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PROJECT CRESTED ICE:  
THE THULE NUCLEAR ACCIDENT (u)

VOLUME I

SAC HISTORICAL STUD! #113

HISTORIC & RESEARCH DIVISION  
HEADQUARTERS STRATEGIC AIR COMMAND  
23 APRIL 1969

## FOREWORD

This study is concerned with the USAF recovery and decontamination effort precipitated by the crash of a B-52G near Thule, Greenland, on 21 January 1968. It is largely the story of Strategic Air Command's Disaster Control Team during the three-month period of Project Crested Ice. The contributions to this operation of other USAF commands and other governmental agencies were substantial, and it is not the intention of the historian to slight them. It must be understood, however, that this history was written from documentation either prepared by SAC or made available to it. Consequently, the history ends with the completion of SAC's decontamination work at Thule early in April. Only mention is made of the Air Force Logistics Command's activities at Thule in the summer of 1968, which included preparing the contaminants for shipment and loading them aboard ships of the Army's Military Sea Transport Service. The final report prepared by San Antonio Air Materiel Area on its activities is included in the supporting documents. These documents are on file in the SAC History and Research Division and in the Air University Historical Archives. Also appended to this history, in Volume II, is a collection of photographs. They clarify dramatically the conditions under which the men of the Disaster Control Team worked.

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## PART I

## The Accident

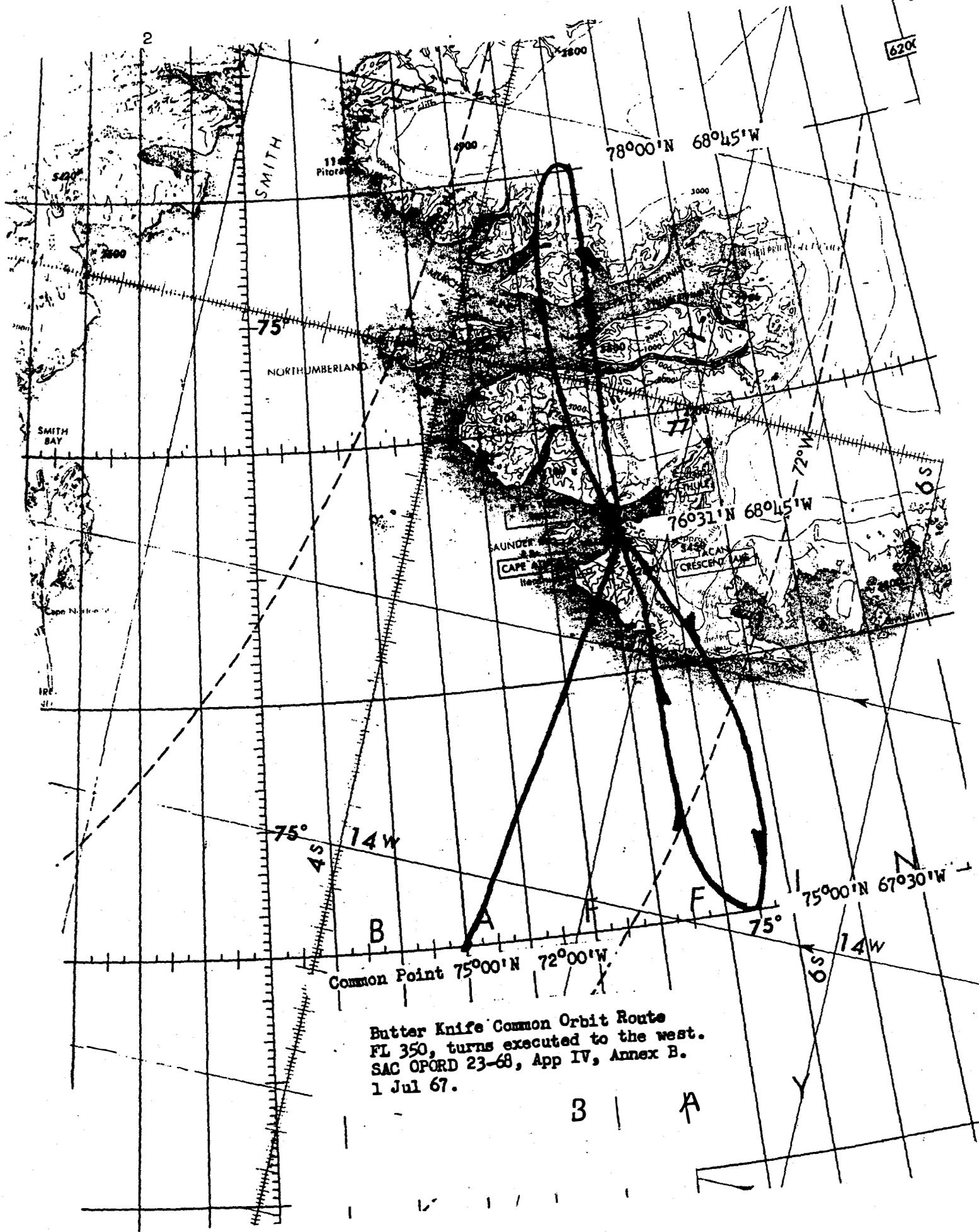
## Junky 14

Strategic Air Command B-52s began flying airborne alert in 1958\*. In August 1961, the CINCSAC, General Thomas S. Power, gave the operation a new dimension when he ordered that one B-52 orbit continuously near the Thule, Greenland, site of the Ballistic Missile Early Warning System. The aircraft would be in a position to determine quickly the nature of any communications failure between the site and warning centers in the United States.

On 1 January 1968, the Strategic Aerospace Wing (SAW) at Plattsburgh AFB, New York started its regular 45-day tour of monitoring the Thule BMEWS site. The Thule monitor mission actually started when the aircraft reached TI^OO'N/ST^O'W. The crew was to fly the aircraft at 35,000 feet in a "bow-tie" pattern, as depicted on the map on the following page.

On 21 January 1968 crew E-14 of the 528th Bomb Squadron, with one qualified substitute navigator and a required third pilot on board, flew mission Junky 14. Before takeoff the third pilot, assigned to occupy the instructor navigator's (IN) position, placed three cloth-covered foam rubber cushions under the seat and on top of the hot air spray tube. Shortly after takeoff a fourth cushion was placed under the seat, and a metal box was placed in front of and against the cushions. After about five hours of flight, the aircraft's cabin temperature became uncomfortably cool. To provide more heat, the third pilot (now occupying the co-pilot's seat) increased the cabin heat by switching to the emergency right hand inboard position of the cabin's heating and pressurization system.<sup>2</sup> This drew hot air from the engine's manifold into the heating system. The temperature of the air bleeding off the manifold increased rapidly to about 428

620X



Common Point 75°00'N 72°00'W

Butter Knife Common Orbit Route  
FL 350, turns executed to the west.  
SAC OPRD 23-68, App IV, Annex B.  
1 Jul 67.

3 | A

degrees, and there was very little drop in temperature between the manifold and the heating system outlets. The heat coming from the duct under the IN's seat was hot enough to ignite the flammable cushions stuffed around the duct. At 2022Z the EWO reported that he smelled burning rubber. After a search, the smoldering cushions were discovered and fire extinguishers were brought into action. These fire fighting actions were unsuccessful. No attempt was made to pull the cushions away from the hot spray bar. Flames soon blossomed from beneath the seat.

The pilot reported the fire to the ground station and requested clearance to descend immediately. During the fighting of the fire, the pilot started the descent. He raised the airbrakes and increased the speed to 370 knots indicated airspeed (KIAS). The EWO opened the sextant port to exhaust the smoke from the cabin. The navigator attempted unsuccessfully to smother the first with an A-3 bag. He reported the fire as uncontrollable. Shortly after 2030Z the bomber's electrical power failed. When the aircraft commander estimated he was close to Thule AB, he ordered the crew to bail out. The time was 2037Z. Six aircrew members ejected safely, at about 14,000 feet, although all received injuries. The seventh, the co-pilot (it will be remembered that the third pilot occupied his seat at this time), sustained fatal injuries leaving the aircraft through a lower hatch. After the crew ejected, the aircraft continued on over the base, made a 180-degree turn, and at 2039Z crashed on the ice of Wolstenholme Fjord (the point of impact is indicated on the following sketch). \* While making its last plunge the aircraft started to come apart in the air. Later search parties

The location of the bomber crash has been described variously in documents as being in Wolstenholme Fjord and in North Star Bay. Since a bay is defined as "a recess or inlet in the shore of a sea or lake between two capes or headlands," and since the crash site was about seven and one-half miles out and not between the capes or headlands of North Star Bay, the crash is most accurately described as being on the ice of Wolstenholme Fjord. A fjord is described as "a long relatively narrow arm of the sea, bordered by steep cliffs."

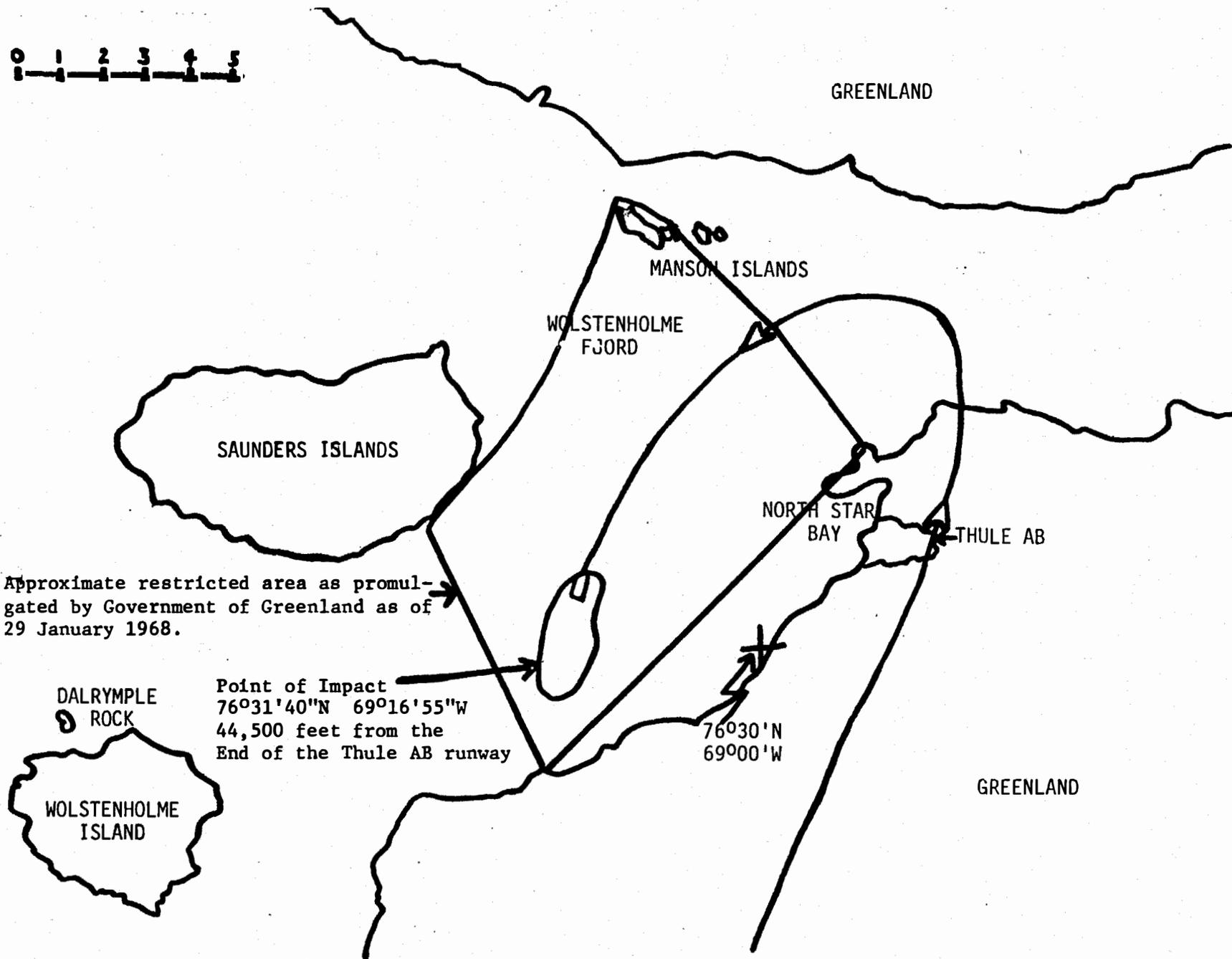
found bomb bay doors, wing panels, and flaps five miles north of the impact point. When it crashed the B-52 still had aboard four thermonuclear bombs with a total yield of megatons.

#### Rescue and First Visits to the Scene

The USAF organization at Thule AB was the 4683d Air Base Group, part of the Air Defense Command. Its reaction to this emergency was prompt and effective. The first priority was of course to rescue the crew; speed was essential since the ground temperature was -24 degrees. Helicopters of Detachment 18, 54th Air Rescue and Recovery Squadron, flew nine sorties in the next 19 hours. Eight other sorties were flown by other base aircraft. Base vehicles, including the taxi fleet, assisted in search operations. Fortunately, the aircraft commander had given the order to bail out as the aircraft approached the base, and the crew had reacted promptly. Two of them landed among the buildings of the base. All but one came down within two and one-half miles of the base. With one exception, all survivors were rescued within two hours. The navigator, first to leave the aircraft, landed six miles south of the base. He wrapped himself in a parachute and spent an uncomfortable night on an ice flow. He was found after 21 hours by searchers from the base. The body of the copilot was found two and one-quarter statute miles from the base within eight hours.^

The Air Base Group also quickly dispatched a helicopter to the crash scene. Its vice commander, Colonel Paul D. Gopher, reported back that the bomber had crashed on the ice approximately seven and one-half miles from the Thule runway. It was still burning. By 0108z the Thule base operations officer had also gone to the scene in a helicopter. He reported that the aircraft had gone through the ice in water 150 to 600 feet deep.\* He estimated the ice to be about

\* The main reasons for this initial and erroneous conclusion were that neither the aircraft's tail section nor any other major structural pieces were evident. Normally, the tail section survives an accident as an entity; usually whole sections of the wing can be found; and large panel sections are frequently in evidence. But in the case of Junky 14, those first at the scene reported only small bits and pieces of aircraft visible.



