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50-170

27 December 1993

U. S. Nuclear Regulatory Commission
Executive Director for Operations
Document Control Desk
Washington, DC 20555

Subject: Request For Approval of Slightly Radioactive Material Disposal Procedures

Gentlemen:

A major construction project to replace the ventilation system for the exposure rooms associated with the Armed Forces Radiobiology Research Institute (AFRRI) TRIGA Reactor Facility (License R-84) has been underway since October 1993. This project has required major excavation efforts to permit access to the ventilation ducts for the facility. During the excavation process, extensive radiological monitoring was performed using survey instrumentation with a sensitivity in the micro-Roentgen per hour range and environmental sampling and counting techniques with a lower limit of detection (LLD) in the range of 10^{-7} curie per gram.

While performing this work, we detected trace amounts of radioactivity in the corroded steel duct at the access point into the facility and in soil samples taken adjacent to that duct. The steel duct and contaminated soil were removed and retained for analysis and appropriate disposition. The duct will be disposed of as low-level radioactive waste. Soil samples taken from the excavation pit indicated there was limited migration into the soil and at locations one meter radially from the duct no radioactivity was detected using similar counting techniques. The specific activity of all soil samples is well below one picocurie per gram. The total activity in the contaminated soil is estimated to be less than ten microcuries. The contaminated soil is currently being contained and segregated from other soil.

Due to the extremely low activity of the material, AFRRI is requesting authorization to rebury the material as described in the attachment in accordance with 10 CFR 20.302. If authorization is granted prior to January 8, 1994 the contractor will be directed to put the soil back into its original location at a depth of approximately eight meters below the final grade. If authorization cannot be granted until after that date, we propose to bury the soil at a depth of at least one meter in another location on-site. In either case the projected dose equivalent for the maximally exposed individual is expected to be well below one millirem per year. Moreover, both the specific activity of the soil and the total activity is well below values that have already been authorized for on-site disposal as discussed in "Disposal of Slightly Contaminated Radioactive Wastes from Nuclear Power Plants", *Radiation Protection Management* 9(6):72, 1992.

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The attachment describes the site, counting data, principal exposure pathways, and calculations of the estimated dose to the maximally exposed individual. In the interest of enhanced protection to the general public and maximum savings in dollars to the government, we request the most expeditious reply to this request that is possible.

The point of contact for further information is Thomas J. O'Brien, AFRRI Radiation Protection Officer (301-295-1285) or Mr. Mark Moore, Reactor Facility Director (301-295-1290).

Attachment:
as stated

Sincerely,

JOHN R. SHEEHAN
Colonel, USAF, MSC
Acting Director

Cy Furn:
USNRC Region 1
Attn: Mr. Thomas Dragoun
475 Allendale Road
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USNRC
Attn: Mr. Marvin Mendonca
Mail Stop 11B20
Washington, DC 20555

Attachment to AFRRI Application for Proposed Burial of Radioactive Material Under 10 CFR 20.302

Reference:

a. NUREG 5512, Residual Radioactive Contamination from Decommissioning.
b. Radiological Health Handbook. Washington, DC: USHEW, 1970.

BACKGROUND INFORMATION

A major construction project to replace the ventilation system for the exposure rooms associated with the AFRRI TRIGA Reactor Facility (License R-84) has been underway since October 1993. This project has required major excavation efforts to access the ventilation ducts for the facility. During the excavation process, extensive radiological surveying and sampling has been conducted.

High resolution gamma spectrum analysis of the soil adjacent to the facility was conducted at various depths of excavation. Gamma analysis of the soil immediately surrounding the exhaust ventilation duct for Exposure Room 1 (figure 1) indicated trace amounts of the activation products Mn-54, Co-60, and Eu-152.

