LA-UR- 91-1555

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investigation report

Plutonium Contamination Incident

Wednesday, October 14, 1981

[redacted]

Issued: March 1982

INVESTIGATION REPORT

of the

PLUTONIUM CONTAMINATION INCIDENT

Wednesday, October 14, 1981

UNCLASSIFIED

March 18, 1982

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List of Abbreviations

CAM	Continuous air monitor
CMB	Chemistry - Materials Science
CMR	Chemistry Metallurgy Research
cpm	counts per minute
DOE	Department of Energy
dpm	disintegrations per minute
H	Health
HPT	Health Physics Technician
PCB	polychlorinated biphenyls
SECA	State Employees Commuter Association
TA	Technical Area

I. SCOPE OF INVESTIGATION

An Investigation Board consisting of three members and a medical advisor was appointed (see Exhibit A) to investigate an incident in which plutonium was released in the CMR Building (SM-29, TA-3) at the Los Alamos National Laboratory on October 14, 1981, followed by the transport of a very small amount of plutonium beyond the Laboratory boundary. The Board was required to determine the causes of the occurrence and to make recommendations for appropriate corrective action to prevent or minimize similar occurrences in the future.

The investigation included a determination of the sequence of events, training of personnel, usual procedures, ameliorative action after the incident, and possible effects on the environment. Analysis of the data led to the recognition of specific procedures and requirements that need improvement.

II. SUMMARY

Ten samples contaminated with $^{238}PuO_2$ were prepared from special alloy capsules; each was placed in a glass vial, and the set of vials was placed in a metal can. The samples were submitted to the analytical chemistry group in Wing 3 of the CMR Building on August 22, 1981, for analysis. None of the containers were labeled in such a way as to clearly indicate that contamination was present. The sample originator incorrectly marked the analytical request forms "uncontaminated".

The error mentioned above was not detected and on October 14, 1981, the sample containers were opened in a laboratory where plutonium is not handled. Since contamination on the samples was not expected, and because of the density and size of the $^{238}PuO_2$ particles involved, contamination was spread to the analyst, several laboratories, a small shop, and the hands and protective clothing of several other workers before it was detected.

Several individuals left for home before the contamination was discovered at about 5:00 p.m. on Wednesday, October 14, 1981. One of

these failed to check himself for contamination using a readily available instrument, as is required, and spread a small amount of radioactive contamination to a vehicle and two homes.

The people who found themselves contaminated remained in the contaminated area and telephoned for assistance. The arrival of Health Physics personnel was delayed about 30 minutes because it was at the end of the work day. Prior to the arrival of these personnel, contamination was spread to two additional rooms during self-decontamination efforts. Inadequate access control allowed several additional people, including several Health Physics personnel, to become contaminated as they entered the area.

All of the people who became contaminated in the incident were readily decontaminated except the analyst. This individual has been given chelation therapy for internal contamination and is under continuing medical surveillance. Excretion and in vivo counting data indicate that the total body burden of plutonium is about 20 nanocuries, one half the maximum permissible amount. Other people who might have become contaminated were carefully checked and no contamination was found. The vehicle and the two homes were readily decontaminated.

Ventilation stack effluents from the CMR Building are monitored continuously. Average concentrations of airborne plutonium contamination inside the stacks during the two week period after the incident were very low, amounting to about 15% of the occupational maximum permissible concentration for a 40 hour exposure. No release of radioactivity by way of the drain lines from the building was detected.

News releases were prepared and the event received nation-wide coverage.

III. FACTS

A. The Laboratory

The Los Alamos National Laboratory is operated by the University of California under contract with the Department of Energy and

is located in Los Alamos, New Mexico. Approximately 7000 persons are employed by the Laboratory. About half the effort at the Laboratory is in the area of nuclear weapons research, and the other half involves various energy research programs. The Laboratory is divided into support and technical divisions. The organization charts correct for October 14, 1981 and pertinent to the present investigation are given in Figures 1, 2, and 3.

B. Background and Description

1. Facilities

The CMR Building (Bldg. 29, TA-3) has been occupied since 1952 by groups doing research, development, and analysis in chemistry and metallurgy. The building is located inside a security fence and consists of eight wings arranged along either side of a spinal corridor (Figure 4). There are three floors, including the attic and basement.

The building was designed for work with plutonium and other radioactive elements. Fabric shoe covers (booties) are required in many areas of the building. These areas include all those in which material more radioactive than ^{238}U is handled. Booties are removed on leaving these areas to prevent the tracking of possible radioactive contamination into other parts of the building in case of a spill. As of October 1981, booties were not required in the Administration Wing, Wing 1, the first floor of Wing 4, or any of the attic areas. The other Wings (2, 3, 5, 7, and 9) and most of the basement, including the spinal corridor, are bootie areas. The change rooms, where individual lockers are located and where booties and other protective clothing are put on, are not bootie areas.

Normal working hours in the CMR Building are 8:00 a.m. to 12:00 noon. and 1:00 p.m. to 5:00 p.m. on weekdays. However, some individuals have arranged with their supervisors to regularly work hours different from these; 7:30 a.m. to 4:30 p.m.

is common. Other individuals find it necessary or convenient to work in the building at irregular times outside the normal working hours. The building is patrolled during non-regular hours by Laboratory Services Inspectors who check for fires, leaks, etc., and monitor the operation of certain equipment. The building is also patrolled during these hours by Mason and Hanger Protective Force Inspectors.

The plutonium contamination incident described in this report occurred on the first floor of Wing 3, so pertinent features of this wing will be described in more detail. Normal access to the wing from outside the building may be described as follows. A worker or visitor will enter the security area surrounding the building at Security Station 321, which is on the street in front of the building. At this point he will show his badge to a Protective Force Inspector for access. He will then proceed to the building, go through the front door and into the lobby where a second Inspector, at Station 322, will examine his badge. Approximately 350 people who regularly work in the building and approximately 850 others who have occasional duties in the building are allowed access on the basis of information on their badges. Other individuals are logged in after being cleared for entry by one of a number of designated employees in the building. This same procedure is used for access via the rear door at the loading dock. Access to the interior of Wing 3 (see Figure 5) is by way of door A into one of the change rooms (3100 or 3105). These rooms are furnished with clothing lockers for regular employees, showers, and wash basins. Supplies of booties and smocks are available and workers or visitors are required to put on booties before proceeding by way of door B into the working area of the wing. Exit from the wing is the reverse of that described above except that a person enters the change room by way of door C after monitoring his hands and booties with a nearby instrument. Booties are removed upon entering the change room and

either discarded down a laundry chute or stored for future use. (Similar procedures are used for the other bootie area wings.)

Occasional access to the wing was by way of Room 3143. It is also possible to access the working areas of the wing by way of the basement or by way of the door to the equipment room, Room 3195. The door between 3140 and 3142 is blocked. The doors at the west end of the central corridor of the wing are for emergency exit and are also used for getting bulky items in and out of the wing. Emergency exits are located at various places in the wing.

The working area in the Wing is approximately 18,000 square feet. The change rooms are not considered to be inside the Wing because they are not bootie areas. As shown in Figure 5, the various laboratory and office modules are arranged in four rows separated by three corridors. The two central rows are laboratories and the rows along the north and south walls are mainly offices but include some laboratories and a small shop (Room 3153). The basement and attic areas of Wing 3 will not be discussed.

Ventilation air is supplied through the ceilings and is exhausted through separate stacks for each of the four rows, by way of floor vents in the offices and shop, and by way of hoods in the laboratories. Air from the outside rows (mainly offices) is forced up the stacks without filtration. Air from the north side laboratory row is passed through two stages of M-80 prefilters, while that from the south-side laboratories is passed through an M-80 prefilter and one stage of Aerosol 95 filters. Air from all the stacks is routinely sampled and monitored for radioactivity. (The filtration systems in Wings 2, 5, and 7 were upgraded in 1974 and are very much better than

those in Wing 3. Problems with the Wing 3 ventilation system are well known and plans for up-grading are being considered.)

The sinks and drains in the Wing 3 laboratories and the shop are connected to the acid drain line which goes to the Laboratory waste treatment plant at TA-50. However, the showers, basins, and toilets in the change rooms and rest rooms are connected to a sanitary sewer line that goes to the TA-3 sewage treatment plant.

Telephones in Wing 3 are located in the three section leaders' offices, in two laboratories, and at four locations in the halls.

A Health Physics Technician (HPT), an employee of the Health Physics Group (H-1), is assigned to Wing 3. The HPT (HPT A) at the time of the incident had been working in this wing for about one year but had been reassigned and was to report to another area on October 19, 1981. The duties of the HPT include (a) surveying all laboratory modules and corridors for radioactive contamination, (b) surveying all apparatus, empty gas cylinders, etc., that are to leave the wing for non-bootie areas, (c) checking stack sampling systems, and (d) providing monitoring support for CMB-1 and Zia crafts jobs in the wing. Because these duties cover a rather large area, the HPT is sometimes difficult to find quickly. For this reason he is equipped with a radio pager.

Since H-1 provides many instruments for detecting radiation, the HPT is also responsible for checking these instruments with known sources and seeing that the instruments are properly maintained. Particular kinds of instruments will be discussed individually.

Group H-1 has installed seven continuous alpha air monitors (CAMs) in Wing 3 at locations where airborne plutonium

contamination might occur. These are Rooms 3111, 3117, 3119, 3125, 3129, and 3135, on the south side of the wing. The CAMs are set to give an audible alarm when airborne contamination reaches a preset level, usually 80% of full scale. When any CAM alarm is detected, personnel should leave the room and call an H-1 employee who will determine the cause. Occasionally false alarms occur during the night. To minimize this inconvenience, the HPT routinely sets the CAMs to the x10 scale (1/10 sensitivity) for all times outside normal working hours. Since all H-1 personnel in the CMR Building routinely work from 8:00 a.m. to 5:00 p.m., the CAMs are usually set to x10 at about 4:45 p.m. and back to x1 at about 8:15 a.m. In addition to the CAMs, fixed-head air samplers are located in some of the rooms and the filters from these are counted weekly to measure possible airborne contamination.

Eleven portable alpha survey meters are distributed among various laboratories. According to the H-1 inventory, these instruments were in Rooms 3111, 3117, 3122, 3125, 3126, 3127, 3135, and 3146 on September 30, 1981. These instruments are used for checking hands, smocks, booties, bench tops, apparatus, etc. for alpha contamination. Common complaints are that there are not enough of these instruments and sometimes they are not reliable.

Five hand and foot counters are located at various places in the wing. They are used to monitor for possible alpha contamination when individuals leave particular laboratories or the wing. These instruments are located in Rooms 3117, 3125, and 3135, and near the wing exits, outside rooms 3106 and 3109. It is noteworthy that no hand and foot counters were located in the change rooms on October 14, 1981. A common complaint about these counters is that check sources are often not provided to show that the instruments are working properly.

Instruments for detecting beta and gamma radiation are also available, but they will not be discussed here.

2. Safety in Groups CMB-1 and CMB-5

These are the two groups which were principally involved in the incident, so their safety procedures were reviewed with particular emphasis on radiation safety.

a. Training

The training given a new employee in these groups involves an orientation and indoctrination talk by the Group Leader, and a second discussion by the chairman of the group's safety committee or his designee. These talks include such topics as the general operating rules of the group, change room procedures, an orientation and guided tour of the facilities, and detailed instructions in the areas of safety, contamination control and response, and emergency procedures. CMB-1 uses a Safety Indoctrination Checklist as shown in Exhibit B, while CMB-5 uses an outline as shown in Exhibit C.

New employees are also required to attend an indoctrination session presented by one of the two H-1 Health Physics Technical Supervisors for the CMR Building. This indoctrination describes radiation, radioactivity, and working with radioactive materials. The checklist used is shown in Exhibit D.

Each employee is given a copy of the group Safety Manual and provided with an opportunity to read it. These manuals were reviewed by the Investigation Board and found to contain instructions as to what the employee should do under specified emergency conditions and contamination events within a laboratory. The manuals state or imply that response to extensive contamination may be to evacuate the wing. In CMB-1, the decision to evacuate is made

by the Group Leader, Section Leaders, Safety Committee members, or the H-1 representative, and notification is given by means of the fire alarm. In CMB-5, the decision is to be made by the senior group representative and the CMR Building control room is to be called so that notification can be given be means of the PA system. People are then to leave by the nearest exit.

The CMB-1 Safety Manual is dated September 1980 and attempts are made to update it annually. Safety meetings are held in the individual sections bimonthly.

The CMB-5 Safety Manual was issued in February 1972. However, there are many standard operating procedures for handling radioactive materials that are approved by H-1 and updated annually. In addition, a memorandum on radiation safety was issued to CMB-5 personnel in February 1977. Regularly scheduled safety meetings are not held.

b. Understanding by Employees

The Board investigated the Wing 3 CMB-1 employees' understanding of the proper response to contamination incidents. CMB-5 employees were omitted because they were not directly involved in the spread of contamination in Wing 3. Many of the approximately 45 CMB-1 persons interviewed stated that most of their understanding of safety matters is from the original indoctrination talks, the Health and Safety Manual, memoranda from the group office, and from senior co-workers. These employees can be placed into two broad general categories: those involved in operations with plutonium and those not involved with plutonium.

It appeared to the Board that most workers routinely involved in plutonium operations are trained and

experienced in many aspects of radiation monitoring, contamination control, self-monitoring, and emergency response procedures. These workers understood the CMB-1 procedures in response to a contamination event: that they were to call for assistance from co-workers and stay in place until help arrives, unless other emergency conditions exist that dictate evacuation of the area or emergency first aid measures to be taken immediately. They also understood that they are to change into clean booties and other protective clothing, to locate the source of the contamination, and to contain and clean it up.

Personnel in CMB-1 not routinely involved in handling plutonium are typically less experienced, less well-trained, and less adept in all phases of contamination control, emergency response to contamination, and self-monitoring. Several persons in this category stated that they did not always use the hand and foot monitors for self-monitoring when they exit the wing in which they work. The Board noted that many of these same people routinely handle uranium samples, including enriched uranium, and sometimes in accountable quantities. Further, many of these individuals do not consider uranium to be significantly radioactive. Several persons in each category stated that the occurrence of a contaminated bootie is not uncommon.

The response to a contaminated bootie has sometimes been simply to throw it down the used bootie chute and then leave the wing without trying to find the source of the contamination.

There appears to be no clear understanding of the proper response to various levels of bootie

contamination. Most workers in CMB-1 apparently were not aware that H-1 personnel are required to put booties and smocks with contamination levels between $5x10^2$ and $5x10^3$ counts per minute (cpm) into plastic bags before putting them down the chutes and to dispose of items with higher contamination levels as compactable radioactive waste. The incident under investigation did show that a finding of gross contamination involving many people, extensive floor areas, and several thousand cpm, did trigger the response of telling coworkers the advisability of checking their booties.

Interpretation of some of the requirements listed in the CMB-1 Health and Safety Manual is inconsistent in practice. For example, people have been observed in the laboratories without smocks, even though the Manual specifically prohibits this.

c. Responsibility for Radiological Safety

It is Laboratory policy that radiological safety is considered to be the responsibility of the operating groups, with H-1 supplying assistance and advice. The HPTs assigned to the wings survey the laboratory areas and notify the operating personnel when contaminated spots are located. The HPTs are also sometimes called upon for advice and aid in certain operations that require the presence of a monitor. The operating personnel are responsible for decontamination, but an H-1 decontamination team may be requested if group leaders and section leaders decide that it is necessary. The feeling seems to exist among some workers that if H-1 becomes involved in modest contamination events, it will be reported to the detriment of their own and the group's safety record. In practice, a Radiation Occurrence Report is prepared by H-1 only when alpha contamination levels exceed 10^4 cpm, airborne contam-

ination exceeds a prescribed level, documentation of the personnel involved is needed, or other exceptional circumstances are present.

Many H-1 personnel feel that they could be of greater service in a number of ways, especially if they were called in to help in the amelioration of an event at the earliest time, rather than later in the event sequence.

d. Inspections and Appraisals

Routine safety inspections are made in the areas occupied by CMB-1 and CMB-5. Quarterly inspections are made by an H-3 Safety Engineer accompanied by the respective group safety committee. In CMB-1, individual sections inspect their own areas bimonthly. Any deficiencies are noted and called to the attention of the group management. Follow-up to ensure that corrective action has been taken is the responsibility of the respective group safety committees. In CMB-1, a monthly safety report is distributed to each section leader, with instructions to have each employee read it.

Two safety appraisals that included groups CMB-1 and CMB-5 were made by outside committees during the year prior to October 1981.

