HEALTH PHYSICS ACTIVITIES IN CONNECTION WITH THE DISESTABLISHMENT OF NRDL: DISPOSAL OF RADIOACTIVE MATERIAL AND TERMINATION OF AEC LICENSES

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by

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I. INTRODUCTION

On April 25, 1969 the Navy announced the disestablishment of NRDL with a closure date of about December 31, 1969. At that time the radioactive material on board and at outside activities was authorized by the Atomic Energy Commission (AEC) under the following licenses:

1. Byproduct Material License No. 04-00487-03 allowing possession of 5000 curies cobalt-60, 2000 curies cesium-137, 500 curies hydrogen-3 (tritium) plus up to an additional 500 curies of various isotopes of atomic number 4 to 82. Of this total 3,500 curies of cobalt 60 was located at the Camp Parks range, with the remainder at the Laboratory.

2. Byproduct Material License No. 04-00487-09 allowing possession of 66,000 curies of strontium 90 encapsulated and contained in two SNAP-21 fuel capsules. This license authorized exposure of the fuel capsules at an underwater location adjacent to San Clemente Island off the coast of California. The two sources were stored at the NRDL facility at San Clemente rather than at the Laboratory.

3. Source Material License No. SMB-376 allowing possession natural uranium and thorium up to a maximum of 560 pounds.

4. Special Nuclear Material License No. SNM-35 allowing possession of 2000 grams plutonium 10 grams uranium-233 and 1000 grams uranium-235.

Termination of the AEC licenses required the transfer of all licensed sources to other activities and disposal of sources no longer needed. Termination of the Byproduct Material License required the further decontamination of all radioactive areas occupied by NRDL at the San Francisco Bay Naval Shipyard. Final clearance of building areas was made by the AEC

on the basis of an independent survey conducted by a team of inspectors from the Division of Compliance.

Health Physics activities were carried out under the direction of Mr. A. Smith until November 3, the official disestablishment date of NRDL. On November 4 an NRDL Disestablishment Group, San Francisco Bay Naval Shipyard, was formed. At this time Mr. E. Tochilin was placed in charge of a six-man group responsible for Health Physics operations leading to final AEC clearance of all buildings and termination of all AEC licenses.

This report describes the Health Physics activities carried out during the period from about August 15 to December 31, 1969. The goal of this decontamination effort was to reduce all radioactivity to negligible levels, so that buildings and laboratory facilities could be returned to the Shipyard in a radiologically safe condition.

II. DECONTAMINATION OF NRDL AND OUTLYING BUILDINGS

A. Decontamination Procedures

The Health Physics Division of NRDL was responsible for the general surveillance of all radiation activities conducted in the laboratory and outlying areas. A continuous program of personnel monitoring, together with overall supervision and inspection of all radioactive material, went into effect prior to the Laboratory's move into building 815. Because of these protective measures no serious radiological problems were anticipated in Building 815 and the adjoining buildings 816 and 830.

Unfortunately, Health Physics practices in the early years of the Laboratory were considerably less stringent. Some Shipyard buildings

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previously occupied by NRDL still had significant radioactive contamination; namely, buildings 506, 364 and 707. These areas had not been turned back to the Shipyard. Instead, they were used as NRDL experimental areas for various radiological studies.

Decontamination activities in the building areas occupied by NRDL may be summarized as follows:

1. Removal of all radioactive source material.

2. Measurement of external radiation levels with an open-window G-M instrument for beta-gamma contamination and with a thin-window proportional counter for alpha contamination.

3. Swipes of all radiation areas to determine the presence of removable contamination. A swipe count is made by rubbing a piece of absorbent tissue or filter paper over a 100 cm^2 area and counting the activity with an appropriate instrument.

4. Swipes of hoods, hood filters, sinks, drain lines, vacuum lines and work areas wherever radioactive material was used.

5. Decontamination of radioactive surfaces where the level of activity was sufficiently low to warrant such procedures. Decontamination methods mostly included washing or scrubbing with detergents, dilute complexing agents or mild acids, or with combinations of the above. In more extreme cases chipping, sand-blasting, vacuuming and high pressure steam cleaning was required. Special protective clothing and face masks were issued to personnel engaged in these operations.

6. Dismantling of radioactive equipment that could not be readily decontaminated (hoods, bench tops, floor tiles, filter banks, storage tanks, etc.) and crating it for removal as radioactive waste.

7. Final inspection of all monitored and decontaminated areas by the AEC Division of Compliance.

Decontamination procedures used during the cleanup operation at NRDL were successful in removing detectable radiation in all but a few locations. Although it is highly desirable to remove all traces of radioactive contamination, the AEC recognizes that small quantities of residual contamination can be tolerated in special cases. A certain amount of alpha and beta-gamma contamination is permissible if the contamination can be demonstrated to be fixed as determined by swipe count.