The soil from this area has been environmentally isolated in an eleven foot square holding compartment. External dose rate surveys using a micro-R meter indicate levels do not exceed existing background levels (9 μR/h). Gamma analysis of this soil was performed by sampling approximately 3500 grams of soil from the center of the eleven foot square and from the center of each quadrant. Samples were analyzed in a Marinelli beaker geometry on a gamma spectroscopy system. The results are documented in Table 1.

Table 1. Gamma Analysis of Soil Excavated to Access ER1 Duct

#	Co-60 (pCi/g)	Mn-54 (pCi/g)	Eu-152 (pCi/g)
1	<LLD	<LLD	<LLD
2	0.18 ± 0.06	<LLD	0.23 ± 0.09
3	0.08 ± 0.05	<LLD	0.17 ± 0.09
4	<LLD	<LLD	<LLD
5	0.05 ± 0.05	0.05 ± 0.03	<LLD

The maximum lower limits of detection (LLD) for the radionuclides are as follows:

Co-60	0.04 pCi/g
Mn-54	0.04 pCi/g
Eu-152	0.09 pCi/g

It is estimated that the total volume of soil is 11.3 cubic meters and, based on a density of 1.7 g/cm^3, the total mass of the soil is 2×10^7 grams. If the sample with the maximum specific activity is used (sample #2 from Table 1), the projected total activity is 9 μCi. Based on the average value of the five samples and assuming the LLD value for samples below the LLD of the counting technique, the projected total activity is 1.7 μCi.

BURIAL SITE INFORMATION

Method of Disposal

Alternative 1: Replace the contaminated soil to its original location as a part of the scheduled completion of the ventilation system replacement project. The soil would be covered by approximately 8 meters of uncontaminated soil.

Alternative 2: Bury the contaminated soil at a depth to ensure that at least one meter of "clean" soil covers the contaminated soil in an alternate on-site location.

Location of the disposal site:

Figure 2 marks the proposed burial sites.

Local land use:

Both of the proposed sites are adjacent to the Armed Forces Radiobiology Research Institute which is located on the grounds of the National Naval Medical Center (NNMC). The NNMC government facility is used by the Department of Defense for medical care, research, education, and some limited residential areas (see Figure 3). There are no drinking water wells on the NNMC site, only environmental monitoring wells.

Physical or administrative barriers to prevent present or future use of the site for other than its intended purpose:

At least one meter of "clean" soil will cover the contaminated soil. The property is exclusively a federal installation and is likely to remain such for the indefinite future. Both sites are adjacent to the Armed Forces Radiobiology Research Institute. Excavation of these areas cannot occur without authorization by the Director of the Institute (Licensee) and other higher authorities.

EXPOSURE PATHWAYS:

External Exposure: The external exposure for the maximally exposed individual was calculated for the three radionuclides of concern (^{54}Mn, ^{60}Co, and ^{152}Eu). The maximum values of the specific activity of each of these isotopes reported in Table 1 was used to calculate the dose equivalents reported in Table 2. The second column of Table 2 is the dose equivalent rate factor taken from Table 2.1 of reference (a). This external dose rate factor can be used to calculate the dose at the center of the surface of a cylinder of soil with uniform activity of the indicated isotope having a radius of 5 m and a depth of 15 cm. The third column is the maximum value of the specific activities of each of the isotopes reported in Table 1. The fourth column is the product of columns two and three and displays the projected external dose equivalent rate if the contaminated soil makes up the top 15 cm. The fifth column is the projected annual dose equivalent calculated by multiplying column four by 8760 hours. The sixth column is the projected annual dose equivalent corrected by the attenuation factor for 100 cm of soil placed directed over the contaminated soil. The attenuation factor was calculated by the product of a buildup factor (18.0) and a mass attenuation coefficient of 0.0518 cm^2/g, the minimum mass attenuation coefficient for the gamma rays of interest.