Approximate restricted area as promulgated by Government of Greenland as of 29 January 1968.

Point of Impact  
76°31'40"N 69°16'55"W  
44,500 feet from the  
End of the Thule AB runway

76°30'N  
69°00'W

GREENLAND

six feet thick and noted that the impact and burn area had already-frozen over. He had not landed because the rotor downwash of the helicopter caused the snow to blow and limited visibility. Also, the condition of the ice was not known.

During the first four hours after the crash, base personnel had found all but one of the crew survivors, visited the crash site by helicopter, and checked the base and shoreline for radiation (with negative results). Also, a Danish official of the Greenland Trade Department, Mr. Jens Zinglensen,<sup>7</sup> set out to warn the Eskimos not to approach the crash site.

Thule Air Base immediately reported the B-52 crash to the SAC Command Post. The senior controller then alerted the headquarters Disaster Control Team. It assembled and under the command of Major General R. O. Hunziker (SAC DCS/Materiel) departed Offutt AFB in a KC-135 at 0125Z, 22 January, arriving at Thule about five hours later.<sup>8</sup> After being apprised of the situation and actions taken prior to its arrival, the DCT established a command post.<sup>9</sup> The Air Base Group provided office space in the Service Club. Office machines and other staff equipment came from base stocks. Telephones were installed. A separate room served as a debriefing office. An adjoining room was made available first to the Accident Investigation Board and later to the Danish scientists who arrived.

While the command post was being set up, the DCT commander flew over the accident site in a helicopter. Because of darkness, no photos could be taken, but from what he saw General Hunziker concluded that most of the bomber had gone through the ice. He saw a tire without a wheel and six engines, but there was no evidence of the empennage or a major piece of the fuselage. The scene also gave evidence-that the aircraft had exploded violently upon impact, probably because its JP-k fuel ignited. The only recourse was to send a reconnaissance survey team to the site by dog sled.'\*''\*

Four SAC personnel conducted the first ground reconnaissance of the crash scene. They were Major D. R. Gowing and CMS B. E. Friend, radiation control monitors; and Captain J. R. Gooderham and TSgt J. L. Calhoun, explosive ordnance disposal experts. Gowing and Galhoun constituted one team and Gooderham and Friend the other. The two teams were to survey the general situation and determine the extent of the damage, the amount of area affected, the existence of contamination; attempt to find the missing crew member; and to look for any classified materials. The two parties left the base together at approximately 1330Z on 22 January. They traveled by dog sled driven by Greenlanders and were guided by Mr. Zinglensen. It took about half an hour to reach the crash scene. The two parties then split up and entered the burn area. One party went north and the other south. They traversed the area burned by the crash seeking its boundaries. They met on the opposite side and crossed the burn area moving west to east. The four men spent about two hours at the crash site.<sup>12</sup>

Upon their return, the teams reported their findings to General Hunziker and the Disaster Control Team. It will be recalled that at first it was feared that the bomber had gone through the ice. The six engines and thousands of pieces of debris found by the recon teams, and the identification of three and possibly four weapons chutes, gave the first evidence that in fact it had not.\*

\* Boeing Company experts visited the crash scene on 27 January. From evidence of the wreckage and the patterns made by the debris, they concluded that the bomber was structurally intact until the impact with the ground. They believed it impacted in a left wing low, nose down attitude of approximately  $k-5$  to 55 degrees. They concluded that Junky 14 disintegrated due to impact, explosion of the weapons and fire, and that no part of it had penetrated the ice. (Observation Report, Col W. R. Grady, Dir of Aerospace Safety, and Mr. L. D. Lee, Boeing Company, to Maj Gen Hunziker, n.d., circa 1 Feb 68).

Radiation monitoring equipment carried by the teams gave positive readings of alpha and gamma radiation of a type consistent with plutonium contamination, but most significantly, no evidence of nuclear contamination was found.\* The teams and their Greenlander sled drivers registered only light contamination when they returned. The teams determined that the ice of the fjord was strong enough to permit construction of a camp adjacent to the crash site. They did not find the missing crew member nor any classified documents.<sup>18</sup>

The day following the first ground reconnaissance of the crash site, two RR-^Cs flew the first photo recon sortie over the scene. SAC's U-2s did not have the ability to take usable photos at night, so Major General A. C. Gillem II, DCS/O arranged for the Tactical Air Command to send three RF-J+Cs to Thule from their station at Mountain Home AFB, Idaho.<sup>1k</sup> Between 23 and 26 January these aircraft flew nine sorties out of Thule. Each aircraft carried ES-72 cameras. These were activated by photo flash cartridges when the cartridges illuminated to their peak intensity (about 562 billion candlepower). Each aircraft took about 120 pictures a sortie.<sup>1k^</sup>

## PART II

### Recovery Operations

Armed with the knowledge provided by the recon teams, the SAC Disaster Control Team began planning the work ahead. It based its recovery plans on several assumptions. It was probable that the high explosives in all four nuclear weapons and the fuel on board the aircraft had detonated. The explosion had spread significant amounts of contaminated weapons and aircraft

\* Interrogation of the B-52 flight crew by the Eighth Air Force Aircraft Accident Investigation Board had definitely verified that the aircrew had taken no action to change any of the prescribed positions of the weapon control switches. All controls had remained in a safe configuration in accordance with technical data. (Memo, Brig Gen A. J. Bowley, Pres AIB, to DCT Cmdr, n.s., n.d., circa 24 Jan 68).

debris over an area about one and one-half by three miles. Recovery of the debris and decontamination of the area would require a maximum of 90 days to complete; exact levels of decontamination would of course have to await the outcome of government-to-government negotiations. Climatological conditions would probably slow down operations and place the recovery crews in some danger. Storms could not only delay the work, but also spread debris and contamination.

The policies of disaster control, already set down in regulations, determined in large measure the priorities given to the work ahead. Major General Hunziker explained them to his staff on 24 January. First priority called for the recovery of classified documents carried aboard the bomber, specifically materials contained in the combat mission folder. Second priority was to find and recover the nuclear weapons or rather the pieces of them. Third was to control the spread of contamination. The fourth priority was to remove the aircraft wreckage from the crash site. The last and most difficult task would be to decontaminate the area in accordance with whatever agreement was reached between the United States and Denmark.<sup>17</sup> Several objectives- could, in fact, be pursued concurrently. The entire operation (given the nickname of "Crested Ice" on 26 January) was more conveniently divided into two phases: Phase One, the retrieval and disposition of aircraft wreckage and bomb components; and Phase Two, the cleanup or decontamination effort.

#### The Disaster Control Team Staff

Before proceeding with a description of Phase I operations, it will be necessary to discuss in general how the over 500 military and civilians who participated in the work were organized.\* When the

Other organizations besides SAC represented at Thule were: U.S. State Department; U.S. Information Agency; U.S. Atomic Energy Commission; Field Command, Defense Atomic Support Agency; Office of the Assistant Secretary of Defense Public Affairs; Secretary of the Air Force, Office of Information; Directorate of Nuclear Safety Headquarters USAF; Los Alamos Scientific Laboratory; Sandi Corporation; Boeing Company; Air Defense Command; Military Airlift Command; Lawrence Radiation Laboratory; U.S. Army; U.S. Navy; Air Force Logistics Command, and Tactical Air Command.

DCT set up a command post in the Thule service club, 68 people were assigned to it, including the group which had come from Offutt. From this nucleus, the number of temporary duty personnel at Thule increased to a maximum of 565 on 1<sup>^</sup> February, and then began to decline. In all, 381 SAC personnel were sent to Thule. They came from the headquarters and all three numbered air forces. The maximum number there at any one time was 278 on 1<sup>^</sup> March. The Disaster Control Team Staff was organized into seven divisions under the command of Major General Hunziker: Weapons Recovery; Radiological; Base Support; Administration; Plans, Report, and Safety; Information; and Communications. (see chart on next page). An American Scientific Group assisted General Hunziker on a wide range of technical and scientific matters. It was composed of specialists in nuclear weapons safety, radiation, glaciology, and packaging and storage of radiological materials. This group, established on 25 January, also worked closely with a similar Danish delegation which arrived at Thule on 2<sup>k</sup> January.<sup>13</sup> Of particular importance in the DCT organization was the site commander and his staff. They set up a camp on the ice at the crash scene and took direct control of the work from there.

#### Camp Hunziker

Junky lit- crashed over seven miles from Thule AB on the ice of the fjord. It was immediately clear then that some kind of work site would have to be erected at the scene. General Hunziker decided to begin with a small camp and add structures as they were required. The camp would serve as a command post for day-to-day operations and as a refuge for personnel during arctic storms. Most of the personnel would commute each day from Thule.

Construction of the camp began on 23 January when helicopters lifted to the site sheets of plyboard for construction of a heliport and a command post. The heliport was built by placing sheets of four by eight plywood on the ice and fastening them there by pouring water over them and allowing them to freeze in place. By using the landing pad.

# SAC DISASTER CONTROL TEAM STAFF

## ON SCENE COMMANDER MAJ GEN HUNZIKER

### CHEF OF STAFF COL HOCKETT

I  
ADMM  
MAJ SCOTT  
MAJ SEAWARDS

### SCIENTIFIC GROUP COL FITZPATRICK

REPORTS LT/COL LUCADEIXO j	---m : OoMMUNCXnoNS CAPT McQVESTON CAPT ZMACYNSKY	X WEAPONS RECOVERY COL MARCUM ^1----- PLANS MAJ UOTC	SITE COMMANDER COL GODWIN	T RAOIOLOCAL CAPT (USM McEUVEE COL BUCKINGHAM	DXI COL LYNN	-----11 BASE SUPPORT COL KREKTZ
MAY REPORT MAJ KOC	z : NCOC TSGT POOLE	J----- 1 to MLTY I	CXCL/TIVE LT/COL TURCOM LVOOL tUCAW110	CONTAM CONTROL LT/OOL THOMPSON	PUBUC AFFARS MAJ JOUE CAPT ICNNGER	- SECURITY X MAJ LUCKETT
FINAL REPORT MAJ PURCELL SMSGT PIRTLE	f j RAOOOPS I TSGT NELSON I	RPR A SPEC PfiOJ LT/OOL MIAUR j	STTE MORS MAJ 00*1NO CAPT OOOERHAM	MASON SUPPORT MAJ McNUTT	11STCORT VR 00m0	SUPPLY LT/OOL KERR
IRCFtNCS 1 LT/OOL SOLOtWNS	J L COACJ CENTER TSGT OWENS	"1 OPERATIONS MAJ RUSSELL I I..		RAOUC M3TR MR OOSSETT	PHOTO OOCITJomDN TSGT SANCKTZ	CROTfS) TR/J3 CtftC3SjP0!34
RECOVERY PLAN 1 OtSCT FRCM) j	" L CRYPTO LUKT "1 TSGT NOROQUST J	"1 IICOVtHV TtAMt TEAM o«rs ICAFT ***** >>CtPT caxMM snat *WMT 4M NkCOCN Stkt HvwWOTC* : tmr MOCT		PLAK3 BOPS MAJ OJty.'X		An TR/:3 LT/COL XtZZXi
OPS PLANS LT PEESC J	F j MOO MAINT ~1 SGT OLSON I			izrt PAOMXJlQKtO TtAUJ IttJO #190 IIU r4TM 6/3a) SCAN VSRcNUIU)		OVL EL3 13COL K^::3t  1EP.*iL

Organizational structure as of

2 February 1968

helicopters no longer created a "whiteout" by stirring up the snow with their rotors. The first pre-fab building raised, the command post, was an 18 by 92 foot Mark 3 arctic hut. This plywood building, and others built on the ice later,\* were fastened down by running cables over them then anchoring the cables to the ice. A hole was drilled into the ice; the stanchion was inserted in the hole; water was poured in the hole; and after it froze the cables were attached to the stanchion. As the camp grew, buildings were placed in a single row with a minimum of 60 feet between them. This prevented overloading the ice.<sup>19</sup> Collectively, the buildings came to be known as Camp Hunziker.

Until 25 January dog sleds and helicopters provided the only means of transportation out to the site from Thule AB. On 2k January, two U.S. Army M-116 Weasels and four drivers arrived from the ST^h Artillery Battalion, Ft Rucker, Alaska. The next day these vehicles were first used to place a telephone line from the base to the site.<sup>20</sup> Next, the Weasels marked out an ice road to the site. Ice core samples were taken to test the strength of the ice along the route.<sup>21</sup> After the road was marked with the stakes, a road grader removed the snow cover from the ice. The ice road was then complete. A second road was immediately begun because the weight of two vehicles meeting on one ice road might crack the ice. Two roads permitted one way traffic to the base from the site and return.<sup>22</sup> By 9 February, a third road was completed. After that one road could be closed each day for strengthening and repair.<sup>23</sup>

\* The camp ultimately consisted of a command post, supply buildings, decontamination station, personnel shelters, and an identification building for initial processing of wreckage and pieces of bombs. In all, two 18 by 92' foot huts, six 8 by 16 foot huts, three mobile Wanigan huts, one Jamesway hut, and some other sled-mounted facilities were erected at the site or moved there. Several igloos were also built as emergency shelters.

