MEMO ROUTE SLIP
Form AEC-93 (Rev. May 14, 1947) AECM 0240

☐ See me about this. ☐ For concurrence. ☐ For action.
☐ Note and return. ☐ For signature. ☐ For information.

TO (Name and unit)	INITIALS	REMARKS
T. F. McCraw Health Protection Br. Division of Operational Safety, ERDA/HQ	DATE	SUBJ: DRAFT - "RADIOLOGICAL CLEANUP PLAN FOR ENEWETAK ATOLL," DATED 16 JANUARY 1976 by FIELD COMMAND, DEFENSE NUCLEAR AGENCY
TO (Name and unit)	INITIALS	REMARKS
	DATE	ERDA 402915 DIVISION OF OPERATIONAL SAFETY FEB 20 1976
TO (Name and unit)	INITIALS	REMARKS
	DATE	
FROM (Name and unit)		REMARKS
Bruce W. Church Radiological Br. BSD/NV		For your information, and review & FCDNA interested in any further comment you might have!
PHONE NO.	DATE	
	2/11/76	

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GPO : 1971 O - 445-469

RADIOLOGICAL CLEANUP PLAN FOR ENEWETAK ATOLL

(D R A F T)

16 January 1976

Field Command, Defense Nuclear Agency

RADIOLOGICAL CLEANUP PLAN FOR ENEWETAK ATOLL

RADIOLOGICAL CLEANUP PLAN FOR THE ENEWETAK ATOLL

I. PURPOSE

This Plan serves as the basis on which the radiological cleanup of Enewetak Atoll will be conducted. (Nonradiological cleanup is included only where necessary to differentiate the two.) The Plan attempts to structure a cleanup which incorporates the AEC Task Group Recommendations and other established radiation principles and practices with engineering methods and technology available for cleanup within the major constraint of limited funds authorized by the Congress. It covers the cleanup of contaminated soil and debris in accordance with the Environmental Impact Statement, and the radiation safety necessary to accomplish these endeavors in a satsifactory manner. Following approval of this Plan, detailed Standing Operating Procedures (SOPs) will be prepared as necessary.

This covers "cleanup of contaminated soil and debris". what about disposal?

II. SOIL CLEANUP

A. GENERAL.

1. The only contaminated soil to be removed as part of Cleanup is that which is contaminated with plutonium and its decay products. A basic assumption of the Cleanup Plan is that the AEC Enewetak Radiological Survey (AEC Report NVO-140, Oct 73) located all significant areas of such contamination. The Survey did not investigate every "square inch" of the Atoll; however, a random-sampling method was employed which was biased to increase sampling frequency in areas suspected of being contaminated because they were previously surface ground zeros and/or in fallout patterns, and in areas which were considered likely to be inhabitated someday. Sufficient samples were taken and analyzed from other areas such that the probability of any significant "hot spots" being missed is considered negligibly small. In other words, the Survey will be accepted as an authoritative source for having identified all areas potentially requiring plutonium-contaminated soil removal and no additional areas or "hot spots" are expected nor will any be searched for intentionally. Only if additional evidence is forthcoming will other areas be investigated for plutonium contamination.

2. Areas will be investigated as potentially requiring soil Cleanup only if the Survey reported them to have plutonium at concentrations greater than 40 pCi/g. Further, the numerical concentration values reported in NVO-140 will be the deciding factor irregardless of

sample dimensions or configuration. Thus, for example, samples which were 10-cm thick will be considered equally with samples which were 15-cm thick if they both were reported to have the same plutonium concentrations. Accordingly, islands or portions of islands which the Survey showed to have plutonium at less than 40 pCi/g will not be investigated.

B. PU SUSPECT AREAS.

1. Enclosure 1 differentiates those islands and portions of islands which might require soil removal from those which will definitely not require soil removal. (Approval of this Plan by ERDA is tantamount to a certification that the islands and portions of islands excluded from cleanup according to Enclosure 1 do not have plutonium contamination; namely, 40 pCi/g.) Without strong and new evidence to the contrary, only the areas designated for sampling in Enclosure 1 will be investigated. These areas will be referred to henceforth as "Pu suspect areas."

No!

No!

2. Pu suspect areas will be sampled at the locations specified in Enclosure 1. Each Pu suspect area will be surveyed to establish the horizontal coordinates and elevations of locations to be sampled. These sample locations will be uniquely marked so that on subsequent visits to a Pu suspect area the sampling locations can be readily identified. For areas having dense or tall vegetation that might interfere with survey-

ing and sampling, paths will be made. In so doing, vegetation will be removed with the least possible disturbance to the underlying soil; e.g., brush will be mowed down by either manual or mechanical means which attempt to leave root structures intact. Any brush which is cut will be collected and removed from the Pu suspect area and mechanically chopped to make mulch. All vegetation thus removed will be assumed to be noncontaminated with plutonium, but will be treated respectfully as though it might contain other radioactive contaminants. Accordingly, it will not be burned.

3. ~~HPIDLER~~ appropriate instrument readings will be made while the soil sampling is being performed. Locations which give a clear plutonium response will be documented (by the surveyors) along with the reading.

