shoulder and severe frostbite. Captain Criss was evacuated by helicopter to the dispensary for treatment.

With the last crew member accounted for, the base's mission shifted to supporting the Strategic Air Command's recovery operation. All base personnel including the Danish Construction Corporation, the base's operations and maintenance contractor, began working 7 days a week along with the Strategic Air Command team to get the control and recovery effort started, and to support it as the tempo increased.

The first order of business was to establish a base camp at the site to provide shelter, equipment support, decontamination control points, and communications. The base shops built six small 8x16 foot buildings—they marked each piece as to location, then disassembled the buildings and packed the pieces for movement.

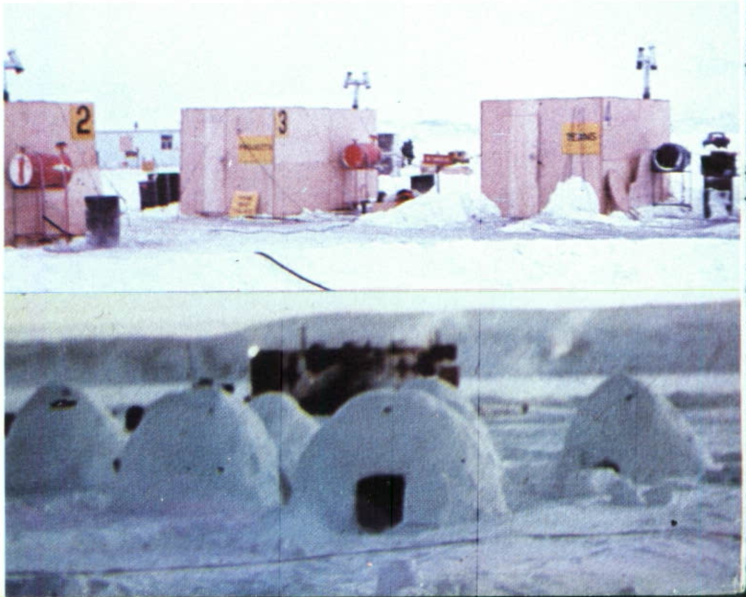
Within three days, the Prime Beef (Base Engineers Engineering Forces) Team, working in almost total darkness and bitter cold, had built a heliport and six prefabricated buildings; installed generators for electricity, telephone landlines and radio communications, and completed the first of three ice roads to the accident work area. Radiological monitoring teams had completely staked out the entire zero line with hundreds of reflectorized steel stakes made by the base shops. Floodlights were mounted on steel poles placed in weighted 55-gallon barrels to illuminate the area. Work crews now had an operating base for the recovery of aircraft debris.

Greenlanders built survival igloos as backup shelters in case a severe arctic storm should blow away the prefabricated buildings. Jens Zinglersen acted as guide, interpreter, and consultant to General Hunziker, the On-Scene Commander, and to Col C. S. Dresser, Base Commander.

Danes in the Packaging and Crating Branch of the Transportation Section constructed 14 sleds for use on the ice by the recovery teams. With sleds and tractors, the recovery teams began collecting wreckage. Using hand tools, sacks, marker poles and steel barrels, the men

Planting a reflector on the ice.

Prefabricated buildings and igloos—the beginnings of an operating base for the recovery of aircraft debris.



Recovery teams collecting wreckage—note the reflectors in the background.

Arctic building, 92- x 18-foot, on the sea ice.

walked shoulder-to-shoulder gathering bits and pieces of the aircraft ranging in size from a dime to a package of cigarettes. They piled the debris and secured it with wire net against the wind.

Road graders windrowed the snow in the area and personnel sprayed the windrows with foam to freeze them so that the winds would not spread the debris and contamination.

With the activities of the recovery operation increasing, there was a constant demand for more space at Camp Hunziker. A 92x18 foot arctic building was flown in and transported to the site in sections where civil engineers put it together. Civil engineers discovered three wannigans (portable buildings on skis) at Camp Tuto, an Army installation near Thule, and hauled them to the site. One was placed outside the zero line for decontamination control of personnel leaving the crash site; one was moved with the work crews to serve as a coffee break facility; and the other was placed midway between the shore and the site to be used as an emergency shelter. The men also erected a Jamesway building to serve as a supply point and built a second heliport.

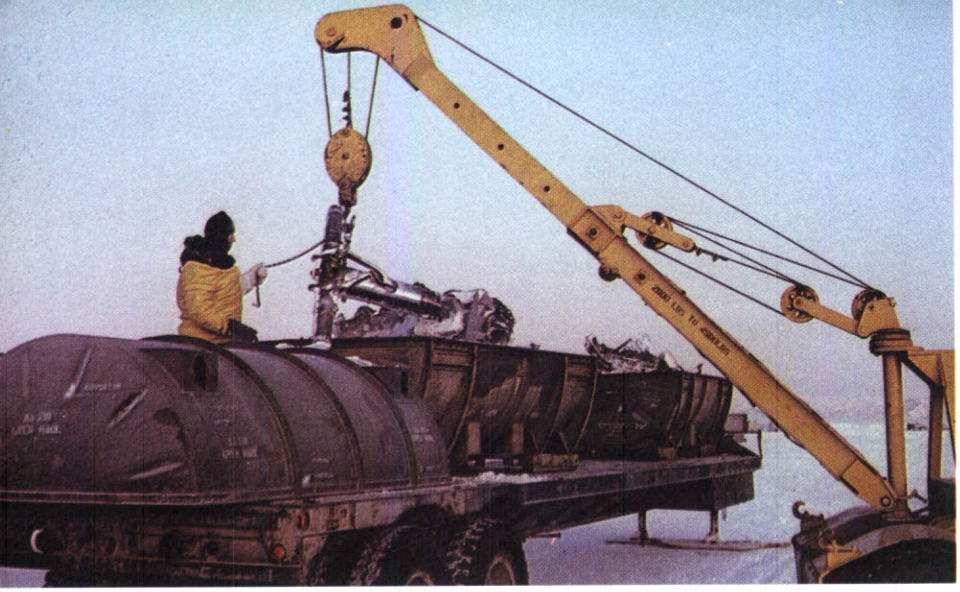
Fourteen large R-4360 engine containers were flown in to be used to hold aircraft debris. Civil engineers found 11 large tanks in the base salvage yard and these too were used to contain wreckage. Danish construction workers prepared the tanks for use by sealing existing holes and cutting access openings. The tanks were then hauled to the site on large flatbed trailers, filled, returned, and welded shut. They were stored in the old Strategic Air Command munitions storage area. The cleanup of the aircraft debris was completed on 20 February.

During this period the various supporting base activities at Thule had performed their special functions. Security police controlled entry, exit, and traffic to the site; accounted for the numerous personnel on the ice and controlled the entry for the Disaster Response Force Command Post, and a holding area for classified material recovered at the crash site.

By 29 January, 65 security police from First Air Force had arrived fully equipped with arctic gear. After a 2-day familiarization briefing with local security police, the personnel manned the special posts

Road grader windrowing the snow in the crash area.

Danish construction worker cuts a filler pipe hole in the top of an R-4360 engine container.



Crane hoisting engine into container.

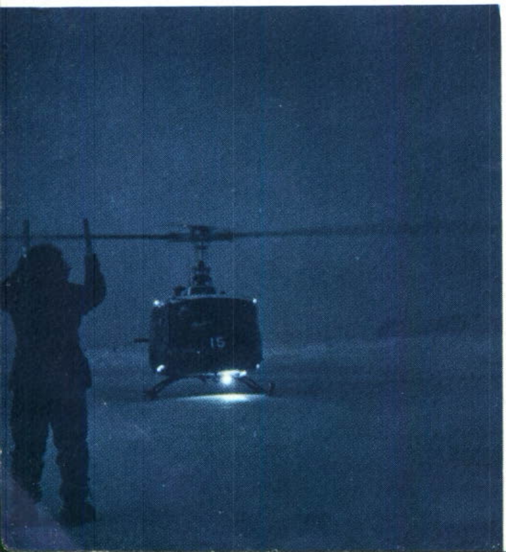
set up for the recovery operation.