Another important link between Thule AB and the site camp was communications. The rearward communications between the base and the U.S. were considered adequate and of good quality. More important to daily recovery operations was the interconnection of the SAC DCT command post with the accident site. The initial survey party carried portable FM transceiver radios. Since there was no line-of-sight between the command post and the accident site, communications personnel established a relay post at the base hospital which was on the line-of-sight between both points. Eventually, a 50-watt station was established there which relayed information from a remote radio in the command post to a 10-watt base station at the site, and to portable radios used on the dog sleds and tracked vehicles. In addition, there were telephones installed in the command post. By 2k January a telephone cable was installed to Camp Hunziker. The next day additional teletypes, voice and data encryption equipment, and additional portable radios arrived. By 5 February 1968, the system was fully developed.<sup>pl.</sup> Cold weather caused most of the problems encountered. It rapidly drained portable radio batteries of their power. Snow plows also by accident frequently cut the telephone cable linking the site and the base because snow covered tie cable.<sup>25</sup>

In addition to shelter, roads, and communications, searchers at the site camp needed light to work by. It is almost totally dark in the arctic in January. The first survey team carried flashlights, but the cold drained their batteries in from eight to 15 minutes. During the first days out on the ice, searchers also used Coleman lanterns, but they proved to be inefficient. The lanterns required an inordinate amount of maintenance, and when operating they shed only a small circle of light. Beyond the circle of light the shadows cast by the lantern's glow distorted objects. It was soon apparent that better lighting would be needed. The first powered lights brought to the site were NF-2 light carts. Normally these were used to illuminate flight lines for maintenance. Each cart had its own generator which operated two 1000-watt lights. Three gasoline powered generators, one of 10KW

capacity and the other of            were used also. Together, the KF-2s and the three generators provided electrical power for Camp Hunziker. Lights for the crash scene of course required more power. The inventive base electrical shop then fabricated a lighting system consisting of a 15KW diesel generator which powered 15 1000-watt light bulbs. Each bulb was mounted on a ten foot pole embedded in cement in a 55 gallon drum. These light poles were placed 100 feet apart at the crash site and then wired to the generator. A second set of lights was added later. This system proved effective.<sup>27</sup>

Lights could be brought to the ice to help the search teams, but nothing could be done about the all-prevailing cold. Thule is located at 76° 32' North. The temperatures during the first week of work ranged from -29 to -k. Personnel wore full arctic clothing at all times when they were on the ice. The bulky clothing, built for warmth, handicapped movement and restricted vision. The cold affected man and machine alike. Its effect on batteries has already been mentioned. Mechanical equipment also suffered. When exposed to low temperature for an extended period of time, oils, rubber, metals, and even paper changed in tensile strength, resiliency, and size. The result was fuel leaks, frozen oil and grease, and brittleness. Wind combined with the cold to drive the chill index downward. In the first week of operations the winds varied from 12 to 58 knots. When they reached a certain velocity, work stopped and all personnel on the ice sought shelter. Each individual was eventually provided with a flare. Should they become trapped out on the ice by a sudden "whiteout," the searchers were told to stay put and to light their flares to guide rescuers to their aid. The base camp also had a Very pistol and flares, and later a siren and a flashing light to warn of approaching phase conditions.\*

\* Storms were categorized as Phase One, Two, or Three. Phase One storms had winds of 20 knots or more, Phase Two 30 knots or more, and Phase Three above 50 knots.

Arctic storms stopped operations on several occasions. They also increased snow depth and made it increasingly difficult to locate aircraft and weapons debris. On 24 January operations at the site did not begin until 1500 local. Four days later, 28 January, work stopped at 1630 local because a storm moved in. It lasted through the next day. Additional storms threatened on the following days, but the adverse conditions failed to materialize. However, high winds on 3 February delayed the start of work. The following day witnessed a complete shutdown. Work resumed on 5 February, but the support personnel were unable to resupply the site that night because of high winds and blowing snow. The storm lasted over into 6 February and stopped any work until 1400 local. Then good weather lasted until 10 February. Once again operations were hindered because of the high winds and blowing snow. The next two weeks saw good weather for continued operations. As a result, recovery of aircraft debris was completed quickly. The stormy weather returned on 24 February and prevented work. Adverse weather conditions did not return until 2 March. No outside work could be done that day, but the next three days were perfect. Once again operations stopped (06/1500L March) for nearly 24 hours. Then operations resumed for only four hours when the site had to be shut down again. Good weather favored operations during the next week. Except for a single stoppage on 14 March, weather remained good until 2 April. By then, all recovery and search activity had ceased.

#### Phase I: Picking Up the Pieces

Even as the prefabricated buildings of Camp Hunziker were being raised, search teams again went out to the crash site. It has been mentioned that on 22 January the initial survey party had found no pieces of weapons, but had discovered three and probably four weapons chutes. It had also found radiation. The next day twelve bomb disposal and radiological experts went out to mark the outer limits of contamination (the so-called "zero line" where

their dose meters no longer registered contamination) and to search for weapons parts. The party hurriedly criss-crossed the crash area in order to cover the maximum amount of ground before a threatening storm set in. The team found the valve from the gas bottle of one bomb, but no other bomb components. It confirmed that the fourth chute found by the earlier party belonged to a weapon. The team marked the "zero dine" with flags. The area inclosed measured about three miles long and one mile wide.<sup>28</sup>

An arctic storm prevented further searches on 24 January. The next day the same coarse search pattern produced two tritium bottles, the first weapons components that could be identified by serial number as being part of a particular bomb.<sup>29</sup> The next day, a 52-man search and recovery team, still pursuing the coarse search pattern, turned in a third tritium bottle. Equally significant, it found portions of three warhead secondaries with legible serial numbers. This confirmed that the high explosive of three warheads had detonated on or above the ice.<sup>30</sup> As a matter of fact, now that the location of three bottles was known, the searchers could estimate the probable location of the fourth bottle. On 28 January it was found, damaged like the other three by high explosive detonation.<sup>31</sup>

Up to this point, 28 January, identification and collection of parts of weapons had occupied the attention of the teams working on the ice. Weather now intervened to change the character of the search. High winds were forecasted. They threatened to move pieces of the wreckage, thus enlarging the total area of contamination and making the eventual task of decontamination much more difficult. Consequently, on 28 January, and for the next eight days, teams switched their main effort to collecting pieces of aircraft debris.<sup>32</sup> Armed with picks and shovels, and dragging box sleds behind them, the men went about their work. As the boxes were filled, they were dragged to a central collection point, and their contents dumped in piles.

Later, when more tractors and Weasels became available, they pulled the sleds.<sup>33</sup> By 30 January (weather prevented work on the twenty-ninth) the men had filled the hoppers of two Dempster Dumpsters and had accumulated a pile of debris 5 by 30 by 30 feet.<sup>34</sup> Weasels and tractors dragged the heavy pieces (engines, tires, wheels, outriggers, etc.) to a central collection point. Another pile of wreckage was collected on 31 January. The debris was covered by chicken wire, which was in turn staked to the ice.<sup>35</sup> By 2 February all the larger pieces of aircraft wreckage within the "zero line" had been picked up.<sup>36</sup>

Mention should be made here also of the search for the classified documents which went down with the B-52. Although this effort would normally have a high priority, their retrieval on this particular occasion could not in practice be separated from the total search effort. Besides, the isolated location of the accident and the fact that the aircraft broke up into thousands of pieces upon impact made it highly improbable that any compromise existed.<sup>37</sup> On 27 January two-thirds of the metal combat mission folder container and several pieces of charts were recovered.<sup>38</sup> During the next several days additional pieces of maps were found. All had been subjected to fire. None were identifiable. The investigating officers then concluded that no classified materials had been observed by foreign nationals; that their loss was not deliberate or the result of negligence; and finally, that no compromise in fact existed.<sup>39</sup>

Up to this point, early February, search teams had criss-crossed the crash scene following a rather random pattern. In this way the larger pieces of wreckage and bomb fragments had been located. As more men arrived at Thule from SAC numbered air forces, it became possible to expand the search. On 6 February crews moved side-by-side slowly across the ice in a series of sweeps east to west. They found no weapons components, but additional small pieces of aircraft debris were picked up.<sup>40</sup> Teams of 50 to 60 men continued the search during the next several days.<sup>41</sup> Newly-arrived Army mine detectors helped in

detection and location of buried metal. They were particularly valuable since by now about 20 inches of snow covered the crash site.<sup>42</sup> Also, beginning on 7 February teams using special radiac equipment supplied by the Lawrence Radiation Laboratory probed the southern portion of the crash site to locate buried weapons components.\*<sup>43</sup>

By 12 February there were 206 personnel on duty at the crash site, the largest number to that date. More intensive searches were now possible. Shoulder-to-shoulder in a "dressed right" line the searchers picked up debris in an area 150 yards wide and 900 yards long on the west side of the burn area along its length north to the "zero" reading contamination line.<sup>44</sup> Similar searches were made during four of the next five days, and in this way a total of seven square miles at the northern area were covered.<sup>45</sup> Radiological teams continued to range north and south of the burn area in Weasels equipped with Lawrence Radiation Laboratory instruments. Whenever a reading indicated something buried which emitted gamma rays, the searchers stopped and dug up the object.<sup>46</sup> By 17 February General Hunziker could report that: "Collection of aircraft debris is now complete with the exception of those small pieces that remain frozen in beneath the surface of the burn area."<sup>47</sup>

There remained aircraft and weapons debris which had been embedded in the snow by the force of the crash or had been covered by subsequent snow falls and wind-driven snow. To facilitate finding this debris, the DCT used road graders equipped with large steel teeth ((scarifiers)) to rip up the snow crust. Search teams followed behind the graders to recover the exposed debris.<sup>48</sup> Scarifying began on 25 February in an area just south of the bomber's impact point where several pieces of weapons had already been found. Coverage was later extended south all the way to the coastline.<sup>49</sup> Before all search

\* The nomenclature of this equipment was PRM-5/SPA-3. Perhaps the non-specialist need only know that it was mounted on Weasels and detected the gamma rays given off by debris contaminated by U-235.

activity ended, on 30 March<sup>50</sup>, about 30 square miles had been covered by searchers on foot, in Weasels, and in helicopters.<sup>51</sup>

It was mentioned earlier that Phase I of the Crested Ice Recovery Plan consisted of picking up and then disposing of the pieces of the bomber and its load of bombs strewn over Wolstenholme Fjord. Bomb components had first priority for disposal. One of the first huts erected on the ice served as a collection point for them. After a suitable building was found on the base, the pieces were moved there, and personnel from the Atomic Energy Commission and the Pantex Ordnance Plant, Amarillo, Texas, identified them and packaged them in sterile containers.<sup>52</sup> These were subsequently flown out of Thule on a KC-135. The cargo went in four shipments, on 3, 8, 19, and 26 February. The first two went to the Pantex Plant, the third to Dow Chemical Company's Rocky Mountain Flats Division, and the fourth to the AEC's Los Alamos Scientific Laboratory.<sup>53</sup> Eventually located were four reservoirs, serial numbered parts of three weapons secondaries, weapon parachutes, and numerous small fragments. In his summary of "Crested Ice," Major General Hunziker said that identifications made by AEC indicated that recovery had been made of 85 percent of the uranium and 94 percent, by weight, of the weapons secondary components.<sup>54</sup>

The great bulk of the debris to be collected consisted of aircraft parts. The DGT decided to use barrels (20, 30, and 55-gallon oil drums), aircraft engine containers, and fuel storage tanks. The smaller pieces of debris were dumped into barrels. These were sealed and remained on the ice until a suitable place for storage could be found on the base.<sup>55</sup> Engine containers and fuel storage tanks were used for the larger pieces. Fifteen R-4360 engine containers were flown in from San Antonio Air Materiel Area. They arrived in deplorable condition, minus nuts and bolts and full of trash and pieces of ice. However, 14 of them were refurbished and used.<sup>56</sup> A search of Thule itself turned up 11 large fuel tanks, 10,000 and 18,000 gallon capacity, left over from the days when the Thule AB mission was much

more extensive. These were sent out to the ice and filled with debris. By 15 February a suitable place for storage of the debris had been found, the old SAC munitions maintenance squadron area.<sup>57</sup> On that day DCT personnel began transporting containers of debris the 12.6 miles from the crash site to the MMS area. By 20 February all debris not frozen in the ice had been picked up, packaged,<sup>58</sup> and moved to the base to await shipment during the summer months. The total accumulation consisted of 163 drums, 14 engine containers, and 11 large fuel tanks--a capacity of 14,720 cubic feet.<sup>59</sup>

#### Phase II: Removing the Contamination

Phase I of Project "Crested Ice" ended with the cleanup of debris not embedded in the ice and its temporary storage on Thule AB, or, as in the case of weapons components, shipment of the pieces by air to the United States. Phase II of the recovery plan ultimately consisted of removing the contaminated ice and snow, transporting it to Thule AB, and packaging it in containers suitable for transportation back to the U.S. for disposal.<sup>60</sup> Planning for this second phase began even as searchers were still picking up pieces of the bomber. Five possible courses of action were considered. They ranged from simply roping off the contaminated ice to prevent inadvertent entry and allowing the summer melting to dump the debris into the fjord, to the much more complicated job of collecting and disposing of all the snow within the three mile square area encompassed by the "zero line" and the ice within the area burned when the aircraft exploded.<sup>61</sup> The final decision awaited findings by the technical representatives of the two governments at the crash scene, the Danish and American teams of scientists.

Greenland is Danish territory. The crash also occurred during a Danish election. It is not surprising, therefore, that Denmark immediately notified the U.S. Embassy in Copenhagen that it wanted to send a team of scientists to work with American scientists responsible for the radiological survey of the crash scene.<sup>62</sup> The

U. S. had no objection.<sup>63</sup> The first team of four Danes arrived at the scene on 24 January.\*<sup>64</sup> The next day Dr. Wright Langham, Biomedical Research Leader, Los Alamos Scientific Laboratory, and Dr. H. D. Bruner of the Division of Biology and Medicine, Atomic Energy Commission, flew in to Thule.<sup>65</sup> They formed the nucleus of the U. S. Scientific Group for which 23 scientists would work at one time or another during the next few months.

