PRIVACY ACT MATERIAL REMOVED

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DEFENSE NUCLEAR AGENCY
WASHINGTON, D.C. [illegible]

29 APR 1985

Orangeburg, SC 29115

Dear Mr. :

Enclosed is the requested radiation dose reconstruction for your activities while in the Marshall Islands.

I trust this answers your inquiry.

Sincerely,

PAUL BOREN
Assistant NTPR
Program Manager

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(SUPERSEDES MEMORANDUM OF 14 MARCH 1986)

MEMORANDUM

15 April 1986

TO: File

FROM: C. Thomas

SUBJECT: Calculated Radiation Dose for - Operations IVY and CASTLE

PURPOSE

The purpose of this memorandum is to assess the radiation exposure potential for during November 1952, while a participant at Operation IVY. Although did not directly participate in Operation CASTLE, conducted at Bikini and Enewetak Atolls during the spring of 1954, he was stationed on Kwajalein during this test series; hence, his potential for radiation exposure resulting from the CASTLE tests is also addressed.

OPERATION IVY

During the month of November 1952, participated in the two atmospheric nuclear tests conducted at Enewetak Atoll in conjunction with Operation IVY. During this time period, as a Yeoman 3rd Class (YN3) assigned to the Gunnery Department aboard the USS RENDOVA (CVE-114). Specific shot data are detailed in Table 1.

Table 1. Operation IVY Shot Data

Shot	Date (Time)	Yield	Type Detonation
MIKE	1 Nov 52 (0715)	10.4 MT	Surface
KING	16 Nov 52 (1130)	500 KT	Air (1,480 ft)

Source: Reference 1

Dose reconstructions for Navy units participating at Operation IVY have been performed (Reference 2). activities while at Enewetak appear to deviate somewhat from the typical crew scenarios used in that analysis; therefore, the dose presented in Reference 2 for the crew of the USS RENDOVA is adjusted to account for his specific activities.

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As stated by , major deviations from typical crew activities were: (1) Except for times when his attacks of erythemia, urticaria, and pruritis were severe and he was in the sick bay, he spent most of the time in the shade on the hangar deck (02 deck) or in the vicinity of a 40mm gun mount on the fantail. From here he could look up and see the helicopters parked on the aft flight deck. (2) When recreation parties were permitted to go ashore on Japtan Island, he, being a former lifeguard instructor for the Red Cross, would accompany the parties to serve as lifeguard. estimates that he spent 85 percent of his time either on the hangar deck or an island.

RADIATION ENVIRONMENT

From Reference 2, the integrated free-field intensity on the USS RENDOVA's weather decks (topside) for the first 18 days of November was calculated to be 65.7 mR; all of which resulted from secondary (late-time) fallout from Shots MIKE and KING. The aft end RENDOVA's flight deck, which had become contaminated on 1 November by radiologically "hot" helicopters returning from early survey missions, was a restricted area and was roped off; hence, this area was not considered a radiation source which contributed to the typical crew exposure. Radiation environments on the residence islands of Enewetak Atoll were, in the absence of radiological survey data, estimated based on shipboard radiological data obtained on ships anchored in close proximity to the islands. On Parry Island, the residence island closest to Japtan, the integrated intensity for the same period was estimated to be 70.1 mR. It is assumed Japtan Island received comparable levels of radioactive fallout.

states that he spent "a lot of time" on the RENDOVA's hangar deck and fantail which were directly below the contaminated helicopters parked on the aft flight deck. A 1 November survey of the ship's interior revealed a maximum intensity of 35 mR/hr, obtained on the hangar deck directly below the contaminated helicopters. Figure 1 depicts the reconstructed radiation environment on the RENDOVA's aft flight hanger decks resulting from the contaminated helicopters. The roll-up phase report from the RENDOVA (Reference 3) states that the maximum intensity of helicopter #28 was [illegible] mR/hr at H + 1.1, and that of helicopter #26, 1 R/hr (1000 mR/hr) at H + 4.5 hours. However, the RENDOVA's deck log states that the maximum intensities on helicopters #28 and #26 were 2.0 R/hr at H + 1.1 hours and 1.5 R/hr at H + 4.2 hours, respectively (Reference 4). The intensities and times reported in the deck log are plotted in Figure 1 and are used in this analysis. Attempts to decontaminate helicopter #26 between H + 4.2 and H + 9 hours appear to have been somewhat successful as evidenced by the steepened decay