Table 2. Total Dose for the Maximally Exposed Individuals

Radionuclide	External Dose Rate Factor (mrem/h/pCi/g*)	Maximum Value of Specific Activity (pCi/g)	External Dose Rate (μR/h)	Annual Dose Equivalent (no attenuation) (mrem)	Annual Dose Equivalent with 100cm Soil Cover (mrem)
^{54}Mn	7.9×10^{-4}	0.05	0.04	0.35	0.001
^{60}Co	2.4×10^{-3}	0.18	0.43	3.77	0.010
^{152}Eu	1.1×10^{-3}	0.23	0.25	2.19	0.006

* Obtained from table 2.1 of reference (a)

An alternative and more conservative external dose equivalent calculation is to assume that all of the activity is reduced to a point source located at a depth of one meter below the surface. Using the maximum values of Table 1 for the specific activity of each of the isotopes, a soil mass of 2×10^7 grams, individual Γ factors for each of the isotopes (reference b), and the attenuation/buildup factors used above, the total annual dose equivalent is 0.2 mrem/year.

Inhalation of Resuspended Radionuclides: Inhalation of resuspended radionuclides will not occur because the material will be isolated from surface winds or disturbances by at least one meter of earth.

External and Internal Exposure to an Inadvertent Intruder: External and internal exposure to an

inadvertent intruder will be significantly less than 0.2 mrem/yr due to lesser occupancy time.

External and Internal Exposure from assumed recycling of the contaminated material: External and internal exposure of an individual from assumed recycling of the contaminated material at the time the disposal site is released from regulatory control will be significantly less due to decay of isotopes concerned. The time of government oversight, assumed to be 50 years for purposes of this document, will assure that all of the ^{54}Mn and ^{60}Co will have decayed approximately ten half-lives. The ^{152}Eu will have decayed approximately four half-lives.

Internal Exposure from Ingestion of Groundwater: Both proposed burial sites are located at least 50 meters from the closest surface water. The composition of the soil is predominantly clay which will reduce transport of these isotopes. Furthermore, sampling one meter from the duct did not show detectable contamination. Historical environmental monitoring records of soil and water samples completed around the National Naval Medical Center have shown no evidence of contamination. Therefore, internal exposure from ingestion of groundwater will be significantly less then the external exposure calculated above.

Internal Exposure from Ingestion of Food Grown on the Disposal Site: Due to the present and future anticipated uses of the proposed burial sites while under government control, no food will be grown. The proposed burial depth is well below plow depth cited in reference(a)