After their initial study of the crash site and the contamination remaining, the American scientists agreed among themselves that no significant danger would exist if the Disaster Control Team did nothing more than pick up all the pieces of the bomber which might attract the interest of the Eskimo population and restrict entrance to the area of the crash until the ice melted. Dr. Langham said that if all of the plutonium in the four weapons were dumped into Wolstenholme Fjord the health of the natives in the area would not be threatened since dilution of all the plutonium in even 1/500th of a cubic kilometer of water would reduce the concentration to safe levels for drinking. The volume of the water in the fjord was reckoned at 50 cubic kilometers.<sup>66</sup> Also, plutonium was primarily an inhalation or wound contamination hazard and not an ingestion hazard. This meant it was not dangerous to man whether he ate it directly or whether he ate a plant or animal which contained it.<sup>67</sup> But while the Americans were confident that it would be sufficient to "police up" the area and then allow the spring thaw to do the rest, it was also clear that the Danes did not find this satisfactory.

The Danes, described as "capable, multi-disciplined and generally friendly and cooperative,"<sup>68</sup> were primarily interested in

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\* They were: Prof. Joergen Koch, Physicist, University of Copenhagen and Prof. O. M. Kofoed-Hansen of the University of Copenhagen; Mr. H. L. Gjorup, Health Physicist of the Danish Atomic Research Establishment at Risø; and Dr. Per Grande, Director, Radiation Hygiene Laboratory and Health Physicist, National Health Service, Copenhagen. The number of Danish scientists at Thule varied from 12 in the early weeks of the project to one in the later stages of Crested Ice.

the residual effects of the contamination on the ecology of the region.<sup>69</sup> Thus, their initial feelings toward the eventual job of decontamination were described by Dr. Langham as a "tough policy." He explained:<sup>70</sup>

- a. Dumping anything in the bay or allowing disposal in the bay when the ice breaks up is not acceptable.
- b. All sizeable pieces of debris must be picked up and hauled away.
- c. Packed snow, out to some unspecified contamination contour should be graded up in rows or piles and stabilized with foam or water frozen into a crust that will resist serious wind corrosion. This material must then be removed before break up of ice. What is to be done with it seems to be our problem. It, however, cannot be allowed to go into the bay because of the many small highly contaminated pieces of aircraft it will contain. Also, highly contaminated pieces of fabric, etc., that could float may drift ashore and be picked up by an unsuspecting Greenlander.
- d. The area of ice melted as a result of the fire and refrozen is highly contaminated. Although this is fixed now when ice melts and breaks up the plutonium and contaminated debris will fall into the bay or be washed ashore. They insist this should be removed which they calculate to be about 1000 tons of ice.
- e. They worry also that contaminated plane and weapons parts most likely broke through the ice and sank in 600 feet of water, this and the plutonium oxide blown down by the blast poses a water contamination problem.
- f. f. They feel any contamination of the bay in addition to low level general contamination which may be extensive because of height of cloud plus stable inversion conditions at crash time and subsequent 60 knot winds poses ecological problems which should be looked into.

The first formal scientific meeting, on 4 February, brought no agreement on the level of contamination above which decontamination would be required. Relations were friendly, but the Danes held to their "tough" policy. They were anxious to work jointly with the U.S. scientists in collecting samples for laboratory analysis. Colonel Jack C. Fitzpatrick, MC USA, said: "It was my distinct impression that what the Danish Group would like most is for us to promise to do a long term ((many years)) ecological study in which they could participate - this would be of academic scientific interest but

is not at all necessary nor indicated and was not mentioned at all by our group." One thing pleased the Americans, however; in their observations of the work at the crash scene, the Danes had observed that the searchers did not wear respirators. They seem to have considered this to be strong evidence that the plutonium was fixed in the ice and did not represent an inhalation hazard.<sup>71</sup> They also studied the ice cores collected from the crash scene and areas in the immediate vicinity. These examinations, plus the frequent contacts and mutual confidence built up between the two groups as a result, seems to have softened the Danes' attitude toward the eventual decontamination effort. After a 6 February meeting, the last before the majority of the Danish group returned home, they were reported to be " . . . more willing . . . to accept removal of just the impact area ice down to the water and the superficial crust of the blackened area only." They also seemed willing to accept the American position that the plutonium oxide was not an ingestion hazard, and that dilution of the plutonium in the water of the fjord would bring it far below acceptable standards for drinking water. No decision was reached regarding the extent of the cleanup; this would have to wait until the Danes discussed their findings with their government. But all in all, the Americans were confident that " . . . their general feelings and attitudes did not indicate as tough a policy on their parts as existed one week ago."<sup>72</sup>

The chief American scientist, Dr. Langham, was not at Thule to see the Danes off. On 2 February CSAF notified the Disaster Control Team that a joint Department of Defense and Atomic Energy Commission Advisory Group had been organized to examine the effects of the plutonium contamination. Langham and several others flew back to report at a meeting on 5 February.<sup>73</sup> They presented detailed briefings on the situation and their findings to date to the Advisory Group. As a result of this meeting, the Washington-based scientists agreed that no biological hazards existed as a result of the crash. Still, it was understood that as much of the debris and contamination

as was reasonably possible would have to be removed. Also, it was decided to invite the Danes to a formal meeting to discuss the situation and to arrive at a mutually agreeable solution before the spring weather made the ice unsafe.<sup>74</sup> The Danes quickly agreed to the meeting to be held in Copenhagen and proposed it begin on 15 February. Dr. Hans H. Koch, head of Denmark's AEC,\* emphasized, however, that the Danish scientists had not as yet finished their report and it would not be done prior to the meeting.<sup>75</sup> The U. S. had no objection to the date and the meeting was scheduled to begin on the fifteenth.

This meeting, like all others with the Danes, was cordial. The Danes were not inclined to make strong demands, still they remained "conservative" (as the American scientists put it) regarding the clean-up of the ice and monitoring of the ecology of the region. The U.S. was prepared to agree to clean up the surface of the ice, the crust, and loose snow in the blackened crash area. Both sides agreed that more study was needed to determine if removal of any of the ice would be necessary. The Danes seemed to expect that some areas of the ice would be removed if ice core samples revealed important amounts of trapped plutonium and fuel. The Danes did not seem to be worried about contamination of the food supply of local inhabitants, but they were interested in a joint ecological study.<sup>76</sup> At the conclusion of the two day meeting, the two groups of scientists consummated a so-called "gentleman's agreement." Dr. Carl Walske, Assistant Secretary of Defense for Atomic Energy provided its details in a message to the Secretary of State:<sup>77</sup>

a. A cleanup undertaken as good housekeeping measures.

(1) Clean the crust and loose snow within the blackened area. Remove the material to shore and contain it in some way judged safe for the present, but for eventual removal from Greenland if jointly found desirable. This involves about ten thousand cubic meters of material.

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\* Brother of Proj. Joergen Koch who headed the team of Danish scientists who first went to the site in mid-January.

(2) Examine the area in the vicinity of impact. Lay out a grid of 25 meters spacing and begin core sampling up to estimated 65 samples to determine location of oil, contamination criteria below the ice (if any) as well as near surface and in depth of ice (area is a rectangle about 200 meters forward, 100 meters back and 50 meters each side of impact).

(3) Assess the situation in the light of number 2 and remove major areas of contamination where possible and especially where oil is involved.

(4) All steps of the program are to be "best efforts" to clean up in a housekeeping sense, not necessary steps to remove a demonstrated hazard.

(5) It is anticipated that not less than 50 percent of the total contamination in the ice and snow will be removed. It is more likely that about 80 percent will be removed. If the program goes well in the field the removed amount should get in the 90-95 percent range.

b. ~~Monitoring - Surveillance of the ecological system relating to man.~~(1) 2

(1) Routes by which contamination can be introduced into the human inhabitants of the area will be kept under surveillance until there is agreement that the risk of transfer of plutonium to man is negligible. Particular attention will be given to the seals, eider duck and little auk, mussels, plankton of the bay and the local blue fox. During the dry season, the dust of the Cape Athol area and elsewhere south of the bay will be examined for resuspension of plutonium. The walrus and the off-shore migratory [migratory] species need not be considered except as special questions may be raised.

(2) The collection and sampling will be carried out according to predetermined protocols. The above monitoring program will be supported by appropriate hydrographic and bottom sampling of the bay.

Discussions between U.S. officials on the scene, at SAC Headquarters, and in Washington of course antedated the Copenhagen meeting. Alternative courses of action were examined any one or a combination of which might become necessary depending upon what level of decontamination was eventually agreed upon. On 9 February the Disaster Control Team sent to SAC five courses of action which it said " . . . may be helpful to you in developing estimate of magnitude of tasks and a plan." They are summarized as follows: <sup>723</sup>

Course of Action One: Plow snow within zero reading line into windrows, stabilize, collect and process through melting and filtration plants. Uncontaminated water separated from contaminated debris.

Course of Action Two: In addition to One above, remove ice from burn area and impact areas, melt and filter.

Course of Action Three: Remove contaminated ice and snow from area within 3000 microgram per meter squared contour. This area generally the same as burn area plus impact area. Process same as in Courses One and Two.

Course of Action Four: Stabilize snow within area bounded by zero line to prevent wind spread of contaminated particles of snow and debris; secure these areas from inadvertent entry; and wait until thaw drops the material into North Star Bay.

Course of Action Five: Merely prevent inadvertent entry into area until thaw drops material into North Star Bay.

The least acceptable decontamination effort in terms of cost and time available was one which would require removing the snow and ice, melting and filtering the water, and returning it to the bay. In this connection, Headquarters SAC examined two possibilities: (1) removal of 10 inches of snow and exposed surface ice from a three square mile area, plus all ice from a 300 foot diameter circle; convey the snow and ice to a site near the former power ship basin at Thule; melt it; filter out the contaminants; and return the water to North Star Bay; and (2) remove two inches of snow and two inches of ice from an area 160 yards by 720 yards, except a 300 foot diameter circle within this area (all ice would be removed from this 300 foot circle); melt all ice and snow; remove contaminants; and return water to North Star Bay.<sup>79</sup> It considered the first infeasible in terms of cost, availability of resources, and time (to the spring thaw). The second was feasible, although still expensive in the use of men and equipment. The command understood that the decisions of the scientists would prevail. Still, if only for the record, it provided Headquarters USAF with its position on the matter:<sup>80</sup>

"... factors of cost, other USAF priorities, availability of personnel, airlift and equipment dictate a plan such as securing the area from inadvertent entry by natives and stabilizing area by flooding contaminated material remaining after search to freeze and thereby containing it until spring break-up injects debris into sea water."

Headquarters USAF said that it did not visualize a job as extensive as the one outlined by SAC in the first of the alternatives above. But neither was it optimistic. Several days before the opening of the Copenhagen meeting it told SAC to complete plans for accomplishing the second of the alternatives above.<sup>81</sup>

As we have seen, from the Copenhagen meeting came a decision which was not the one favored by either the U.S. military or the U.S. scientists at the scene (restrict entry and await the spring thaws), but neither was it the expensive solution which, as has been mentioned above, the Air Force was already planning for. The direction was at last clear. Asked for his recommendations regarding the work ahead, Major General Hunziker said he preferred to store the contaminated snow and ice in surplus 25,000 gallon tanks and then bury them in the permafrost. This was a simple, cheap, and safe method. He also described, however, another alternative which involved shipping the tanks back to the United States during the summer season.<sup>82</sup> On 19 February Headquarters USAF notified the Disaster Control Team that the decision had been made to store the ice and snow in the 25,000 gallon tanks and eventually remove them from Greenland. This procedure seems to have been the one most consistent with the terms of the gentleman's agreement. It also had been discussed with Dr. H. Koch, and he had found it acceptable.<sup>83</sup>

Before continuing on with a description of the decontamination effort, it seems necessary to sum up what had happened on the ice from the middle of January to the middle of February. In the month since the B-52G had crashed an operations site, Camp Hunziker, had been built on the ice, and roads had been graded to connect it with Thule AB. The contaminated crash scene had been

delimited. The highest contamination readings were within the so-called burn area where the bomber hit and exploded (a black scar about 2150 feet by 470 feet oriented north and south). Some shifting of the contaminated ice and snow had occurred, but new boundaries had been identified and marked. During the month all aircraft and weapons debris, except for pieces buried in the ice, had been collected, placed in containers, removed to Thule AB, and stored in bunkers at the old munitions storage area.