rate during this time period. Further attempts to decontaminate helicopter #26 between H + 9 and H + 13 hours had little or no effect, as decay during this time period was approximately proportional to $t^{-1.2}$, the same decay rate as would be expected from natural radioactive decay alone. Decontamination efforts on helicopter #28 reduced intensities from 500 mR/hr at H + 8 to 120 mR/hr at H + 10 (Figure 1). Intensity measurements are not reported after H + 13 hours and it is assumed the decay rate of helicopter #26 (and the aft flight deck), remained constant until the helicopters were transferred to shore on 4 November (approximately H + 77 hours). After removal of the helicopters, "a through scrubdown of the exterior decks with soap and salt water reduced the intensity to a background level" (Reference 3). During the period 1-4 November, the only source of significant radiation on the RENDOVA was the contaminated helicopters. It is assumed that the 35 mR/hr intensity measured on the hangar deck resulted solely from the presence of the contaminated helicopters. Further, it is assumed that subsequent hangar deck intensities, although not reported, were directly proportional to the intensity of the helicopters parked above it. This environment is depicted by the dashed line in Figure 1 and is the environment to which YN3 was exposed when on the hangar deck. The integrated free-field intensity on the aft hangar deck between H + 4.5 and H + 77 hours (1200 hours, 4 November) is 242 mR.

INITIAL RADIATION DOSE

At the time of Shot MIKE, the RENDOVA was 30 miles away, far beyond the range of meaningful radiation exposure. For Shot KING, the distance was 24 miles. In both cases, the initial radiation dose, including that from neutrons, was zero.

RESIDUAL RADIATION DOSE

The integrated free-field intensities to which YN3 was exposed are adjusted to account for time spent topside (or on an island) and below decks, and for any shielding provided by the ship's structure while below. The adjusted integrated intensities are then converted to an equivalent film badge dose using the conversion factor 0.7 rem/R as described in Reference 5.

It is assumed that during the period 1-4 November YN3 remained onboard the RENDOVA (the first Shore Patrol to Japtan Island doesn't show up in the deck log until 5 November). The fallout contribution on the ship to the integrated intensity during this