The first was by a committee appointed by the Department of Energy Office of Military Applications, with G. C. Facer as Chairman. This group visited laboratory areas at Los Alamos on October 30 through November 7, 1980. Among the pertinent findings of this committee were that self-monitoring requirements are sometimes neglected and that the number of HPTs assigned to the CMR Building at that time seemed inadequate.

The second appraisal was conducted during January and February 1981 by a team comprised of representatives from the Health Physics (H-1), Safety (H-3), and Industrial Hygiene (H-5) groups. The general findings were that the two groups' safety training, organization, and procedures were adequate. The team did indicate the advisability of conducting periodic safety meetings to reinforce good safety practices (CMB-1). The team also recommended that supervisory safety training and routine safety training be provided for all employees (CMB-5).

e. Labeling

Appropriate labels are required on all sample containers or equipment that are taken out of the CMR Building. It is required that an H-1 HPT check the exterior surfaces for radioactive contamination and affix an appropriate tag. In the case of a container, the HPT will ask whether radioactive material is inside the container in order to use a tag of the correct color. A white tag is used for nonradioactive material with no contamination inside or outside the container. A yellow tag marked "Radioactive Material" is used if appropriate. It will be marked to indicate what radioactive material is present, the radiation level outside the container, and the fact that the external surfaces are free from removable radioactive contamination.

Checking and tagging by an HPT was not required for material transferred within the CMR Building.

Confusing or inadequate labeling of radioactive or other hazardous substances has been a serious but neglected aspect of safety procedures in the CMR Building. For example, the designation "cold inside" is commonly used on containers, although this phrase has crucially

different implications for different individuals. To experienced plutonium workers "cold inside" clearly implies that the container so labeled could be opened without encountering radioactive contamination, but that containers inside the labeled container could contain radioactive material. On the other hand, most non-plutonium workers interpreted "cold inside" literally, to mean that radioactivity would be found nowhere inside the labeled container.

Other examples of inadequate labeling have been brought to the attention of the Board. On October 14, for example, two old unlabeled samples from a desiccator were put into the trash; later this caused confusion about the possible spread of contamination since it was not known what the samples were. As a further example, the Board learned that although americium is brought into the CMR Building properly labeled and shielded, two samples (each emitting 5 Roentgen/hr) of ^{241}Am were taken from one wing of the CMR Building to another wing without labels to indicate the hazardous nature of the contents, or the radiation levels outside the containers.

3. Description of CMB-1

Group CMB-1, consisting of 101 employees in nine sections, is the Analytical and Instrumental Chemistry Group; it is responsible for performing routine and special analyses on a wide variety of samples that originate in almost every part of the Laboratory.

Three of the nine sections occupy the first floor of Wing 3. These are:

(a) The Sample Preparation Section - 6 employees.

(b) The Radiochemical Section - 10 employees.

(c) The Non-Plutonium Analysis Section - 12 employees.

In addition to the 28 people mentioned above, an HPT and a janitor are assigned to the wing.

a. The Sample Preparation Section is responsible for receiving analytical samples and the accompanying analytical request forms into CMB-1. Occasionally, however, samples will be delivered directly to the section leader or even an analyst, if the originator of the samples believes he knows who will do the analysis. This may save some time but it interferes with an orderly control of the flow of samples in the group.

Samples from programs operating under Quality Assurance (QA) standards are assigned to the appropriate sections in the group by the CMB-1 Group Leader, the CMB-1 Quality Assurance Representative or his assistant, on the basis of information on the analytical request forms. Other samples submitted to CMB-1 are assigned by the leader of the Sample Preparation Section or the Group Leader. This Section is also responsible for dividing the samples as required for analysis for different elements or compounds by different sections in CMB-1. Since many of the samples received are radioactive, much of this work is done in glove boxes.

b. The Radiochemical Section occupies the southeast portion of the wing. It deals with various radioisotopes including ^{239}Pu (1.4×10^5 disintegrations per minute, dpm, per microgram) and ^{238}Pu(3.9×10^7 dpm per microgram). This section is provided with CAMs, hand and foot counters, and portable alpha survey meters as described previously.

c. The Non-Plutonium Analysis Section works primarily on the north side of the wing. It does not deal with samples

more radioactive than enriched uranium, which undergoes about 160 dpm per microgram. Thus the north side of the wing is referred to as the "cold side" of the wing. Two portable alpha survey meters were available in this area as of September 30, 1981, in Rooms 3122 and 3126.

The Acting Section Leader of the Non-Plutonium Analysis Section was appointed October 1, 1981. Although he has been at the Laboratory nearly three years, all of this time in this section, he was still learning the details of the new position at the time of the incident. After the incident, he stated that his training prior to October 1, 1981, for the position of Section Leader had been inadequate. He was particularly bothered by the large backlog of samples to be analyzed in the section.

The Acting Section Leader is also the driver for one of the State Employees Commuter Association vans. This requires that he routinely leave work by 4:30 p.m.

4. Heat Source Development Program

Many programs in the Laboratory generate samples that are analyzed by CMB-1. The program that is pertinent to the incident discussed in this report is described below.

A compact, self-contained thermal power source is being developed. It is to provide about 4.5 watts thermal over its 8-year service life. It is fueled with 10-11 gm. of $^{238}PuO_2$ that must not be released even under severe impact. The oxide is mixed with a small amount of yttrium metal. A testing program involving many such heat sources is underway in the Space Programs Section of CMB-5, the Physical Metallurgy Group. This section is located in Wing 2 of the CMR Building. The sources are prepared by CMB-11, the Plutonium Chemistry and Metallurgy Group, using cups similar to those

shown in Figure 6. The inner and middle cups are made of an alloy of tantalum, tungsten, and hafnium, designated T111. The outer cup is made of Hastalloy C. The $^{238}PuO_2$ (53 - 500 micron size range) is put into the inner cup, covered with a shield, and the lid welded on. This, in turn, is placed into the next cup and its lid welded on, and so on, to form a triply sealed capsule.

The right-hand side of Figure 7 shows an assembled heat source before impact, while the left-hand side of the figure shows the source after an impact test.

After impact, the source is placed in a glovebox and the outer cup is peeled off. The $^{238}PuO_2$ fuel is removed by way of a rectangular hole cut in the side of the capsule. The capsule is cleaned ultrasonically to remove most of the remaining fuel; it has been estimated that no more than about 2 mg typically remain. After impact, about 2% of the PuO_2 particles are found to pass through a 5 micron screen showing that impaction produces some pulverization of the oxide particles. After the fuel is removed, the capsule is sectioned as shown in Figure 8. Impact also causes folds and wrinkles in the liner cup and some of the fuel may remain embedded as shown in Figure 9. The capsule is further sectioned to provide samples of the welds and other regions for chemical analysis. The testing program began in December 1979, and by September 30, 1981, a total of 17 heat source capsules had been tested, giving rise to 160 separate analytical samples. An additional 10 weld-test samples, also contaminated with $^{238}PuO_2$, were submitted to CMB-1. In the capsule development stage of this program, 43 noncontaminated samples of the T111 alloy were prepared. The last set of these was submitted to CMB-1 on July 14, 1980.

The metallurgist, Staff Member A, who is responsible for opening and sectioning the capsules and preparing the samples

has been in CMB-5 for more than 24 years. He has been characterized as a careful, conscientious scientist.

C. Pre-incident

The analytical samples that were ultimately responsible for the spread of plutonium contamination on October 14, 1981 were generated as part of the heat source development program described in the previous section of this report. The samples were submitted to CMB-1 on August 22, 1981. The lapse of 53 days between the submittal of the samples and the incident was so long that Staff Member A cannot remember the details of that particular set. For this reason the usual procedure followed by Staff Member A is described in the following paragraphs.

Individual samples of the alloy, cut from various parts of the heat source capsules, would be brought out of the glovebox and dropped into glass vials in such a way as to leave the outsides of the vials uncontaminated. Plastic lids would be put into place, the exterior surfaces monitored to ensure the absence of alpha contamination, and then the lids would be secured with tape. The vials would have been prelabeled with the appropriate sample numbers, but with no indication that the contents were radioactively contaminated. An appropriate set of these vials would then be put into a small plastic bag marked "hot inside" and the bag securely closed with tape. The bag would then be placed inside a metal can and the friction-fit lid taped securely. The lid of the can would be marked "cold inside" and a paper label describing the samples fastened to the outside of the can.

Accompanying the can containing the samples would be a set of standard CMB-1 forms called Analytical Request-Travelers, one for each sample analysis requested. The same forms are used for radioactive and non-radioactive samples. Examples are shown in Figures 10A and 10B. The Traveler lists the sample originator, sample number, types of analysis requested, special instructions for

the analyst, and any special hazards associated with the sample (e.g., the presence of radioactive contamination). For radioactive samples, the radioactive isotope(s) present would be listed.

It was anticipated at the beginning of the program that a large number of samples, both contaminated with ^{238}Pu and uncontaminated, would be sent to CMB-1 for analysis. In order to minimize clerical work, Staff Member A filled in blank Traveler forms in six different ways: two for nitrogen analysis, two for oxygen analysis, and two for spectroscopic analysis. One of each pair was labeled "uncontaminated" and the other "contaminated with ^{238}Pu." At the time samples from individual heat sources were prepared, the appropriate partially completed Traveler would be selected and the leading part of the sample number (the heat source number) and the date filled in. Then the Traveler would be photocopied to give a copy for each of the individual samples. Finally, each Traveler would be completed by adding the remainder of the sample designation (L-B-N, SM-D-N etc.).

After packaging the samples and preparing the Travelers as described above, Staff Member A would carry the multiply-packaged samples to the CMB-1 sample receiving area by way of the basement spinal corridor, a bootie area. The samples would be transported by Staff Member A without further monitoring or labeling by an H-1 HPT. However, whenever appropriate, Staff Member A would make a special effort to tell the person who received the samples that the samples were radioactive. Samples are not routinely monitored on receipt in the Sample Preparation Section.

On July 22, 1981, Staff Member A prepared alloy samples from two heat sources, designated 17666 and 17667. Thirteen samples were prepared from different parts of each of the heat sources: six for oxygen, five for nitrogen, and two for spectrographic analysis. The usual procedures, described above, presumably were used except that this time a serious error was made. Staff Member A accidentally

started with two partially completed Travelers, one for oxygen and one for nitrogen, each erroneously marked "uncontaminated" even though he knew these samples to be highly contaminated. The copying process then propagated this error to the Travelers for all of the samples, including the 10 for nitrogen analysis.

The 10 samples for nitrogen analysis, the 12 for oxygen analysis, and the four for spectrographic analysis were packaged in separate cans as described above. The three cans were carried to the Sample Preparation Section of CMB-1 as usual. All of these samples were contaminated. The ten for nitrogen alaysis were later shown to have been contaminated with a total of about 1.5 mg of $^{238}PuO_2$.

If Staff Member A told the person who received the samples that the samples were contaminated, this information was lost. People in the Sample Preparation Section did not notice that the message "Cold Inside" on the lid of the can might be inconsistent with the word "uncontaminated" on the Traveler.

The cans containing the samples were stored in the Sample Preparation Section and the Travelers were sent to the Quality Assurance Representative for logging and assignment. For these particular samples, the Quality Assurance Representative's assistant assigned the samples to the appropriate CMB-1 Sections on the basis of the information on the Travelers and his knowledge of where the requested analyses could best be done. The samples for spectrographic analysis and for oxygen analysis were assigned to sections where all samples are assumed to be contaminated, but the 10 samples for nitrogen analysis were assigned to the Non-Plutonium Analysis Section. This was a proper assignment because the Travelers indicated that the samples were uncontaminated. After assignment of the sample, the Traveler is to be approved by the CMB-1 Group Leader. However, he has delegated signature authority for the Travelers to the QA Representative and the QA Representative's

assistant. Copies of the Travelers were returned to Staff Member A. At this time, he did not notice that the Travelers were incorrectly marked "uncontaminated".

Previously, five sets of correctly marked uncontaminated T111 samples for nitrogen analysis had been received. Three sets were submitted between December 19, 1979 and March 28, 1980 and were assigned to the Non-Plutonium Analysis Section. Two sets were received in June and July of 1980 and assigned to the Plutonium Analysis Section and run in plutonium contaminated glove boxes. These different assignments were based on the relative workloads in the two sections.

The Travelers were sent back to the Sample Preparation Section Leader. In this case it was not necessary to divide the samples for analysis for different elements in different sections of the group. Thus the can containing the 10 samples for nitrogen analysis was taken directly to the appropriate section along with copies of the incorrectly marked Travelers. In this way ten highly contaminated samples were delivered to the Non-Plutonium Analysis Section.

D. Incident Sequence

The ten samples for nitrogen analysis were stored for 53 days because of the backlog of work in the Non-Plutonium Analysis Section. Then about October 13, 1981, the Acting Section Leader assigned the samples to his most experienced analyst because this analyst was QA certified for the analysis requested and because he was available to do the work along with other analyses.

On October 14, 1981 Staff Member B readied a combustion apparatus in Room 3111 for a different sample and began work on the T111 alloy samples in Room 3110 between 3:00 and 4:00 p.m. that day. He noted the words "cold inside" on the lid of the can and carefully checked the Travelers; these stated that the samples were uncontaminated. He opened the can on a bench top in Room 3110 and found

10 vials containing metallic fragments. The vials were individually labeled with only the sample numbers and the plastic lids were taped on. The analyst later recalled that the vials were not in a plastic bag. However, when Room 3110 was inspected after the incident an unmarked plastic bag, very similar to one that should have been used in packaging the samples, was found. Photographs of the can, the sample vials , and one of the Travelers are shown in Figures 11, 12 and 13. Contaminated alloy may be seen in some of the vials.

The alloy fragments in each vial were weighed in Room 3114. Staff Member B then worked on a few of the samples at a time. The fragments were cut into appropriately sized pieces in the shop (Room 3153) using a vise, side cutters, bolt cutters, etc. in order to get proper amounts of alloy for the analyses. The samples were taken to Room 3110 and cleaned with an acid solution for a few minutes, as requested on the Travelers. After this, the samples were dried on watch glasses and placed back into their respective vials. The vials had previously been rinsed with water and methanol, and dried in an oven in Room 3112. As Staff Member B continued to work on the individual samples, numerous trips were made between the shop in Room 3153 and the laboratory in Room 3110. During these trips, Staff Member B went through Room 3111 to check the combustion furnace but he knew of no reason to use one of the portable alpha monitors there. It is quite likely that Staff Member B also made a trip to his office, Room 3152. Staff Member B thus contaminated all the rooms mentioned and parts of the three main corridors in Wing 3.

There were twenty four people in Wing 3 after about 3:00 p.m. on October 14, 1981, all of whom could have contributed to the spread of contamination. The Investigation Board attempted to determine the approximate activities of all these people on the afternoon of October 14. The various accounts were found not to be completely consistent at every point. However, the description given below is believed to be accurate in all the important details.

The Health Physics Technician assigned to Wing 3, HPT A, performed spot checks for contamination in some of the laboratories along the south corridor between 4:00 and 4:30 p.m. No contamination was found. HPT A recalls that about 4:40 p.m., as part of his routine assignment, he reset the seven CAMs in the wing to the x10 scale, thus reducing the sensitivity and the alarm point by a factor of ten. He recalls that the lights had been turned off in Room 3111 and he did not visually check the meter reading or the strip-chart of the CAM. The audible alarm was not sounding and he concluded that there was no problem. It was not required that the strip charts be initialed when the sensitivity was changed.

At about 4:50 p.m., HPT A exited the wing via the basement spinal corridor and went to the lunch room in the basement for a can of cola to relieve a migraine headache. Between 4:50 and 5:00 p.m. no one paged him on his radio pager. He left for home at about 5:05 p.m. by way of the Administration Wing exit.

During the 3:30 to 4:15 p.m. time interval the Acting Section Leader for the Non-Plutonium Section walked through Rooms 3110 and 3111 and worked in an office, Room 3166. At about 4:15 p.m., the CMB-1 Acting Group Leader visited the Acting Section Leader in Room 3166, then the two walked to the Section Leader's office, Room 3142. The Acting Group Leader recalls checking his hands and feet using the hand and foot counter outside Room 3106. The Acting Section Leader did not monitor himself. At about 4:30 p.m., both men left Room 3142 and entered the men's change room through door C. It is to be noted that door C and the door to Room 3142 are about 15 feet from the hand and foot counter outside Room 3106. The Acting Section Leader was in a hurry because he was late for the van pool for which he is the driver. It was later determined that the Acting Section Leader was already contaminated at this time.

Between 4:45 and 4:55 p.m., several people left the wing via the change rooms. Most recalled monitoring themselves using the

hand and foot counters outside Rooms 3106 and 3109, and exiting after finding no contamination. Several, however, admitted to leaving without monitoring themselves. When monitored later in the evening, however, none of these people was found to be contaminated.