One unique factor was that the supervision of security police forces was split. Base Central Security Control supervised security posts on base and in the debris storage area, while the On-Scene Commander directed security police activity at the crash scene. Both radio and longline communications were used to coordinate the activities of the two security forces.

Air Transportation Service coordinated, scheduled, and monitored all air traffic associated with Crested Ice. Due to Thule's isolated location and winter conditions, the only means of transportation was by airlift. Military Airlift Command and Strategic Air Command aircraft were used. Seventy-eight sorties were flown carrying 749 personnel and 1,770,499 pounds of cargo.

Air transportation was also the primary means of moving personnel and cargo from Thule to the crash scene during the first few days of the recovery operation. A task force of three HH-43s of Detachment 18, Eastern Air Rescue and Recovery Center stationed at Thule and three UF-1Fs of the 341st Strategic Missile Wing flown in on a C-133 from Malmstrom Air Force Base, Montana, were used. The choppers flew 1,583 sorties, transporting 4,524 personnel and 185,128 pounds of cargo.

Helicopter used in ferrying personnel to and from the camp site and Thule AB.



The Base Transportation Branch manifested all personnel and equipment going to the site at Hangar 6. Vehicle drivers presented a copy of the manifest, a modified entry and exit roster, to the guard at the entry control point at DeLong Pier. A person's name on the manifest was his authorization to proceed to the accident area. Transportation personnel forwarded copies of all manifests to the decontamination station in Building 773. As personnel returned from the site and were processed through decontamination, their names were crossed off the list. Personnel traveling to the site by helicopter were authorized to proceed to the site directly from Hangar 6. Upon their return, they were sent by bus to the decontamination center where their return was recorded.

Danish civilians employed by the Danish Construction Company controlled, dispatched, and maintained most of the surface vehicles. Three general purpose vehicles were made available to the team on a 24-hour basis for the On-Scene Commander, the ice survey team, and the supply services section. Other transportation requirements were superimposed on the normal base needs. Taxi runs increased from thirty thousand to seventy thousand a month. Vehicles were often used for tasks which they were not designed, and it was frequently necessary to attempt to match cargo loads to the vehicles available. When buses and other vehicles arrived from the United States, Transportation scheduled regular passenger and resupply runs to the site.

Base Supply coordinated requirements of the Weapon Recovery Division, Communications Division, Radiological Health and Contamination Control Division, and the Base Support Division for Project Crested Ice.

Three supply locations were manned 24 hours, 7 days a week, to respond immediately to all supply requirements. Daily, supply personnel monitored all outstanding due-ins and receipts to insure that received property was made immediately available to the requester.

According to a Strategic Air Command-Aerospace Defense Command agreement, Thule went directly to depots for stock numbered items using their transceiver or telephone. For local purchase items, base supply called the requirements to the Strategic Air Command where they were passed to the procurement office at Westover Air Force Base, Massachusetts. Aerospace Defense Command furnished the necessary funds to Westover for the procurement. Requirements for support of Strategic Air Command assigned aircraft passed directly from Thule to 8th Air Force Not Operationally Ready-Supply Control at Westover for lateral support and completed supply action.

Supply personnel processed many thousands of line items ranging from long underwear to weasel tractors. They maintained a complete status of equipment and items shipped including stock number, quantity, description, source and document number. All items were issued to the Strategic Air Command on custody receipt.

With the removal of the aircraft debris from the area completed, the Strategic Air Command Disaster Response Force departed and a new phase of operation began. The Danish-American meeting held in Copenhagen on 15 and 16 February had established the general conditions for the decontamination of the accident area. Tons of snow and ice contaminated at low-level would have to be removed. An expanded civil engineering division was established 1 March with full responsibility for directing the snow removal operation.

Under the direction of Lt Col Thomas W. Evans, Base Civil Engineer, and the San Antonio Air Materiel Area team chief, Danish construction workers disconnected abandoned 25,000-gallon POL tanks and transported them on flatbed trailers to Hangar 2 where workers steamed the tanks clean of petroleum and other possible explosive material. They welded all unwanted openings and cut three 5x8 foot openings for snow-loading in each tank. Workers moved the adapted tanks to a storage area near the shore for filling.

At the site, Air Force personnel, driving road graders, windrowed the black crusted snow, and mechanized loaders poured it into 10-foot long, 7-foot wide, 4-foot deep wooden boxes placed on 30-foot flatbed trailers. When the boxes were full, military personnel at the site placed tarpaulins over the tops to keep the snow from blowing. The flatbed, covered with a double layer of plywood to facilitate decontamination, was swept clean inside the zero line and hauled to the site control point where another tractor pulled it to the tank storage area.

At the storage area, Danish crane operators lifted the boxes in slings and tripped the hinge on the end of

Aerial view of tank farm showing converted fuel tanks being loaded with ice.

Mechanized loaders filling wooden boxes with black crusted snow.

Tarpaulins being placed over the tops of boxes to keep the snow from blowing.

the box to let the snow tumble through a specially constructed metal chute into the tank. When the tanks were full they were sealed and fitted with a pressure vent. A total of sixty-seven 25,000 gallon tanks were filled with low-level radioactive residue. An additional four tanks were filled with contaminated equipment such as brooms, tires, and handtools.

After the area was clean of contaminated snow, civil engineers spread the cracked ice section (impact point) with black carbonized sand to absorb the sunlight and melt at a faster rate than the ice around it.

Workers painted the tanks black to absorb the sun's energy in order to melt the snow and ice inside. The San Antonio Air Materiel Area shipped specially constructed plastic greenhouses to Thule to speed the process. These proved effective until the first arctic storm blew them out to sea. As it turned out, the black paint did the trick. The resulting water was pumped into smaller containers to facilitate shipping the residue and the lightened 25,000-gallon tanks to the United States for disposal.

During August, Danish and American scientists, using a 54-foot Danish motor launch, MS AGLANTHA, and a 24-foot minisubmarine, STARR III, conducted repeated radiological surveys and ecological studies along the shores of Wholstenholme Fjord to insure that no contamination remained in the area.

The U.S. Navy Ship MARINE FIDDLER sailed with the last container of contaminated residue Tuesday, 17 September 1968, on an 11-day voyage to Charleston, South Carolina, where the containers and their contents were moved by rail to the Atomic Energy Commission's Savannah River Plant near Aiken, South Carolina.

As the huge cargo ship picked its way through the icebergs in North Star Bay and began slipping into fog-shrouded Wolstenholme Fjord, bystanders on the pier smiled as they read an inscription someone had painted on the end of the last barrel: "That's All Folks!"

Snow being poured through a specially constructed metal chute into 25,000-gallon tank.