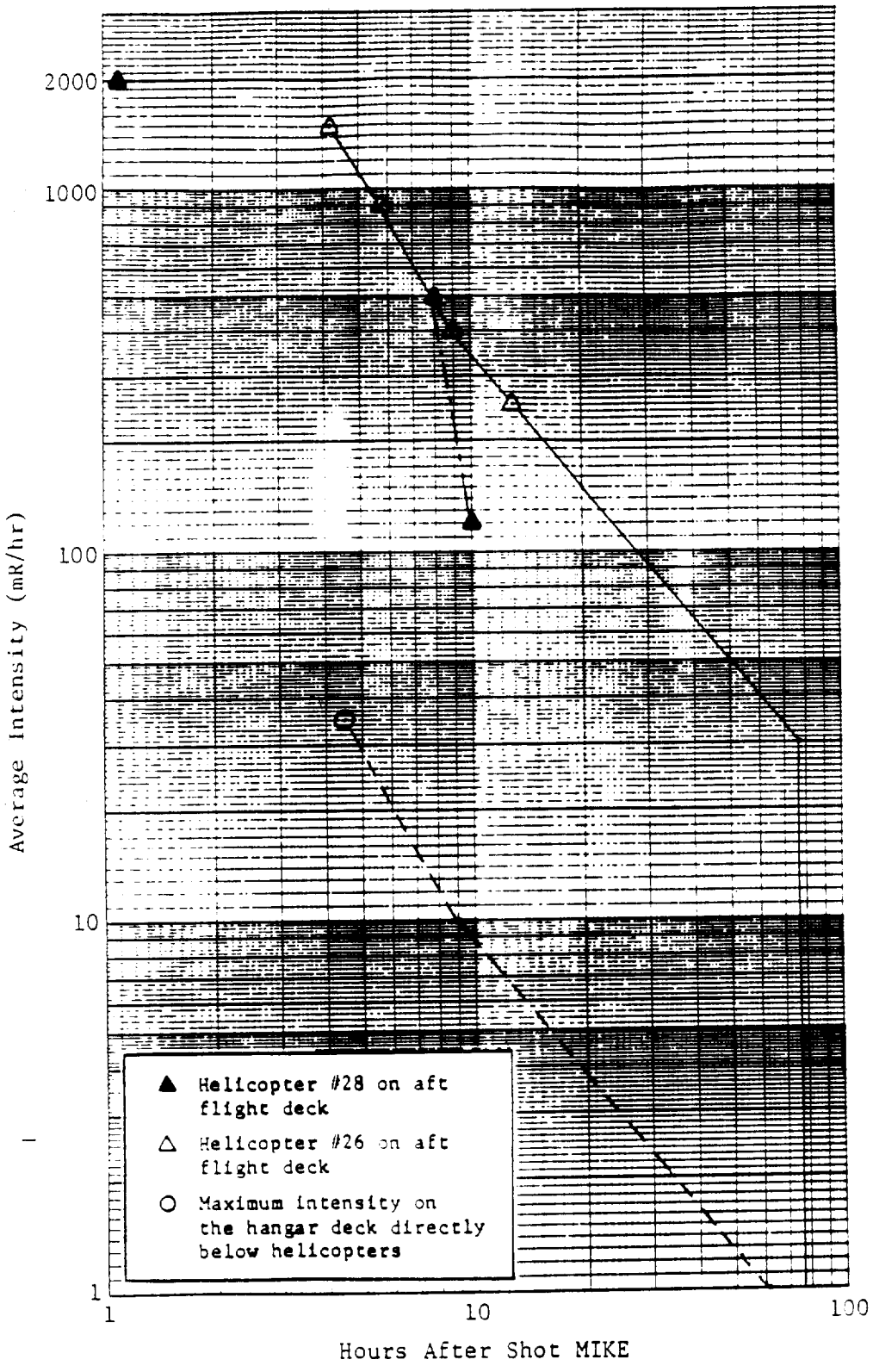

Figure 1. Intensity on aft flight deck and hangar deck of USS RENDOVA (CVE-114) 1-4 November 1952.

period is 6.4 mR (light fallout occurred on the RENDOVA during the early morning 4 November). Thus, the total integrated intensity to which YN3 was potentially exposed during this period is 248.4 mR. This analysis assumes that between 1-4 November, YN3 spent 60 percent of the day topside on the hangar deck with no shielding and 40 percent below decks. While below, he was offered a shielding factor of 0.06 by the ship's structure (Reference 2). (Typically, a crewmember is assumed to spend 40 percent of the day topside and 60 percent below). The dose calculations for 1-4 November are as follows:

$$\text{Dose}_{1\text{-}4\ \text{Nov}} = (.25\ \text{R})(0.7\ \text{rem/R})\left[0.6(1) + 0.4(.06)\right] = 0.11\ \text{rem}.$$

During the period 5-18 November, it is assumed that YN3 spent approximately 85 percent of each day either topside (on the hangar deck) or on Japtan Island. Trips to Japtan are assumed to have lasted for six hours. The free-field integrated intensities on the RENDOVA and Japtan during this time period are 59.3 mR and 62.2 mR, respectively. Again, while below deck, he was shielded by the ship's structure. The dose calculations for the period 5-18 November are as follows:

$$\begin{aligned}\text{Dose}_{5\text{-}18\ \text{Nov}} &= (0.7\ \text{rem/R})\left[6/24(0.062\ \text{R}) + 14/24(0.059\text{R}) + 4/24(.059\text{R})(.06)\right] \\ &= 0.04\ \text{rem}\end{aligned}$$

YN3 total gamma dose while at Enewetak during the period 1-18 November is therefore 0.11 + 0.04 = 0.15 rem.

also states that he swam in radioactive water while he was a lifeguard on Japtan Island. Water samples were obtained off Miramar Beach (Parry Island) on 3, 4, 6, 7, 8, 9 and 17 November 1952. Activity was noted only on 4 and 6 November when water samples showed activity concentrations (beta-gamma) less than one-tenth the maximum permissible concentration; it was concluded "that swimming at Miramar Beach involved no hazard because of radioactivity" (Reference 6). Samples obtained between Parry and Japtan islands revealed even less activity than those at Miramar Beach; hence, swimming at Japtan would have provided no significant dose contribution.