The AEC has specified that a localized radioactive area may be considered to be decontaminated when the beta-gamma dose rate at one cm averages less than 0.2 mr/hr and the removable activity per 100 cm^2 of surface is less than 1,000 disintegrations per min (dpm). For alpha contamination the fixed activity should be less than 500 dpm per 100 cm^2 while the removable activity should be less than 100 dpm.

While most areas, including Bldgs 815, 816, 820 and 707 were decontaminated to background levels, a small amount of localized radioactivity in and around Building 364 and 506 could not be removed. These residual levels were inspected by the AEC and determined to be below AEC minimum permissible requirements. The areas are identified in the last section of the report "Final Condition of NRDL Buildings."

B. Radiation Monitoring and Decontamination

1. Building 815

The critical areas in Building 815 were the sixth floor occupied by the Nuclear Technology Division, the fifth floor occupied

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by the Biological and Medical Sciences Division and Room 1109, the Isotope Storage Room. These were the principal areas where unsealed liquid and solid radioactive sources were used and from which serious radioactive contamination could result. Radiation surveys and subsequent decontamination efforts began on the sixth floor and proceeded downward to the first. The following is a brief description of initial radiation surveys performed on each floor and subsequent decontamination procedures.

Sixth Floor

There was widespread use of transuranic sources on this floor, particularly plutonium. Since many sources were in liquid form there existed a potential hazard from alpha particles. Surveys were made in all rooms with both a beta-gamma G-M survey instrument and an alpha proportional counter type survey meter. All bench tops, sinks, hoods, desks and floors were monitored. Hoods were monitored up to the back side of the filter banks. All hood filters were removed and disposed of as radioactive waste. A total of ten swipes were made in each laboratory area and counted for gross alpha and beta-gamma activity. A total of five swipes were made in each office area (this included the floor and each wall). All vacuum lines and sink drains were opened and swiped for possible radioactivity. The same procedure was followed on all other floors where there were vacuum lines and sink drains.

Contaminated areas were found in the eight rooms listed below. Most of the radioactive components were physically removed and disposed

of. No radioactive contamination could be detected following completion of the decontamination effort.

ROOM	CONTAMINATED AREAS	ALPHA or BETA	ACTION TAKEN
631	Floor tiles	B	Removed
634	Floor tiles	A	Removed
	Bench top	A	Removed
658	Sink and drain lines	A	Removed drain
670	Cabinet drawers	B	Removed
	Floor tiles	B	Removed
679	Hoods (2)	A	Decontaminated
680	Hoods (2)	A	Removed
	Cabinets	A	Removed
	Bench top	A	Removed
	Floor tiles	A - B	Removed
	Floor under tiles	B	Decontaminated concrete floor
682	Floor tiles	A	Removed
683	Mercury in hood		Removed mercury

Fifth Floor

The two sources most widely used on the fifth floor were carbon-14 and tritium, both of which are low energy beta emitters. Radiation surveys were made with a thin-walled G-M survey meter which could detect the presence of carbon-14 but not tritium. Extensive swipes were made in all laboratories where tritium was used. The swipes were analyzed for tritium contamination with both a gas-flow proportional counter and with a tritium scintillation detector. All swipes were further counted for gross alpha and beta-gamma activity. Except for some low level activity concentrated in the filter hoods, there was no detectable radioactive contamination on the fifth floor.

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Fourth Floor

Radioactive sources located on the fourth floor were mainly sealed gamma emitters which normally would not produce any radioactive contamination. A radiation survey was made of all rooms with a beta-gamma survey meter. Five swipes were made in each laboratory room and two swipes in each office area. All swipes were counted for gross alpha and beta-gamma activity.

Several low-level radiation check sources were found during the radiation survey. No detectable radioactive contamination was found by the radiation survey. All swipe counts were negative.

Third and Second Floors

Except for rooms 218, 222, 255 and 2153 occupied by the Health Physics Division all remaining areas were used primarily by administrative personnel. The probability of radioactive contamination on these two floors was, therefore, extremely small. All rooms were surveyed with a beta-gamma survey instrument and a minimum of two swipes taken in all rooms.

All radiation measurements (swipes and meter readings) on the second floor were negative, including Health Physics rooms 218, 222 and 255. Room 2153 contained a filter housing connected to a blower which maintained a negative pressure in Room 1109, the Radioisotope Storage Room. Filters removed from the housing were found to be slightly radioactive. Radiation levels in the housing ahead of the filters ranged from 0.05 to 0.2 mr/hr; this was mostly contained in a thin layer of dust which was removed with a vacuum cleaner. Final radiation levels in the filter housing averaged 0.05 mr/hr approximately two times background.