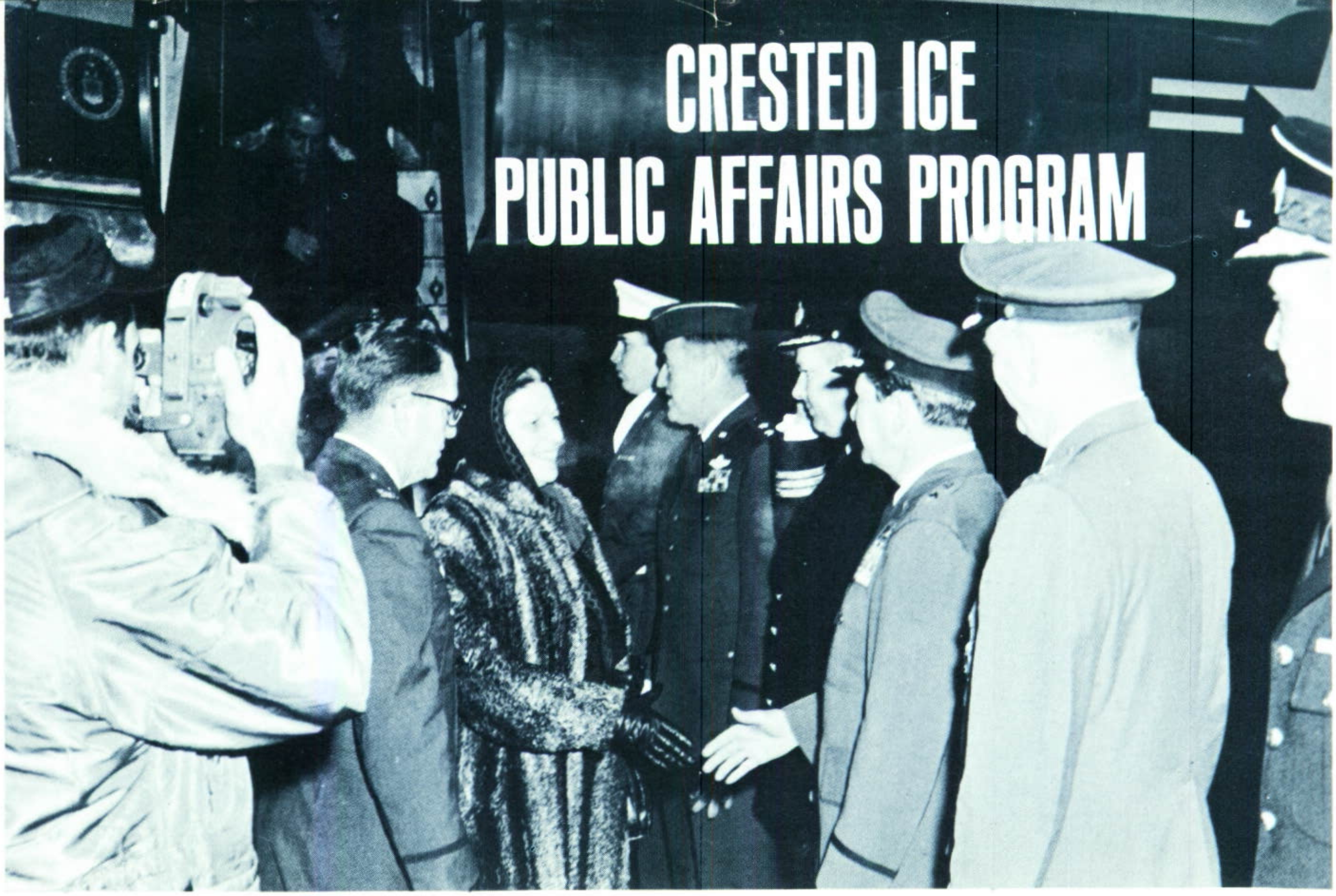
Landing gear being prepared for removal from the sea ice.

The Air Force tugboat at Thule AB eases the U. S. Navy Ship MARINE FIDDLER out into foggy North Star Bay.

Unloading mini-submarine, STAR III, onto flatbed at Thule AB.

Col C. S. Dresser, (right), base commander at Thule AB, and Commander Jorgen Molgard, Danish Liaison Officer, make a clean sweep of Project Crested Ice.

CRESTED ICE PUBLIC AFFAIRS PROGRAM



DIRECTORATE OF INFORMATION
HQ, Strategic Air Command

MEMBERS of the Strategic Air Command Directorate of Information (DXI) are well aware that each aircraft accident is different. Each involves variable circumstances which often present unique problems in making complete and factual information available to news media as rapidly as possible.

Thus, when SAC DXI was alerted by the command post shortly before 3 p.m. (CST) Sunday, 21 January 1968, that a SAC B-52 Stratofortress was down near Thule Air Base, Greenland, reactions were prompt and based on well-established procedures.

THE ALERT

The first call was to the Public Information Division's Disaster Control Team (DCT) alert officer. He is always on telephone alert and is prepared to deploy immediately with the SAC DCT to the scene of any SAC accident having a major effect on a civilian community.

Within minutes the DXI office was staffed by the Director of Information, Col Mason A. Dula, his deputy, Col Alfred J. Lynn, and representatives from the Public Information Division. In addition to the sketchy initial notification of the accident, it was learned that the B-52, with nuclear weapons aboard, was from the 380th Strategic Aerospace Wing, Plattsburgh Air Force Base, New York.

While the DCT staff was forming, the Secretary of the Air Force Office of Information (SAFOI) alert officer was notified. The Director of Information also contacted Phil Goulding, Assistant Secretary of Defense for Public Affairs (ASDPA), and Maj Gen William C. Garland of SAFOI. It was then agreed that SAC DXI would draft the initial news release and coordinate it with Mr Goulding's office for release. (As the only specified command in the Department of Defense, SAC works directly with the Office of the Secretary of Defense on many matters, particularly those involving public affairs.)

As a member of the DCT, Robert J. Boyd, a civilian historian, arrived at Thule on one of the early deployments. He was able to gather material and begin the documentation of events—as they occurred—rather than retracing past events.

By being on the scene during the critical first two weeks, the historian established his requirements for the staff, and built a foundation for his final report. As the search and recovery operation continued, the DXI staff was able to gather source documents and compile reports necessary for an accurate story.

It should be noted that the final report of the Palomares accident was on file with the Historical Division. It was taken to Thule and used as an organization guide.

THULE

The first news release concerning the accident was drafted by SAC and coordinated through the Defense and State Departments and also with the Government of Denmark. It was released by ASDPA at 9:45 a.m. (EST) 22 January.

The first announcement acknowledged that the crash had taken place, identified the aircraft's home station and unit, and stated the aircraft was carrying nuclear weapons which were unarmed so that there was no danger of a nuclear explosion at the crash site.

The announcement confirmed some of the rumors which had been circulating among a few news medium representatives in the Plattsburgh Air Force Base vicinity. The release naturally provoked a deluge of inquiries directed toward ASDPA, SAC, Thule Air Base, and Plattsburgh Air Force Base.

Weather and travel conditions from Thule to the accident scene, approximately 8 miles out on North Star Bay, prevented immediate response to most questions.

RELEASE RESPONSIBILITY

The responsibility for release of information for the United States rested with ASDPA, represented by Col Willis L. Helmantoler who arrived at Thule in a matter of hours after the SAC DCT. He remained for the next 7 days. Colonel Helmantoler and the SAC officers worked jointly on the early release of information on the Thule accident to the news media. After Colonel Helmantoler's departure, however, United States release responsibility rested with the SAC Information Officers on the scene who acted on behalf of ASDPA, USAF, and SAC.

On 1 February, ASDPA delegated the authority to the SAC Directorate of Information to release daily public affairs summaries, and later added the authority to periodically release photographs. Forty-one consecutive daily summaries were provided 14 addressees for reply to news queries. Once Project Crested Ice operations settled into a routine, the daily summaries were discontinued. Periodic reports were provided whenever new information warranted them.

There were three U.S. points of information release: ASDPA in Washington, SAC DXI at Thule, and the American Embassy in Copenhagen. The latter, however, generally deferred to the other two agencies in matters of technical expert opinion and facts. Particular care was taken to keep the Danish Government informed on all announcements. All other policies followed were general public information policies spelled out in Air Force Regulations 190-10, "Release of Information on Accidents," and 190-12, "Release of Information to the Public."

A second news release was made by ASDPA approximately 7 hours after the first. It described the aircraft's approach for an emergency landing after declaring an emergency because of fire in the navigator's compartment and intense smoke in the cockpit. It concluded by describing the locale and the extremely difficult environmental conditions under which searchers were operating. Because of these difficult search conditions the acquisition of new information was very slow. Thule temperatures were below -25 F. The area was in polar darkness except for a 2-hour twilight period each day, thereby requiring flares to assist searchers in helicopters and dogsleds. This second news release noted that more details would be available as additional dogsled teams returned.