At about 4:55 p.m., several people who work in the Radiochemical Section went along the south corridor toward the Women's Change Room. All arrived at the hand and foot counter outside Room 3109 with contaminated booties. Persons in the south corridor and in the west end of the north corridor were then verbally warned of the presence of contamination in the wing. There is no CMB-1 PA system in Wing 3 or any other wings occupied by the Group. (There is a building PA system based in the control room in the Administration Wing.)

These people found that they too had contaminated booties. Technician A, an employee in the Non-Plutonium Analysis Section, went through the Men's Change Room and brought back many clean booties. Technician B, an employee in the Radiochemical Section, put on clean booties, rechecked himself, and left the wing through Rooms 3143 and 3141. He met the CMB-1 Acting Group Leader in the spinal corridor of the Building, told him of the contamination inside the wing, and left for home.

Approximately four or five other Radiochemical Section employees assumed that the contamination on their booties had come from their laboratory in the southeast part of the wing, so they decided to leave and clean up the contaminated spots the next day.

Staff Member B checked and found his protective clothing contaminated. Clean booties and smocks are not stored inside the wing, so it was necessary to go into the change room for replacements. Staff Member B entered the Men's Change Room by way of door C, threw his booties and smock down the laundry chutes, and put on clean ones. In this way the change room became contaminated.

Staff Member B then returned to the wing to look for the source of contamination.

Staff Member C, an employee in the Radiochemical Section, changed booties and entered the Men's Change Room on his way to inform the Acting Group Leader, who by this time had already entered the change room from the spinal corridor. Technician A re-entered the change room from the wing, also reported the contamination, and left to join his car pool. It was later determined that Technician A's shirt and moustache were contaminated. The Acting Group Leader then entered the wing from the change room and upon checking himself found that his booties were already contaminated. Staff Member C went to the H-1 office in the Administration Wing of the CMR Building, found it locked, went to the CMB-1 Group office across the spinal corridor from Room 3141, and phoned HPT Supervisor A, assigned to the CMR Building, at 5:15 p.m. at his home. Staff Member C then returned to the wing. At this time he did not know the extent of the contamination in the wing, so he did not turn the magnetic sign on the door to display the message "Evacuated Area - Keep Out".

Meanwhile, the people remaining in the wing gathered at the hand and foot counters and all found themselves to be contaminated.

The Acting Group Leader asked whether anyone there had notified H-1 and was told that CMR Building Health Physics Supervisor A had been called. Actually, H-1 had not been called at this time; in the confusion, two people each were sure the other had called H-1, but neither had. However, shortly after this, Staff Member C phoned H-1 from the CMB-1 Group Office, as described previously.

At about 5:15 p.m. there had been no response from H-1, so Staff Member D phoned Protective Force Station 100 and requested that they inform someone in H-1 of the problem in Wing 3. He also asked that Station 322, at the front entrance of the CMR Building,

be told to tell the H-1 people that they should start monitoring at that point. He then turned the phone over to Staff Member E who asked that a message be relayed to her husband explaining her delay. The message to H-1 and to the husband were relayed, but that regarding Station 322 was either lost, unclear, or misunderstood.

At this time, about 5:15 p.m., there were eight people in the wing with varying degrees of contamination on their hands and booties. This number was increased to nine sometime before 5:30 p.m. when Staff Member F, an employee in CMB-5, came into the wing by way of the change room to find out why his wife, a technician in the Non-Plutonium Analysis Section, had been delayed. At the time of his entry, there were no signs on the outer doors indicating that the interior of the wing was contaminated.

During this period, the activity peak on the strip chart (Figure 14) on the CAM in Room 3111 was noticed by at least two people.

Various people made unsuccessful attempts to remove contamination from their hands in the rest rooms (Rooms 3106 and 3109). It is probable that this is how these rooms became contaminated.

Paper from a roll was laid on the floor leading to door C of the Men's Change Room so that people could exit without recontaminating themselves. This was unsuccessful because much of this work was done by Staff Member B, who, it was later learned, was the most highly contaminated person present.

At about 5:35 p.m., the Acting Group Leader telephoned the H-1 Associate Group Leader in charge of the Chemistry Health Physics Section at his home to stress the seriousness of the contamination in Wing 3.

E. Post-incident Events

HPT Supervisor A for the CMR Building was the first H-1 person to be notified of the difficulty in Wing 3. The second person to be reached was the H-1 Associate Group Leader in charge of the Chemistry Health Physics Section. He was called at his home by someone apparently on the Protective Force at about 5:30 p.m. The Associate Group Leader then called other H-1 personnel and asked them to report to the CMR Building. HPT Supervisor B, who works with HPT Supervisor A, was contacted and he arrived at the CMR Building at about 5:40 p.m. His understanding was that a number of people were in Wing 3 with contaminated booties, so he picked up a portable alpha counter at the H-1 CMR Building office and entered Wing 3 via the Men's Change Room. After putting on booties and smock and picking up a bundle of clean booties, he proceeded into the wing. He found nine people standing near the hand and foot counter near the men's exit. He was warned that his hand was probably contaminated from the door he had come through. He checked his hand and found about 10^4 cpm. He made an unsuccessful attempt to phone the H-1 Associate Group Leader and then proceeded to determine the extent of the contamination. The CAM in Room 3111 was checked; the observed small rise indicated that airborne contamination was not serious. The nine people were checked and found to have extensive contamination, 10,000-20,000 cpm, on hands and clothing except for Staff Member B, who had much higher levels of contamination.

HPT Supervisor A arrived about 5 minutes after HPT Supervisor B by the same route; he also became contaminated in the change room. Attempts at decontamination of people's hands were made in the Women's Rest Room (3109). This was not very successful because that room had also become contaminated. The two HPT Supervisors did some preliminary surveying and decided that the best place to start decontaminating the people in the wing was the Women's Change Room.

At about 5:40 p.m., the CMB-1 Acting Group Leader telephoned the CMB-Division Leader to report the severe contamination incident that had occurred.

The H-1 Associate Group Leader arrived at the CMR Building about 5:50 p.m. accompanied by HPT B. They entered the wing by way of the Men's Change Room, but were sent back at the door of the wing by HPT Supervisor B. They had become contaminated, but decontaminated themselves and proceeded back to the CMR H-1 office by way of the spinal corridor. They used a floor monitor that had been left in the corridor, to check the floor as they went. Since sufficient decontamination supplies were not available in Wing 3, some of these were picked up, together with additional monitoring instruments that were required. On the way back to Wing 3, the H-1 Associate Group Leader phoned the H-1 Deputy Group Leader from the CMB-1 Group office. HPT B sealed the entrance to Wing 3 from the spinal corridor and continued to check that corridor for contamination. Two small spots were found and covered with masking tape. Sometime after 7:00 p.m., the entrance to the spinal corridor from the Administration Wing was cordoned off.

Meanwhile, the HPT supervisors had set up decontamination stations in the Women's Change Room. Decontamination involved scrubbing, showering, and checking. The H-1 Associate Group Leader closed off the Men's Change Room and then helped with the decontamination. Soon after this, HPT Supervisor C and HPT's C and D arrived to help. HPT Supervisor A went to search for more decontamination supplies and to seal the attic and basement entrances to the wing.

Another person in addition to those described above became slightly contaminated. Staff Member G, employed in the Spectroscopy Section of CMB-1, had spent most of the afternoon in Room 3143, a nonbootie area, working at a computer terminal. At about 6:30 p.m. when he was ready to leave, he was warned from within the wing to check his hands and feet for contamination. He did this using a floor counter in the spinal corridor of the building. His hands and shoes were contaminated so he was directed to the Women's Change

Room where he was easily decontaminated using soap, water, and paper towels.

The contaminated individuals were decontaminated approximately in order of their degree of contamination, except the CMB-1 Acting Group Leader was given priority so that he could make necessary phone calls. With the exception of Staff Member B and Staff Member H, all the people were decontaminated with relative ease. Difficulty was encountered in decontaminating Staff Member H's hands. About 10^3 cpm remained after more than ten washings with special decontamination soap, so she was released with "fixed" contamination on her hands. However, when her hands were checked three days later, they were found to be uncontaminated.

Clothing was monitored and some contamination was removed by applying and then stripping off pieces of masking tape. The monitoring of clothing proved to be difficult because of the nature of the $^{238}PuO_2$ particles and the low level of contamination. In at least two instances contamination was found on places previously monitored and found uncontaminated. Contaminated clothing and personal belongings were confiscated and placed in individual plastic bags. Laboratory underwear, coveralls and tennis shoes were issued where necessary.

All people were given nose swipes before leaving. These swipes were alpha-counted in the H-1 laboratory in the CMR Building within a few minutes, in order to ascertain if internal contamination might be expected for any individual. Three people were found to have apparent contamination in just one nostril. Only Staff Member B had contamination in both nostrils sufficient to suggest internal contamination.

Staff Member B showered a great many times but at about 9:00 or 9:30 p.m. it was concluded that no further progress in decontamination was being made. At this time many parts of his body

had contamination levels in excess of 10^3 cpm, including $5x10^3$ cpm on his right heel, $6x10^3$ cpm near his mouth, average nose swipe of $4.6x10^4$ cpm, $6x10^4$ cpm on the backs of both hands, and 10^5 cpm on his right palm. The H-1 Associate Group Leader discussed the situation with his Group Leader by phone, and it was decided to take Staff Member B to the H-2 Occupational Medicine clinic where it had been arranged for him to meet H-2 Staff Physician A. This doctor discussed with Staff Member B the proposed chelation treatment. The necessary form (see Exhibit E) was signed by Staff Member B and a treatment was given. A urine sample was submitted at this time.

In order to prevent the possible spread of contamination, Staff Member B's hands were covered with cotton gloves and latex surgeon gloves, taped into place. He was then given urine and fecal sample kits and sent home, arriving at about 11:40 p.m. In addition, he was requested to bring his sheets and pillow cases to the Laboratory the next day for monitoring.

During the course of the decontamination efforts, the CMB Division Leader, the Associate Director for Technical Support and his assistant, the H-1 Deputy Group Leader, and the Laboratory Public Affairs Officer came to the CMR Building to make sure that everything was proceeding as well as possible. The Associate Director had been called about 9:00 p.m. by both the CMB Division Leader and the H-1 Group Leader. At about 10:15 p.m. the Associate Director phoned the Department of Energy, Los Alamos Area Office, Technical Programs Branch Chief to tell him of the incident.

F. Call-back of Possibly Contaminated Personnel

During the time that people from the interior of Wing 3 were being decontaminated, it was decided that all other Wing 3 employees who might have become contaminated should be recalled for monitoring. This decision was made by the CMB-1 Acting Group Leader, the CMB Division Leader, and the H-1 Associate Group Leader.

On the morning of October 15, the Acting Section Leader drove the van and his passengers to Los Alamos. He was monitored when he reported for work and found to be contaminated, about 10^3 cpm on one hand and about $6x10^3$ cpm on his beard and moustache, but a nose swipe indicated insignificant contamination. He was readily decontaminated.

The van was checked and found to be slightly contaminated on the steering wheel, gear shift knob, driver's seat and seat belt. The van was decontaminated, completely monitored and returned to the Acting Section Leader on October 19. (See Exhibit F)

G. Monitoring of Other Possibly Contaminated Personnel and Places

On the morning of October 15, it was apparent that many more people should be checked for possible contamination. These included the friend the Acting Section Leader had visited, all the van pool riders, and those who car-pooled with Technician A. All of these people, a total of twenty four, were easily located at work at the Laboratory. They and the clothing they had worn on the evening of October 14 or the morning of October 15 were carefully monitored and no contamination was found.

Permission was granted (see form shown as Exhibit G) to send a monitoring and decontamination team to the homes of the Acting Section Leader and the friend. Low level contamination was found in both places. Contaminated clothing was packaged and other contamination cleaned up. Contamination on a bathtub drain and on a dog were not completely removed until October 16.

Two other homes were checked and found not contaminated. One was that of the parents of Technician A with whom he lives. The other was that of the owner of the house in which the Acting Section Leader lives. The owner had been in the house of the Acting Section Leader on the morning of October 15.

Twenty-four people were known to have worked or have had other duties in the wing on October 14. Sixteen of these had left for home at or before 5:00 p.m., and eight had been detained by the spread of contamination. A ninth had come in about 5:15 p.m. looking for his wife. It was not readily discernible whether casual visitors, fire safety inspectors, etc. had been present because there is no access control to the wing. Apparently, the visitor log kept at Security Station 322 was not checked. It was determined, however, that Zia craftsmen had not been on jobs in the wing.

All but one of the sixteen people were contacted during the evening of October 14 and checked for possible contamination. This included one employee who learned early and indirectly of the contamination incident and came back to the CMR Building for monitoring; this person was found to be uncontaminated. Eleven of the people contacted, including the janitor assigned to the wing, were monitored between 9:15 and 10:45 p.m. at Security Station 321 outside the CMR Building. Nose swipes were taken and counted the next day, October 15. A twelfth person, Technician A, was checked at Station 321, found to be slightly contaminated and sent into the CMR Building for decontamination. His moustache was found to have 500 - 600 cpm which was easily removed by washing. About 400 cpm was found on his shirt, which was confiscated.

Two people were not contacted until after midnight, so arrangements were made for them to be checked in Espanola by an HPT who lives near there. At about 2:00 a.m. October 15, it was reported that no contamination had been found.

The Acting Section Leader, the sixteenth person, could not be reached at home in Santa Fe by phone. The phone number available in Acting Group Leader's file was apparently incorrect although the number in the secretary's file, and that posted in the Wing was correct. In a further attempt, a CMB-1 employee who lives in Santa Fe was sent to the Acting Section Leader's home, but by then he had gone to visit a friend.

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The vehicle used by the car pool in which Technician A rides was checked on October 15, and found not to be contaminated.

During the period from October 19 through December 21, all 31 persons known to have been in Wing 3 on the afternoon or evening of October 14, were counted for possible internal contamination in the H-4 In Vivo Laboratory. Included were six H-1 personnel and a fire safety inspector who had been in the wing. In addition, the friend of the Acting Section Leader was counted. The Wing-3 janitor was not included because he had not been in the wing on the afternoon of October 14.

Analysis of the in vivo counting results showed no positive amounts of internal radioactivity except for Staff Member B and one H-1 employee. The H-1 person has shown positive results since 1973, but no additional radioactivity was measured in the current test. All measurement results have been recorded according to standard procedure and are on file in the In Vivo Laboratory.

H. Further Examination and Treatment of Staff Member B.

Staff Member B, the most highly contaminated person involved in the incident, returned to the H-2 Occupational Medicine clinic on the morning of October 15. He was again carefully examined by Staff Physician A. His general condition had remained good with all vital signs normal. He showed no unexpected ill effects from the chelation treatment the previous evening. At this time he was given a second chelation treatment. He was given a third, and probably final, chelation treatment on October 19.

Many urine and fecal samples were taken for plutonium analysis. Extensive efforts were made to remove external contamination using soap and water at the time of each visit to the clinic. About a month after the incident about 200 cpm of external contamination remained in Staff Member B's hair and the inner surface of one ear.

Clinical laboratory tests were performed on blood and urine samples provided on both October 14 and October 16. His chemistry profiles remained quite normal as well as the complete blood count and ordinary urinalysis. Medical surveillance of Staff Member B will be continued for several more months.

Determinations were made on numerous urine and fecal samples after the chelation treatment had been administered. In addition, many in vivo counts were made of Staff Member B's chest, head, etc. After about three months when all external contamination was finally removed, in vivo counting showed no detectable ^{238}Pu contamination in the lungs. After this time, internal chelate concentrations were low enough to allow an interpretation of the urine assay data. The results show that Staff Member B's internal body burden will be about 20 nanocuries, one half the maximum permissible body burden.

I. Re-entry and Decontamination of Wing 3

During the morning of October 15, two health physics technicians, HPT A and HPT E, using portable, supplied air, breathing apparatus (Scott Air Paks), re-entered the wing to locate the principal source of the contamination. They located the metal samples and sample vials in Room 3110. Their survey meters gave off-scale readings when brought near the material. Later the same day Staff Member I, an employee in the Plutonium Analysis Section of CMB-1, accompanied by HPT E, returned to Room 3110. They carefully sealed the samples, including the vials, sample can, and Travelers into a series of plastic bags. The bagged material was then taken to Wing 5 and stored in a glove box used for substances containing ^{238}Pu . The photographs for Figures 11, 12 and 13 were taken through the window of this glove box.

