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HEADQUARTERS TASK UNIT 13
Task Group 7.1
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(initials)
CA046

12 March 1954

TU-13-54-375

SUBJECT: Radiological Survey of Downwind Atolls Contaminated by BRAVO

1. Acknowledgement

The members of the survey team wish to express their appreciation to Captain, officers and members of the crew of the USS NICHOLAS (DDE 449) for the assistance and cooperation in conducting the survey herein reported. Captain Elliot turned over all possible facilities of his ship in order to assist in the survey. LT Frink, the Executive Officer, organized all the operations of the boat parties, and it was only through his personal direction and participation that it was possible to carry out the small boat surveys under extremely difficult conditions. Since most of the lagoon waters were not navigable by a DDE, it was necessary to make long boat trips in high seas and land on tricky coral reefs. That it was possible to make, without mishap, a detailed survey of five widely separated atolls in the course of three days with only two boats was largely due to his efforts.

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2. Introduction

The BRAVO Shot contaminated a number of atolls in generally eastward direction from Bikini to such an extent that it became necessary to evacuate the native populations from Rongelap, Alinginae and Utiirik Atolls and the military personnel on Rongerik Atoll. Following this evacuation CJTF SEVEN organized the subject detailed radiological survey of the atolls to the eastward of Bikini (Ref. CJTF SEVEN Eniwetok 060400Z). The data from this survey were required for the following purposes:

- a. The evaluation of the radiation effects on evacuees.
- b. The estimation of the elapsed time before reoccupancy.
- c. The estimation of the residual radiation effects of large yields surface detonations.

In connection with this survey, teams from various Task Groups and Mr Wilds, Trust Territory Representative, returned to the atolls to secure the evacuated habitations, service military equipment, and obtain documentary photography.

3. Operational Schedule

8 March - 0800 Survey team rendezvous aboard USS NICHOLAS (DDE 449) in Rongelap Lagoon.

Classification (Unclassified)
By Authority of TF REVIEW POE/DNA Class C
Ch ISO/UNA Date 29 Oct 80

DNA 30/058

NO RESTRICTED DATA OR FORMER RESTRICTED DATA
DOES HAS NO OBJECTION TO ITS DECLASSIFICATION.
COORDINATION REQUIRED WITH POD
DATE 10/21/80
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THIS DOCUMENT CONSISTS OF 11 PAGE(S)

SRD-213-54-3E

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- 88 ~~March~~ - 1000 - 1800 Two parties in small boats surveyed living area on Rongelap Island and eastern half of Rongelap Atoll
- 9 ~~March~~ - 0700 - 1130 Two parties in small boats proceeded from the I which was stationed outside Utirik Atoll and surveyed Utirik and Aon Islands, the main islands of the Atoll
- 9 ~~March~~ - 1500 - 1700 One party in a small boat landed on the outer reef of Bikar Island and surveyed the island, the on large island of Bikar Atoll.
- 10 ~~March~~ - 0700 - 1100 Two parties in small boats proceeded from the I which was stationed outside Rongerik Atoll and surveyed Eniwetak Island (where the Task Force's Units had been stationed) and the other important islands of the Atoll.
- 10 ~~March~~ - 1430 - 1900 Two parties in small boats proceeded from the D which was stationed outside Alinginae Atoll and surveyed the inhabited islands of the Atoll.
- 11 ~~March~~ - 0700 - 1400 One party in a small boat surveyed the northwestern islands of Rongelap Atoll and one party rechecked the living areas on Rongelap Island and established a reference location for future decay measurements.
- 12 ~~March~~ - 0800 Survey team arrived Eniwetok Atoll via DDE.

4. The following personnel from test projects in TG 7.1, TU 13, served as members of the survey team:

TU-13 Staff
Project 2.1
Project 2.5a
Project 6.4

The USS NICHOLAS (DDE 449) supplied boat crews under the direction of LT Cliff Frink, Executive Officer, for surveys.

5. Instrumentation

PRIVACY ACT MATERIAL REMOVED

Radiac set AN/PDR-39 was selected as the instrument to be used in the conduct of the survey. Five (5) each of AN/PDR-39 were calibrated with an ^{60}Co Curie source twenty-four hours before departure. The calibration yielded zero variation between instruments - any scale. Upon cross checking three of those instruments, (a point of actual survey) in a radiation field of 0.320 r it was found that all three instruments gave the same reading.