The third news release was made at 2 a.m. (EST), 23 January. It summarized a 2-hour visit made by a ground survey team by dogsled to the scene. This release described the fuel-burn pattern on the ice and the small fragments in and around the burn area. More important, the announcement stated that none of the parts located were identified as nuclear weapons or parts of them. Also, a nonhazardous amount of "light—fixed and closely confined" radioactivity was found in the survey area. In an effort to report all available information, this third release went on to point out that personnel on the scene had picked up limited amounts of low-level radioactivity on their footgear. All were reported to have undergone normal decontamination procedures with no resulting problems.

FIRST DAYS

During the first 3 days when these news releases were made, news media interest in the crash was intense in the United States and Europe—particularly Denmark. The initial public announcements generated a variety of questions. Some could be answered readily; most required research or coordination with Thule DXI who worked out replies with Danish, Greenland, and American scientists at the scene. Other questions touched on classified information and simply could not be answered.

Despite the fact Thule was geographically difficult to visit, newsmen indicated considerable interest in traveling to the accident scene. The difficulties in getting there, however, did discourage a number of them.

Two press visits materialized early. Members of the press arrived at Thule within an hour of each other, about noon on 25 January. The first group included 25 American newsmen flown in by ASDPA. The second group of 26 newsmen included Danish, French, West German, and British reporters who arrived on a Scandinavian Airlines System flight after coordinating the visit with Danish officials and the American Embassy in Copenhagen.

PRESS PROBLEMS

The arctic darkness and severe weather caused some problems in accommodating the 51 newsmen. Transportation of the newsmen to the accident scene was difficult and time-consuming. Two flights were made over the crash area in an Air Force C-121. Photographers and newsmen were airlifted to the scene by helicopter.

Darkness, extreme cold, and bulky arctic clothing made identification of newsmen at the crash scene and the base a problem. Small DOD press badges were not adequate; therefore, armbands labeled "Press" were locally produced, easing the problem.

Photographs taken during the first few weeks following the accident were poor. The polar darkness and cold provided serious problems. Shutters became inoperative and batteries failed after only a few minutes exposure to the numbing cold. It was cumbersome to use many cameras due to bulky clothing. Rubber flash attachment extension cords became so brittle they disintegrated in the cold.

Maj Gen Richard O. Hunziker (2nd from left), SAC On-Scene Commander, and Dr Wright Langham (left) of the University of California's Los Alamos Scientific Laboratory, briefing Greenland officials shortly after their arrival at Thule AB.

PRESS CONFERENCES

Four press conferences were held during the early days when the first large group of newsmen were at Thule. Maj Gen Richard O. Hunziker, DCT commander, hosted four conferences which included participation by members of Danish and American scientific groups at Thule. The third conference in the series consisted of a short interview with the B-52's aircraft commander, one of the survivors still at Thule.

General Hunziker informed the press that there had been an explosion of the conventional materials in at least some of the nuclear weapons, that some radiation was present, and that there had been no nuclear yield. Credibility in the conferences was strengthened by the openess with which everyone answered questions and the maximum Danish and American scientific participation.

Because of the extreme sensitivity of all public affairs actions concerning the crash and recovery proceedings, the release of all information was triple-checked to make certain it did not mislead or distort, and that it was in the best interest of the nations concerned. Such a challenge was never-ending, for it required utmost integrity and perception to distill the often technical, often classified facts into a releasable piece of information comprehensible to the general public. The fact that information of this nature could be exchanged during detailed press conferences attests to the briefers' overall knowledge of the situation. They received full support from the DCT staff and scientific groups in preparing for the conferences.

COMMUNICATIONS

Virtually nonexistent commercial telephone and wire service to outside points caused some communication problems for newsmen. Arrangements had been made for copy to be filed through Dundas Radio, a Greenland village station about 8 miles from Thule. Although a system had been established for hourly delivery of news copy, this proved untimely and awkward for the newsmen who wanted to file each story immediately as material became available.

One military telephone line to Cornerbrook, Canada, was made available. Calls out of Cornerbrook were placed collect to the United States or Europe. Those to Europe experienced some difficulty getting through since overseas calls had to be billed to a U.S. address, but generally the system worked well. Calls were normally limited to 5 minutes and priorities were established by newsmen drawing numbers from a hat. Photographs were sent at the conclusion of each daily session.

All of the American newsmen, except four, returned to the United States with their ASDPA escorts on January 27th. Thereafter, formal news releases were made almost daily. Many replies to queries were researched and answers provided. The newsmen remaining at Thule were handed a short statement on January the 29th which announced that parts of all four nuclear weapons had been found. The release stated that serial numbers on fragments found on the ice at the crash site corresponded with SAC records of numbers on various components of the four weapons. The three-sentence announcement concluded by saying that the search was continuing for the remaining weapons fragments. The last of the 51 newsmen left Thule on 31 January.

During the next 2 months only three more news media visits were made to Thule.

PROTOCOL

Although considerable time was required to escort the visiting newsmen, the DCT information representatives were also involved in protocol matters and liaison with scientific teams. Normally information personnel prefer to point out that events involving protocol also invariably have news media interest, and that the information man best be left to meet the needs of the press. However, events at Thule demanded the attention of a senior officer knowledgeable in all facets and ramifications of the operation, one capable of acting as an intermediary between the military, scientific, and governmental agencies of the countries involved. Colonel Lynn, by virtue of his years of information experience and his close working relationship with General Hunziker, was ideally suited for this responsibility.

Since the Government of Denmark obviously had an inherent interest in all Project Crested Ice actions, Danish and Greenlander officials and scientists had to be kept fully apprised of all actions taken with respect to the search, debris recovery, decontamination, and long-range clean-up planning. Similarly, American scientists and State Department officials had an equal requirement and interest. News releases and answers to media questions had to be discussed and coordinated with these individuals. The rapport established with these individuals and groups during the crucial early stages of operations extended to liaison on matters in many other areas and proved beneficial to the overall success of the public affairs program.

THE DXI TEAM

Unlike other Disaster Control Team members who remained at Thule throughout Project Crested Ice, the two SAC Directorate of Information representatives and Combat Documentation Team members were rotated every several weeks. While Colonel Lynn primarily directed public affairs throughout the first 5 weeks, other select officers and noncommissioned officers participated without in any way diminishing the daily effectiveness of the information program. The rotation provided a training experience that could never be "simulated." The experience gained by those involved fully justified the rotations.

Mr Jens Zinglersen, a Danish citizen who was the Thule area representative of the Royal Greenland Trade Department, Ministry for Greenland, provided invaluable services throughout the operation. The importance of his technical assistance and untiring efforts at the accident scene during the first days were obvious to all who depended upon him. It was therefore gratifying that the United States Government officially acknowledged Mr Zinglersen's valued contributions by awarding him the Air Force Exceptional Service Award. The presentation was made by the U.S. Ambassador to Denmark, The Honorable Katharine E. White, in a specially arranged ceremony on 24 February 1968.

The DCT information personnel were responsible for making arrangements for the visit of Ambassador White and her party, which included distinguished Danish officials and five Danish news media representatives.

After Ambassador White presented the award to Mr Zinglersen the entire visiting party toured the accident scene and held a press conference.

IN RETROSPECT

If one were to attempt to pinpoint a single reason for the success of Project Crested Ice's public affairs program, he would undoubtedly have to hedge a bit and attribute it generally to cooperation. True, full disclosure about the presence of weapons and the search for them was made rapidly, and daily follow-up reports about the status of operations at Thule contributed immeasurably to a lessening of public concern.

None of this information could have been made available as quickly, fully, and as frequently as it was without the unqualified cooperation and coordination of the United States and Danish Government officials, scientific team members, and the many agencies involved with Project Crested Ice.

Such cooperation permitted spokesmen for both countries to discuss the accident and subsequent proceedings candidly and fully with newsmen, thereby discouraging uninformed speculation and any resultant unnecessary fear.