FIGURE 1

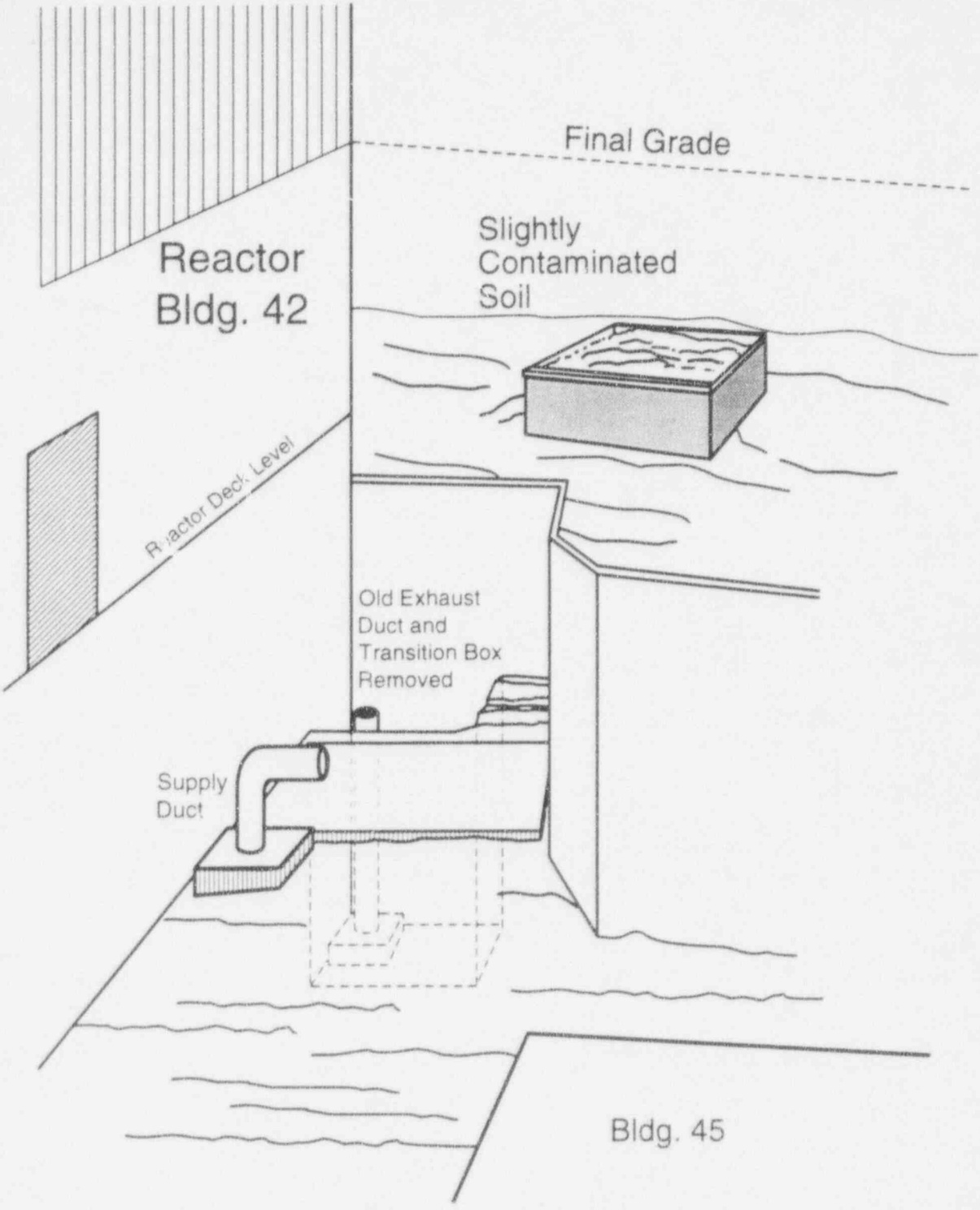

Final Grade
Reactor
Bldg. 42
Slightly
Contaminated
Soil
Reactor Deck Level
Old Exhaust
Duct and
Transition Box
Removed
Supply
Duct
Bldg. 45