With the decision now made regarding the decontamination job, Phase II of Project "Crested Ice" could begin. The basic plan prepared by the DCT staff listed the following objectives:<sup>84</sup>

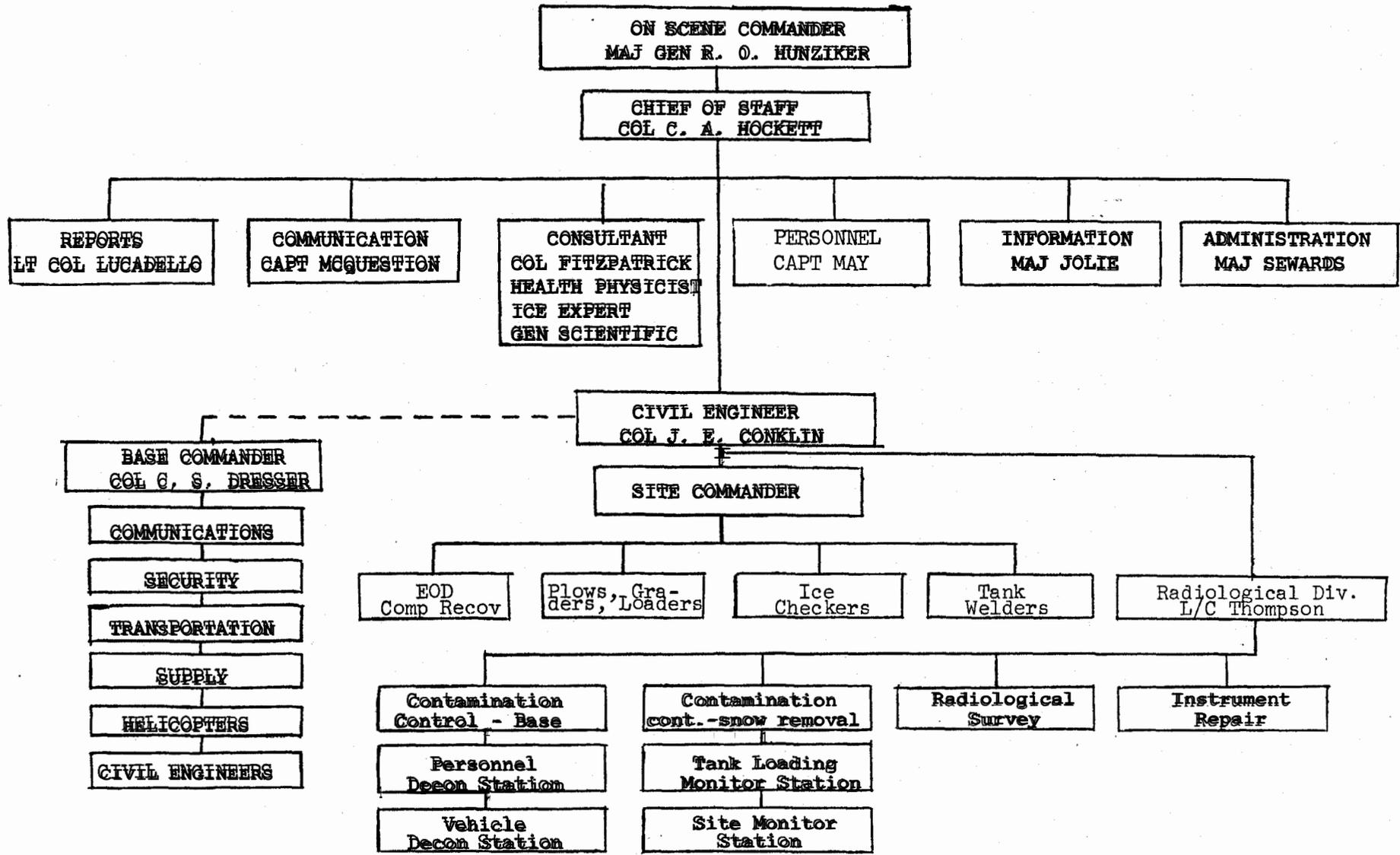
- a. Removal of contaminated ice and snow per the existing agreement between the U.S. and Danish authorities.
- b. Transporting the removed ice and snow to Thule AB.
- c. Packaging the contaminated ice and snow in suitable containers for subsequent sea shipment to a U.S. designated disposal area.
- d. Modification of surplus 25,000 gallon storage tanks to satisfy the requirements of . . . c above.
- e. Design and fabrication of any special equipment to accomplish the above tasks.
- f. Recover any weapon debris that may be uncovered during snow plowing.
- g. Continued vigilance to locate any classified documents which may be uncovered during snow plowing operations.
- h. Insure that there is no spread of contamination to Thule AB and that proper personnel and vehicular decontamination procedures are adhered to at all times.
- i. Insure that a Certificate of Decontamination is properly accomplished.

Since Phase II would be essentially a civil engineering job (involving the scraping and loading of snow and ice and its transportation to and storage at Thule AB to await shipment by water), Major General Hunziker reorganized his DCT staff accordingly. The specialist staff was reduced to four divisions: Reports, Administrative, Information, and Consultant. Major responsibility for plowing, loading,

transportation, storage, and sealing of the contaminants now fell to the Civil Engineer, Colonel J. E. Conklin (see organizational chart following).<sup>85</sup>

Although the actual cleanup of the blackened crash area did not officially begin until early March, the accumulation of equipment, the preparation of storage tanks, and the testing of techniques for removing the snow began weeks before. A trial run using a grader to scrape up the snow and crust in a portion of the blackened area was generally successful, although the blade did not loosen the crust uniformly. Because plutonium oxide can be dangerous when inhaled, the grader operators wore respirators. Air samplers inside and outside the cab recorded no contamination, however.<sup>86</sup> Meanwhile, back on base Danish nationals (employed by the Danish Construction Company) began preparing the first of 75 surplus 25,000 gallon fuel tanks to serve as containers for the contaminated snow. These tanks were moved by flatbed trucks to a hangar where they were purged of any fuel contaminants which might remain. Three holes were then cut in the top of each one and all unwanted outlets welded shut. Next, the tanks were transported once again by flatbed to a storage area on a beach 7.5 miles from the crash site and lined up to await the arrival of the snow. An average of five tanks a day were prepared and delivered between 27 February and 13 March.<sup>87</sup> To carry the snow and ice from the scene to the beach, the civil engineers used trailers pulled by 10 ton tractors. Each trailer carried two plywood boxes each with a capacity of 11 cubic yards. These boxes were fabricated by Thule AB personnel.<sup>88</sup>

Phase II of Crested Ice began officially on 3 March when graders began to work in the blackened area. They cut the snow down to a depth of about two inches and piled it into windrows. Civil engineers followed the graders to scoop up with shovels areas of discoloration missed by the blade. The windrows were also



constantly checked for radioactivity by crews with SPA-3 probes. All personnel working in the area wore respirator masks and the vehicles were equipped with air samplers. Workers also wore complete anticontamination clothing (mitten covers, mittens, coveralls, booties, and caps). At the end of each work shift all personnel passed through a decontamination station.<sup>89</sup>

In an effort to reduce the hazard of contamination, plans called for the removal operation to be performed by mechanical means as much as possible. Following the graders came belt loaders to dump the snow into the before-mentioned snow hauling boxes mounted on flatbed trailers. When the boxes were filled, a tractor pulled the trailer to a point outside the possible area of contamination. There it unhooked and returned to the snow loading area, and a "clean" tractor hooked up and hauled the snow boxes the seven and one-half miles to the loading area. On the return trip the "clean" tractor left the trailer outside the "hot area" to be picked up by one which had been used at the site.<sup>90</sup>

Blessed with good weather during the week 4-11 March, the civil engineers made good progress in cleaning up the burn area. With experience operational proficiency improved. The low temperatures continued to cause problems with the vehicles, however. The belt loaders broke down frequently, but they were replaced by front-end loaders. On 10 March 128 snow hauling boxes were delivered to the tank farm from the ice. By the end of the next day the graders had completed their first pass over the entire burn area. After this was done, six areas still showed significant readings of contamination. The graders then made more cuts to remove additional snow and thereby lower the contamination to an acceptable level.<sup>91</sup> Cleanup of the burn area was completed 15 March. In all, over 800 boxes of snow were delivered to the tank farm. On 16 March Hunziker reported 64 of the 25,000 gallon tanks filled with contaminated snow.<sup>92</sup>

It has been mentioned how the storage tanks were modified at Thule AB and transported to the off-base storage area, a beach 7.5 miles from the crash site, and set up in rows. The following sequence of events took place at the tank loading farm when the contaminated snow arrived:<sup>93</sup>

a. Each arriving tractor/trailer was positioned adjacent to the storage tank to be filled and the rigger/cleaners [Air Force personnel] proceeded to attach the crane sling and unfasten the tarpaulin cover on the dump end of the first box.

b. The box was then lifted above the tank and positioned over the hopper.

c. The box and gate was tripped and the contaminated snow and debris dumped.

d. The box was then inspected by the rigger/cleaners to insure it was empty and returned to the trailer.

e. The same steps were then repeated with the second haul box.

f. The tractor/trailer then returned to the crash site for another load.

g. Rigger/cleaner personnel used shovels and rakes to distribute evenly contaminated materials within each tank to insure maximum utilization of available volume. When a loading port was full, loading operations were moved to the second hopper which was already prepositioned over an empty loading port by the second crane. Rigger/cleaner personnel then swept down the hopper located over the loaded port and the second crane removed this hopper and placed it on an adjacent empty loading port. The exterior of the tank around a filled loading port was monitored for contamination and cleaned by brushing and sweeping as required. When cleared by a radiological monitor, the second crane replaced the lid on the filled loading port.

The final step in the loading process was for welders to seal the three tank openings to provide an air and water seal. The last tanks were sealed on 5 April. In all, 71 of the 75 tanks transported to the beach were filled (one of these only partially).<sup>94</sup>  
the beach were filled (one of these only partially).

On 18 March, three days after the cleanup of the burn area was completed, American and Danish scientists held their second and last formal meeting, this time in Washington. They reviewed progress to date, and considered what actions needed to be taken to remove the contaminated snow and to provide for a continuing program

of ecological study and surveillance of the region. At the meeting Major General Hunziker presented a report on progress of the removal operations and what was proposed for the balance of the operation.\* Dr. Wright Langham offered analyses of ice core samples taken since the 15 February scientific meeting. At the end of two days of discussions another "gentleman's agreement" was issued which detailed U.S. and Danish responsibilities during the final stages of the project: 95

1. The aircraft debris currently stored in sealed containers will be removed from Greenland as soon as convenient, possibly this summer, based on the availability of retrograde cargo.
2. Regarding the black area, the removal measures completed to date are considered adequate. The snow and ice which has been removed is stored in sealed metal containers and presents no hazard in this state. It is agreed that the contained radioactive material will be removed from Greenland as soon as convenient. The exact approach to be employed (i.e., concentration by filtration versus bulk removal) is to be the subject of detailed study by the U.S. Air Force. The recommended plan will be presented to both governments for approval prior to implementation.
3. The vehicles will be decontaminated to levels consistent with good health physics practices. It is agreed that less than  $2 \times 10^{-6}$  uc/cm<sup>2</sup> (450 CPM) as measured by a standard swipe sample) constitutes an acceptable level insofar as the tires are concerned. On the vehicle itself, a factor of 10 below this level is considered adequate.
4. The proposal to enclose the crash scene by stanchions and rope is acceptable. At an appropriate time the Danish AEG will take measures to release the hitherto restricted area for public use with the exception of this limited zone, which will continue under observation. The Danish AEG will be notified when this rope is in place.

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\* After attending the Washington meeting Major General Hunziker returned to Headquarters SAC and resumed his duties as Director of Materiel. Before he left Thule he was officially replaced by Brigadier General Albert J. Bowley, Commander of the 45th Air Division, Loring AFB, Maine, and lately President of the Accident Investigation Board. Brigadier General Bowley then supervised the terminal phases of the project. He departed on 31 March when all recovery, search, and scarifying work ended.

5. It was agreed that the U.S. Air Force would implement the suggestion to treat the 2500 square meter active region of the impact area with carbon/sand to accelerate the melting of this region. This technique will be tested on similar ice as early as possible.

6. The region outside the so-called "black area" and "cracked ice area" which is estimated to contain an insignificant part of the total Pu distributed on the ice, will be left in its present state.

7. Roads and other public areas will continue to be monitored and detected contamination will be kept to levels consistent with good health physics practices.

8. The tank farm and other restricted work areas will also be monitored and, by the conclusion of operations, contamination will be reduced to levels consistent with good health physics practices.

9. The Danish AEG will conduct an ecological program as described in the attached plan with logistic support being provided by the U.S. Air Force as required.

10. The Danish AEG will conduct surveillance of the shore lines in accordance with the attached plan. The U.S. Air Force will be available to assist as required in the removal of any discovered debris.

11. The question of a possible sea bottom search was reserved for further study of costs and utility by the U.S. Air Force. Should a search be undertaken, the results would be made available to the Danish AEG.

12. As a general policy, any of the above plans are subject to modification based on new evidence as it is collected.

13. Major policy questions will continue to be decided on the basis of Washington/Copenhagen agreement. Minor policy and detailed operational decisions will be made jointly at Thule.

Three tasks remained for the Disaster Control Team: roping off of the crash area, treatment of the ice to accelerate melting, and final decontamination of vehicles and other equipment used in the crash area.

Representatives to the March meeting had agreed that as an additional safety precaution the crash area should be roped off and warning signs posted. Civil engineers therefore erected a fence by driving steel stanchions into the ice and fastening rope to them. The fence enclosed an area 4000 feet long by 2500 feet wide.<sup>96</sup> Every 100 feet signs painted yellow and lettered in black and fastened to the rope. They warned, in the Greenlander dialect, "Tikinioga Inerter-kautauvek" ("Admittance Not Permitted") and in English "Keep Out."<sup>97</sup> Completed on 24 March,<sup>98</sup> several days later the fenced area was enlarged to give an additional margin of safety.<sup>99</sup>

Also in the interests of health and safety, the U.S. had agreed to treat the crash area (about 2500 square meters) with carbonized sand. It was hoped in this way to accelerate melting. On 21 March the DCT began by spreading a mixture of carbon and sand on a test area about 20 by 60 feet.<sup>100</sup> No melting took place during the next few weeks, however; the sun was still too low on the horizon and it was too cold.<sup>101</sup> When all DCT activity ended on 30 March the responsibility fell to the Thule base commander to apply the carbonized sand when weather conditions permitted.<sup>102</sup>

All during the "Crested Ice" operation the Radiological Division of the DCT had given careful attention to the safety of personnel working at the crash site and to the containment of contamination there and at the tank farm.<sup>103</sup> Personnel were processed through a decontamination building when they left the ice and were rechecked again upon arrival at Thule.\* The only contaminated vehicle permitted to leave the crash site was the flatbed used to haul snow and ice to the storage area; and each time before leaving it was brushed and swept

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\* Standards used were a maximum of 450 GPM for U.S. personnel as measured by PAC-1S instruments and zero level for foreign, i.e., Danish, personnel.

to remove loose contamination ((down to 1000 CPM for the flatbed and 1500 CPM for the tires)). No vehicles used to transport men and supplies back and forth between Camp Hunziker and Thule AB were permitted beyond a so-called "hazard line" at the crash site, and they were carefully monitored when they returned to Thule.