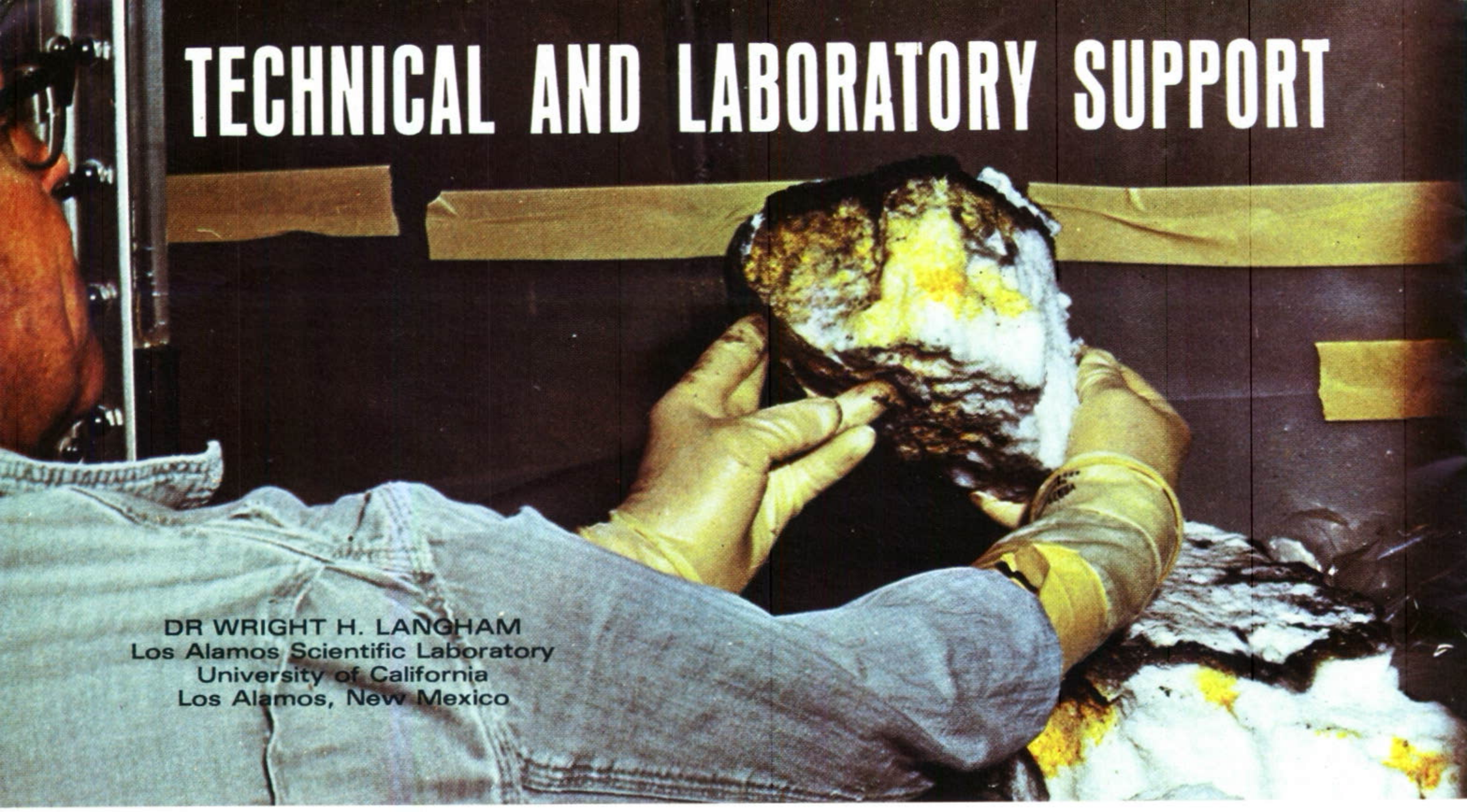
When the last 25,000-gallon tank of melted snow from the accident site was loaded at Thule for shipment to the United States, the most significant thing about the event was that it was Friday, the 13th of September 1968. There was no ceremony, no need to call attention to the climax of a gigantic task, and no requirement to reassure everyone that all was well. This confidence had been established and accepted long before.

Instead of any fanfare, some unknown soul merely annotated the final tank: "That's all folks!"—and it was.

Ambassador White presenting Mr Zinglersen with the U. S. Air Force Exceptional Service Award.

General Hunziker talking with Ambassador White's party on the sea ice.

TECHNICAL AND LABORATORY SUPPORT



DR WRIGHT H. LANGHAM
Los Alamos Scientific Laboratory
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A contamination incident such as the one described in other articles in this magazine invariably creates a real or anticipated need for specific technical information not readily available or easily obtained under field conditions. The type of supplemental information required is usually determined by the specific needs of the field commander and various special committees and policy-setting groups as an adjunct to their making decisions as to the extent of contamination, the magnitude and nature of the potential hazards to operational personnel and the inhabitants of the region (whether direct or through ecological modes), and the extent of decontamination that is acceptable and technically feasible.

Within 5 days after the incident an American technical advisory group was assembling at Thule, and discussions were initiated with a similar group of Danish and Greenland scientists. In the next few weeks various agencies (Atomic Energy Commission [AEC], Department of Defense [DOD], etc.) assembled expert committees to advise them. In addition, joint U.S.-Danish policy-setting groups met in Copenhagen and Washington to consider the technical aspects of the incident. The final decisions as to clean-up levels, methods of disposal and many other issues were made by these high-level groups and committees. Since these authoritative committees and groups needed all the information possible within the time frame of the negotiations, the demands placed upon the field operations became one of the field commander's biggest problems. Often these demands could not be met without additional technical and laboratory support beyond that available at the scene. To comply with these demands, data and samples were sent to the Los Alamos Scientific Laboratory and other laboratories in the U.S. for analysis and interpretation. This article summarizes the early work done at the Los Alamos Scientific Laboratory and elsewhere in an effort to provide some of the information requested.

PARTITIONING OF THE CONTAMINATION

In an incident of this type the most important information to have as soon as possible is the absolute quantities of material partitioned among the various vectors, modes or regions of dispersal, and deposition. At Thule the important considerations in this regard were:

- The amount of contamination carried aloft in the cloud from the detonation of the high-explosive and fire and dispersed over the general area by the prevailing meteorological conditions.
- The amount deposited on the surface locally.
- The amount deposited on aircraft and weapon debris.
- And the amount in and beneath the ice at the impact point.

Contamination associated with debris would be expected to be distributed beneath, in, and on the surface. Absolute determination of the quantities of contamination associated with each of these vectors or modes of dispersal and deposition was essentially impossible. However, from the practical viewpoint, the most important considerations at Thule were the amount, form, and fixation of plutonium and tritium on the surface in the immediate vicinity of the crash site and in the refrozen ice at the impact point where decontamination operations were technically feasible.