These survey meters were subject to prolonged use under adverse conditions of dampness (to the point of sea water splashing over them), salt deposits and continual rough handling. With one exception, all instruments operated efficiently for the duration of the operation. On the final day it was found

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that one survey meter could not be properly zero adjusted. The four remaining AN/PDR-39, still operated efficiently and seemed to be in good working order.

One (1) each Beckman MX-5, and one (1) each AN/PDR-27A was brought along for any low intensity checks necessary. Two (2) each calibrated AN/PDR-T1B, were on hand to serve as spares in the event of operational failure with the AN/PDR-. None of these instruments were required.

6. The average and maximum gamma dose rates measured on the various islets of each atoll are plotted in Figures 1 through 5. All measurements were made at waist height unless otherwise indicated. The maximum readings do not include measurements made with the instrument next to a contaminated surface.

Detailed surveys were made of all the inhabited localities. Typical readings are given in Tables 1 and 2 for the native village of Rongelap Island, and the TG 7.4 camp on Eniwotak Island. In general, the villages and the camps appeared to have slightly lower average dose rates than the remainder of the island. This can perhaps be ascribed to different geometry of the contamination and to slightly greater penetration into the loose gravel in the native village. The dose rates inside the native huts appeared to be almost the same as the dose rate outside. The dose rate in the middle of the military barracks, tents, and shacks was 1/3 to 1/2 that outside. This reduction is probably largely a geometric effect. The dose rate fell off rapidly on the beach below the high tide mark. There was no evidence of rain washing off the contaminated material. The foil on the windward sides of the islands appeared to be slightly above average contamination.

TABLE 1

TYPICAL READINGS IN RONGELAP VILLAGE - 8 MARCH

<u>Location</u>	<u>Dose Rate (mr/hr)</u>
Rongelap Island (average)	375
Center of village	280
Near central cistern	300
Near southern cistern	220
Near northern cistern	350

TABLE 2

TYPICAL READINGS IN CAMP ON ENIWOTAK IS. - 10 MARCH

<u>Location</u>	<u>Outside Dose Rate (mr/hr)</u>	<u>Inside Dose Rate (mr/hr)</u>
Eniwotak Island (average)	280	--
Mess hall	220	110
Tent, edge of main camp	270	175
Latrine	260	160
Sleeping quarters	260	90
Dispensary	220	110

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	290	160
Radio Station	280	110
Weather Station (N end of island)	240	--
Proj 6.6. Station (S end of island)		

In order to estimate the rate of decay between 8 and 11 March, the following radiation measurements were taken on three days on Rongelap Island:

	<u>8 March</u>	<u>11 March</u>
Central living area (village)	280 mr/hr	179 mr/hr
Southern most cistern	220 mr/hr	145 mr/hr
Roof of cistern (Southern most)	240 mr/hr	140 mr/hr
Ground (contact) cistern area	220 mr/hr	110 mr/hr

An area was selected 30 yards inland from the Rongelap cemetery as a measuring point for future decay measurements. This area is outlined with 2X4s placed on pails. The waist height reading was 210 mr/hr at 1000 hours, 11 March 1954

7. Sample collections

Water samples were collected from the water supplies of all inhabited areas. About two quarts of water were transferred to a polyethylene bottle at each site. These will be turned over to the New York Operations Office, AEC for analysis.

Soil samples were collected at all inhabited areas and also at several uninhabited islands. In collecting the soil samples a one foot by one foot square was marked on the ground and soil to about one inch of depth was removed from the square and transferred to a cardboard container. The primary samples will be turned over to the New York Operation Office, AEC, for analysis, and some smaller samples will be analyzed by Program 2 of TU 13.

Listed in Table 3 are the samples taken with the dose rate measured at waist height at the location where they were taken.