During the morning of October 16, plans for decontaminating the wing were made and the operation was started soon after, using H-1 and CMB-1 personnel. Decontamination was continued on October 17, 19, and 20. By 3:00 p.m. on October 20, all the areas in the wing

were returned to service except Rooms 3110, 3111, 3112, 3114, 3152, and 3153. Decontamination efforts in these rooms continued over the next several weeks. The last room to be decontaminated was the shop, Room 3153. It was returned to service on November 7. It was attempted to bring the contamination levels to below 500 cpm on all accessible surfaces, but in order to resume work in the laboratories in a reasonable length of time, an absolutely complete decontamination was not possible. The H-1 Associate Group Leader and the CMB-1 Acting Group Leader attempted to explain to Wing 3 Non-Plutonium Section personnel that complete decontamination is extremely difficult and contaminated spots should be expected, even though the workers consider their side of the wing to be "cold". Some of these workers were quite upset when they found a few highly contaminated spots in their laboratories, because they thought the rooms were thoroughly rather than superficially decontaminated.

J. Related Facts and Events

In this section some miscellaneous facts are described that do not have a direct bearing on the incident investigated. They are important, however, because some contribute to an understanding of previous sections, some are related to the impact of the incident, and others indicate areas where improvements might be made.

1. Maintenance

Maintenance of the buildings and facilities in the various Technical Areas of the Laboratory, including the CMR Building, is performed by the Zia Company under contract with the DOE. This means that many Zia craftsmen, electricians, fitters, etc. have routine access to the CMR Building, as well as other security areas.

2. Security

Most physical security functions in the CMR Building and the rest of the Laboratory, are managed by the Mason and Hanger Protective Force under contract with the Laboratory. For

example, access control stations (including Stations 321, and 322) are manned where badges are checked to prevent unauthorized entry. Various security areas are patrolled during non-work hours. An additional important function of the Protective Force is manning the Communications Center, Station 100, for the Laboratory and the Los Alamos Area Office of DOE.

3. Sample Can Label

Inspection of the label on the sample can (see Figure 11) shows the expected sample designations but in addition, the name of the Plutonium Analysis Section Leader is written in red ink and obliterated with blue ink. Also the initials of the Non-Plutonium Analysis Section Leader (as of August 1981) are written at the lower right. The sample designations were written by Staff Member A, but the Investigation Board has been unable to determine who wrote the name and initials or why the name was obliterated. It appears that some confusion existed as to the assignment of the samples but the Board has been unable to find a satisfactory explanation.

4. Effluents to the Environment

Group H-1 monitored the plutonium concentrations in the four exhaust stacks from Wing 3 from October 15 through October 31, 1981. Daily releases up to 2.6 microcuries were recorded. However the total effluent from the four stacks for the 15 days was only about 13 microcuries. This is to be compared with an average of 4 microcuries per month for the preceding 10 months. Although the emission after the incident was larger than average, it should be pointed out that the 15-day average concentration of radioactive material inside the four stacks was about 3×10^{-13} microcuries per cm^3, or 15% of the maximum permissible concentration for radiation workers on a 40-hour week (2×10^{-12} microcuries per cm^3).

Since the wash basins and showers used during the decontamination of personnel are connected to the TA-3 Sewage Treatment Plant, the influent to and the effluent from that plant were checked by H-7. Plutonium concentrations above background were not detected.

5. Disposal of Possibly Contaminated Protective Clothing

On October 15, 1981, HPT Supervisor A put all the booties, smocks, towels, etc., that had been put down the laundry chutes in Wing 3 into plastic bags and had them sent for on-site burial.

Under ordinary circumstances, booties and other protective clothing from the laundry chutes are bagged, the bags are monitored and tagged, and shipped to Santa Fe to the licensed commercial laundry under contract with the Laboratory. Since under special circumstances contaminated clothing might be a possible route for off-site contamination, the Investigation Board briefly examined the procedures used by H-1 in overseeing these operations. To date there has been no known spread of contamination off-site from contaminated clothing by way of the laundry.

A discrepancy was noted, however, between a statement in the CMB-1 Health and Safety Manual and the requirements for H-1 personnel. The former states that protective clothing contaminated with as much as 2×10^4 cpm may be put directly down the laundry chutes. The latter states that laundry items with contamination levels between 5×10^2 and 5×10^3 cpm should be put into plastic bags before being put into the laundry chutes. Items with contamination in excess of 5×10^3 cpm are to be disposed of as compactable radioactive waste.

6. Costs

The costs of the incident cannot be estimated accurately. The time spent in decontaminating the laboratories and in

investigating the incident and preparing the report represent the largest costs. A total of about 2500 man-hours is a reasonable estimate, with about 58% of this for the investigation and report. The cost of equipment that could not be decontaminated was only about $1000. Decontamination supplies were estimated at $1500, and $500 was estimated for illustrations, etc. An estimated loss of $7600 is given in Item 1 1. in the report "Annual Industrial Summary of Fire and Other Property Damage Experience. 1981 CY" Reference: letter from C. I. Browne, Los Alamos National Laboratory, to H. E. Valencia, Los Alamos Area Office, U. S. Department of Energy, February 24, 1982.

7. News Release

On October 15, 1981 a news release was prepared by the Laboratory so that a prompt response could be made to queries by the news media. A copy of this release is shown as Exhibit H. This was released at 3 p.m. on October 15, 1981 to the local radio station. Subsequent queries were received and news stories about the incident have appeared in many parts of the country.

8. Emergency Telephone Numbers

The Board noted that emergency telephone numbers readily available were confusing to many of the employees interviewed. Emergency numbers that apply only to specific areas, such as Wing 3, are often listed near various telephones in those areas. The Board observed that many of these lists are incomplete, out of date, and often partially obscured with other telephone numbers.

Page ii in the Laboratory telephone directory (Exhibit I) lists four emergency numbers. The first is 9-911, the number widely used to report a fire or to request an ambulance or the police. Calls to this number are received at the Protective

Force Communications Center and relayed appropriately. The second number listed is that for the Emergency Operations Center, but apparently this center is activated only in case of a large scale emergency in which the general public might be involved. The third number, 7-7878, is to be used to request Health Division assistance for radiological, chemical, or industrial accidents. However, this number is to be used only during normal working hours. During nonworking hours, the Protective Force Station 100 number is to be called. The Station 100 number 7-4437 is also to be called in case of bomb threats, etc., and it is also used for a large amount of routine Protective Force business.

9. Beta-Gamma Radiation from the Contaminated Samples

The possible usefulness of monitoring samples received by the Sample Preparation Section was discussed by the Board. Detection of penetrating radiation would be required because it would not be practical to open all nominally nonradioactive samples at the time they are received. To check the feasibility of monitoring for penetrating radiation, a simple experiment was performed that showed that the beta-gamma radiation from the contamination on the samples involved in the present incident could be detected easily without opening the can. Staff Member I and HPT E returned the samples, vials, and can to approximately their original configuration and brought them out of the glove box in which they had been stored, into a plastic bag. The can and contents were brought up to a National Nuclear Model HM-3 beta-gamma counter which then gave a reading of 25 cpm. The background reading in the plutonium laboratory where the experiment was done was 7.5 cpm, without the can and contents. The background would have been lower in a nonplutonium laboratory. The implications of this experiment will be amplified in Section IV. The amount of ^{238}Pu on the ten samples was determined to be 1.5 ± 0.4 mg by alpha particle emission assay.

10. Additional Hazards

Additional hazards may exist within CMB-1 because samples are received which contain other potentially hazardous materials, for example beryllium and polychlorinated biphenyls (PCBs). The Board did not investigate the procedures used for receival, analysis, and disposal of these samples.

IV. ANALYSIS

This analysis presents a description of individual and group actions and conditions followed by an analysis of the management systems.

The Investigation Board identified a number of causal and contributing factors which caused and contributed to the October 14 plutonium contamination incident. The more direct and significant of these are summarized diagramatically in the Events and Causal Factors Chart, Figure 15. The Board identified several items as deficient and others where it is believed that improvements could be made.

The Board considered the contamination incident to be comprised of three major components:

1. The use of Analytical Request forms erroneously marked "uncontaminated" and the failure to use adequate labeling for samples known to be contaminated with plutonium.

2. The opening and manipulation of these contaminated samples in a nonplutonium area. This resulted in the contamination of several rooms and three corridors, and involved more than twelve persons.

3. The transportation of contamination off-site because of the failure of a contaminated individual to self-monitor. This resulted in the contamination of a commuter van, two homes, and other private property. It also resulted in adverse national publicity.

No physical or administrative barriers were required that might have detected the error described in 1, above. With respect to 2 and 3, the barriers were ineffective.

Actions of various individuals that might have prevented or minimized the incident are discussed below:

1. Had the sample originator, Staff Member A, labeled or tagged the samples or the sample container in a clear and positive manner, the incident could have been prevented.

2. The analyst, Staff Member B, knew of no reason to monitor the samples after he opened the vials, and he did not monitor his booties, hands, etc. during the working and cutting of the samples. Had he done so, using one of the available instruments, it is highly probable that the incident would have been discovered earlier, before the end of the day, before the contamination had become so widespread, and before personnel had left for home.

3. Had the Acting Section Leader monitored himself before leaving, he would have discovered that he was contaminated. The incident would then have been discovered earlier (about 4:30 p.m.) and the contamination would not have been transported off-site.

4. The Wing 3 HPT failed to detect the rise above background on the CAM in Room 3111 at about 4:30 to 4:40 p.m. when he switched the scale setting (Figure 14). However, the room lights were turned off, with only the emergency service light on, and the HPT stated that he had a migraine headache. Because of the design of the CAM, it is difficult to see the most recent portion (about the last 15 miniutes) of the strip chart. Had the HPT noticed the most recent portion of the strip chart, or the CAM meter reading, he should have been suspicious and taken steps to investigate what was occurring.

The probable result is that he would have monitored and the contamination would have been found before 5:00 p.m. Then the incident would have been less complex.

5. The extent and source of the contamination was inadequately assessed by the persons involved. They reacted to what they perceived to be a minor rather than a larger contamination event. Most of the people were unaccustomed to working with plutonium, and plutonium was not expected in their areas. The fact that the contamination became widely but erratically spread may be explained by the small particle size and the high specific activity of the plutonium dioxide involved.

6. The time of day (about 5:00 p.m.) complicated the incident in that many people were in a hurry to leave and response personnel were in transit between work and home.

Change Analysis was used to evaluate possible effects that changes may have had on this incident. The only substantive change was that the Acting Section Leader had been appointed only two weeks earlier. In addition to his supervisory duties, he was also the driver for a SECA van pool, which required him to leave work promptly at 4:30 p.m. This may have conflicted with his supervisory responsibilities, and probably contributed to his leaving without monitoring, resulting in the transportation of the contamination off-site.

Management Oversight and Risk Tree (MORT) techniques were used to evaluate the management systems which could have prevented, influenced, or mitigated the outcome of the incident, had they been in place and effective. Certain management systems were identified as deficient and others which could be substantially improved.

Management systems identified as deficient included the following:

1. Distinctly different Analytical Request forms were not required for contaminated and uncontaminated samples.

2. Proper labeling of radioactive samples was not required, and ambiguous labeling was allowed.

3. Training and supervision, especially in self-monitoring and in response to contamination of the magnitude of this incident, were less than adequate.

4. Monitoring and tagging of radioactive samples for transfer between groups and wings in the building were not required.

5. There were no barriers in place to help detect the incorrectly labeled samples or the incorrect Analytical Request forms.

Management systems which could be improved include the following:

1. Practices and procedures in place for exiting from bootie areas were less than adequate. There were no monitoring instruments in the Wing 3 change rooms. This probably contributed to the transportation of the contamination off-site. The location of monitoring instruments and other facilities near the laundry chutes could be improved. Exiting via rooms other than the change rooms was allowed.

2. Procedures in the CMB-1 Health and Safety Manual for response to a contamination event of the magnitude of this incident were:

    a. Less than adequate

    b. Not understood by the employees, and

    c. Not followed.

    The CMB-5 Health and Safety Manual could also be improved in this regard.

3. The CMB-1 Health and Safety Manual states that the proper response would have been to activate the fire alarm system.

The actual response, calling Protective Force Station 100, was more appropriate. Also it should be noted that there is no single Laboratory emergency number to call and the telephone lists near the hall telephones in Wing 3 were out of date, partially obscured, and did not list the numbers to be called for assistance.

4. Even though much more radioactivity is handled on one side of Wing 3 than the other, contamination hazards exist throughout the wing. The distinction made by employees between the "hot" side and the "cold" side of bootie area wings has not been adequately discouraged . A common attitude among workers on the so-called "cold" side is that they do not have to be as concerned about contamination and often become lax about self-monitoring of their work areas and of their hands and booties when leaving the wing. This problem also exists in Wing 5.

5. Clean protective clothing was not available within Wing 3. The Men's Change Room was probably contaminated by persons going into that room for clean clothing.

6. There were no suitable warning systems in place to prevent people from entering the contaminated wing. Five people entered the wing through the Men's Change Room and became contaminated. Station 322 did not warn the health physics personnel responding to start monitoring when they entered the building. Communication within the wing was by voice only, but in the present incident was adequate.

7. Overall, the actions of the health physics personnel who responded were adequate, but in retrospect, could be improved. Improvements could be made in the procedures for entering unknown situations, for better access control, and for obtaining decontamination supplies.

8. Management allowed an employee who supervised laboratory work to engage in an outside activity with a time constraint (leaving early to drive a SECA van) which conflicted with his work duties.

9. The receipt of incoming samples into CMB-1 could be improved:
   a. Receipt is not well controlled. Samples are received by the Sample Preparation Section, by the Section Leaders, and directly by the analysts.

   b. Other hazards may exist in that CMB-1 is also involved in the analysis of other materials that might be hazardous, for example, beryllium and polychlorinated biphenyl (PCB) samples.

10. Procedures for the disposition of protective clothing contaminated at various levels are in place but are not well understood by all employees, as evidenced by the actions of the Wing 3 personnel. CMB-1 procedures and H-1 recommendations are not in agreement regarding the proper disposition of clothing contaminated at various levels.

11. The verbal transfer of known information was less than adequate in the following ways:
   a. Information about the nature of the samples was lost, misunderstood, or not given when the sample originator delivered the samples to the Sample Preparation Section.

   b. The extent of contamination in Wing 3 was inadequately communicated to people outside the wing.

   c. The warning that the health physics personnel responding should start monitoring on the way into the CMR Building was lost.

d. The understanding was inadequate concerning the levels of contamination which could be expected in the rooms after decontamination when the rooms were accepted for use.

12. The inventory, labeling, storage, and disposal of left-over samples in the Non-Plutonium Analysis Section could be improved. This item did not have a major bearing on the incident, so the Board did not investigate it further.

13. The Sample Preparation Section is not required to monitor incoming samples for radioactivity. Had they used a beta/gamma instrument, as described in Section III J, Related Facts and Events, to monitor the sample can, the radioactivity would have been detected. Then perhaps, the error on the Travelers and the assignment of the samples to the Non-Plutonium Analysis Section would have been questioned. It should be pointed out, however, that a beta/gamma survey could not be expected to detect all contaminated samples. For example, if the contamination had been 1/10 as large, or if the Pu-238 had been recently separated from its daughters, the penetrating radiation level of the samples could be too low to detect outside the can with a portable survey instrument.

14. The present system of sample assignment does not formally take into account whether or not the samples come from an area where contaminated or radioactive samples originate.

V. CONCLUSIONS

A. Findings

1. Alloy samples contaminated with $^{238}PuO_2$ were sent from Wing 2 to Wing 3 accompanied by analytical request forms erroneously marked "uncontaminated."

2. The labels on the sample can and the individual sample vials did not clearly and positively state that contamination was present.

3. Tagging and monitoring or other methods for checking for contamination were not required or performed for transfer of the samples within the CMR Building.

4. The samples were assigned to the Non-Plutonium Section on the basis of the information on the incorrect analytical request forms.

5. The samples were opened and worked on in rooms in which plutonium should not be handled.

6. The analyst became contaminated internally, and on his face, hands, smock, and booties.

7. Contamination was spread to several other rooms and halls before it was discovered.

8. The rise on the CAM strip chart was not observed in time to minimize the incident.

9. Many people were in a hurry to leave between 4:30 and 5:00 p.m.

10. Contamination was transported off-site when one of the contaminated individuals left the laboratory area without the required self-monitoring.

11. The contamination was discovered close to 5:00 p.m., so notification of the appropriate health physics personnel was impaired.

12. Inadequate communication allowed people to enter Wing 3 and become contaminated.

13. Amelioration by the health physics personnel responding was adequate under the conditions of the incident, but could be improved.