The Radiological Division began its final decontamination of vehicles prior to their return to base stocks on 14 March.<sup>104</sup>

This involved rough decontamination at the camp and then processing through one of two water and steam cleaning facilities at the base.<sup>105</sup>

In all, 144 vehicles and pieces of equipment were decontaminated. The job was finished 5 April.<sup>106</sup> One of the belt loaders used on the ice could not be decontaminated down to an acceptable level ((set at 0 CPM for removable equipment and 450 CPM for fixed equipment)). It was finally painted to fix the radioactivity, labeled radioactive waste, and placed at the tank farm to await removal from Greenland.<sup>107</sup> During

the final weeks of work the Radiological Division also monitored all buildings at Thule frequented by DCT personnel, but no significant contamination was found.<sup>108</sup>

Eight buildings used at Camp Hunziker were decontaminated by 5 April.<sup>109</sup> On that date the senior SAC Disaster Control Team Officer remaining, Colonel Walter B. Greer, informed Major General Hunziker: "I have personally reviewed the final decontamination of buildings and equipment and the procedures recommended for the continuing monitoring of the base. I am assured that SAC's decontamination responsibilities are completely met . . . ."<sup>110</sup>

On 10 April the CSAF asked the U.S. Embassy in Copenhagen to notify Danish AEC authorities that all vehicles used in the project had been decontaminated as agreed upon at the March meeting, and that 70 of 71 storage tanks had been welded shut.<sup>111</sup> One had been left open in case additional contaminated debris was discovered during periodic monitoring of the storage areas. Air Defense Command personnel at Thule had been trained to operate radiological equipment and would maintain surveillance until the tanks were removed from Greenland.<sup>112</sup>

The SAC Disaster Control Team ceased all its recovery, search, and scaring operations at 1800 local time on 30 March.<sup>113</sup> Less than 75 SAC officers and airmen remained for a week and a half longer, completing the job of decontamination. The last of them departed Thule on or about 10 April.<sup>114</sup>

Headquarters USAF gave Air Force Logistics Command the job of disposing of the radioactive waste during the summer shipping season. A task force from San Antonio Air Materiel Area went to Thule in July. It pumped the now melted contaminants from the 25,000 gallon tanks into smaller modified R-4360 engine containers. These containers had arrived earlier by ship. The tanks of liquid residue and the barrels of contaminated wreckage were then transported by ships of the Military Sea Transportation Service to the Atomic Energy Commission's facility at Savannah River, arriving there on 4 October. The AEC buried them beside the barrels of contaminated soil collected at Palomares, Spain.<sup>115</sup>

### PART III

#### Conclusion

Strategic Air Command had flown airborne alert with nuclear weapons for nine years before a B-52G crashed near Palomares, Spain, and precipitated an extensive recovery and decontamination operation. The percentages might seem to have been against a similar incident, considering that airborne alert was reduced in scope following the 17 January 1966 crash, but accidents have a way of picking their own time to happen. Two years and four days later another B-52G slashed a blazing path across the ice of Wolstenholme Fjord seven miles from Thule AB, Greenland. The two immediate effects of the accident were the cancellation of airborne alert flights with weapons and the launching of a "Palomares type" recovery operation. The prohibition of further flights affected command operations little. Plans had already been approved for the replacement of airborne alert by a new and much more flexible concept called Selective Air and Ground Alert or SEAGA

effective 1 July 1968. SAC declined to fly the indoctrination program without weapons, so except for the lone B-52 which continued to monitor the Thule BMEWS, the program became moribund. With the Palomares experience still fresh in mind, it was anticipated at once that a similar decontamination of the crash scene would have to be accomplished, this time to the satisfaction of the Government of Denmark.

The Palomares and Thule accidents were superficially similar: they both involved B-52Gs each carrying four MK 28 nuclear bombs; each required an extensive weapons recovery and decontamination effort; and in each instance the radioactive waste was shipped back to the U.S. for disposal. But despite their general similarity, the two situations were very different in detail. The Palomares accident occurred on one of the most heavily populated continents on earth. The Thule accident occurred on one of the least populated continents. Quite naturally then, public interest was more manifest during the first accident than during the second. Also, concern for the one missing bomb at Palomares kept that accident on the front page for several months. Early in the Thule investigation it became quite clear that all the bombs had been destroyed in the crash when their high explosive content detonated, and that none of the pieces of the aircraft had gone through the ice. Also, within three days after the crash public interest was at least partially diverted by the capture of the U.S. intelligence ship Pueblo. Also important was Thule's relative inaccessibility. The base was difficult to get to, the accommodations were spartan, and the climate quite inhospitable in winter. Of course the fact that public relations regarding the Thule operation were much better than they had been at Palomares, the Air Force Chief of Information, Major General W. C. Garland, called them 1000 percent better;<sup>116</sup> cannot be considered completely fortuitous. Public relations personnel had learned from the Palomares episode. The policy for release of information was determined before the newsmen arrived. A representative of the Department of Defense's Public Affairs office was present to make decisions. The few reporters who came (47 from six nations, but 25 were from U.S.)

were given every assistance and treated with candor. Press conferences brought them up to date on work at the crash site. This done, their main interest was to get some photographs and leave that icy twilight world.

In magnitude of effort, the Palomares operation was by far the greater of the two in terms of manpower and money expended. When comparing the working environment of the two crash scenes, however, the Thule recovery and cleanup must be counted as the more difficult of the two to accomplish. At the height of the operation around 800 USAF personnel were involved in the Palomares operation. This does not take into account the considerable Navy task force anchored off the coast during recovery of the missing bomb. The maximum number of personnel assigned to "Crested Ice" (SAC, ADC, and other commands) was around 500. While no definitive costs are available for either operation, some comparisons can be made. In claims alone the USAF paid over a half million dollars to Spanish citizens. The U.S. Navy presented the Air Force with a bill of \$5 million for its assistance. The historian of the Palomares operation reckons the total cost to the U.S. at about \$25 million.<sup>117</sup> Operations and Maintenance funds expended by SAC during Crested Ice totaled \$272,000.<sup>118</sup> No claims had been filed by Greenlanders to the date of the preparation of this history. Air Force Logistics Command reckoned the cost of disposing of the contaminated waste at \$998,440 (this does not include cost of transport by the Military Sea Transport Service or port handling costs, but does include the AEC costs of disposing of the contaminants).<sup>119</sup> The total cost of the operation is estimated at around \$2 million.

The Headquarters SAC Disaster Control Team dispatched to the crash scene was composed of individuals with the skills necessary to make an assessment of the situation and to determine what needed to be done. Other USAF commands and other governmental agencies responded quickly to requests from the DCT for assistance. A group of American scientists arrived to advise the control team commander

on technical and scientific matters. Perhaps their most important contribution, however, was their day-to-day working association with the Danish scientists who came to Thule. The Danes, a highly intelligent and skilled group, held all the cards, yet they chose not to be difficult or demanding. Initially, and quite understandably, cautious and conservative regarding the extent of the danger presented by the contamination, they tended to move toward the opinion of the U.S. scientists as evidence was gathered at the scene. The decontamination effort then must be considered largely as fulfilling a political responsibility and completed in the interests of what has been called "good housekeeping practices." The weapons recovery and decontamination objectives of "Crested Ice" were successfully completed well before the thaw set in at Thule; the Government of Denmark was satisfied; and despite the arctic environment, the general lack of experience in such a climate, and the existence of contamination, personnel illness, injury, and frostbite were minor and the precautions taken to control contamination were quite sufficient to prevent it from becoming a hazard to health. In all ways, "Crested Ice" must be judged a highly successful and well-managed operation.

## REFERENCE NOTES

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3. Ibid.
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5. Ltr, Brig Gen A. J. Bowley, President, Accident Investigation Board to SAC(DOSD), "Report of Major Aircraft Accident," n.d., circa 7 Feb 68, w/2 atch, (1) Distribution Table, and (2) Accident Report, Tab H, AF Form 711g; Ltr, Col C. S. Dresser, 4683 CCR to Chief SAC Disaster Control Team, "Report of Support, 4683d Air Base Group, B-52 Accident, Thule Air Base, 21 through 28 January 1968," 30 Jan 68.
6. BOJO Report, 109 B4 H2, as of 24/2107Z Jan 68.
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15. Ltr, Maj Gen A. C. Gillem, II, DCS/O, Hq SAC, to CINCSAC, "B-52 Accident Update," 22 Jan 68; Interview, R. J. Boyd, Historian, with Maj John Rasmussem, Mission Commander, 22d Tactical Recon Sq, 27/0900 (local Thule AFB) Jan 68.
16. Basic Plan, "Crested Ice Recovery Plan," 2 Feb 68.
- 17\* Taped statement of Maj Gen R. O. Hunziker, DCT Comdr, 24 Jan 68.
18. Rpt, "Hq SAC Project Crested Ice," 15 Apr 68, "Commander's Summary," pp 1, 2, 5-6; Annex G, Appendix I, "Personnel Buildup;" "Crested Ice Recovery Plan, Phase I, 2 Feb 68, pp 3-8.
19. Crested Ice Recovery Plan, Phase I, Annex A, "On-Site Camp," p 8; Interview, Robert J. Boyd, Historian, with Lt Col W. N. Turcotte, Plans and Reports Division, DCT, 26 Jan 68; Msg, 4683 ABG to CINCSAC, "Daily Report Number One," 24/0745Z Jan 68; Report, "Hq SAC Project Crested Ice," 15 Apr 68, Vol 1, Annex C, Appendix V, pp 1-2.
20. Msg, CSAF to SAC(DCT), A.S., 24/1458Z Jan 68; Interview, R. J. Boyd, Historian, with 1st Lt J. L. Thompson, Jr., 29 Jan 68; Msg, SAC DCT to CINCSAC, "Daily Report Number Two, 24 Jan 68," 25/0415Z Jan 68. Under the general supervision of Mr. Zinglensen,

the Greenlanders and their dog sleds provided valuable assistance early in the operation transporting personnel. After ice roads had been cut to the scene and a heliport installed, their services were no longer needed. Fourteen drivers, their dogs, and sleds served until 9 February. The drivers were paid \$13 a day. The Air Force also fed the dogs from its stocks of veal and horsemeat dog food. During their activity at the scene several Greenlanders picked up contamination on their clothing. Some articles could not be cleaned and had to be replaced by polar bear skins purchased from Denmark. This was the only claim made by Greenlanders against the U.S. Government as the result of the crash. (Interview, Robert Boyd, Historian, with Col C. S. Dresser, 4683 CCR, 31 Jan 68; Ltr, Col C. S. Dresser, 4683 CCR to SAC DCT, "Report of Support . . . 4 Feb through 11 February 1968," 20 Feb 68; Msg, SAC DCT to CINCSAC, "Daily Report Number Two," 24 Jan 68; Ltr, Col C. S. Dresser, 4683 CCR to IAF (CJA), "Claims Evaluation," 22 Feb 68.)

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27. Annex C, Base Support Division Report, Hq SAC, "Project Crested Ice," 15 Apr 68.

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33. Ibid., pp 2-3.
34. Msg, SAC DCT to CINCOSAC, "Situation Report #5 as of 1400Z, 28 Jan 68," 28/1945Z Jan 68.
35. Statement on tape of CMS Hadden, Team Chief, Recovery Division, 30/2030L Jan 68.
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38. Msg, SAC DCT to CINCOSAC, "Situation Report #5, as of 1400Z 28 Jan 68," 28/1945Z Jan 68.
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58. Msg, SAC DCT to AEC/ALO Sandia Base, "Eighteenth Situation Report of AEC/ALO Representative . . ." 16/0003Z Feb 68.

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60. Rpt, Project Crested Ice," Hq SAC, 15 Apr 68, Recovery Plan, Phase II, p- 3\*
61. Msg, SAC DCT to CINCSAC, n.s., 09/2210Z Feb 68.
62. Msg, AMEMBASSY Copenhagen to SecState, "Thule B-52 Crash," 23/1330Z Jan 68.
63. Msg, CSAF to SAC, "Danish Assistance in Radiobiological Survey at Thule," 23/11415Z Jan 68.
64. Msg, SAC DCT to AEC Sandia Base, "Second Report of Nuclear Accident," 24/1900Z Jan 68.
65. Msg, SAC DCT to AEC/AEO Sandia Base, "Fourth Report by Paul R. Smith, AEC/AEO," 26/1610Z Jan 68.
66. Rpt, "Project Crested Ice," 15 Apr 68, Annex I, Scientific Advisory Group, pp 5-6.
67. Ibid., p 6.
68. Rpt, "Project Crested Ice," 15 Apr 68, Commanders Summary, p 6. The exception was Otto Kofoed-Hansen, described variously as "unfriendly and difficult" and a "brilliant scientist, but erratic intellectual." He left Thule on 1 February, reportedly with a report for the Danish Government which was "damaging to U.S. interest." He was said to have concluded that the problem of contamination was very serious and that a large portion of western Greenland and its adjacent waters were endangered. While Kofoed-Hansen must have caused the Americans at Thule some anxious moments, it is clear from the attitude of his fellow Danes and the character of subsequent joint agreements, that his opinion was a minority of one. (Rpt, "Project Crested Ice," 15 Apr 68, Annex I, Scientific Advisory Group Rpt, p 4; Msg, SAC DCT to DepState, "B-52 Crash (Project Crested Ice)," 02/2230Z Feb 68.)
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82. Msg, CSAF to SAC DCT, n.s., 19/2304Z Feb 68. This message discusses telecon between Gen Hunziker, Dr. Carl Walske (OSD Atomic Energy), and Maj Gen Otto Glasser (Asst. DCS/R&D, USAF).
83. Ibid.
84. Rpt, "Project Crested Ice," Basic Plan, Recovery Plan Phase II, p 3.
85. Msg, SAC DCT to SAC (IM), "New Organization Structure of the DCT," 26/1852Z Feb 68; Rpt, "Project Crested Ice," 15 Apr 68, Basic Plan, Recovery Phase II, pp 3-6.
86. Msg, SAC DCT to CINCSAC, "Situation Report 325," 17/1345Z Feb 68.
87. Rpt, "Project Crested Ice," 15 Apr 68, Annex L, Civil Engineers, pp 4-5.
88. Ibid., pp 3-4.
89. Msg, SAC DCT to CINCSAC, "Situation Report #41 as of 1400Z, 4 Mar 68," 04/1230Z Mar 68; Rpt, "Project Crested Ice," 15 Apr 68, Annex I, Appendix IV, Tab II, p 11.