TABLE 3 - SOIL

<u>Sample No.</u>	<u>Atoll</u>	<u>Island</u>	<u>Date</u>	<u>Mr/Hr</u>
1*	Rongelap	Rongelap (North end)	8 Mar	440
2	Rongelap	Rongelap (Center of village)	8 Mar	280
3	Rongelap	Rongelap (1 mile north of village)	8 Mar	340
4	Rongelap	Rongelap (near South cistern of village)	8 Mar	220
5*	Rongelap	Eriirippu	8 Mar	2200
6*	Rongelap	Eniaetok	8 Mar	900
7*	Rongelap	Kabelle	8 Mar	2000
8*	Utirik	Utirik	9 Mar	40
9	Bikar	Bikar	9 Mar	160
10	Rongerik	Eniwetak	10 Mar	280
11*	Ailinginae	Sifo	10 Mar	100

*Small additional sample taken for analysis by Program 2 of TU 13

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TABLE 3 - WATER

<u>Sample No.</u>	<u>Atoll</u>	<u>Island</u>	<u>Date</u>	<u>Mr/hr</u>
1	Rongelap	Rongelap (central cistern)	8 Mar	300
2	Rongelap	Rongelap (North part of village)	8 Mar	350
3	Rongelap	Rongelap (Northernmost cistern)	8 Mar	400
4	Rongelap	Rongelap (Southernmost cistern)	8 Mar	220
5	Utirik	Utirik (cistern near church)	9 Mar	40
6	Utirik	Utirik (cistern at south of village)	9 Mar	40
7	Rongerik	Eniwetak (Distillation water)	10 Mar	240

In addition to the above, a sample of foliage was taken at the windward side of Bikar Island. The radiation field was 180 mr/hr on 9 March 1954 at this point.

8. Conclusions and Recommendations

a. The radiological survey proved that a large yield surface detonation can produce extremely serious radiological contamination over a distance more than 120 miles downwind and important contamination about 250 miles downwind.

b. The center of the contamination pattern from the BRAVO Shot lies somewhat north of Rongelap and Rongerik Atolls and probably not far from a line between Bikini and Bikar.

c. Although the fall-out was serious on Rongelap Island located at the extreme southeast tip of the atoll, the contamination was about ten times greater at the north side of the atoll, twenty miles away.

d. The contamination decreased by a factor of about eight over the downwind distance of 50 miles between Rongelap and Rongerik.

e. Standard military field housing provides a significant degree of protection to personnel inside.

f. The AN/PDR-39 proved to be a very satisfactory instrument for field survey work under rigorous environmental conditions.

g. A single DDE with two (2) whale boats is not a completely satisfactory method of conducting a broad radiological survey of the type just completed. Future surveys should consider using vessels capable of entering more of the atolls and of handling a helicopter and several small boats.

6 Incls:

1. Rad. Survey Rongelap
2. Rad. Survey Utirik
3. Rad. Survey Bikar
4. Rad. Survey Rongerik
5. Rad. Survey Ailinginae
6. Summary of Rad. Survey

/s/ Herbert Scoville
DR. HERBERT SCOVILLE
Technical Director
AFSWP

which commenced about 1015, 5 May following Runt II, and did not materially interfere with the work carried on by the Section.

5.4.2 Discussion

1. Lagoon and drinking-water samples: After the Shrimp event it became evident that recovery programs and preparations for future detonations at Bikini Atoll could only be accomplished by personnel working from ships anchored in the lagoon. Each detonation resulted in the lagoon water being contaminated; the magnitude and persistence of the contamination depended on the yield and location of the shot with respect to the anchorage sites.

A program was initiated by the TG-7.3 Rad-Safe Officer to pick up daily samples, both from the surface and 90 ft below the surface, at various points in the lagoon. The samples were turned over to the Radiation Analysis Section, where the specific beta activity in microcuries per milliliter was determined. The purpose of the program was to protect the ships from the accumulation of hazardous amounts of radiation when anchored. The maximum concentration encountered in the lagoon anchorages was 8.4×10^{-3} $\mu\text{c/ml}$. The average activity varied from 1×10^{-4} $\mu\text{c/ml}$ to 3×10^{-4} $\mu\text{c/ml}$.

Also of interest was the drinking water on the ships since it was derived from the distillation of the lagoon water in the ships' evaporators. The possibility of carrying radioactive particulate matter into the fresh-water output existed, especially on board ships used primarily as hotel accommodations. Accordingly a program was set up by which ships turned in samples of drinking water and intake water from the lagoon on at least a daily basis. These samples were also analyzed for beta activity in microcuries per milliliter. No drinking water on board the ships was found to contain any appreciable radioactive material. In view of the fact that the activity found in the lagoon water was associated with the sediment left after evaporating the water, it was not surprising that the drinking-water samples derived from the condensation of water vapor from a distillation process contained no activity.