FIGURE 2

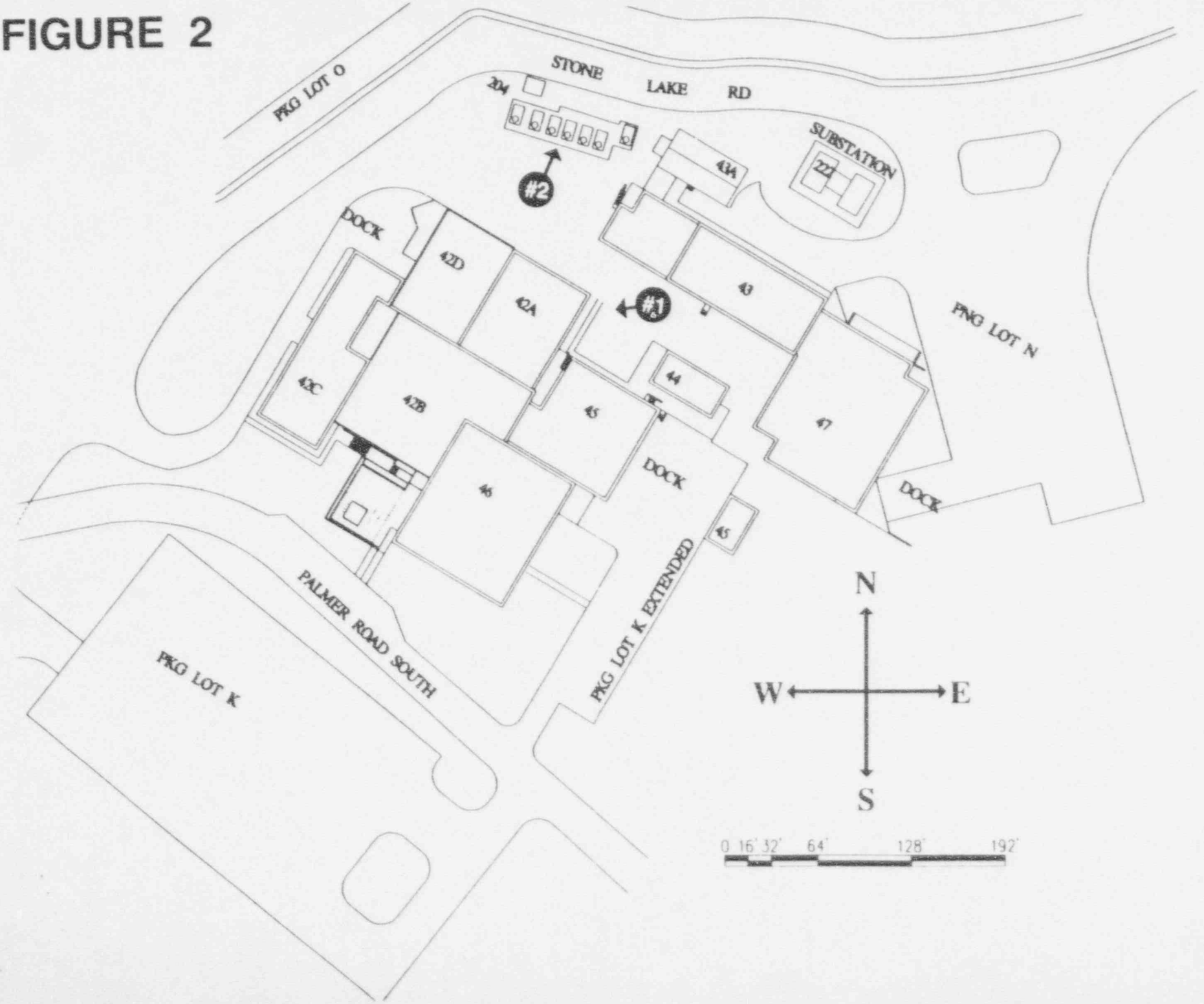
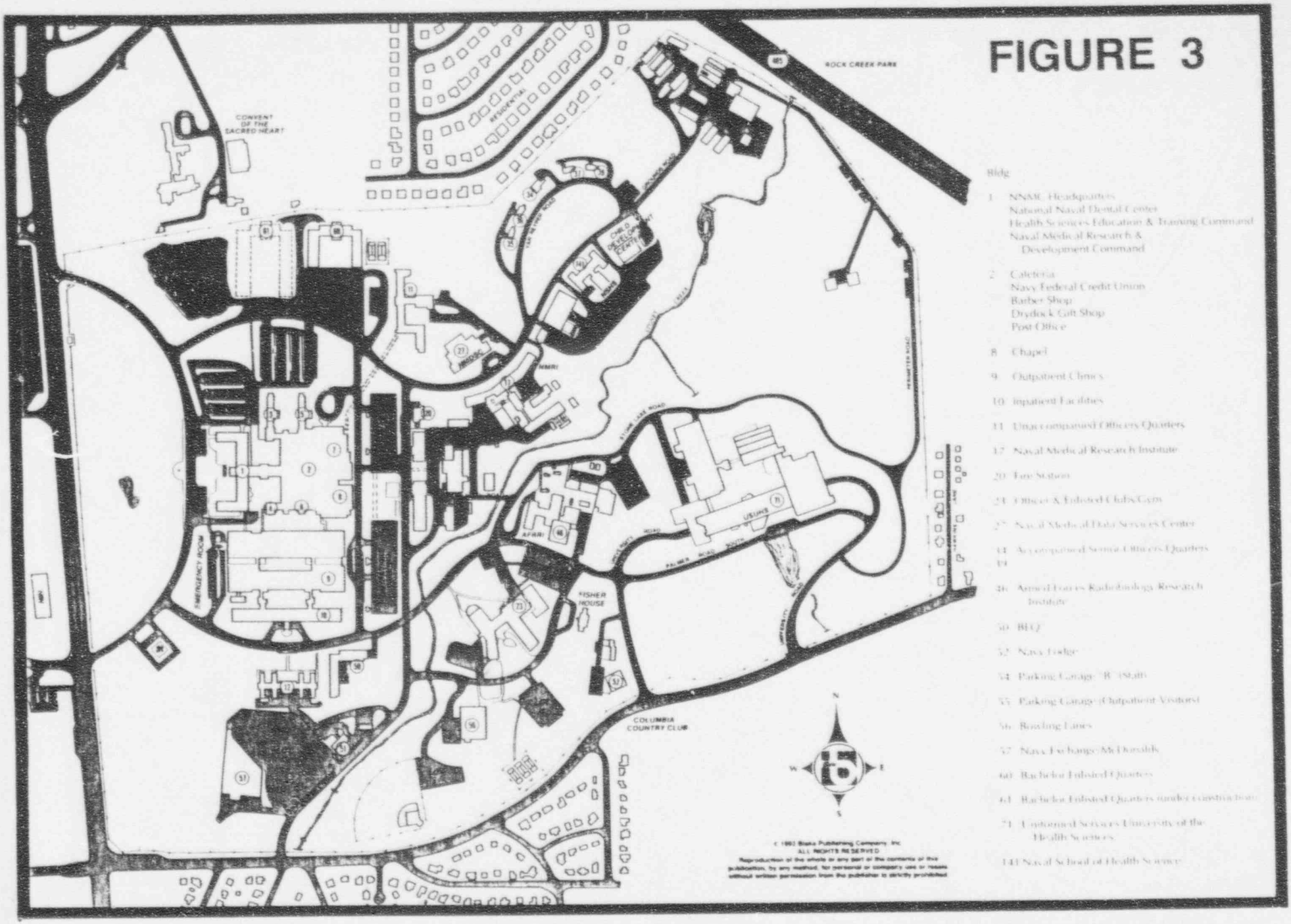