The speed of the plane at impact was in excess of

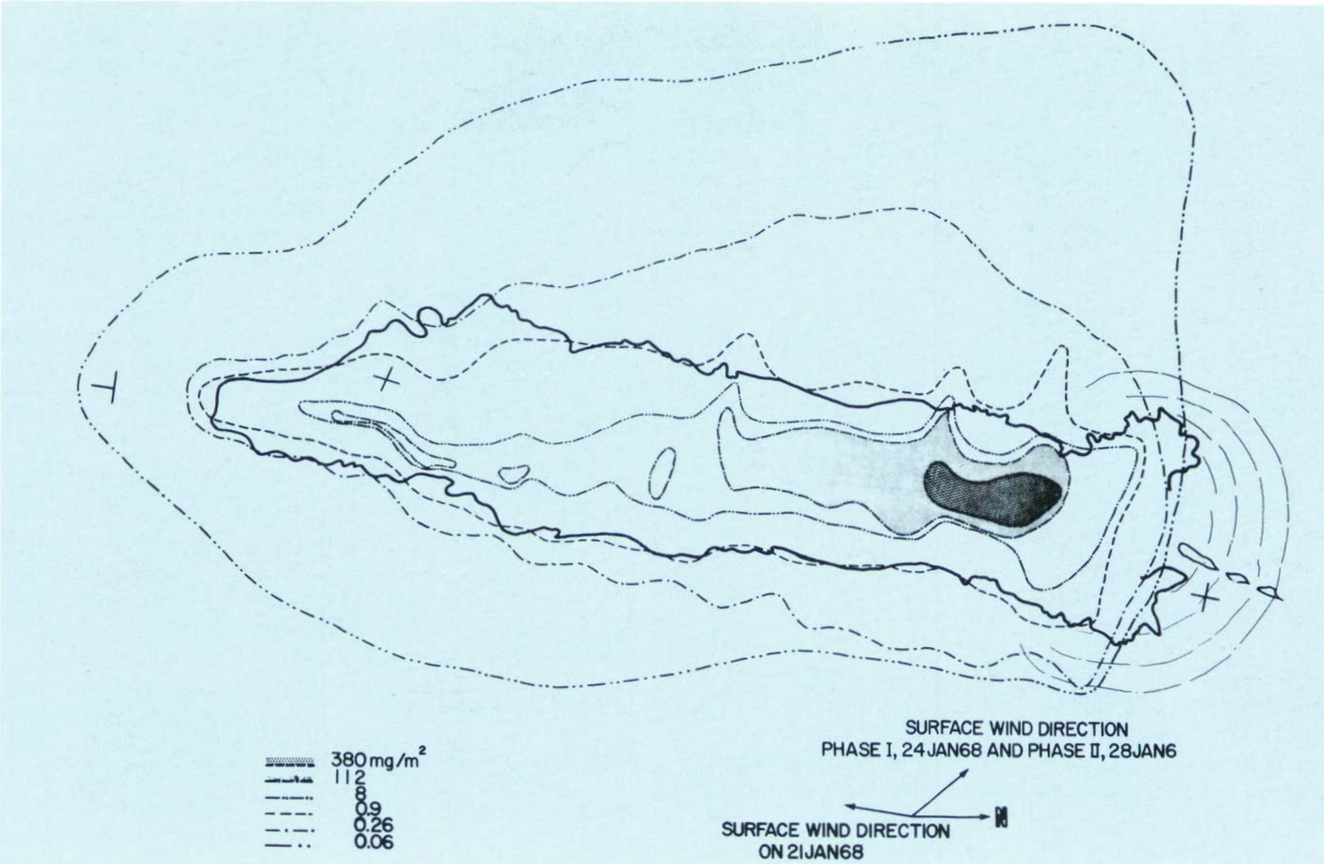

Figure 1 Plutonium contamination levels observed.

500 knots. Its gross weight was about 410,000 pounds—this included about 225,000 pounds of JP-4 fuel. The shallow impact angle and mass and speed of the aircraft resulted in a great forward vector of momentum. When the high-explosive components of all four weapons detonated, the contamination was blown out in all directions and impinged into the materials of the weapons and the aircraft and blown into the splashing, burning fuel. The fuel and much of the debris from the aircraft were catapulted forward on the surface of the ice. When the burning fuel fell back to the surface the fire was soon extinguished, leaving the blackened refrozen crust on top of the snow pack (Figure 1). The ice was completely shattered and disoriented at the impact point and sustained circular cracking out to a distance of about 100 yards in all directions. The peculiar markings on the ice showed the drag and destruction of the left wing, from this the crash attitude of the plane was deduced. From momentum considerations and the pattern on the snow pack, one would expect to find a large fraction of the surface contamination confined to the blackened crust where it was fixed by refreezing of the melted surface. This was indeed found to be the case.

The remainder of the contamination was dispersed in the smoke plume, impinged on the debris of the bombs and the aircraft, and blown into the ice at the site of impact.

CONTAMINATION OF THE SURFACE

Plutonium Distribution and Amount. Simple autoradiographic studies, as well as instrument measurements, established unequivocally that the depth-distribution of plutonium in the snow pack was strictly a function of the depth of blackening and melting of the surface. Over a large part of the blackened area, this depth was no more than about one-half inch. More plutonium contamination was found and its distribution was to a greater depth in those areas where more fuel collected and burned, resulting in more melting of the snow pack. In the most highly contaminated area, the snow pack had melted down to the surface of the ice. Surface distribution of plutonium (other than that adhering to large pieces of aircraft debris which were picked up) is shown in Figure 1. The contours were established by the monitoring teams using the Lawrence Radiation Laboratory Field Instrument for Detection of Low Energy Radiation (LRL FIDLER instrument). Because of the variable thickness of the overburden of ice and snow (complicated further by the two phases of 25 and 28 January), it was necessary to apply different calibration factors to the instrument readings for the areas within each contamination contour. As an example, where the contamination level was highest (380 mg/m^2) more fuel had burned and the snow pack had melted down to and even into the ice. Upon refreezing, the

TABLE 1

Distribution of plutonium on the surface in the vicinity of the crash (excluding that picked up on aircraft debris).

Contamination Boundary (mg/m²)	Enclosed Area (m²)	Plutonium (g)	Deposition* (%)
380	1.97×10^3	845	27
112	1.10×10^4	2816	89
8	2.49×10^4	3014	96
2.4	3.90×10^4	3079	98
0.9**	5.97×10^4	3109	99
0.26	1.10×10^5	3135	99+
0.19	1.34×10^5	3140	99+
0.06	2.23×10^5	3151	100

*Total out to the specified boundary.

**Edge of the blackened area.

absorption characteristics for the soft X rays from plutonium and americium were quite different than where little depth of melting and refreezing had occurred. Absolute contamination levels were obtained by taking representative samples in each contour area subsequent to a careful instrument reading and returning them to Los Alamos for plutonium and americium analysis. Total amounts of plutonium were obtained by integrating the surface concentration as a function of area (Table 1).

The plutonium values are probably good to ±20 per cent out to the edge of the blackened crust area, which corresponded roughly with the 0.9-mg/m² contamination contour. This information indicated 3150±630 g of plutonium on the surface (excluding that picked up on aircraft debris), of which about 99 per cent was in the blackened pattern and would be removed by removing the snow pack over this area. Assuming removal of the crust and packed snow to an average depth of 4 inches, the volume removed would be 6000 m³ (1.6 x 10 gallons). Assuming further that the volume ratio of packed snow to water is approximately 2.5, this would constitute about 6 x 10^5 gallons of water, which would contain between 2500 and 37 b of plutonium.

Plutonium-Form, Particle Size and Fixation. It was felt that the ultimate distribution of the plutonium in the event large amounts of the blackened crust were allowed to break up with the ice and go into North Star Bay might be influenced by its form, particle size, and fixation. Detailed nuclear track autoradiographic and microscopic studies of melted crust samples were conducted to obtain pertinent information. These studies showed the plutonium to be in the form of oxide particles with a very wide size distribution. The count median diameter was 2 microns, with a standard deviation of about 1.7. The calculated mass median diameter was about 4 microns. The particles were associated with or adhering to particles and pieces of inert debris of all kinds (metal, glass and nylon fibers, plastic, rubber, flecks of paint, etc.) of all sizes. The mass median diameter of the inert particles with which the plutonium was frequently associated appeared to be at least 4 to 5 times larger than the plutonium particles themselves. Many of the melted crust samples showed the presence of unburned jet fuel. A very crude estimate suggested that as much as 18 per cent (4 x 10 pounds) of the fuel may have remained unburned in the blackened crust. Sedimentation studies showed that up to 80 per cent of the plutonium was associated with low specific gravity debris that remained suspended in the jet fuel. The general feeling was that this fact increased the probability of contamination of the shoreline should the blackened crust be allowed to melt and enter the bay.

Tritium—Form, Distribution, and Amount. Laboratory examination of samples of the snow pack from the blackened area showed the presence of tritium oxide confined largely to the depth of the blackened crust. As water, a major fraction of the tritium contamination would have been expected to be carried away and dissipate with the smoke plume. Only that would remain which condensed on surfaces and nuclei that were rapidly cooled to the ambient temperature (-25° to -35°). The tritium fixed in and on surfaces in this manner would be expected to dissipate at rates that would fluctuate with temperature and wind conditions.