As the operation progressed it became evident that excessively contaminated water could be observed visually as a result of the sediment being deposited in the water and could be evaluated adequately using only a PDR-39 survey type meter operated from a helicopter hovering over the surface of the water. As a result of using this technique, following the Morgenster event the number of lagoon samples to be analyzed was reduced considerably and more time could be devoted to more pertinent problems (see Fig. 5.1).

In addition to the drinking-water samples from the ships, drinking-water samples were analyzed from Rongelap, Kwajalein, and Uterik islands. The initial samples from Rongelap were collected at the time the natives were evacuated from the island on 5 March and followed to the end of the operation for decay characteristics. The specific activity of these samples indicated that the water was contaminated from 2 to 25 times above the AEC operational tolerance of 5×10^{-3} $\mu\text{c/ml}$. A representative decay curve for one of these samples is shown in Fig. 5.2. No appreciable activity was found in the samples from Kwajalein Naval Station. Samples taken on the survey trip to Rongelap and Uterik islands indicated an average specific activity of 1.4×10^{-3} $\mu\text{c/ml}$ and 2.1×10^{-4} $\mu\text{c/ml}$, respectively. Two samples from Rongelap contained no activity and are not included in the above values.

2. Air sampling: Portable air samplers, capable of drawing 0.65 cu ft of air per minute through a 6-in. filter paper, were used on the initial survey flights following each event and during those periods when fall-out occurred on board ship. With the instrument on for 15-min intervals during the fall-out period, a continual check could be made as to whether fall-out was still occurring and at least a qualitative estimate could be made of the order of magnitude of the concentration of the radioactive contamination in microcuries per cubic foot of air. Using such a large-sized filter paper necessitates folding the paper twice in order to place it on the bottom of a large lead pig. Only gross counts per minute were obtained in counting. After these initial data were taken, however, a small portion of the filter paper was mounted on a brass planchet and followed for a period of time in order to obtain the decay characteristics of the sample. The decay curve for two such samples, collected after Alarm Clock and Runt II, are shown in Fig. 5.3. The air samples collected on 1 March, when the USS Batoko received a

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trajectory for the twenty thousand foot level. This trajectory, formerly moving toward the ENE, was reforecast to move in a circular clockwise path through south to west. The CINCPACFLT advisory included no health hazard problem for surface and air routes, but that fall-out on Bikini Atoll, as well as damage to structures, would delay re-entry several days. Further, the advisory stated that NYKOPO Flight Able was scheduled for 2 March and that it was not anticipated further action would be necessary.

During the trip back to ENIWETOK on the night of B Day, the fleet encountered a wide area of finely divided (apparently less than 5 micron) particles which caused top-side intensities as high as 350 mr/hr. Appropriate measures were instituted by the Navy Task Group Commander to the effect that all personnel not essential to open deck duties would remain indoors. Ships' weather doors were closed and the washdown systems operated intermittently. All personnel were debarked at ENIWETOK by about 1000H, 2 March.

The TG 7.4 radsafe monitor order to RONGERIK via KWAJALEIN, arrived over RONGERIK at about 0945H, 2 March. A pass was made over the length of the island where readings from 4 IN/TDR T1B instruments were 200 mr/hr at 500 feet and 350 mr/hr at 250 feet. The latter reading and a request for additional aircraft was relayed back to TG 7.4 via KWAJALEIN. The relay resulted in considerable delay and misunderstandings due to garbles. Upon landing at RONGERIK at 1130H, the monitor advised the detachment to evacuate. The following additional radsafe readings were taken:

- a. Inside a building where the men spent most of their time: 600 mr/hr. (Reading was low because the building had been washed down early in the morning.)
- b. Outside the above building, waist height: 1800 mr/hr to 2400 mr/hr.
- c. Surface of a bed in a living tent: 1200 mr/hr.

Eight men were loaded on the aircraft and evacuated to KWAJALEIN arriving at about 1400H, 2 March. Due to non-availability of additional amphibious airlift, the remaining 20 personnel were picked up on a return trip, and discharged at KWAJALEIN shortly after 1900H, 2 March. All personnel were decontaminated by the TG 7.3 search squadron stationed on KWAJALEIN.