PKG LOT O
STONE LAKE RD
204
#2
#1
SUBSTATION
43A
22
DOCK
42D
42A
43
PNG LOT N
43C
42B
44
45
47
DOCK
DOCK
46
45
PALMER ROAD SOUTH
PKG LOT K EXTENDED
PKG LOT K
N
W
E
S
0 16' 32' 64' 128' 192'

FIGURE 3



Bldg

1 NNMC Headquarters
National Naval Dental Center
Health Sciences Education & Training Command
Naval Medical Research & Development Command

2 Cafeteria
Navy Federal Credit Union
Barber Shop
Drydock Gift Shop
Post Office

8 Chapel

9 Outpatient Clinics

10 Inpatient Facilities

11 Unaccompanied Officers Quarters

17 Naval Medical Research Institute

20 Fire Station

24 Officer & Enlisted Clubs/Gym

27 Naval Medical Data Services Center

41 Accompanied Senior Officers Quarters
19

46 Armed Forces Radiobiology Research Institute

50 BEQ

52 Navy Lodge

54 Parking Garage "B" (Staff)

55 Parking Garage (Outpatient Visitors)

56 Bowling Lanes

57 Navy Exchange/McDonald's

60 Bachelor Enlisted Quarters

61 Bachelor Enlisted Quarters (under construction)

71 Uniformed Services University of the Health Sciences

141 Naval School of Health Sciences