It is not possible to establish tritium surface deposition levels with field monitoring instruments because of the extremely low energy (17.9 kev maximum) of the beta radiation it emits. To determine the amount of surface tritium contamination present with any degree of certainty would have required an extensive and intensive sampling program which hardly seemed justified under the circumstances. It was considered adequate, therefore, to determine tritium in a relatively few samples of the blackened crust to confirm its presence and to establish the magnitude of contamination as assurance that no personnel exposure problems would occur during the operations. Analyses of these samples were considered representative of the areas within the plutonium contamination boundaries (Figure

Table 2

Distribution of tritium on the surface in the vicinity of the crash (excluding that picked up on aircraft debris).

Plutonium Contamination Boundary (mg/m²)	Enclosed Area (m²)	Tritium (curies)	Deposition* (%)
380	1.97×10^3	365	27.2
112	1.10×10^4	657	49.1
8	2.49×10^4	986	73.7
2.4	3.90×10^4	1337	100

*Total out to the specified boundary.

1) from which they were taken. Integration of the tritium levels within these boundaries gave a very crude estimate of the distribution and total amount of tritium within the blackened pattern. The results are shown in Table 2 and suggest a total of approximately 1350 curies of tritium confined to the area in the form of tritium oxide. The estimates are probably accurate to ±50 per cent. This amount of tritium would have to be diluted into only 4.5 x 10 m^3 of water to be at the maximum permissible concentration for continuous consumption.

CONTAMINATION IN THE ICE AT IMPACT POINT

The ice at point of impact was approximately 3-feet thick. Impact of the plane and detonation of the high-explosive components of the four weapons on board completely fractured and displaced the ice over an area of about 2100 m^2 (46 m x 46 m). The ice sustained circular cracking without displacement out to about 100 m from the impact point. Isotropic propagation of the shock wave from the high-explosive detonation accelerated a fraction of the contamination and debris from the disintegrating aircraft in the downward direction, impinging it into the fracture area. When fractured, the pieces of ice were displaced downward into the water, randomly oriented, and returned to the surface where they refroze in position. The attitude of the plane at impact was such that essentially all of the fuel was forward and above the weapons. This would be expected to result in the majority of the fuel and contamination entrained from a large solid angle being accelerated up and forward on the surface of the ice by the dominant forward momentum. The general feeling, however, was that additional information regarding amount, distribution, form, fixation, etc., of the contamination of the fractured area was desirable before making decisions as to its ultimate disposition.

Plutonium—Distribution and Amount. A closely spaced core sampling grid was laid out over and around the fracture area (Figure 2), and 49 full-thickness core samples were taken and examined. These cores were studied visually and microscopically and were scanned inch by inch with monitoring instruments. Representative cores were transported to Los Alamos for further study and chemical analyses for plutonium as a means of standardizing the scanning measurements made at Thule. Results showed that the plutonium contamination was usually confined to a narrow band which often could be detected visually because of the associated debris from the disintegrated aircraft and bomb casings. The band of debris with the associated contamination was sometimes on the bottom of the core, sometimes on the top, and sometimes displaced from either end. Some cores showed diagonal bands and others no bands at all. These observations reflected the fact that the fractured ice was displaced downward, returned to the surface, and refrozen in a more or less random pattern with respect to the reconstituted surface.

The fact that cores were scanned inch by inch permitted a crude statistical estimate of the depth-distribution of the plutonium in the ice. It appeared that about 13 per cent of the total plutonium in the crushed and refrozen area was in the top 2 inches, 36 per cent was in the top 4 inches, and 45 per cent was in the top 6 inches. About 15 per cent was in the bottom 10 inches. The remaining 40 per cent was distributed between 6

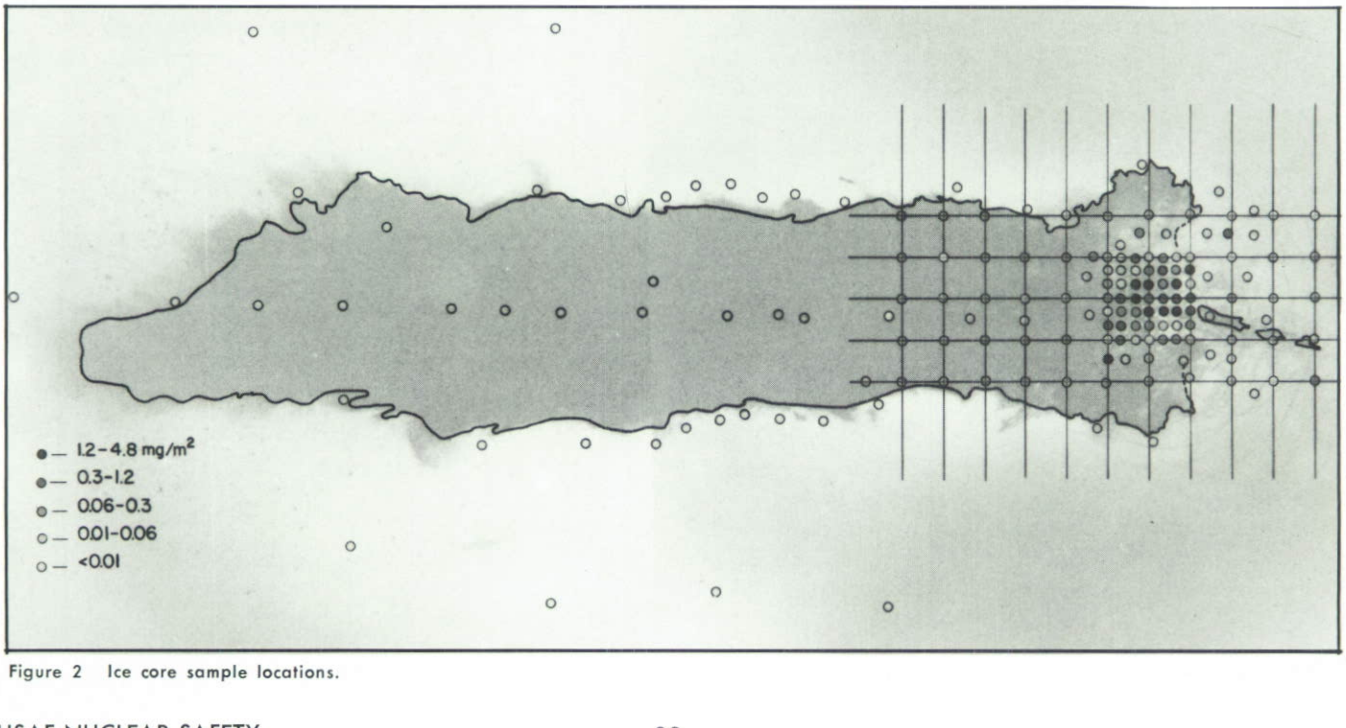

Figure 2 Ice core sample locations.

inches from the top and 10 inches from the bottom.

The plutonium distribution pattern, in terms of contamination per m^2 of surface area, was highly erratic, and it was not possible to represent the results by any simple contour pattern (Figure 2). There was a tendency for the most highly contaminated cores to extend to the back and sides of the center of impact, which might be expected from the relative position of the bombs with respect to the main body of fuel and the crash attitude of the plane. However, cores of comparatively low radioactivity were interspersed among the most radioactive cores, suggesting a highly segregated pattern probably related to reorientation of blocks of ice by the force of the impact and explosion. The random orientation of the rectangular grid with respect to the crushed ice pattern supports the assumption that the cores were statistically representative of the primary impact area in terms of total plutonium and range of local concentrations. Results from the 49 cores showed that 16 per cent contained 65 per cent of the contamination and 52 per cent contained 97 per cent. An estimate of the total amount of plutonium in the fractured ice area ($\sim 2100\ m^2$) showed about 350 g. The accuracy of estimate was probably $\sim \pm 25$ per cent. The amount of plutonium in the ice would have to be dispersed in about $5 \times 10^4\ m^3$ of water to be at the maximum permissible concentration. This is about 60 times the water volume produced by the melting of the porous ice itself.