14. Medical treatment and surveillance were begun on the only individual with internal contamination within about six hours of the incident. This was and is being done under the direction of a Laboratory staff medical doctor appropriately trained in chelate therapy treatment.

15. The externally contaminated individuals, two homes, and a van were successfully decontaminated.

16. Alpha monitoring instruments were not available in all laboratories in Wing 3. Further, the use of the available instruments was less than adequate.

17. No survey or monitoring instruments were available in the Wing 3 change rooms.

18. The transfer of known information was less than adequate:

    a. Verbal warning of the presence of contamination at the time the samples were delivered to the Sample Preparation Section;

    b. Extent of the contamination in Wing 3 to people outside the wing;

    c. Warning to Protective Force Station 322 (via Station 100), to tell responding health physics personnel to start monitoring on the way into the CMR Building; and,

    d. Levels of contamination which could be expected in the decontaminated rooms, to the workers assigned to those rooms.

19. The ventilation stacks for Wing 3 are sampled continuously. Ordinarily, the sampling filters are changed and counted every week. During the two weeks after the incident, these filters were changed and counted daily and the average concentration of plutonium was found to be only 15% of the occupational maximum permissible concentration in air. There was no detectable release of radioactive material via the sewers or the contaminated protective clothing as a result of this incident.

20. Regularly scheduled Group Safety meetings were not held in CMB-1 although section safety meetings were held bimonthly.

21. Self-monitoring in CMB-1 was not rigidly enforced or impressed on the workers.

22. The following procedures are in place but are less than adequate and/or are not well understood by the CMB-1 employees:

    a. Proper disposition of contaminated clothing; and,

    b. Proper response to a contamination incident of the magnitude of the present one.

B. Probable Causes of the Incident

1. The major causes were the accidental use of partially filled in Analytical Request forms marked "uncontaminated", inadequate labeling, and insufficient barriers to detect the errors.

2. The major cause of the transportation and spread of the contamination off-site was the failure of one individual to self-monitor before leaving Wing 3.

3. A primary contributing cause to item 1 (above) was that Analytical Request forms for contaminated and uncontaminated samples were not clearly distinguishable.

4. A primary contributing cause to item 2 (above) was the haste of the driver to meet his van pool.

5. A secondary contributing cause of item 2 was the failure to detect the contamination before it became wide-spread, because available monitoring instruments were not adequately used.

6. Another contributing cause of the incident was the lack of a requirement that material for inter-wing transfer within the CMR Building be monitored and tagged by someone other than the originator.

7. A tertiary contributing cause was the failure to detect an above background reading on a CAM.

C. Judgment of Needs

1. Require that analytical request forms for radioactive or contaminated samples be clearly distinguishable from those for nonradioactive uncontaminated samples.

Note: A practical definition of what is considered to be radioactive material is needed. A possibility would be any material with total radioactivity greater than 0.1 microcuries or any material with a specific activity greater than 10^{-7} curies per gram (that for ^{232}Th).

2. Require that all containers in which radioactive materials are stored or transported outside of glove boxes or hoods be labeled to include the statement "Contains Radioactive Material."

3. Establish improved training to ensure that all workers in potentially contaminated areas (bootie areas) in the CMR Building are convinced of the importance of self-monitoring when leaving these areas. This training must be periodically updated.

4. Improve and enforce the procedure to be followed by persons exiting bootie areas in the CMR Building.

5. Require that an unambiguous label be used in place of "Cold Inside."

6. Revise the Safety Manuals of all groups in the CMR Building that operate in bootie areas to include a discussion of the distinction between between small, routine contamination incidents and major contamination incidents, and the appropriate responses. Provide improved training and periodic retraining to assure that all workers understand the contents of their group's safety manual.

7. Improve emergency communication systems.
   a. Carefully consider the adoption of a single Laboratory-wide, all-hours emergency telephone number.

   b. Carefully consider requiring that the emergency telephone number(s) and the appropriate notification numbers be posted near every telephone in bootie areas.

   c. Carefully consider the desirability of installing warning systems such as illuminated signs, that could be activated from within bootie areas in the CMR Building.

   d. Carefully consider the establishment of a control center within the CMR Building, for example Security Station 322, for use during emergency or hazardous incidents outside normal working hours and when evacuation of the entire building is not required.

8. Carefully consider requiring that all sample containers and equipment be tagged and monitored by someone other than the originator if they are to be transferred from a bootie area in

the CMR Building to a different group in a different wing in the building.

9. Carefully consider requiring that at least one Health Physics Technician or Supervisor remain in the CMR Building 15 minutes after the end of regular working hours in order to minimize the time during which health physics personnel cannot be reached.

10. Carefully consider requiring that the strip charts on the continuous air monitors be inspected and initialed at the times the sensitivity settings are changed.

11. Carefully consider requiring that samples received by CMB-1, except those known to be radioactive, be checked for penetrating radiation.

12. Carefully consider requiring that all samples that originate in bootie areas in the CMR Building be so marked. If these samples are not labeled radioactive they should be monitored upon opening.

13. Reassess the advisability of allowing individuals who directly supervise laboratory workers to engage in outside activities that require working hours different from those of the employees they supervise.

14. Carefully consider requiring that some protective clothing, gloves, smocks, booties, etc., be maintained inside bootie area wings in the CMR Building.

VI. SIGNATURES.

This investigation was conducted and the report prepared by an Investigation Board consisting of the following:

Thomas W. Newton, Chairman
Chemical Physics and Physical Chemistry Group, CNC-2

Lewis J. Walker, Certified Investigator
Environmental Surveillance Group, H-8

P. Gary Eller, Member
Inorganic Chemistry Group, CNC-4

Dr. Samuel R. Ziegler, Occupational Medicine Group, H-2, served as Medical Advisor.

DOE F 1325.8
(7-79)

U.S. DEPARTMENT OF ENERGY

memorandum

LOS ALAMOS AREA OFFICE

DATE OCT 16 1981

REPLY TO ATTN OF LTP:AG

SUBJECT Establishment of Investigation Board

TO Charles I. Browne, ADTS
Los Alamos National Laboratory, MS 120

I hereby establish an Investigation Board to investigate the potential Type B occurrence involving an accidental release of plutonium which occurred in the Chemistry Metallurgy Facility, Building 29, Technical Area 3 at the Los Alamos National Laboratory, on October 14, 1981.

The following persons are appointed to the board in the indicated capacity:

Thomas W. Newton, CNC-2, LANL, Chairman
Lewis J. Walker (Trained Investigator), H-8, LANL, Member
Phillip G. Eller, CNC-4, LANL, Member
Dr. Samuel R. Ziegler (Medical Advisor), H-2, LANL

The board shall investigate the subject occurrence, determine the cause(s) or probable cause(s) for the occurrence and prepare and submit to me a draft written report, including recommendations for appropriate corrective action(s) to prevent or minimize similar occurrences.

The board is requested to submit their draft investigation report to me as soon as possible. The investigation is to be conducted and the report prepared in accordance with DOE Order 5484.1. Neither the report, nor any portions thereof, during its preparation, other than the facts for technical accuracy, shall be given to any persons without my approval. Five copies of the draft report shall be sent to me for coordination and review prior to its preparation in final form.

The board is assigned the authority to call on any technical or administrative assistance it may require from either the Area Office and the Los Alamos National Laboratory or The Zia Company. All three organizations shall make every effort to assist the board.

The board is to meet with me as soon as possible so that I may instruct them and provide any additional information I may have.

By copy of this memorandum, I am advising the supervisors of each of the Board Members that this assignment is full time until the investigation and report are complete. The Advisor to the Board shall assist the Board in the investigation on a priority basis and provide input to the Chairman, as required.

for Gary M. Granere
Acting Area Manager

cc:
All Committee Members
All Supervisors

Original routed to: C.I. Browne
Cy made for: J.H. Birely
Cys att'd for. C.I. Browne
D.C. Hoffman
J. Aragon/
H.S. Jordan
T.W. Newton
L.J. Walker
P.G. Eller
S.R. Ziegler

W J Waterman

Exhibit A. Letter of Appointment for the Investigation Board.

CMB-1 Safety Indoctrination

NAME:_____

1. Talk with CMB-1 Group Leader. Date:_____
2. Talk with CMB-1 Section Leader. Date:_____
3. Read CMB-1 Safety Manual. Date:_____
4. Talk with H-1 Monitor Supervisor. Date:_____
5. H-1 Short Course in Radiation Safety. Date:_____
6. CMB-1 Safety Indoctrination. Date:_____

Employee Signature:_____ Date:_____

Supervisor Signature:_____ Date:_____

Return signed form to the group office.
Dist: CMB-1 Safety Committee Chairman
File

Exhibit B. CMB-1 Safety Indoctrination Checklist.

Exhibit C. CMB-5 Safety Indoctrination Outline.

OFFICE MEMORANDUM

: R. N. R. Mulford DATE: March 18, 1975

: R. O. Elliott for the CMB-5 Safety Committee

: Required Safety Indoctrination of New Employees.

: CMB-5

New CMB-5 employees will in future betrained under a standard indoctrination program prior to working in CMB-5 laboratory areas. The program will include all persons to be working either permanently or temporarily in laboratories under the jurisdiction of CMB-5. Maintenance and service representatives from outside LASL will continue to get their instructions and indoctrination from the H-1 section office before entering CMB-5 work areas.

Members of the CMB-5 Safety Committee will conduct the indoctrination sessions and they will follow the check list below to ensure that each topic is covered:

A. Radiation hazards in CMB-5.
   1. Pu-238 and Pu-239.
   2. Neutron exposures from $^{238}PuO_2$.
   3. X-ray machines.
   4. Np, Am and other actinides.

B. Airborne Contamination.
   1. Use of face mask.
   2. Special air tests.
   3. Warning signs to keep out.
   4. Continuous air monitoring and alarm systems.

C. Protective Clothing.
   1. Requirements.
   2. Self-monitoring practices (to be emphasized).
   3. Disposal of booties and clothing when contaminated and when not contaminated.

D. Accidental "Spills".
   1. Protection of a full face mask.
   2. Don't track from room to room.
   3. Get assistance immediately; inform H-1 monitor.
   4. Locate source of contamination.
   5. Secure area with signs, tape on doors, etc.
   6. Clean-up procedures.

E. Dosimetry Practices.
   1. Film badges and TLD dosimeters.
   2. Chest count.
   3. Urinalysis.
   4. Wound counts.
   5. Skin decontamination.

F. Monitoring instruments.
   1. Locations.
   2. Demonstration.
   3. Radiation signs and tags.
   4. Equipment release requirements.

G. Storage vaults.
   1. Responsibility.
   2. Criticality safety rules.
   3. Packaging in sealed metal containers

H. Smoking and Eating.
   1. Not permitted in work areas.
   2. Offices are O. K. for smoking.

I. Emergency Plans.
   1. Wings 2 and 4, CMR Building.
   2. Wing A, Bldg 2, 10-site.

J. Each individual will be given:
   1. LA-4867 (CMB-5 Health and Safety Manual).
   2. Copy of CMB-5 Emergency Plans.
   3. Copy of CMB-5 Rules for Nuclear Criticality Safety.
   4. [illegible]

K. Each Individual will be taken on a guided tour of the CMB-5 laboratory areas.

cc: R. D. Baker, CMB-DO
S. E. Bronisz, CMB-5 Alt. Grp. Ldr.
J. Gallimore, H-1
J. A. Phoenix, H-3
Dana Rohr, CMB-5 Safety Committee
R. E. Tate, " " "
C. E. Frantz, Jr., " "
M. Barr, " " "
R. O. Elliott,

Exhibit D. Employee Health Physics Checklist.

HEALTH·SAFETY·ENVIRONMENT FORM

LOS ALAMOS SCIENTIFIC LABORATORY

EMPLOYEE HEALTH PHYSICS CHECKLIST

PERSONAL INFORMATION

(This section to be completed by employee. Please print.)

NAME _____ BIRTHDATE _____
LAST FIRST MIDDLE (MONTH/DAY/YEAR)

Z-NUMBER _____ SOCIAL SECURITY NO. _____ SEX: ☐ M ☐ F

WORK LOCATION: TA-_____ BLDG._____ ROOM _____ LAB PHONE _____

GROUP _____ MAIL STOP _____

☐ NEW HIRE Date____ ☐ REHIRE Date____ ☐ TRANSFER Date_____ From_____ To _____

☐ SHORT-TERM EMPLOYEE Approximate Termination Date_____

PREVIOUS OCCUPATION RADIATION EXPOSURE OTHER THAN LASL (New employees only) ☐ YES ☐ NO

RADIOACTIVE MATERIALS TO BE HANDLED OR SOURCES OF RADIATION EXPOSURE:

◯U– _____ ◯Pu– _____ _____ ◯Tritium _____ ◯X-Ray
Atomic wt Atomic wt Max Quantity Max Quantity

◯CTR ◯LASERS ◯FISSION PRODUCTS ◯INDUCED ACTIVITY ◯OTHERS _____
Specify

(This section to be completed jointly by H–1 and employee.)

☐ VISITOR DOSIMETRY BADGE
(Mark box NR if Not Required)

☐ PERMANENT DOSIMETRY BADGE REQUIRED ○
ISSUED ○

Radiations Expected:

○ Pu x-rays ○ Beta-gamma ○ Machine x-rays

○ Neutrons, less than 2 MeV

○ Neutrons, over 2 MeV

☐ PND Issued ○ Yes ○ No

☐ FINGER RING Issued on_____

☐ IN-VIVO COUNT for _____

☐ RESPIRATOR FITTING REQUIRED_____
(Material)

☐ HP INDOCTRINATION on _____using checklist on back of this form.

☐ INITIAL URINALYSIS KITS REQUESTED TO BE ISSUED BY_____
Date

Routine Kits to be Issued

	Type	Frequency	Requirement Code
☐	Pu	_____	_____
☐	U-235	26/year	_____
☐	U-nat or 238	26/year	_____
☐	Tritium	_____	
☐	Gamma spec	_____	
☐	Other	_____	

Kit Delivery Location:

TA-_____ BLDG____ ROOM____

REMARKS _____

SENT TO _____ DATE _____
Group Leader

RECEIVED BY _____ DATE _____
H–1 Section Leader

ORIGINAL: H–1 Records Office, MS- DATE _____

RETAIN COPY: H–1 Section Office

- ○ Dosimetry and Records, MS–692
- ○ *In vivo* Measurements, MS–888
- ○ Urine Assay Lab, MS–486
- ○ Respirator Section, MS–486
- ○ Pu Facility, MS–401

PRIVACY NOTIFICATION

"The State of California Information Practices Act of 1977 and the Federal Privacy Act of 1974 require that the Los Alamos Scientific Laboratory provide the following notification to individuals who are asked to supply personal information and their Social Security Numbers.

The Laboratory requests information on this form for administrative purposes in H–1 and H–5 groups. H-Division is responsible for maintaining the information contained on these forms.

Furnishing the requested information is voluntary, but failure to provide all or part of the information may result in denial of radiation monitoring services and entry into LASL facilities since H-Division will be unable to complete the Administrative Action and maintenance of employee radiation exposure records. The Social Security Number is used as an identifying factor.

The information furnished by you may be used by the Laboratory Staff responsible for fulfilling various radiation exposure responsibilities pursuant to DOE Contract No. W 7405 ENG 36 Modification No. 186. The information may be furnished to third parties, including State and Federal officers as required by law.

You have a right to review your own records in accordance with Laboratory policy. Information on this policy may be obtained from the H-Division Main Office."

CHECKLIST FOR HEALTH PHYSICS INDOCTRINATION

(Check off or write NR for Not Required as the indoctrination is given.)

_____ Proper use of dosimetry badges and other types of personnel dosimeters, and/or procedures for collection of urine samples.

_____ When and where individuals may find information about their own dosimetry badges and TLD readings, and urine analysis results.

_____ Requirements for and use of protective clothing, respirators, etc., as appropriate for the area where the individual will be working.

_____ Observance and description of radiation warning signs, chimes, bells, klaxons, etc., which are found in the area.

_____ A brief description of the types, intensities, and locations of radiation sources in the area where the individual will be working.

_____ The proper use of portable radiation survey instruments, if the individual will have access to or be required to use them for self-monitoring.

_____ Sorting, disposal, and control of radioactive waste, if applicable.

_____ Who to contact for Health Physics assistance.

_____ Availability and location of copies of applicable Health and Safety rules related to radiation, SOPs, etc.

_____ Reporting cuts or other injuries incurred in a radioactive contamination area.

_____ Site or building emergency plan.

_____ Other information pertinent to radiation safety in the area where the individual works, as deemed appropriate by the H–1 Section Leader or his representative who is giving the indoctrination. List topics discussed below:

INDOCTRINATION GIVEN BY _____ GROUP _____ DATE _____

INDOCTRINATION RECEIVED BY _____ GROUP _____ DATE _____

Exhibit E. Chelate Therapy Release Form.