First Floor

Radioactive surveys and swipe tests were made of all rooms. Except for Room 1109 there was no detectable radioactive contamination on the first floor.

Six radioactive areas were found in the Radiosotope Storage Room, 1109. These were primarily around the bottom of the hood and included the drain pipes and adjoining bench top. The door and drain pipe below the hood was removed and disposed of as radioactive waste. The adjoining bench and portions of the wall were also removed in order to dismantle the drain pipe leading into the wall. Contaminated floor tiles in front of the hood and at the back exit were also removed. The vent ducts leading from the hood to the filter bank in Room 2153 were found to be contaminated. They were removed and discarded as radioactive waste. Upon completion of these decontamination efforts Room 1109 was remonitored and found free of all radioactive contamination.

Waste Tanks

All Laboratory sinks and drains in Bldg 815 emptied into two radioactive waste tanks located on the west end of the buildings. During normal operation a daily water sample was obtained from each tank and analyzed for gross beta-gamma and gross alpha activity. In this way the release of radioactivity into the city sewage system was controlled to conform with AEC regulations.

The drain tanks were periodically cleaned by removing the water and then washing out the remaining sludge with a firehose. Both tanks were given a final cleaning in November. On December 9 waste tank No. 1 was

filled and sampled. A 100 ml sample was concentrated to dryness and counted for both beta-gamma and alpha activity. Both counts gave rates below background (28 cpm for beta-gamma and 0.5 cpm for alpha counting). With both counts negative the sample was considered to contain no detectable activity.

The water in tank No. 1 was pumped into tank No. 2. A 100 milliliter sample was taken from tank No. 2, evaporated to dryness and counted for one hour as before. The net counts above background gave the following concentrations:

TYPE OF COUNT	NET cpm	MICROCURIES PER cc
Beta-gamma	1.4	0.95×10^{-7}
Alpha	0.23	4.4×10^{-9}

These levels were acceptable to Mr. R. Fish, Division of Compliance, AEC.

2. Building 816

This building contained the 2-MeV Van de Graaff (VDG) accelerator which was used to accelerate either electrons or positive ions. No radiation sources other than sealed Pu-Be neutron standards were used in this building. The primary source of radiation contamination was from tritium targets used to produce neutrons when bombarded with protons or deuterons. Radiation surveys were initially made with a portable G-M survey instrument. No radioactive contamination was detected by this method. However, swipes counted with a tritium-carbon (TRICARB) scintillation detector showed extensive tritium contamination. The counts generally ranged from 10^4 to 10^5 disintegrations per minute. Figures 1

and 2 give the results of swipe tests made on the first and second floor. Additional swipes were made in the Butler Building Annex which contained a large open pit that was used to provide a scatter-free environment for neutron experiments. Beam pipes were used to extend the VDG beam over the pit. Readings of up to 10^5 dpm were obtained from swipes taken on the metal grating directly below the neutron target. Readings up to 3×10^4 dpm were obtained on the pit floor. Swipes taken in the remainder of the building read background.

The Van de Graaff accelerator was found to be contaminated with approximately 200 millicuries of tritium. The accelerator was disassembled and shipped as radioactive material to USNAD Crane, Indiana where it will be decontaminated and put back into operation.

Following removal of the VDG accelerator and auxilliary equipment the building was steam cleaned for removal of tritium in the concrete walls and floors. Tritium is readily absorbed on porous surfaces and can be driven off into the atmosphere by a combination of heat and high humidity. Swipes were made after the steam cleaning operation in all contaminated areas of Fig. 1 and 2. and in the remainder of the building, including the annex. All counts registered background indicating that the tritium had been successfully removed. An AEC inspection made on Nov 19 indicated no detectable tritium contamination.

3. <u>Buildings 506 and 529</u>

Building 506 was one of the original buildings occupied by NRDL. Most of the earlier radiochemical analyses were carried out here. The building was decontaminated after the move to Bldg 815. However, a stainless steel holding tank for radioactive waste was not removed. In addition, a radiochemical hood and connecting filter-blower system was never