At approximately 1200H, 2 March, Radsafe of the task force was advised of the TG 7.4 monitors intentions to evacuate RONGERIK. In the absence of intensity readings it was mutually agreed not to authorize evacuation and to request radiation intensity readings. This resulted in the puzzling information of "3.2 r/hr at one inch" and the more useful reading of 340 mr/hr at 250 feet. It was mutually agreed (by the TG 7.4 and Task Force Radsafe Officers) that an evacuation was necessary and verbal authority was given to do so. The negative answer to the first request to evacuate

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PRELIMINARY RESULTS NYKOPO AIRBORNE MONITORING SURVEY FLIGHTS
O/A 1 MARCH 1954 (CONDUCTED BY HEALTH AND SAFETY LABORATORY,
NEW YORK OPERATIONS OFFICE, AEC)

LOCATION (ATOLL, UNLESS OTHERWISE INDICATED)	LOCAL TIME (MARCH)	MAXIMUM GROUND INTENSITY (mr/hr)	LOCAL TIME (MARCH)	MAXIMUM GROUND INTENSITY (mr/hr)
<u>APLE</u>				
KWAKALEIN	021800	0.6*	041200	0.5*
LAE	021210	.08	040710	.04
UJAE	021224	.10	040752	.06
WOTHQ	021300	1.00	040819	1.60
BIKINI (NAMU ISLAND)			040913	96,000
AILINGINAE	021328	400.00	041011	200 to 390
RONGELAP (ISLAND)	021340	1350	(RONGELAP survey did not include RONGELAP ISLAND)	
RONGELIK	021400	1720	041410	1050
TONGI	021525	1.4	041533	1.6
BIKIN	021628	600	041632	160
UTIRIK	021651	240	041655	48
TAKA	021656	160	041702	44
AILUK	021716	76	041810	20
JEMO	021725	18	041820	12
LIKIEP	021740	6.0	041830	10

(NOTE: There is some doubt that intensities indicated represent the maximum for the atolls listed or that the re-survey covered the same location as the 2 March survey. Readings marked with asterisk are ground observations.)

BAKER

NAMU	030720	.02
AILINGELAPALAP	030745	.08
NAMORIK	031423	.20
EBON	031247	.20
KILI	031224	.20
JALUTT	031206	.20
MILI	031109	.60
AINO	031028	.60
MUJURO	031016	2.0
AUR	030945	.40
MALOELAP	030924	3.6
ERIKUB	030902	4.0
WOTJE	030850	20

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Based on the Bikini experience and the forecast 72-hour air particle trajectories, NYKOPO Flight Able was scheduled for 30 March to assess the effects of secondary fall-out on the atolls east of Bikini.

On 30 March a report was received from DTG 7.3 to the effect that no early fall-out was received by any ship except the experimental YAG's, that nearly all ships and boats received light contamination from fall-out occurring approximately 40 to 48 hours after shot time, that average readings of 25 mr/hr were reduced due to decontamination and decay, that personnel exposures were negligible compared with BRAVO (estimated average additional individual exposures due to ROMEO was approximately 50 mr), and that, although the western quarter of the lagoon was still highly contaminated, it was doubtful if lagoon contamination would become a serious problem to ships. The above information was passed on 31 March to CINCPACFLT in accordance with a post-BRAVO request by CINCPACFLT for such information.

On 31 March information was received from the TG 7.3 unit on Kwajalein to the effect that 9 mr/hr maximums were observed on the windward side of tree trunks, 1 to 3 mr/hr average on beaches and 1 to 4 mr/hr average on windward sides of buildings. The average Kwajalein background prior to 31 March was 0.05 mr/hr. The advisory further stated that aircraft on training flights in the local area were concentrating contamination reaching maximum values of 20 mr/hr on engines. (Note: Approximately the same values were observed at Eniwetok by the evening of 29 March. Values were 5 mr/hr average, with 15 mr/hr maximum on windward surfaces.)

On 1 April a special radsafe advisory was dispatched to ComNavSta Kwajalein to reassure the garrison relative to the light fall-out experienced. This advisory noted that the fall-out on Kwajalein was of a degree equivalent to that experienced on Eniwetok and considered insignificant from a health standpoint. As a precautionary measure, it was suggested that Kwajalein water catch basins be examined carefully, the first run-off of the next rain be isolated and that a pint sample be taken for analysis. The facilities of the task force were made available (and accepted) for this analysis. (Subsequent analysis indicated no activity in the five samples taken except the one from Open Storage Tank No. 10 which read 4.85×10^{-4} microcuries per milliliter.)

On 3 April in response to a request from Kwajalein the above advisory was re-quoted to include CINCPACFLT, and further stated that the Task Force Staff Surgeon would visit Kwajalein to establish suitable operating procedures for future shots. (No further difficulties arose for the remainder of the CASTLE series.)