90. Rpt, "Project Crested Ice," 15 Apr 68, Recovery Plan Phase II, p 17.
91. SAC DCT Situation Reports Nos. 41-52, in Rpt, "Project Crested Ice., 15 Apr 68, Appendix I, Commander's Summary, Daily Situation Reports, pp 4-1-4-8.
92. Msg, SAC DCT to CINCSAC, "Situation Report #53 as of 16 March 68," 16/1545Z Mar 68.
93. Rpt, "Project Crested Ice," 15 Apr 68, Annex L, Civil Engineers, pp 6-7.
94. Rpt, "Project Crested Ice," 15 Apr 68, Annex L, Civil Engineers, p 7.
95. Rpt, Hq SAC, "Project Crested Ice," 15 Apr 68, Annex I, Appendix V, "Scientific Meeting, 18-19 March 1968," pp 2-3. Article 3 of the agreement was changed slightly later after Dr. Glen Seaborg, Chairman of the AEC questioned the figures used in it. The article then read: "The vehicles will be contaminated to levels consistent with good health physics practices. It is agreed that less than about ten to the minus fifth microcuries per centimeter (450 CPM as measured by a standard swipe sample) constitutes an acceptable level insofar as the tires are concerned. On the vehicle itself, a factor of ten below this level is considered adequate." (Ltr, Hans Henrik Koch, Chairman, Executive Committee, Danish AEC, to the Honorable Dr. Carl Walske, Assistant to the Secretary of Defense (AE), n.s., 26 Mar 68; Msg, CSAF (AFSSSG) to SAC (DCG), "U.S./Danish Gentlemen's Agreement," 04/2014Z Apr 68.)
96. Rpt, "Project Crested Ice," 15 Apr 68, Annex L, Civil Engineering, p 9.
97. Msg, SAC DCT to AMEMBASSY Copenhagen, n.s., 24/1602 Mar 68; Msg, CSAF (AFSSGA/BACG) to SAC DCT, n.s., 26/1751Z Mar 68; Msg, CSAF (AFSSGA/BACG) to AMEMBASSY Copenhagen, n.s., 02/1819Z Apr 68.
98. Msg, SAC DCT to AMEMBASSY, Copenhagen, n.s., 24/1602Z Mar 68.
99. Msg, SAC DCT to CINCSAC, "Situation Report Nr. 64, as of 1400Z, 27 Mar 68," 27/1513Z Mar 68; Rpt, "Project Crested Ice," 15 Apr 68, Annex L, Civil Engineering, p 9. On 29 January Greenland authorities had closed the area around the crash site to entry by the native population. Only those sled drivers employed of the USAF were exempted. On 4 April the off-limits area was reduced to the fenced and marked area around the crash site itself. (Ltr, signed by Erling Hoegh, Chairman of Council, Claus Borneman, Acting Governor of Greenland, and Kaj B. Beck, Chairman of the local Council at Kanak, "Temporary Regulations for Thule District," 29 Jan 68; Msg, USDAO/Copenhagen to 4683d AEG, for commander SAC DCT, "Project Crested Ice," 04/1539Z Apr 68.)

100. Msg, SAC DCT to CINCSAC, "Situation Report Nr. 58 as of 1400Z, 21 Mar 68," 21/1715Z Mar 68.
101. Msg, SAC DCT to CINCSAC, "Situation Report Nr. 61 as of 1400Z, 24 Mar 68," 24/1601Z Mar 68.
102. Msg, SAC DCT to CINCSAC, "Situation Report Nr. 67, as of 1400Z, 30 Apr 68," 30.1800Z Mar 68; Rpt, "Project Crested Ice," 15 Apr 68, Commanders Summary, p 8.
103. For detail of that division's activities during Crested Ice the reader is directed to Rpt, "Project Crested Ice," 15 Apr 68, Annex B, Radiological Division (see Supplementary Documents volumes).
104. Rpt, "Project Crested Ice," 15 Apr 68, Annex B, Appendix I, p 45.
105. Rpt, "Project Crested Ice," 15 Apr 68, Commanders Summary, p 3.
106. Msg, SAC DCT to 45 AD et al., for Maj Gen Hunziker from Col Greer, n.s., 09/2145Z Apr 68.
107. Ibid.
108. Rpt, "Project Crested Ice," 15 Apr 68, Annex B, Appendix I, pp 40-54 passim.
109. Msg, SAC DCT to 45 AD et al., n.s., for Maj Gen Hunziker from Col Greer, 09/2145Z Apr 68.
110. Msg, SAC DCT to 45 AD et al., for Maj Gen Hunziker from Col Greer, n.s., 09/2145Z Apr 68.
111. Msg, CSAF to AMEMBASSY Copenhagen, n.s., 10/1834Z Apr 68.
112. Ibid.
113. Msg, Hq SAC DCT to CINCSAC, "Situation Report #67, as of 1400Z, 30 Mar 68," 30/1800Z Mar 68; Msg, Hq SAC DCT to CINCSAC, "Situation Report #68, as of 1400Z, 31 Mar 68," 31/1700Z Mar 68.
114. Msg, SAC DCT to 45 AF et al., for Maj Gen Hunziker from Col Greer, n.s., 09/2145Z Apr 68.
115. The detail of ALFC's part in Crested Ice is included in Project Crested Ice Radioactive Contaminant Disposal Report, prepared by Hq, San Antonio Air Materiel Area, and included in the supplementary documents volume of this history.
116. Ltr, Maj Gen W. C. Garland, Dir of Info, CSAF, to Maj Gen R. O. Hunziker, n.s., 26 Feb 68.

117. These are explained in some detail in SAC Historical Study #109, Operation Recovery, 17 January - 7 April 1966, in History and Research Division archives, Hq SAC. The total cost estimate was provided by Miss Mary Hayes, formerly historian of the Sixteenth Air Force and author of the above study.
118. SAC Operations and Maintenance costs provided to Robert M. Kipp, Historian, by Mr. M. T. Johnson, Chief of Budget Operations Division, DCS/C, Hq SAC, from his "Crested Ice" records, 25 Feb 68.
119. Section VII, "Project Crested Ice Radioactive Contaminant Disposal Report," prepared by Hq, SAAMA, Kelly AFB, Texas (report included in supplementary documents volume of this history).

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From left to right: Dr. H. Bruner and J. Wolfe of the Atomic Energy Commission; Dr. W. Langham, Los Alamos Scientific Lab; Maj Gen R. O. Hunziker, SAC Disaster Control Team; Dr. W. Carter, Assistant Secretary of Defense, San Francisco; and



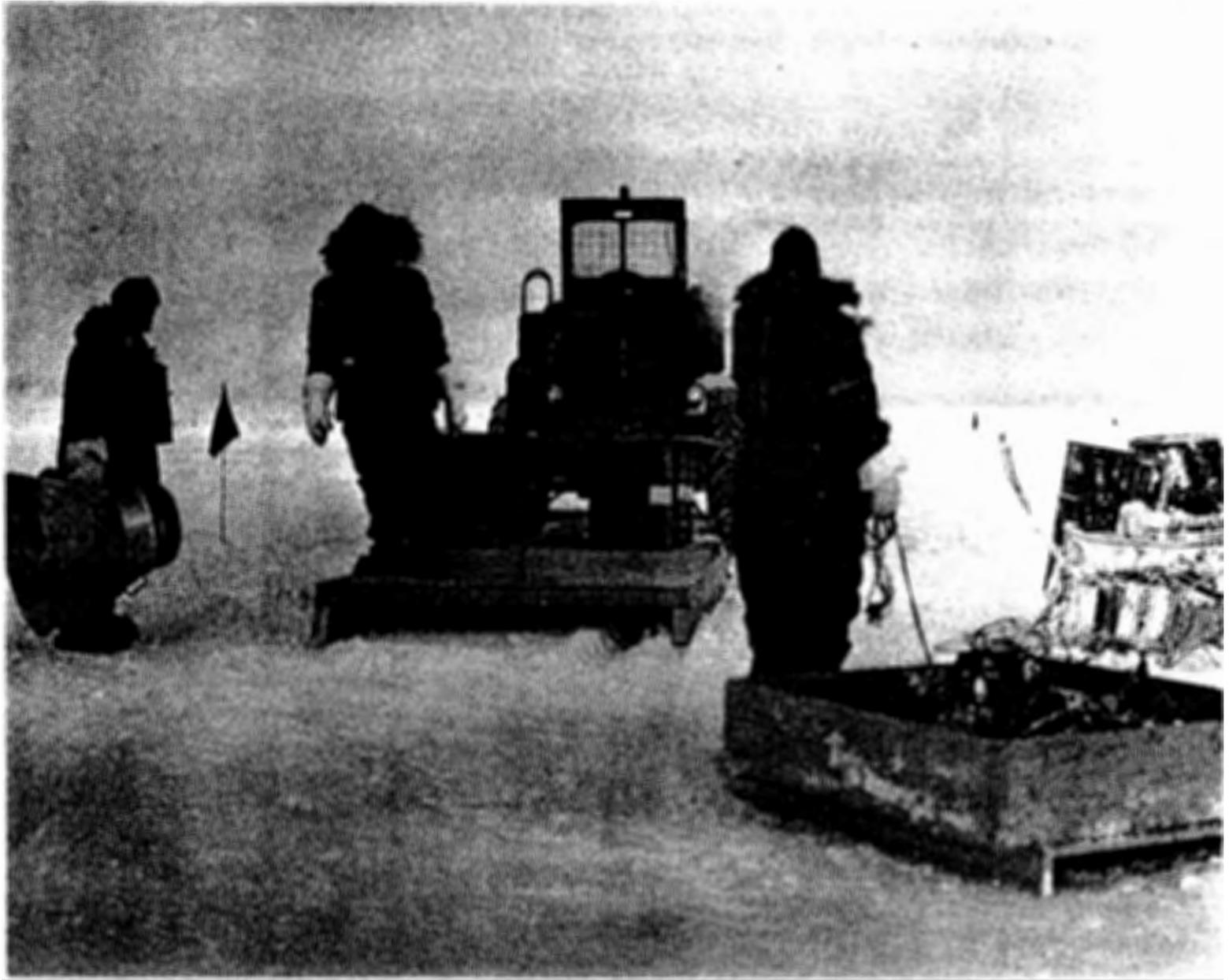
Danish newsmen accompanying U.S. Ambassador White to Manila gather outside of the Camp Hunziker command post.



**Aerial view of Camp Hunziker showing ice roads leading to site  
and ice scraping operations continuing beyond.**



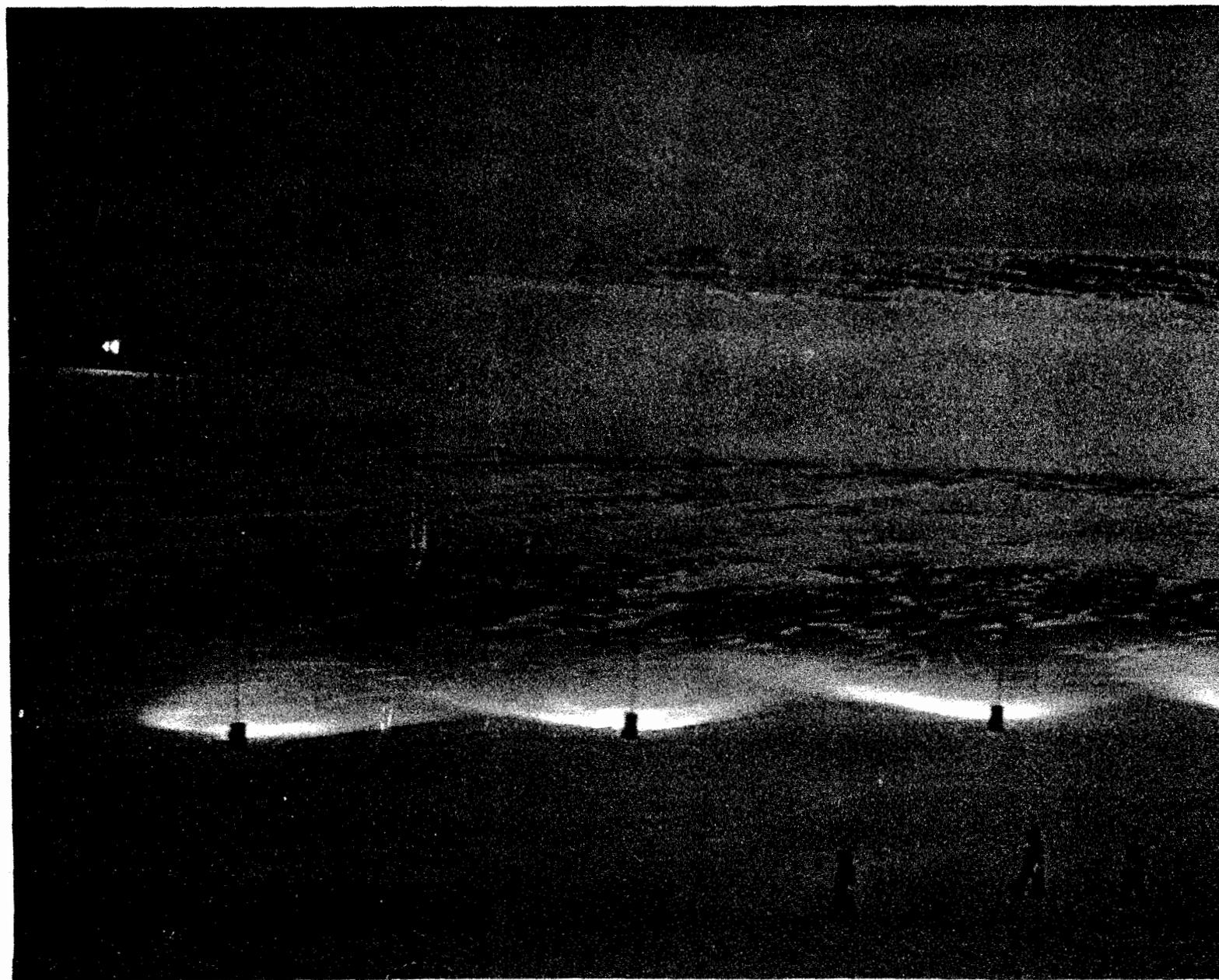
Colonel J. L. Godwin with equipment during Project Crested Ice.