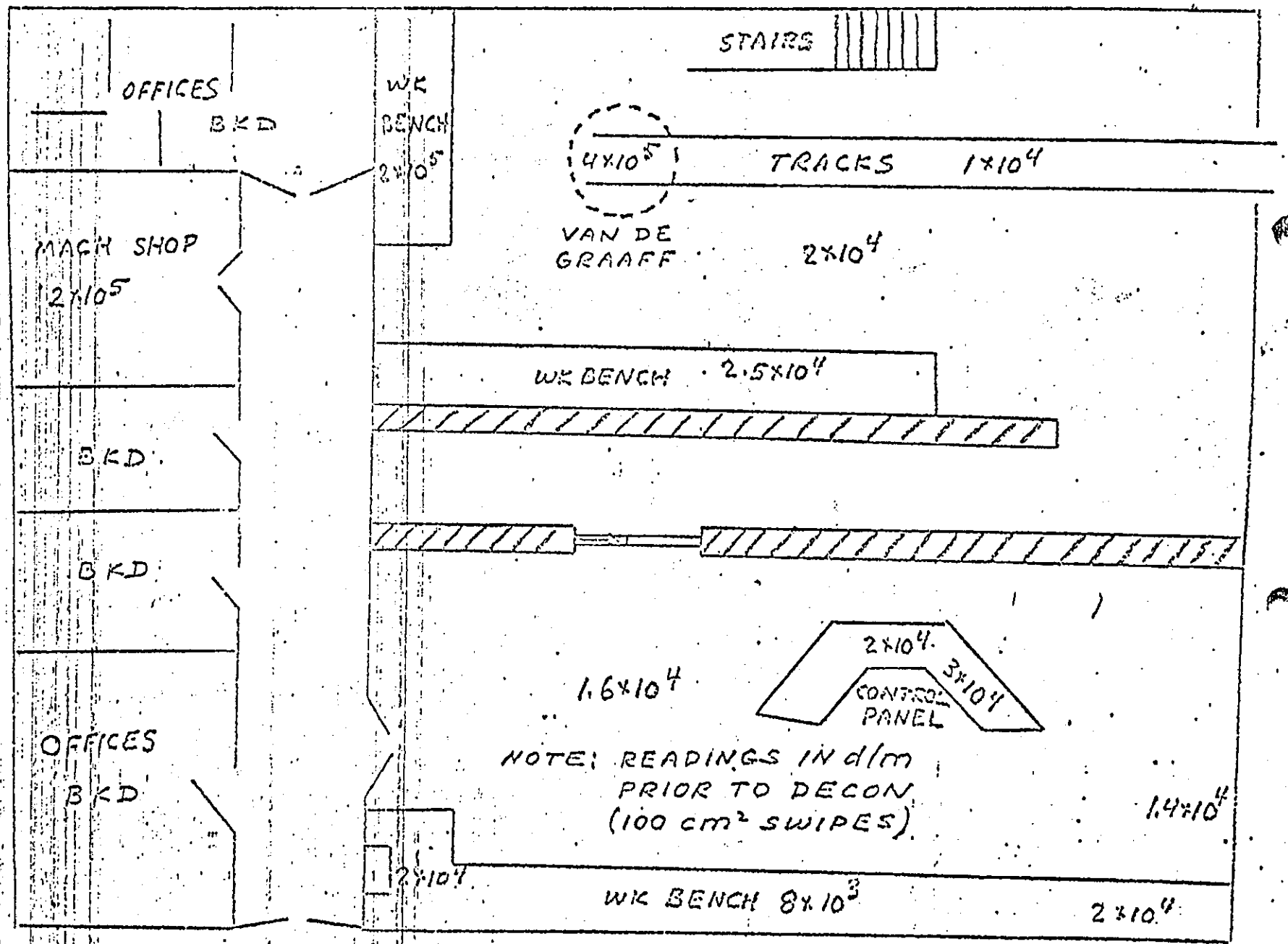

FIGURE 1: TRITIUM SWIPES BLDG 816 1ST FLOOR

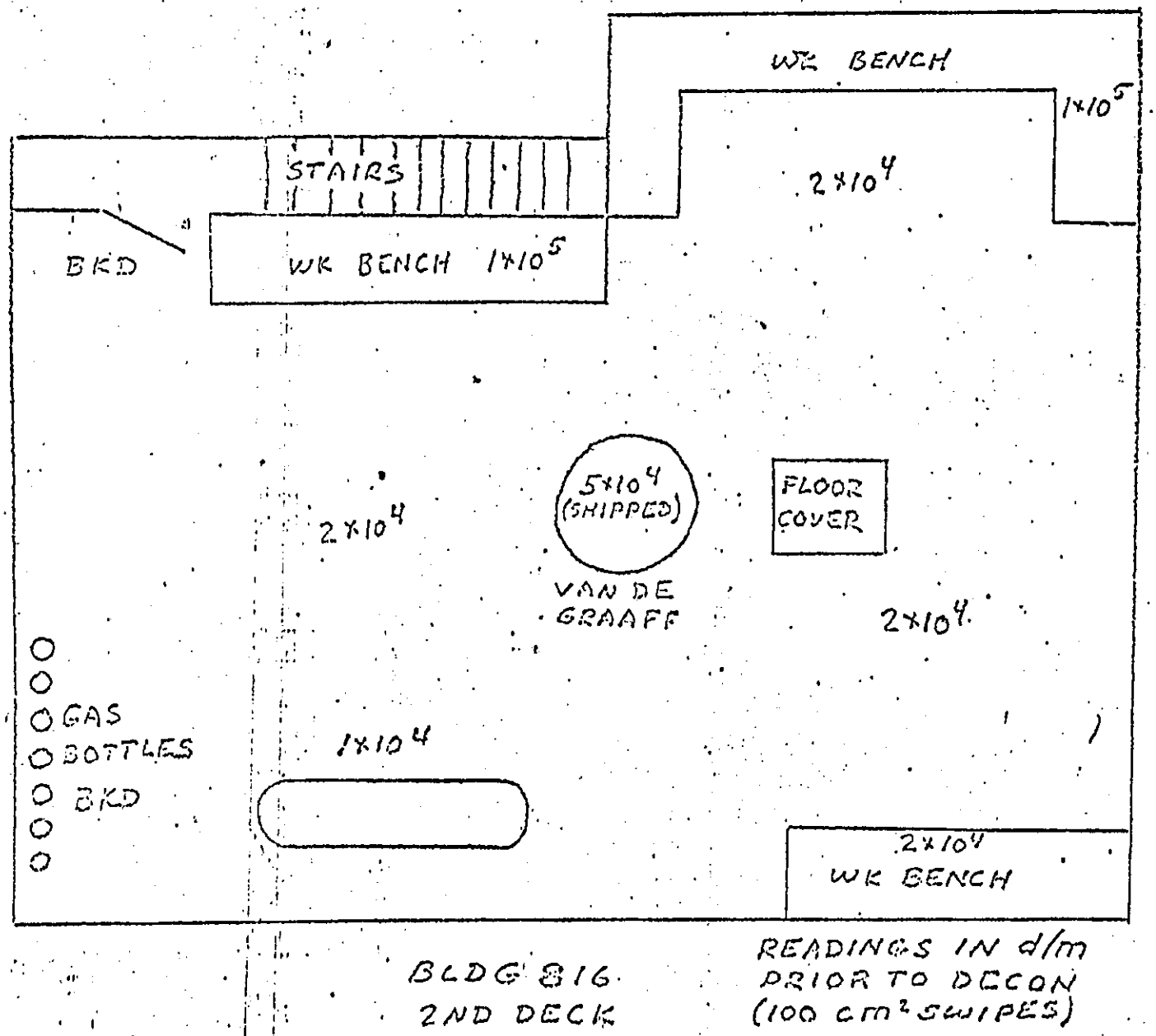

FIGURE 2: TRITIUM SWIPES BLDG 816, 2ND DECK

completely decontaminated.

The western end of Bldg 506, which contained the radiochemical hood, remained occupied by NRDL. The building was used mainly to house the controls of a low voltage neutron generator. Building 529, initially used as an isotope storage building was modified to house the neutron generator and provide necessary shielding. Tritium targets were used to produce neutrons. The targets were vented so as to minimize the possibility of radioactive contamination.

Rooms 35 and 35A located on the north side of Bldg 506 were used for storing tritium targets. Wipe tests indicated considerable tritium contamination in these two rooms and to the equipment stored inside. Counting levels generally ranged from 10^4 to a maximum of 10^5 dpm.

Initial cleanup consisted of washing down all equipment and room areas with hot water and detergent. This procedure reduced the removable activity approximately tenfold but still left many areas above maximum permissible tolerance levels. All contaminated equipment located in these rooms was either disposed of as radioactive waste or crated and shipped as radioactive material to its new destination. Following removal of all equipment, the two rooms were steam-cleaned.

There was no detectable radiation in the hood located in Room 33. However, the filter bank located in a penthouse on the roof of the building was contaminated. Radiation levels of mrad/hr beta-gamma were detected. Decontamination consisted of removing the filter housing as radioactive waste. One wall of the penthouse had to be torn down in order to remove the unit.

Rooms 33 and 33A located on the south side of the building were used as laboratory and office space. No detectable radiation was measured

with a G-M survey instrument. Several localized areas of tritium contamination were detected with swipes. These were scrubbed down with detergent.

Radiation surveys were made in Bldg 529 with a G-M survey meter and with swipes: There was no detectable radiation.

The stainless steel holding tank on the north side of the building has been cleaned approximately 10 years ago but was still contaminated. Beta-gamma readings of 0.5 mr/hr were obtained with a G-M survey instrument. The tank was cleaned two additional times before acceptable radiation levels were obtained. The final beta-gamma readings were 0.11 mr/hr average and 0.16 mr/hr maximum. Swipes taken at ten locations inside the tank measured less than 100 dpm everwhere except on the bottom of the sump which read 570 dpm. The tank was removed from the concrete pit by the Shipyard in December 1969 to be used for boiler feed water storage.