On 9 April information was received that wire services were carrying Tokyo stories reporting two Japanese fishing vessels outside the Danger Area arriving at port with radioactive tuna. These stories indicated that some of the catch was destroyed, vessels reportedly radioactive, but no illness reported on the crews. No official confirmation was received, and from the press stories the contamination appeared to be slight. Considering time and distance factors, the contamination could have come from ROMEO at fishing grounds to the east northeast of OZ.

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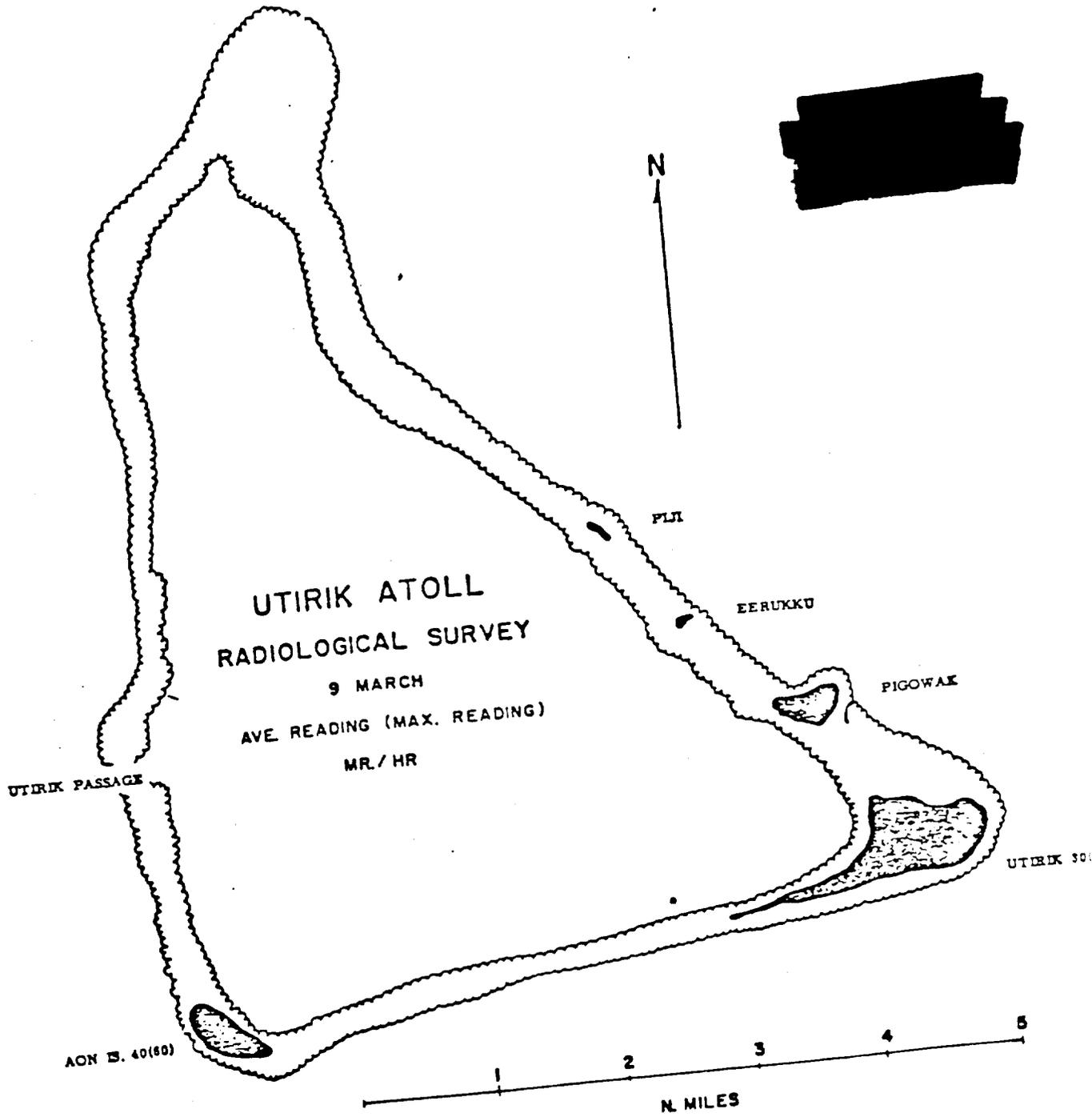