(This form has been approved for use of noninstitutional physicians by the ORAU/ORNL Committee on Human Studies, Oak Ridge, Tennessee, and ERDA Biomedical Research Division of Safety, Standards, and Compliance.)

INFORMED CONSENT FORM

FOR USE OF Zn-DTPA, AN INVESTIGATIONAL DRUG

NAME: _____ AGE: _____ DATE: _____ TIME: _____ AM/PM

I _____, hereby request and authorize _____, M.D.
to give to _____ the drug calcium-diethylenetriamine-pentaacetic
(myself)
acid (Zn-DTPA), in an attempt to enhance the removal of _____ from my body.

I understand that I have been involved in an incident where I was exposed to radioactive _____ and have been contaminated, to some degree, by this exposure. The above named physician has consulted with me concerning this condition and has advised me that one method of treatment is the use of the drug Zn-DTPA. I understand that I may require repeated doses of this drug several times a week for up to several months depending on the level of contamination that I have experienced, should I decide to accept this method of treatment.

I understand that Zn-DTPA is an investigational drug and not available for general use. The term "investigational drug" means that the drug, Zn-DTPA, is undergoing investigation, under FDA control, to determine its effects on man. It has been explained to me that this compound has the property to bind with some heavy metals, including iron, lead, plutonium, americium, and the other heavy metals within the body and helps the body to excrete them. Some risks in taking Zn-DTPA with daily doses up to 1 gm are: possible damage to the kidney and the liver, or additional damage to those organs if they are already diseased. I understand that all risks are not known at this time. I have been fully informed of the known risks and possible consequences and understand that unforeseen results may occur. The alternative methods of treatment such as waiting for spontaneous excretion have been explained to me, and I realize that this drug (Zn-DTPA) is offered to me only after careful deliberation of Dr. _____ and his colleagues.

I am consenting to its use for the study and treatment of my condition with the understanding that the results of this treatment may not necessarily be of benefit to me. The use of Zn-DTPA in the treatment of internal radionuclide contamination is part of a national research program. I do not object if any information relating to my case is used in professional journals or medical books, or for any other purpose in the interest of medical education, knowledge, or research; provided, however, that it is specifically understood that in any such publication or use I shall not be identified in any way. I further agree that I will participate in whatever follow-up studies are deemed appropriate by my physician at whatever intervals are found suitable by the investigators. I am reserving the right to withdraw my permission at any time without prejudicing my further medical care. Dr. _____ has also offered to answer any additional questions about this drug and possible delayed effects.

Signed: _____
(Patient)

Witness: _____

The foregoing consent was read, discussed, and signed in my presence, and in my opinion the person so signing did so freely and with full knowledge and understanding.

Los Alamos

Los Alamos National Laboratory
Los Alamos New Mexico 87545

memorandum

TO File

DATE October 20, 1981

TU : Jerome Dummer, H-1 Group Leader

FROM Ron Stafford

MAIL STOP/TELEPHONE 503/7-7171

SYMBOL H-1-PF-81-151

SUBJECT SECA-6 VAN

The SECA-6 van was completely monitored on October 19, 1981 and found to be free of radioactive contamination. The vehicle was released, the keys were returned to , (Driver and Project Director on Board of Directors for SECA), at 4:30 p. m. on the above date.

RS/gw

XC: , SECA Project Director
[redacted]
H-1 CMR File
H-1 PF File

Exhibit F. Memo certifying the monitoring and release of the SECA van.

The undersigned owner of resident of _____

_____hereby authorizes entry into,

and radiological inspection of, his (her) home by personnel of

the Los Alamos National Laboratory of the University of California.

Signed:_____ Date:_____
Owner or Resident

_____ Date:_____
Laboratory Employee Requesting
Permission

Distribution:

MAT-2
H-1 Files

Exhibit G. *Authorization form for radiological inspection of a home.*

Exhibit H. Laboratory News Release.

A

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

public affairs office
news release

CONTACT: James H. Breen, Public Affairs Officer (505) 667-7000

FOR IMMEDIATE RELEASE

PLUTONIUM RELEASE AT LAB

LOS ALAMOS, N.M., October 15, 1981 -- An accidental release of plutonium occurred in the Chemistry Metallurgy Facility, Building 29, Technical Area 3 at the Los Alamos National Laboratory late Wednesday afternoon. There was no release from the facility to the atmosphere and therefore no danger to the public.

There were eighteen Laboratory employees potentially exposed to the release. All personnel have been examined by the Lab's Health Services Division. Of the eighteen, eleven received contamination. All but one of the eleven is considered to be very minor and no health problems exist. Based on ongoing medical testing it is possible that one worker has received contamination over the permissable body burden. This individual is receiving continual monitoring and medical attention. One individual who left the facility prior to the discovery of the release drove to his home in a van pool. It was later determined that he had been slightly contaminated. All members of the van pool have been checked and found not to be contaminated. The van itself had some minor contamination on the front seat and has been decontaminated. There was minor contamination found in the employee's home and this has been decontaminated.

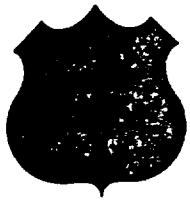
An additional four Laboratory members also received minor contamination in the monitoring process. There is no health hazard associated with these four.

The cause of the accident is being investigated at this time.

The Los Alamos National Laboratory is operated by the University of California for the Department of Energy.

Exhibit I. Page ii of the Laboratory Telephone Directory.

EMERGENCY NUMBERS

FIRE		9-911
AMBULANCE		9-911
POLICE		9-911

EMERGENCY OPERATIONS CENTER
OH1 (TA-59) 7-6211

HEALTH DIVISION ASSISTANCE FOR RADIOLOGICAL, CHEMICAL, OR INDUSTRIAL ACCIDENTS:

WORKING HOURS	7-7878
NONWORKING HOURS (PRO FORCE STATION 100)	7-4437
DUTY OFFICER (PRO FORCE STATION 100)	7-4437

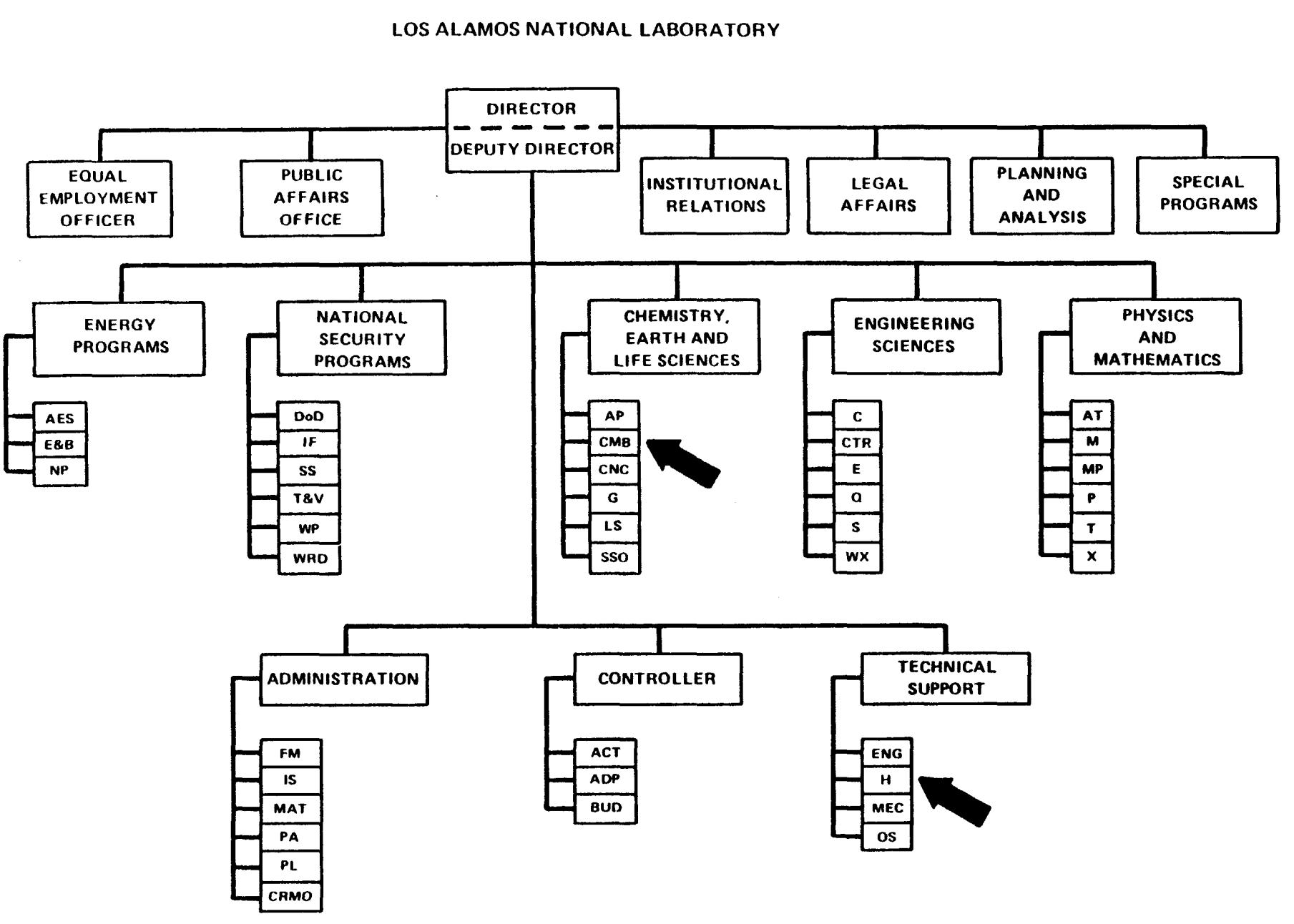


FIGURE 1. Organization Chart for Los Alamos National Laboratory as of October 14, 1981. The two groups primarily involved in the incident are indicated by arrows.

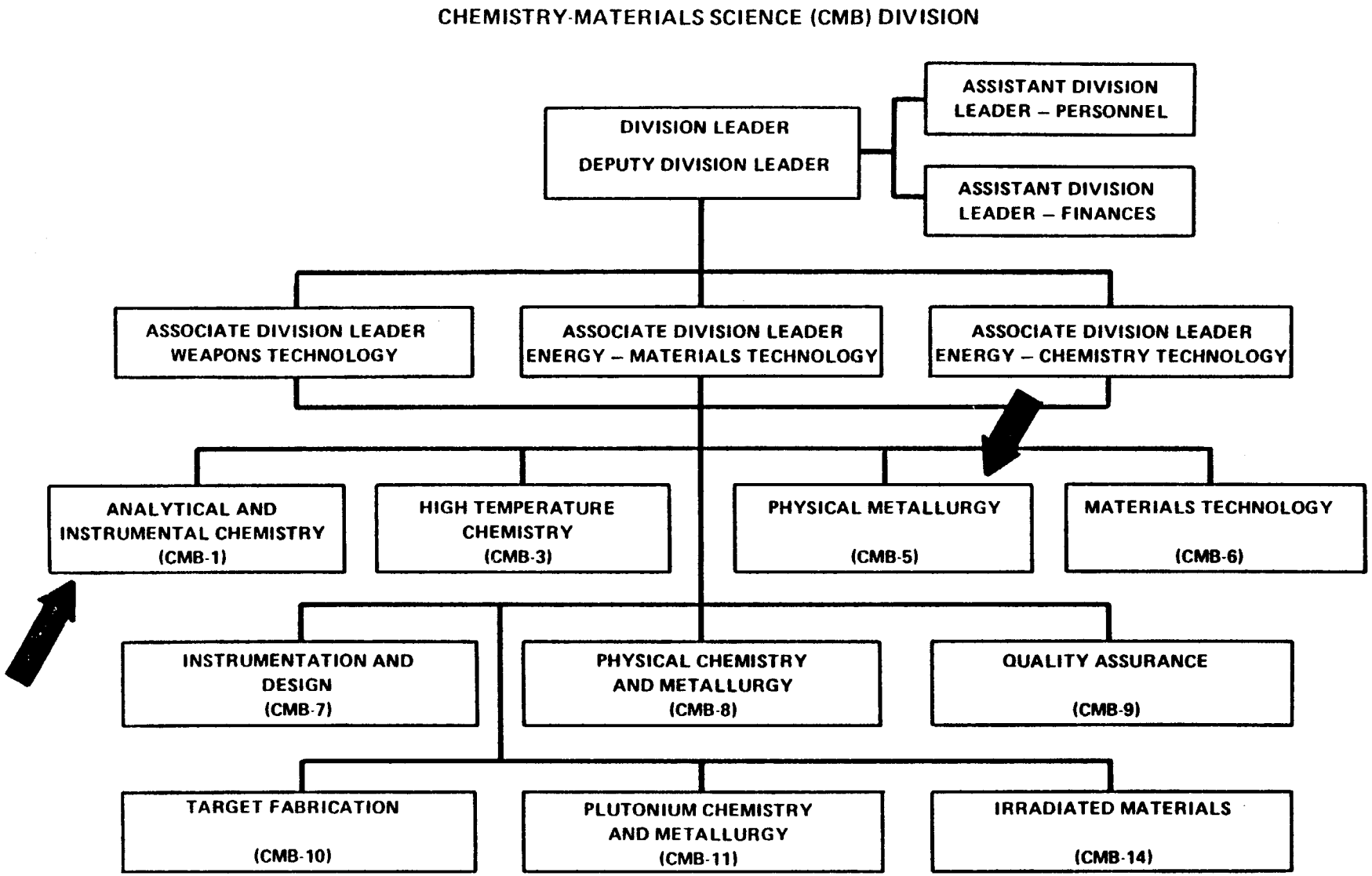


FIGURE 2. Organization Chart for CMB Division as of October 14, 1981. The two groups principally involved in the incident are indicated by arrows.

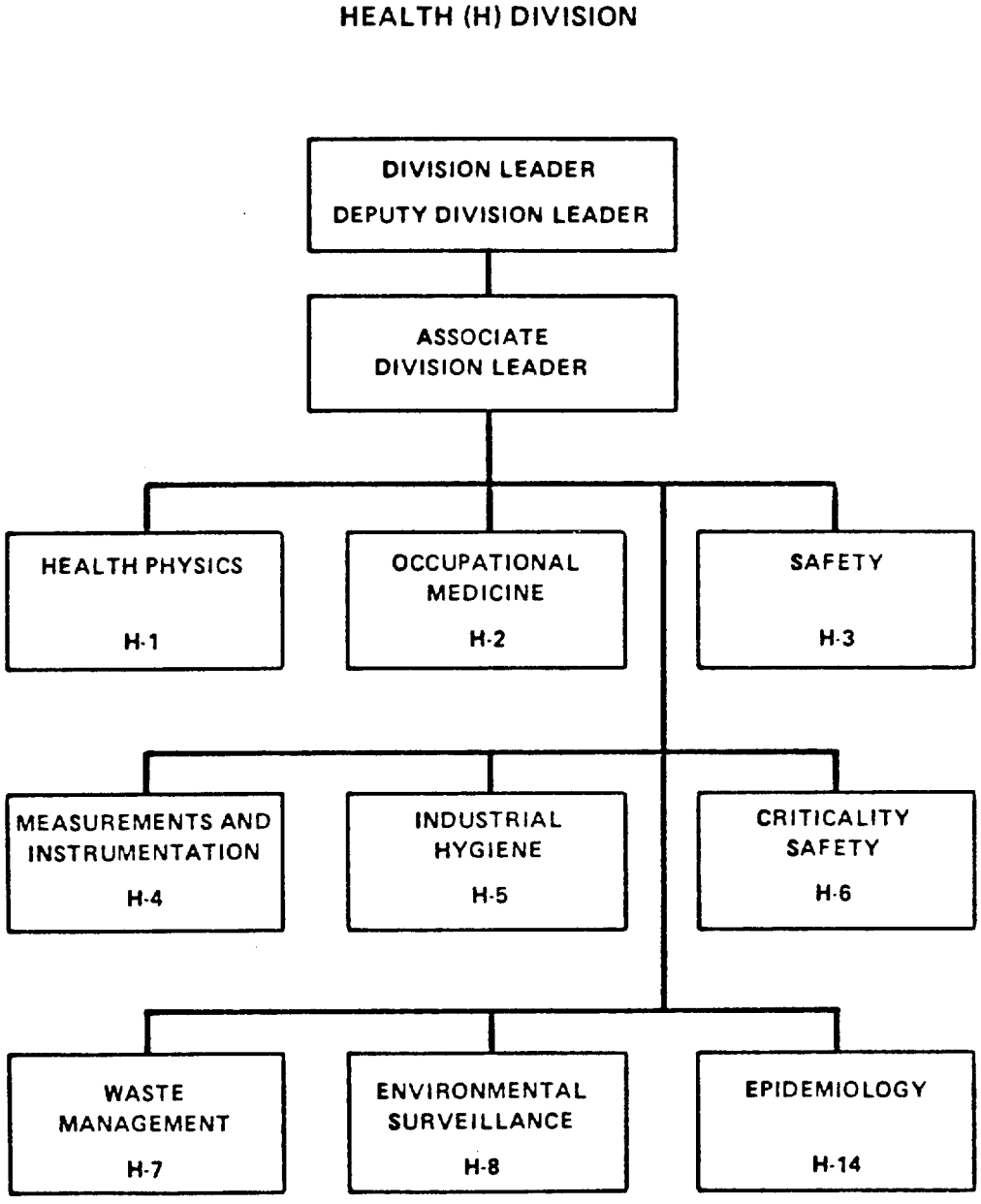


Figure 3. Organization Chart for H Division as of October 14, 1981.