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4. Building 364

There was extensive radioactive contamination in the yard area directly behind Bldg. 364. The main contamination areas were the two holding tanks housed below ground in a concrete tank pit and the pump shed from which liquid waste was pumped into the holding tanks. All pipes leading from the pump shed and from Bldg 364 into the holding tanks were also contaminated.

Radioactive liquids in the holding tanks were pumped into a tank car supplied by Nuclear Engineering Co. and removed from the shipyard. The two tanks were then lifted out of the pit and crated for disposal as radioactive waste.

Radiation levels on the floor and lower walls of the tank pit averaged greater than one mr/hr, while readings in the sump pit were as high as 5 mr/hr. The pit was decontaminated by chipping the surface concrete until radiation levels and swipe counts decreased below permissible AEC levels. Figure 3 gives the radiation levels outside of Bldg. 364 upon completion of decontamination activities. These averaged less than 0.1 mr/hr on the tank pit floor and less than 1 mr/hr in the sump pit.

Radiation levels on the shack floor of the pump shed ranged from 4-6 mr/hr and in the sump pit from 15-20 mr/hr. Decontamination consisted of tearing down the pump shed and all associated plumbing, including the pipes leading to the tank pit. Chipping operations were then performed on the concrete floor and sump pit. Final radiation levels were less than 0.07 mr/hr on the floor and less than 0.2 mr/hr in the sump. Low level activity of less than 0.2 mr/hr was also found in several locations

throughout the yard (see Fig. 3) where radioactive waste had been stored.

All plumbing from Bldg 364 to the tank pit was removed. One piece of pipe going into a concrete slab under the building read 0.5 mr/hr. The other end of the pipe connected to Room 108, originally the decontamination room. The drain which was several feet below floor level had been covered up with sand and a top layer of concrete. In order to determine radiation levels on this end of the pipe, the floor was broken and the sand removed from the drain sump. Location of the drain is shown in Figure 4. Radiation levels on the bottom of the drains were a maximum of 0.07 mr/hr. Following discussions with the AEC it was decided to leave the pipe in the concrete slab. However, their recommendation was that the hole be filled in. This presented no problem since the shipyard had already stated that the concrete floor was to be restored. Some contamination was also detected on the walls of Room 108; this was readily removed by washing down with detergent and water.

Radiation surveys and swipes were made in the remaining rooms of the first floor and mezzanine (see Figure 4). No detectable radiation was found.

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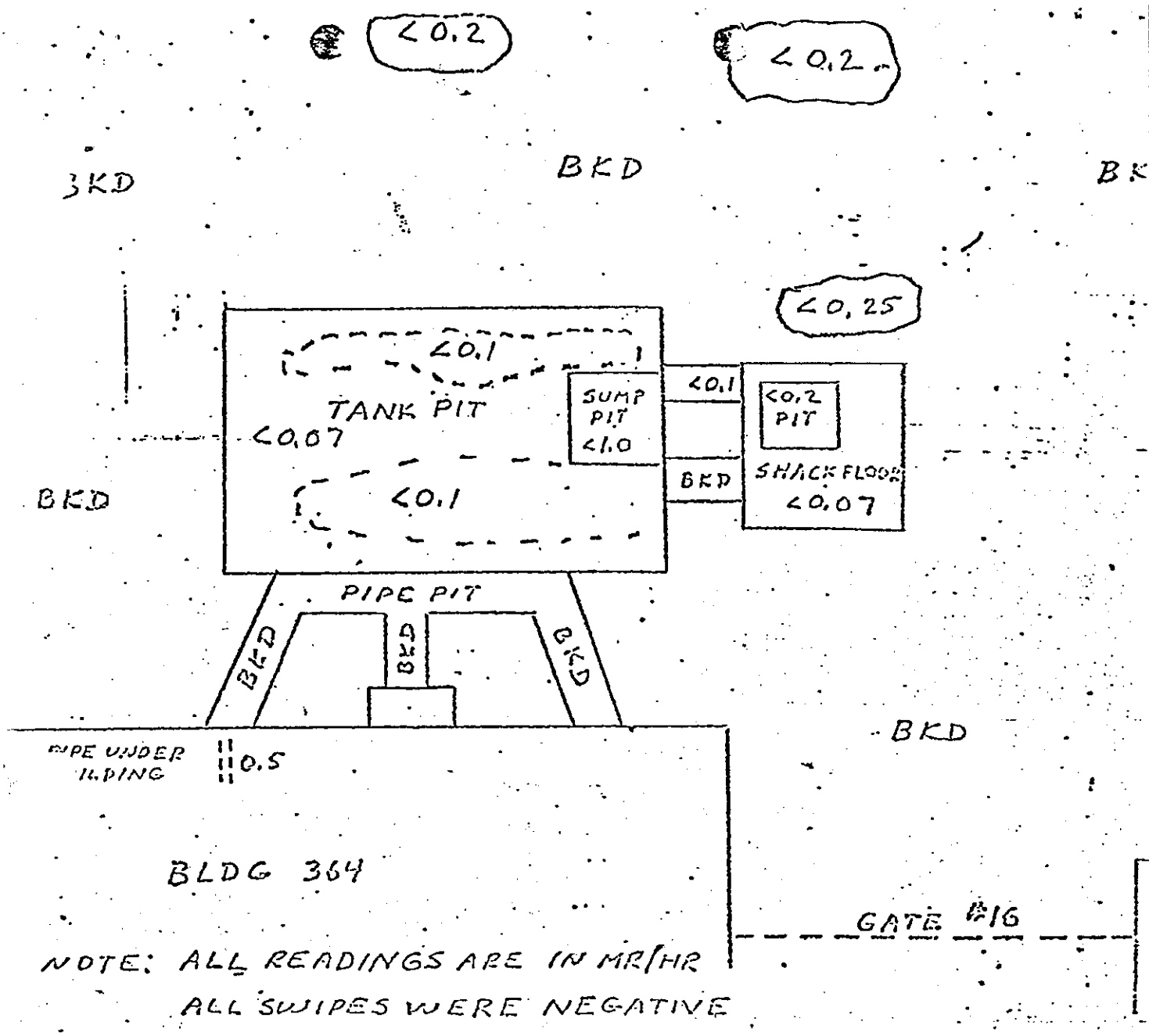