Plutonium—Form and Fixation. It was felt generally that information on form and fixation of the plutonium in the fractured area might have bearing on questions regarding its ultimate availability to local ecological chains. Microscopic and autoradiographic observations of the residues filtered from melted ice core samples showed fine particles of plutonium oxide impinged into or adhering to pieces of aircraft and bomb casing debris of all sizes. The blackened bands in the ice cores consisted of small pieces of metal, rubber, fiberglass, paint, plastic, etc., up to 1 mm in size to which the plutonium oxide particles were fixed. Sedimentation studies of melted ice cores showed that 85 to 95 per cent of the debris and associated plutonium oxide sank immediately. No JP-4 fuel floated on the surface; only a thin film of fine carbonized material. The remainder of the plutonium was retained on the surface associated with this carbonized film. Only about 1 per cent was suspended through the water phase as very fine particles. This rapid settling of most of the plutonium greatly decreased the possibility of shoreline contamination from floating debris subsequent to melting of the ice.

Tritium—Form and Amount. Only a very few cores from the crushed ice area at point of impact were examined for tritium contamination. The contamination was in the form of oxide, and the amount appeared to be of the order of 17 mCi/m^3 assuming the ice averaged 1 m in thickness. This value, multiplied by the area (2100 m^2), suggested a total of only about 35 Ci of tritium activity in the ice at the point of impact.

CONTAMINATION BENEATH THE SURFACE

A very difficult question involved the possibility that contamination might have been dispersed beneath the ice in a form that could reach the shoreline or be concentrated by some biological process in the local food web. Two possible modes of contamination and dispersal beneath the ice were proposed for examination.

One possibility was that a pool, or pools, of highly contaminated jet fuel might have been trapped beneath the surface near the impact point. To examine this possibility the field teams took an additional 133 core samples, 85 on a grid pattern around the fractured area and over the blackened surface pattern and another 48 outside the periphery of the pattern (Figure 2). None of these cores showed any contamination on the bottom end, and no jet fuel or other floating debris was forced up through the core holes by the hydrostatic pressure beneath the ice.

The second possibility considered for plutonium to have gone beneath the ice was in connection with contaminated aircraft debris that might have been blown through the ice and sunk to the bottom. Pieces of the aircraft found on the surface were transported to Los Alamos to observe the amount, form, and fixation of the associated plutonium contamination. No tritium observations were attempted. Debris consisted of pieces of steel, aluminum, and other materials. Some pieces were highly contaminated on both sides, others on only one side, and still others showed hardly any contamination at all. Due to the numerous unknown quantities and inherent inaccuracies, no attempt was made to determine from the contamination observed on the debris the amount of plutonium that might have gone through the ice. However, later underwater observations during the summer season, dealt with in a separate article in this magazine, established that the aircraft debris which penetrated the ice was stabilized on the ocean floor.

Microscopic and autoradiographic observations showed that the contamination on the pieces of debris consisted of particles of plutonium oxide impinged into or adhering to the surface. Lavation tests in sea water were conducted on contaminated pieces of steel and aluminum to determine removal as a function of time. Different rates were observed for different materials, as well as for different pieces of the same material. The observations supported what might be expected, i.e., that removal rate would depend on the nature and hardness of the surface and velocity of the impinging particles, which would be dependent on the distance of the surface from the detonation. In any event, these observations suggest that, if indeed a large amount of plutonium was carried to the bottom associated with aircraft wreckage, it would not all be released rapidly or at the same time. This would make the possibility of high concentrations at any given time very unlikely.

ATMOSPHERIC DISPERSAL AND GENERAL AREA CONTAMINATION

The amount of plutonium and tritium taken up in the cloud from the explosion and fire and its distribution as long-range or general-area contamination were virtually impossible to predict with the available information. All available data, including cloud height, regional meteorological conditions at the time of the crash and for 10 days after, pyrotechnic information, etc., were sent to the Sandia Laboratory for consideration in view of that organization's experience with nonnuclear detonation experiments. These field tests have resulted in the development of detailed data and calculational models for estimating deposition patterns and contamination levels from nonnuclear detonation of plutonium-bearing weapons. The principal parameters needed are source strength, aerosol characteristics, high-explosive yield, and detailed local and long-range meteorology. Unfortunately, conditions at Thule were such that several of these parameters were either obscured, unknown, or unpredictable. Based on the inadequate information and several assumptions, the Sandia Laboratory was able to draw three general conclusions which are summarized as follows:

• Deposition of the aerosol produced initially would have been expected in a west-southwesterly direction on open ice and Wolstenholme Island. No deposition levels could be estimated, since the source term was obscured by the crash conditions and aerosol characteristics were unknown. However, the original long-range deposition pattern would be expected to be changed under the prevailing phase conditions during the first few weeks after the crash.

• Wind-resuspended contamination probably traveled around and possibly over Saunder Island. However, the condition responsible for the transport made redeposition of much activity on the island unlikely.

• The levels of long-range contamination expected would be radiologically insignificant but, because of the inherent sensitivity of chemical methods, plutonium should be detectable in surface samples taken south and west of the crash site.

Plutonium analyses of surface samples from the principal land masses in the general area are presented and discussed in another article in this magazine.

SUMMARY AND CONCLUSIONS

Immediately following the Thule incident a technical and laboratory support effort was mobilized to comply with requests by the field commander, expert committees, and policy-setting groups for additional technical information and consultation. This effort contributed, in part, to the following factors thought pertinent to the Thule situation:

• Laboratory calibration of field instrument readings and integration of deposition contours at the crash site suggested that the amount of plutonium on the surface was 3150 ± 630 g, approximately 99 per cent of which was confined to the blackened pattern on the snow pack. The plutonium in the crust was in the form of oxide particles, often associated with larger particles of low density inert material which tended to remain suspended in unburned JP-4 fuel. Tritium contamination in the form of tritium oxide was found on the surface largely confined to the blackened crust. The amount present was estimated at about 1350 Ci ± 50 per cent. These observations suggested that removal of the blackened crust and its associated plutonium contamination was desirable.

• Laboratory analysis of representative ice cores taken from the fracture pattern at the impact point, which were related to field instrument scans of other cores from the area, gave an estimate of 350 g of plutonium trapped in the ice. Reorientation and refreezing of the broken ice resulted in a segregated contamination pattern both with respect to depth and area. In this area also, the plutonium was in the form of oxide particles associated with inert debris from the bombs and aircraft. There was little or no unburned jet fuel, however, and upon melting of the ice the contamination did not float or remain suspended. This fact was further assured by covering the entire fracture area with black carbonized sand, which in addition to accelerating melting of this area, absorbed and sank any jet fuel film that might have remained afloat to suspend contamination. The estimated amount of tritium (as the oxide) trapped in the ice at the impact point was about 35 Ci. These and other factors, such as distance of the impact point from shore and depth of the bay, suggested that it was unnecessary to remove the approximately 2,000 tons of ice involved.

• Projection of contamination through and beneath the ice at impact point was considered also. Additional core drillings made throughout the general area of the crash failed to reveal any floating pools of jet fuel trapped beneath the surface.

All contaminated large pieces of aircraft wreckage on the surface were picked up and confined. Laboratory studies were carried out to determine the form, fixation, and lavation rates of plutonium from the surfaces of wreckage. These studies suggested that, if indeed large pieces of contaminated wreckage had broken through the ice and sunk to the bottom, there was little likelihood that high concentrations of plutonium could enter some aquatic factor of the local food web.

• Attempts to calculate meteorological transport and deposition of long-range contamination, although quantitatively unsuccessful, did suggest that contamination levels on land masses south and west of the crash site would be radiologically insignificant but probably measureable by chemical analysis of surface samples.