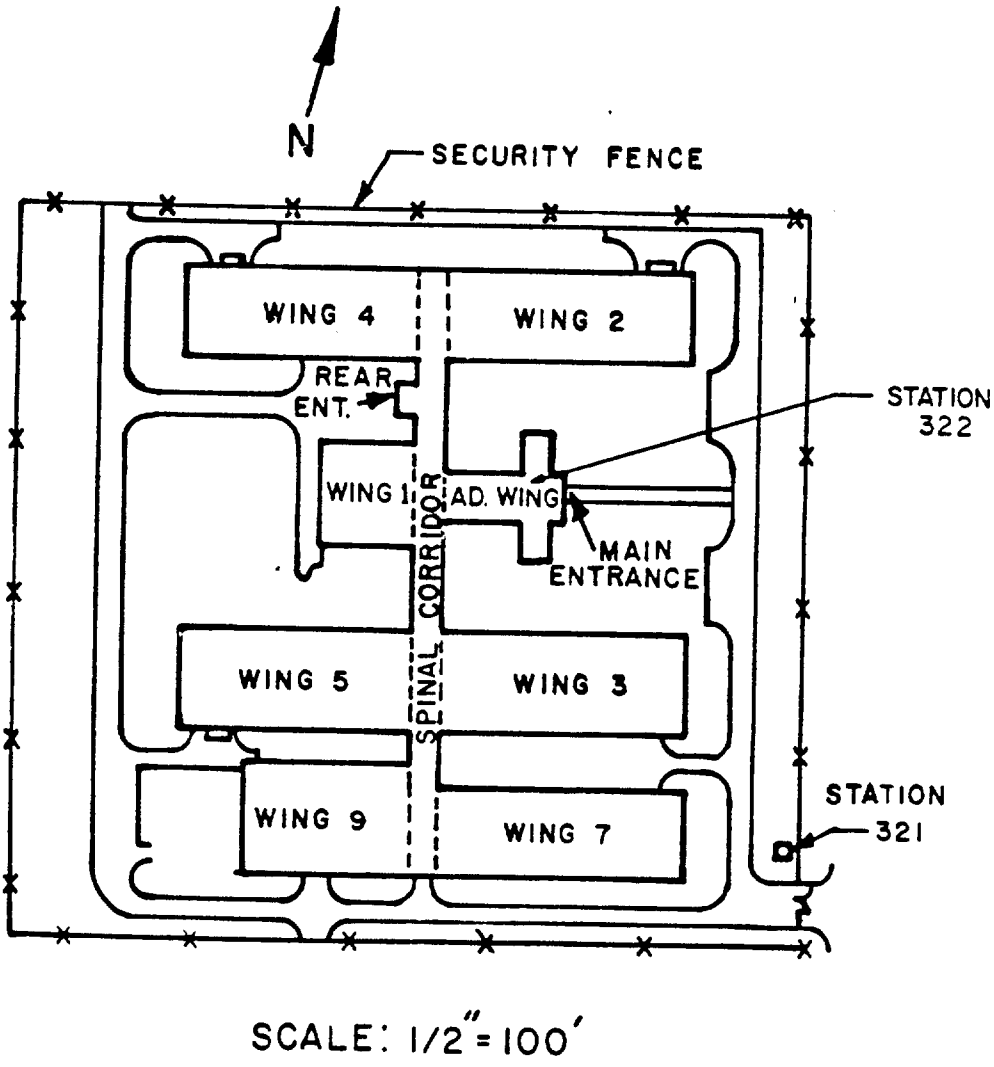


FIGURE 4. Site plan for the CMR building. The contaminated samples originated in Wing 2 and were opened in Wing 3.

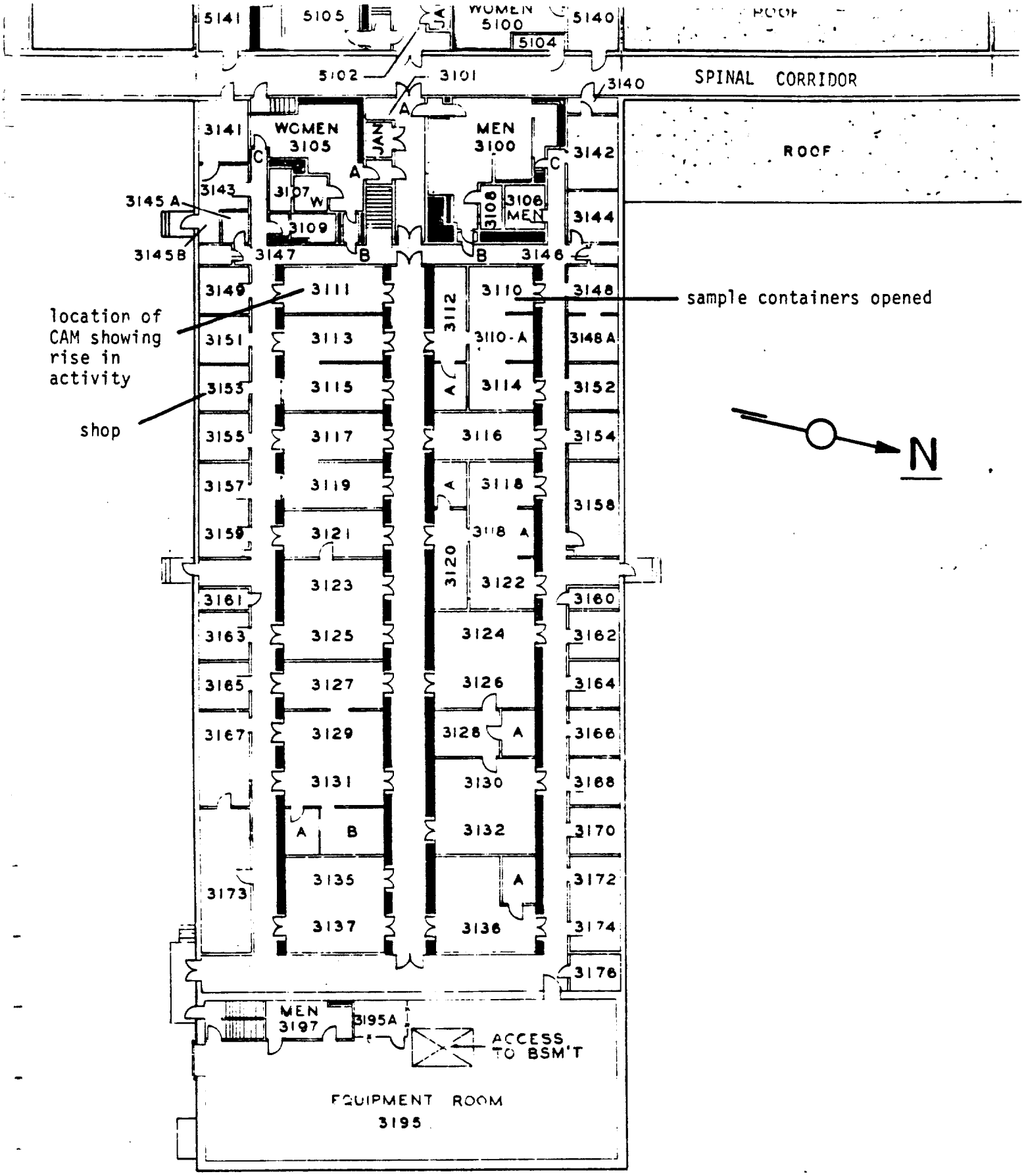


Figure 5. Layout of Wing 3.

FIGURE 6. Heat Source Capsule Components.


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Fig. 7. Appearance of heat source capsule before and after impact testing.

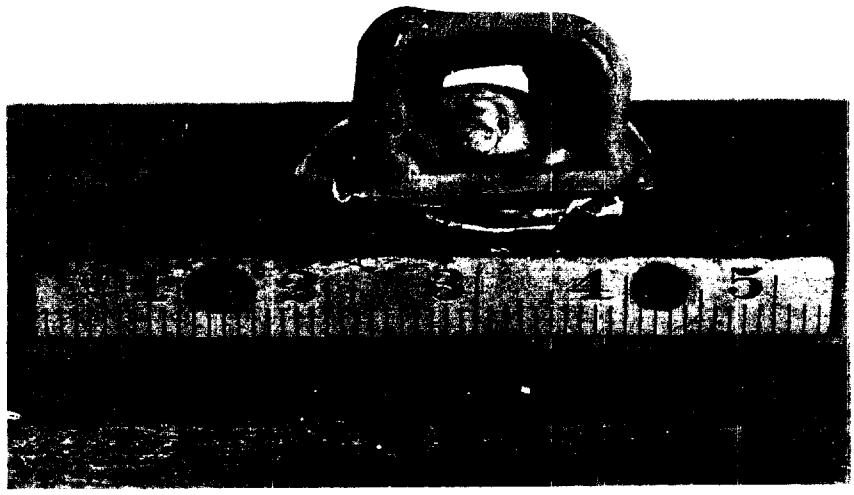


Fig. 8. Sectioned heat source capsule after ultrasonic cleaning.

Fig. 7 Appearance of heat source capsule before and after impact testing.

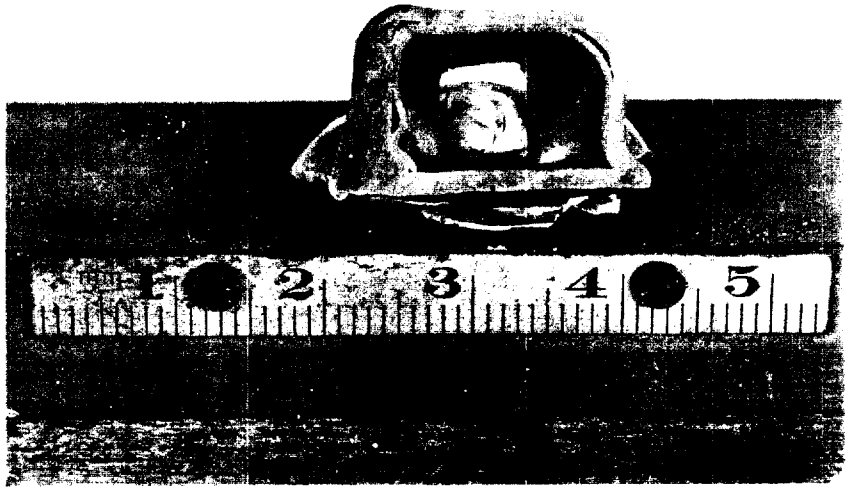


Fig. 8 Sectioned heat source capsule after ultrasonic cleaning.

Fig. 7. Appearance of heat source capsule before and after impact testing.

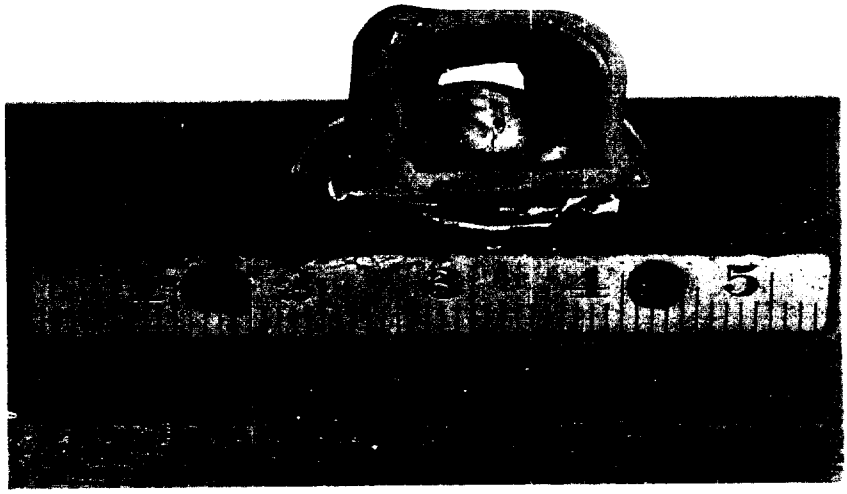


Fig. 8. Sectioned heat source capsule after ultrasonic cleaning.

Fig. 7. Appearance of heat source capsule before and after impact testing.

Fig. 8. Sectioned heat source capsule after ultrasonic cleaning.

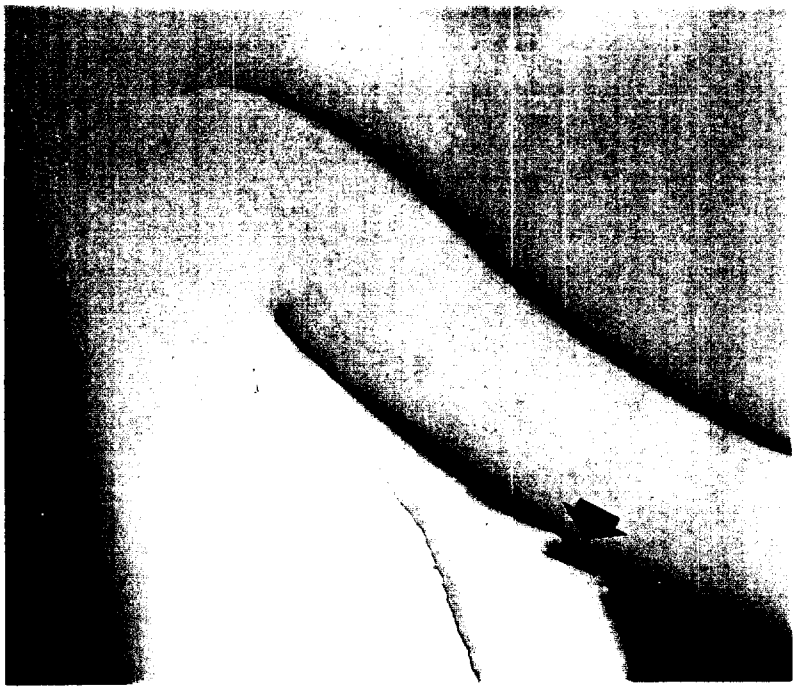


Fig 9 Photomicrograph of a corner of an impacted heat source capsule, showing some entrapped PuO_2

After approval send:
Copy to QA Manager
Copy to Submitter
Copies to CMB-1

Quality Assurance Sample

ANALYTICAL REQUEST-TRAVELER

Sample Identification: CMB-5-[redacted] - _____ Date Submitted: _____
Submitting Group / Submitters Initials / Identification Number

S.O.N. ___ Form B Code: K-510

Sample Material: T-111, Nominally Ta-8W-2Hf, Uncontaminated

Submitted by: [redacted] (signature) Phone: 7-4662 Approved by: _____ CMB-1

Nitrogen analysis requested
Nitrogen content expected < 100 ppm
Please clean surface (1HF-25 H_2O-1HCl)

Figure 10a. Analytical Request-Traveler for Uncontaminated Samples.

Certification: _____ Date: _____

Information for Submitter: _____

Original Data Record: _____

Analyst: _____ Date Reported: _____

After approval send:
Copy to QA Manager
Copy to Submitter
Copies to CMB-1

Quality Assurance Sample

ANALYTICAL REQUEST-TRAVELER

Sample Identification: CMB-5-[redacted] - _____ Date Submitted: _____
Submitting Group / Submitters Initials / Identification Number

P.O.N. ____ Form B Code: K-510

Sample Material: T-111, Nominally Ta-8W-2Hf, Uncontaminated

Submitted by: [redacted] Phone: 7-4662 Approved by: _____
(signature) CMB-1

Nitrogen analysis requested
Nitrogen content expected < 100 ppm
Please clean surface (1HF-2.5H$_2$O-1HCl)

Figure 10a. Analytical Request-Traveler for Uncontaminated Samples.