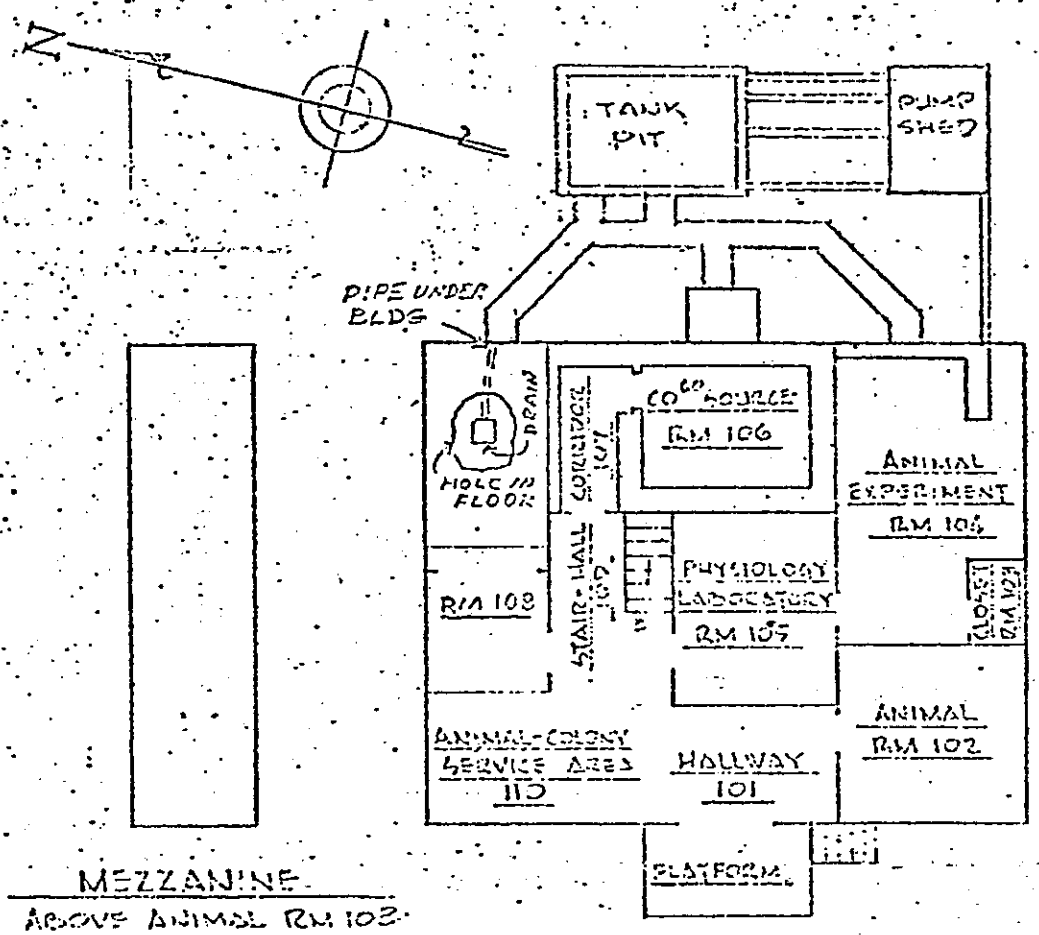
NOTE: ALL READINGS ARE IN MR/HR
ALL SWIPES WERE NEGATIVE

FIGURE 3

FINAL RADIATION LEVELS OUTSIDE OF BLDG 364

U.S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

BLDG. 364			DRAWING NO. S-10-260	ALTERATION
DRAWN BY FJA	CHECKED BY	APPROVED BY	SATISFACTORY TO J. M. Kennedy	DATE



MEZZANINE
ABOVE ANIMAL RM 102
& ANIMAL-COLONY SERVICE
AREA 110

FLOOR PLAN

SCALE: $\frac{1}{16}$" = 1'-0"

FIGURE 4

BLDG. 364 FLOOR PLAN

C. Disposal of Radioactive Sources

In August 1969 there were in excess of 300 individual radioactive sources at NRDL. Approximately 200 of these were transferred to other activities while the remainder were disposed of as radioactive waste.

The three largest transfers involved: 3,500 curies of cobalt-60 located at the Camp Parks Range, transferred to Stanford Research Institute, Menlo Park, California; 800 curies of cobalt-60 in a gamma-ray irradiator transferred to the Naval Ordnance Laboratory, White Oak, Maryland; and 66,000 curies of strontium-90 located at San Clemente Island, Calif., transferred to the Naval Undersea Research and Development Center (NURDC), San Diego, Calif.

In the transfer of sources, first priority was given to investigators with active programs assigned to other naval activities. These were primarily the Naval Ordnance Laboratory and NURDC. Second priority was given to NRDL programs transferring to other government laboratories or non-profit laboratories and universities. A list of remaining sources was prepared and made available to various government agencies, together with laboratories and universities in the immediate geographical area. This procedure allowed the utilization of essentially all radioactive sources of any value.

III. FINAL RADIOLOGICAL CLEARANCE BY AEC

A. Clearance of NRDL Buildings

AEC clearance was obtained through the Division of Compliance, 2111 Bancroft Way, Berkeley, California. Mr. Raymond Fish conducted the

AEC inspection which consisted of spot checks for radioactivity in areas previously cleared by Health Physics. Readings made by the AEC were with alpha and beta-gamma survey meters together with swipes which were counted in their Laboratory.