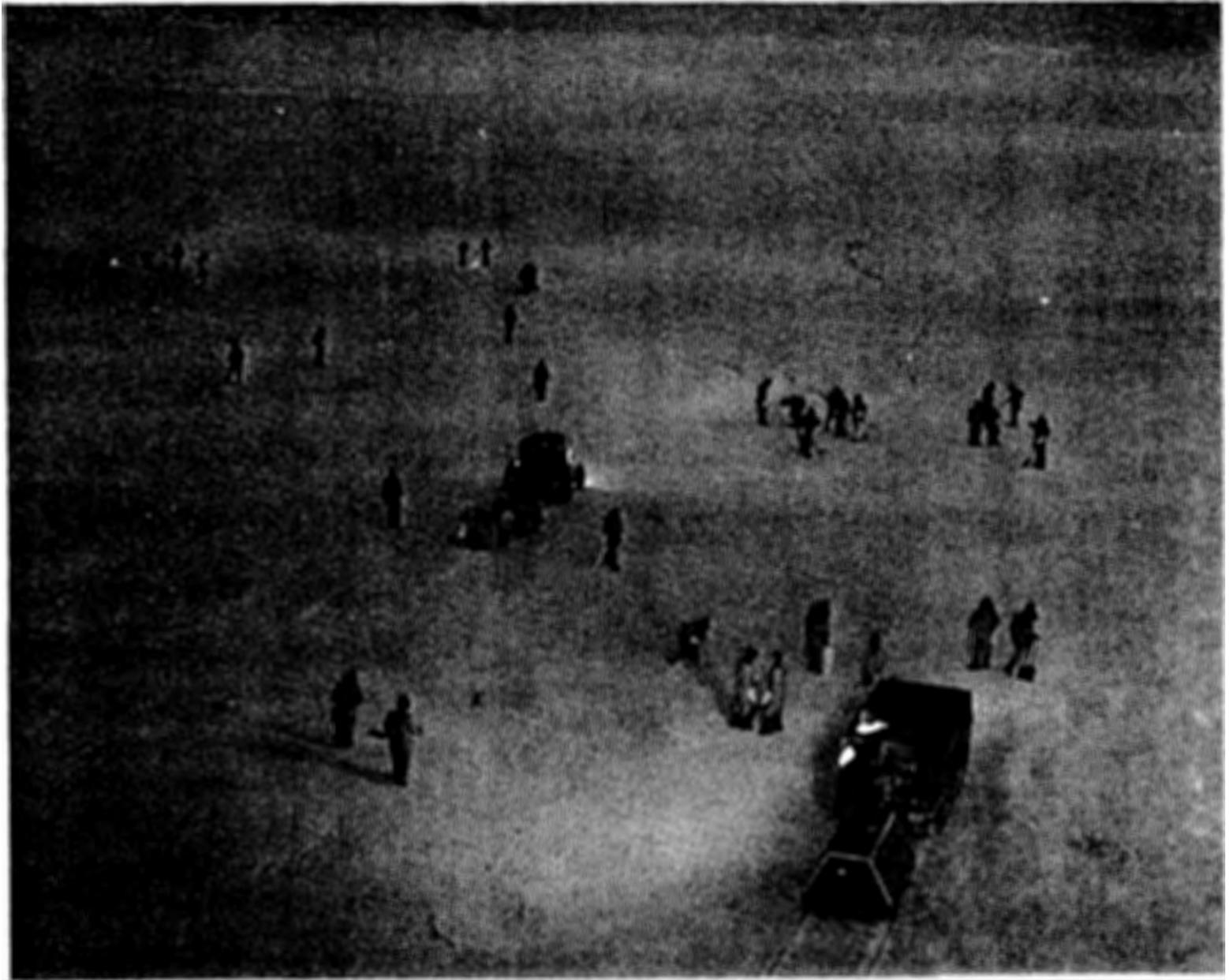
Recovery of aircraft debris. The man at the right pulls wooden sled filled with debris. The man at left carried a funnel for



Colonel J. H. Godwin with (Commander) Alvin K. Pruitt, aft. Created Ice.



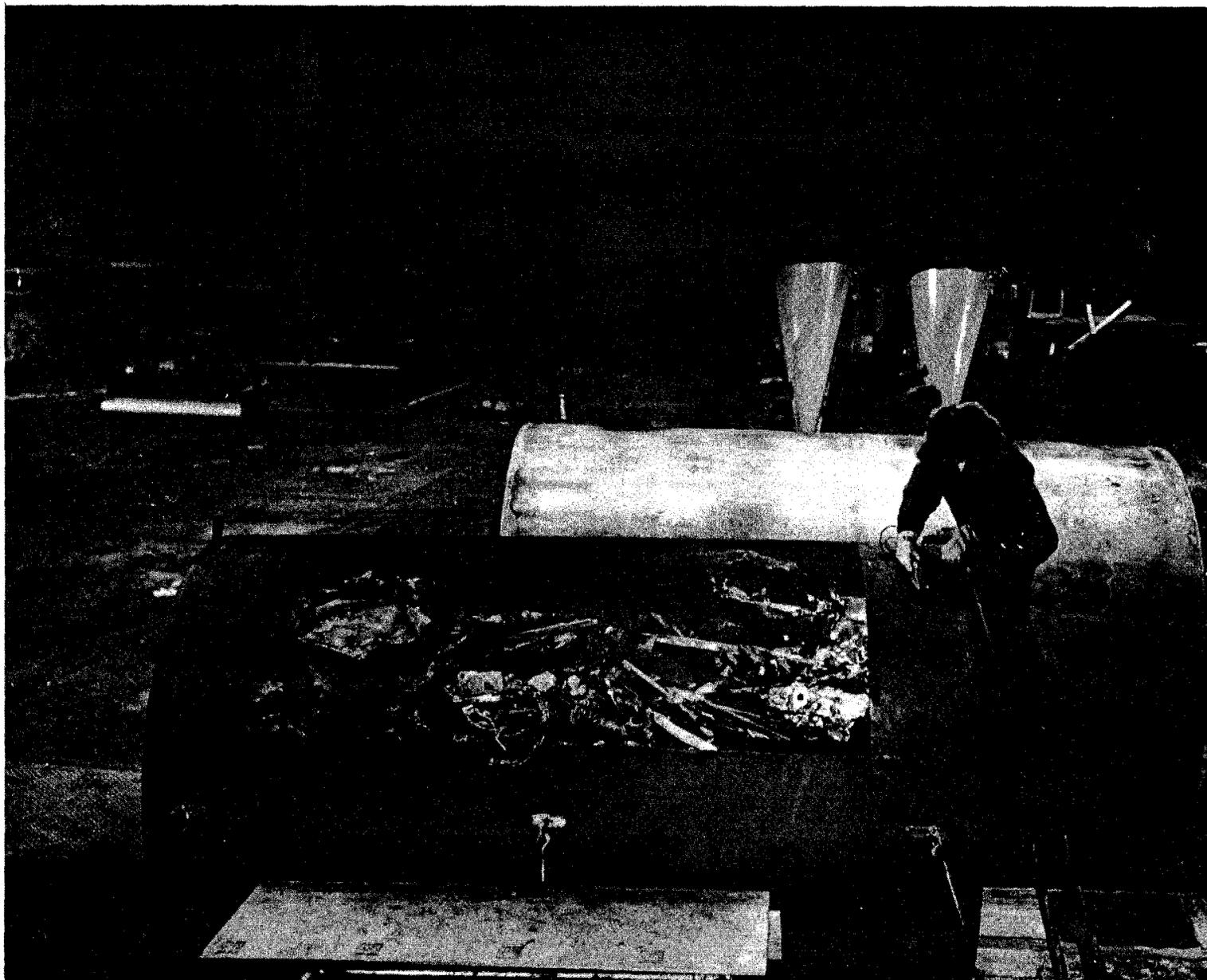
Work goes on with the assistance of artificial illumination provided by 1000-watt light bulbs mounted on ten-foot poles which were in turn embedded in concrete in 45 gallon drums.



Crews scour the ice for pieces of Junky 114. Note weasel pulls light cart which provides illumination for the search parties.



Crane loads a battered engine into a container for removal from the ice. Observing operations at the left is Colonel J. L. ...  
...commander.



Decontamination man takes a reading on a tank of debris before it is welded shut.



Weasel leads group of road graders during ice scarifying operations.



Explosive Ordnance Disposal (EOD) team chief with frost on his  
mustache.  
mustache.



Line of search personnel. "nice s bi" ← = cleaning up debris.  
White bags were used to collect small pieces. Note the parade

UNCLASSIFIED//FOR OFFICIAL USE ONLY



BOD team monitors radiation from piece of debris.



Snow loaders dumping ice and snow into wooden boxes aboard flatbed truck. Men in foreground are shoveling up contami



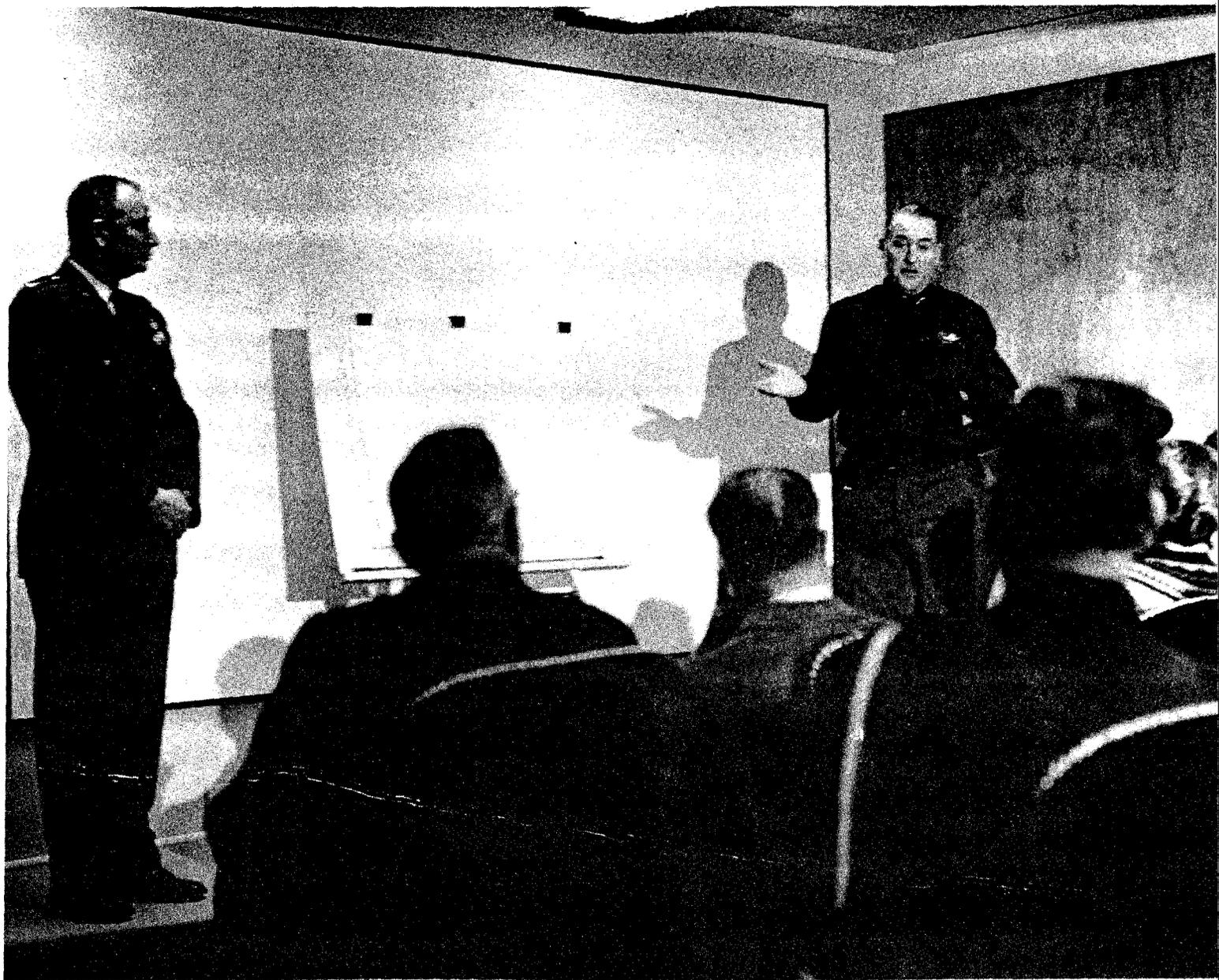
Aerial view of tank farm showing converted 25,000-gallon fuel tanks being loaded with contaminated ice and snow ((center right)).



Interior view of the Camp Hunziker decontamination center with lines of men being checked for contamination after coming in .



United States Ambassador to Denmark Katherine White (at left)  
and Mr. Hans H. Koch, Chairman of the Executive Committee of  
the Danish Atomic Energy Commission, shown on the deck of the



Major General R. O. Hunziker, commander of the SAC Disaster Control Team (at right) briefs U. S. Ambassador to Denmark Katherine White and her party on Crested Iee operations. At Major General Hunziker's right is his chief of staff. Colonel



The Honorable Katherine E. White, U. S. Ambassador to Denmark presents Mr. Jens Zinglensen with the United States Air Force's Exceptional Service Award for his services as arctic consultant to the SAC Disaster Control Team during Project Crested Ice. Award presented at Thule AB on 25 February 1968.