DOSE DUE TO INTERNAL EMITTERS

During YN3 exposure to contaminated helicopters in the period 1-4 November, the possible inhalation of resuspended fallout is considered. It is noted that

the contamination on the helicopters was not easily removed (as evidenced by the decontamination efforts), and that a large portion of any wind-removed contaminants would have blown away from the ship by the constant prevailing winds. Nonetheless, it is assumed for this analysis that YN3 while being exposed on the hangar deck to the external radiation from the contaminated helicopters on the flight deck above him, was also downwind of the helicopters and inhaled contaminants that were resuspended by the wind. Wind-driven resuspension factors range from 10^{-10} to 10^{-5} m^{-1}. For a high-sided factor of 10^{-5} and conditions of exposure necessary to accrue a film badge dose of 110 mrem (the calculated dose while aboard the RENDOVA), the bone dose commitment is about 1 mrem. Conversely, for an internal bone dose commitment of 150 mrem (the threshold for meaningful internal dose), the film badge dose would have had to be 10 rem. Thus, YN3 internal bone dose commitment is less than 150 mrem by two orders of magnitude.

OPERATION CASTLE

Operation CASTLE was conducted at both Bikini and Enewetak atolls in the [illegible] during March-May 1954. Although not a participant at CASTLE, YN3 was stationed on Kwajalein Atoll throughout the duration of the operation and was exposed to radioactive fallout from several of the detonations. Kwajalein received fallout from Shots BRAVO, ROMEO, and YANKEE. Dose calculations have been performed for personnel assigned to Kwajalein during Operation CASTLE (Reference 7). Since Mr. does not refer to any atypical exposure conditions while stationed on Kwajalein, his calculated fallout dose is 0.32 rem. The initial radiation dose is zero and the internal dose, based on 1 R/hr intensities (adjusted to H+1) at up to 100 hours after each shot (Reference 7), is less than 10 mrem.

SUMMARY

YN3 while assigned to the USS RENDOVA (CVE-114) at Operation IVY received an external dose of 0.15 rem gamma. This includes contributions from fallout on the RENDOVA and on Japtan Island, as well as that from contaminated helicopters that were parked on the aft flight deck of RENDOVA. His bone dose commitment for the potentially high risk period (due to resuspended contaminants from helicopters) aboard the RENDOVA was about .001 rem. Initial radiation dose was zero. While assigned to Kwajalein during Operation CASTLE, YN3 received an additional 0.32 rem gamma from fallout that occurred on that atoll. Mr. total calculated dose for the activities he has described is 0.47 rem gamma and less than .15 rem commitment to the bone.

REFERENCES

1. "Compilation of Local Fallout Data from Nuclear Test Detonations, 1945-1962," Volume II - Oceanic US Tests, DNA 1251-2-EX, Defense Nuclear Agency, 1 May 1979.

2. "Analysis of Radiation Exposure for Naval Personnel at Operation IVY," DNA-TR-82-98, Defense Nuclear Agency, 15 March 1982.

3. "Roll-up phase; report of," letter from Commanding Officer, USS RENDOVA (CVE-114) to CTG 132.3, 20 November 1952.

4. Deck Log from USS RENDOVA (CVE-114), November 1952.

5. "Fallout Inventory and Inhalation Dose to Organs (FIIDOS)," DNA-TR-84-375, Defense Nuclear Agency, June 1985.

6. "Radiological Assays with Radiac Set AN/MDQ-1 (EX-3) During Operation IVY," Technical Memorandum 1546, US Army Signal Corps Engineering Laboratories, 16 November 1953 (Unpublished).

7. "Analysis of Radiation Exposure for Naval Personnel at Operation CASTLE," DNA-TR-84-6, Defense Nuclear Agency, 31 January 1984.