In Bldg 815 final clearance was given for the 4th, 5th and 6th floors prior to November 3. Final clearance was given for the 3rd floor on Nov 19 and for the 2nd floor on Dec 23, except for three rooms still occupied by Health Physics. Rooms 1109 and 165 were also given final clearance on Dec 23. Mr. Fish plans to inspect the remainder of the first floor in mid-January 1970, at which time most of the rooms will be vacated. Since the first floor has been given a thorough Health Physics inspection by NRDL personnel, Mr. Fish is reasonably satisfied that there is no remaining activity in the building.

Clearance dates for the remaining buildings are given below:

BLDG	DATE OF AEC CLEARANCE
816	November 24
820	Not required
821	Not required
364 - 365	December 24
506 - 529	December 24

Buildings 820 (Cyclotron Building) and 821 (1 MeV X-ray Facility) contained no radioactive material, and therefore did not require AEC clearance.

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B. Termination of AEC Licenses

The table below gives the AEC licenses held by NRDL, the dates when request for their termination was made, and the date they were terminated.

LICENSE	NO	REQUEST FOR TERMINATION	DATE TERMINATED
Biproduct Material	04-00487-3	10/27/69	10/29/69
Biproduct Material	04-13488-01	12/31/69	
Biproduct Material	04-00487-09	*	11/3/69
Source Material	SMB-376	11/24/69	
Special Nuclear Material	SNM-35	To be made by NAVELEX	

* Terminated on request of Naval Facilities Engineering Command following transfer of material to Naval Undersea Research and Development Center, San Diego, California. NOSC

Request for termination of Biproduct Material License 04-13488-01 was made on Dec 31 following the radioactive waste shipment of Dec 30. At this time there was no known radioactive biproduct material or contamination remaining in previously occupied NRDL areas, except for the two locations described in the next section. This remaining residual activity was certified by AEC inspectors to be within allowable limits for AEC clearance.

The final shipment of special nuclear material held under License SNM-35 left NRDL by December 31, 1969. Mr. George Mahaffey, Naval

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