Certification: _____ Date: _____

Information for Submitter: _____

Original Data Record: _____

Analyst: _____ Date Reported: _____

After approval send:
Copy to QA Manager
Copy to Submitter
Copies to CMB-1

Quality Assurance Sample

ANALYTICAL REQUEST-TRAVELER

Sample Identification: CMB-5-[redacted] - _____ Date Submitted: _____
Submitting Group / Submitters Initials / Identification Number

L.A.N. - Form B Code: K-510

Sample Material: T-111, Nominally Ta-8W-2Hf, Uncontaminated

Submitted by: [redacted] Phone: 7-4862 Approved by: _____
(signature) CMB-1

Nitrogen analysis requested
Nitrogen content expected < 100 ppm
Please clean surface (1HF-25H$_2$O-1HCl)

Figure 10a. Analytical Request-Traveler for Uncontaminated Samples.

Certification: _____ Date: _____

Information for Submitter: _____

Original Data Record: _____

Analyst: _____ Date Reported: _____

After approval send:
1 copy to QA Manager
1 copy to Submitter
2 copies to CMB-1

Quality Assurance Sample

ANALYTICAL REQUEST-TRAVELER

Sample Identification: CMB-5-[redacted] (Submitting Group / Submitters Initials / Identification Number)

Date Submitted:

S.O.N.:

Form B Code: K-510

Sample Material: T-111, Nominally Ta-8W-2Hf, Sample contaminate with 258 Pa Oz.

Submitted by: [redacted] (signature) Phone: 7-4862 Approved by: CMB-1

Nitrogen analysis requested
Nitrogen content expected < 100ppm
Please clean surface (1HF-2.5 H_2O-1 HCl)

Figure 10b. Analytical Request-Traveler for Contaminated Samples.

Certification: Date:

Information for Submitter:

Original Data Record:

Analyst: Date Reported:

After approval send:
1 copy to QA Manager
1 copy to Submitter
2 copies to CMB-1

Quality Assurance Sample

ANALYTICAL REQUEST-TRAVELER

Sample Identification: CMB-5-[redacted] Date Submitted: _____
(Submitting Group) (Submitters Initials) (Identification Number)

S.O.N. _____ Form B Code: K-510

Sample Material: T-111, Nominally Ta-8W-2Hf, Sample contaminate with 258 Pu Oxs.

Submitted by: [redacted] (signature) Phone: 74862 Approved by: _____ CMB-1

Nitrogen analysis requested
Nitrogen content expected < 100ppm
Please clean surface (1HF-25 H_2O - 1 HCl)

Figure 10b. Analytical Request-Traveler for Contaminated Samples.

Certification: _____ Date: _____

Information for Submitter: _____

Original Data Record: _____

Analyst: _____ Date Reported: _____

Figure 11. The can used to transport the sample vials.

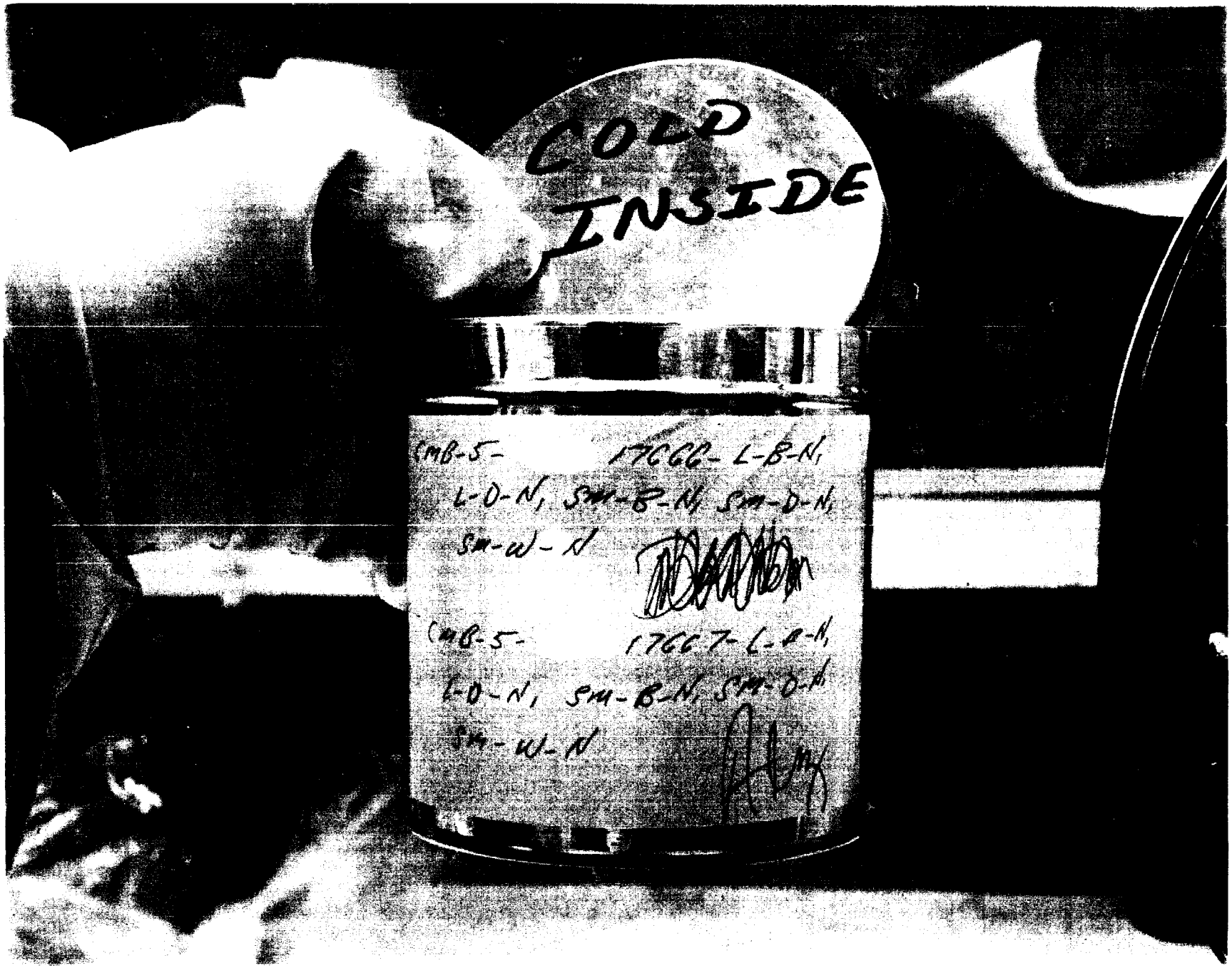
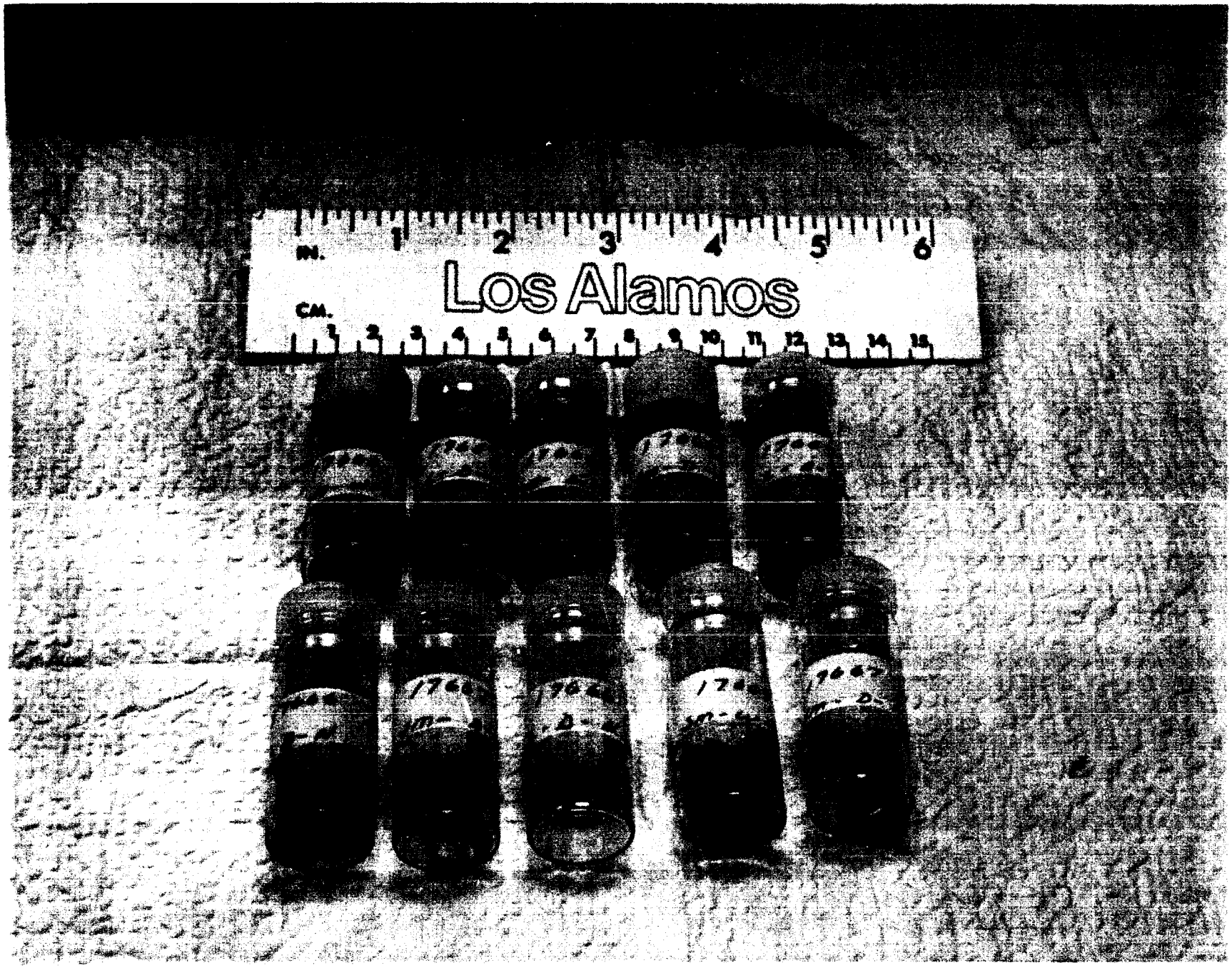

COPP
INSIDE
CMB-5- 17GGG- L-B-N,
L-O-N, SM-B-N, SM-D-N,
SM-W-N
CMB-5- 17GG7- L-B-N,
L-O-N, SM-B-N, SM-D-N,
SM-W-N

FIGURE 12. The ten contaminated sample vials.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CM.
Los Alamos

Figure 13. Analytical Request-Traveler for the contaminated samples, incorrectly labeled "uncontaminated."

...ST-TRAVELER 20000

copy to QA Manager
copy to Submitter
copies to CMB-1

ANALYTICAL REQUEST-TRAVELER 19991 (10)

...mple
...tification: CMB-5- -1767-L-B-N Date Submitted: 7/22/81
Submitting Group / Submitters Initials / Identification Number

O. N. ___ Form B Code: K-510

...mple Material: T-111, Nominally Ta-8W-2Hf, decarburized

...bmitted by: _____ (signature) Phone: 7-4862 Approved by: _____ CMB-1

√Nitrogen analysis requested
Nitrogen content expected < 100 ppm
Please clean surface (1HF-2.5H₂O-1HNO₃)

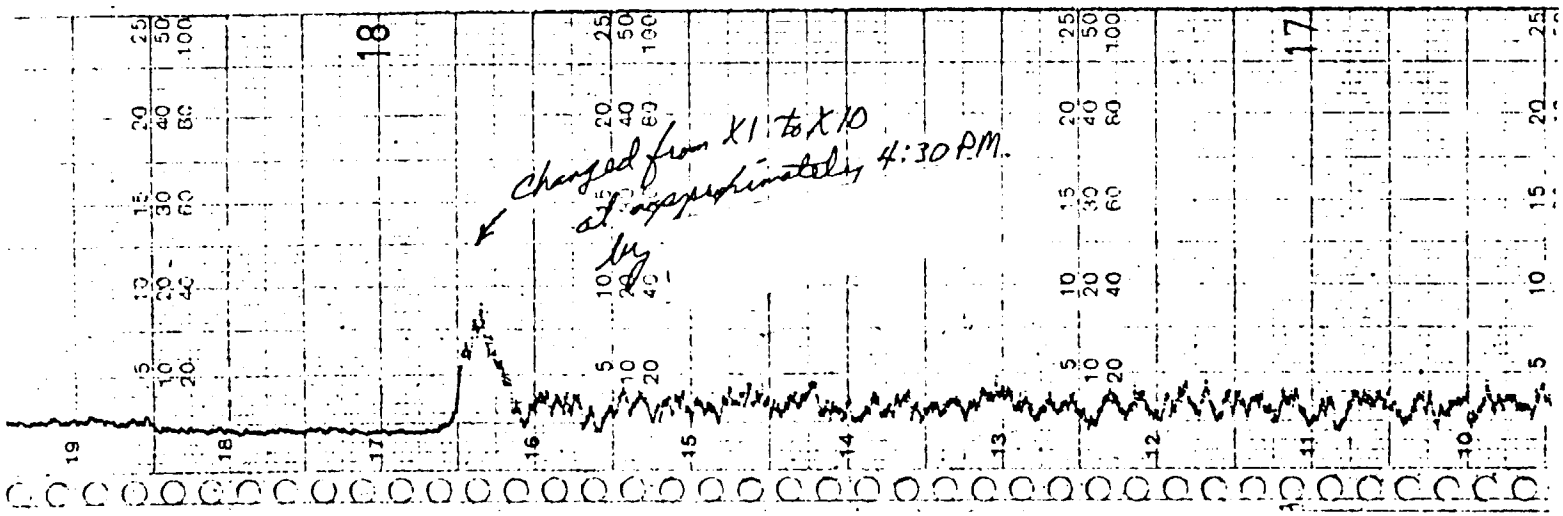
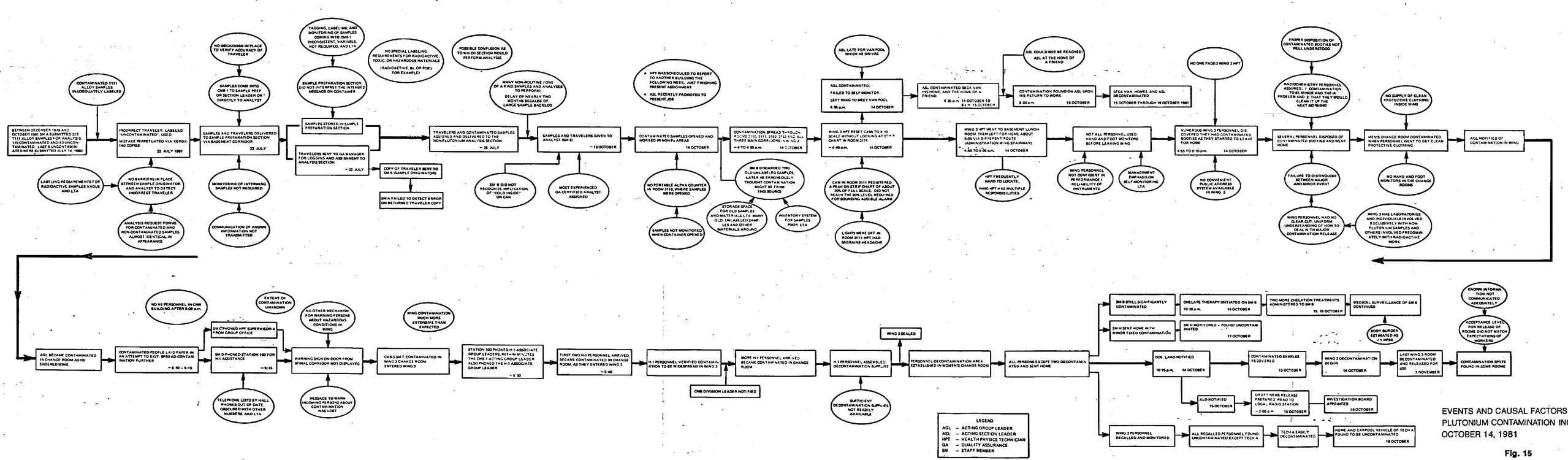


FIGURE 14. Strip chart from the CAM in Room 3111, showing a rise at about 4:20pm.

The sensitivity was switched to the x10 scale at about 4:40pm.

Time progresses from right to left.



EVENTS AND CAUSAL FACTORS C
PLUTONIUM CONTAMINATION INCI
OCTOBER 14, 1981

Fig. 15