FIG. 2

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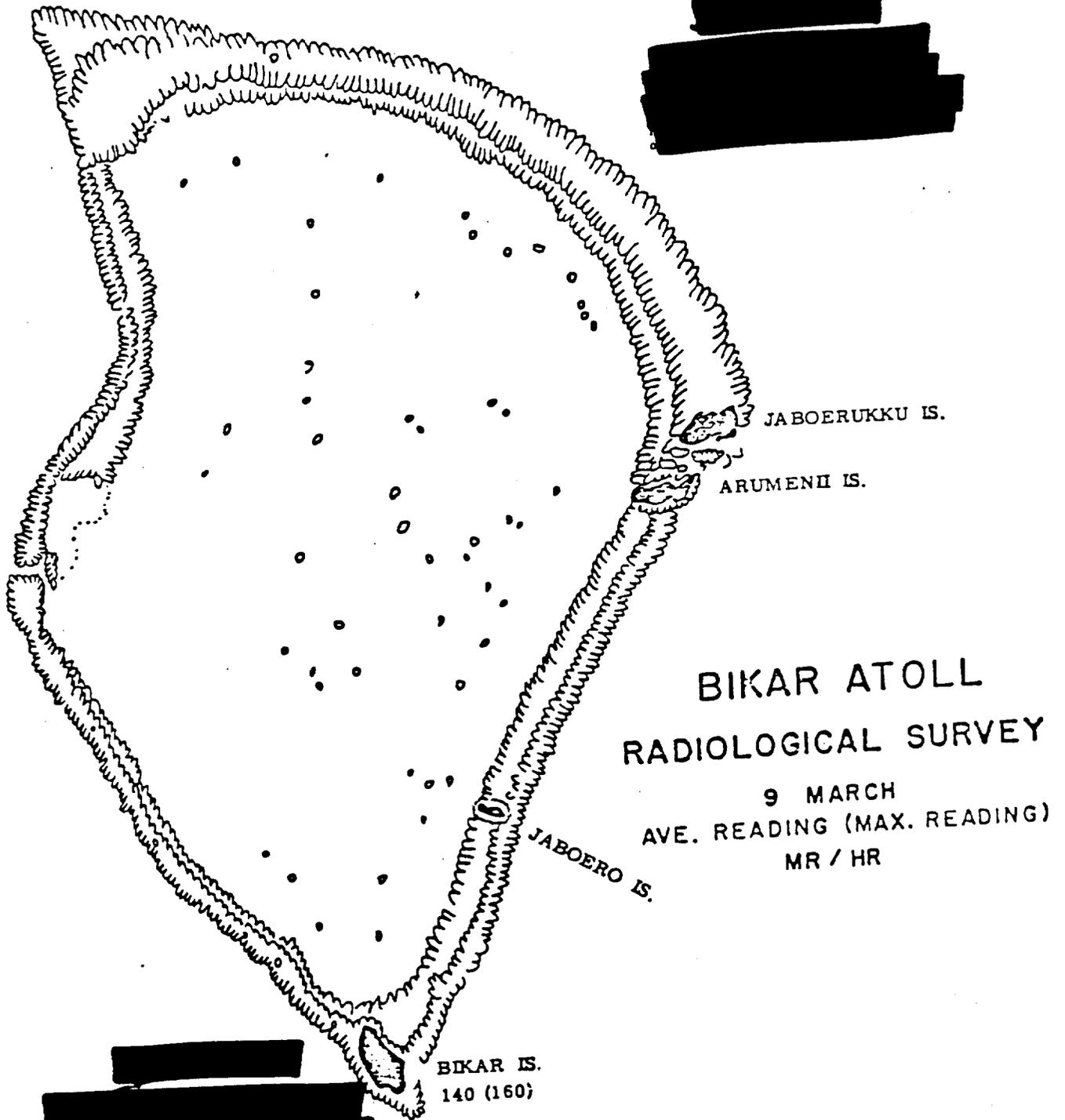


FIG. 3

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plan followed during C STAB.

c. That for future operations, the Task Group be given complete operational control of an entire twelve plane patrol squadron and that no attempt be made to combine missions.

d. That naval search aircraft be based at HOWLAND in future operations, but that provision be made for staging, parking and limited servicing on ENNETOL Island.

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