C. . SAMPLING METHODS.

1. Samples will be taken at either the air-ground interface (surface) or at depths beneath the interface (profile). Surface samples will be obtained by using a "top-soil cutter" tool which will facilitate removing sod to a depth of 5 cm within a well-defined area. The cutter area (or total area sampled) will be sufficient to give a sample mass which can be analyzed for plutonium by gamma spectroscopy (absolute counting of Am-241 gammas) down to the 40 pCi/g range. The mass is to be determined but probably will be in the order of 0.5 kg. Profile sam-

ples will be obtained by digging a trench immediately adjacent to the area to be sampled and removing soil from the trench wall by pushing into it a square pan with cutting edges on one open side. The pan will have a top-to-bottom distance of 5 cm and total mass collected will be the same as with surface samples.

2. Sample locations will be described; e.g., location is open savannah, brush-covered, or forrested, and level, mounded or depressed, as such information might provide additional clues for defining the bounds of cleanup areas.

D. SAMPLE PREPARATION.

Samples will be prepared for gamma spectroscopy by breaking up aggregates and pulling apart topsoil plugs (consisting of vegetation and root mat) as necessary. Any vegetation will be cut up so that it can eventually be distributed homogeneously. Samples will be dried sufficiently to allow successful mixing. Except for large rocks, which will be separated and discarded without taking any special efforts to remove surface deposits, the entire sample will be blended to give a more-or-less homogeneous matrix. A weighed quantity of the mixed sample will be packed into a standard-size container for analysis.

E. PU ANALYSIS.

1. Plutonium assay will be by nondestructive analysis whenever possible, employing high-resolution gamma-ray spectrometers with either intrinsic or lithium-drifted germanium detectors. The 64 keV gamma ray from the decay of Am-241 will be the indicator of plutonium. The counting system will be calibrated with Am-241-spiked soil samples equivalent to plutonium concentrations covering the range of interest, say 10 to 2000 pCi/g. The activity ratio of Am-241/Pu-239 will be assumed to be 0.4 as reported in NVO-, pg 97. In determining the total Pu activity, the Pu-238/Pu-239 ratio of 0.1 will be used, and no other Pu isotopes will be considered. Each sample will be analyzed (counted) once for a specified time, on the order of 50 minutes.

2. For samples whose Pu concentration is deemed critical to the conduct of Cleanup, analysis will be by standard radiochemical means using an acid-extraction, electro-deposition of unknown plutonium with tracer, and counting by alpha spectrometry.

F. PU CLEANUP AREAS.

Sample analyses will be correlated with survey data, any on-site FIDLER readings and qualative observations. If no samples yield Pu concentrations greater than 40 pCi/g, the Pu suspect area will be considered as noncontaminated and certified to be clean. If any positive readings (greater than 40 pCi/g) are obtained, they will either indicate

areas to be sampled in greater detail or will serve to define areas potentially (see Cleanup ranking below) to be cleaned. If more data is deemed necessary in order to better define cleanup areas, the survey/ sampling process described above will be repeated.

G. CLEANUP.

1. The border of areas to be cleaned will be marked by surveyors. The entire enclosed area will then be devegetated in the manner which causes the least disturbance to underlying soil. Mowed vegetation will be removed for mulching. Easily removable contaminated and noncontaminated debris will also be taken away (see Part III B Criteria). Large structures and concrete slabs which likely were in place prior to the deposition of any plutonium and which do not interfere with Cleanup will not be removed unless "swipes" show excessive removable plutonium is present.

2. For those Pu-contaminated areas which have highest concentrations near the air-ground interface (the majority of the Pu suspect areas), the soil will be removed in thin layers, one layer at a time, to a depth of at least 15 cm. The layers of soil and root mats will be assembled at central collection points, loaded into open bed trucks, covered and transported to the ultimate disposal site. where?

3. For Pu-contaminated areas which have high Pu concentrations at great depths, soil will be removed in conveniently thick layers until approaching the required excavation limits, then they will be removed in thin layers as described above.

4. Cleanup areas will be sampled at some to-be-determined frequency during soil removal operations to permit decisions on removing additional soil or certifying the area as cleaned. The scraping/sampling will be repeated iteratively, presumably reducing the area for cleanup with each pass, until an acceptable level has been reached. The endpoint to Cleanup at any site will be when plutonium concentration is assuredly below 40 pCi/g according to the gamma spectroscopy counting method employed. Areas ~~that~~ where the representative ERDA certifies ~~as clean~~ that cleanup is complete will subsequently be sown with grass seed.

check with T T agreement ref.

H. RANKING.

The Pu suspect areas together encompass an area of approximately 150 acres. This total is probably on the high side, however, as suspect area bounds were liberally placed. As summarized in Enclosure 1, nearly 4,000 samples are initially programmed for analysis to eliminate the suspicions and define the areas deserving Cleanup. The last column in Enclosure 1 summarizes an attempt to estimate the quantity of material which would be excised if the entire 150 acres must be cleaned up. The volumes were calculated by assuming that areas with significant contamination at the surface only will require cleanup to a depth of 15 cm, and areas which are contaminated to greater depths will be cleaned up to a depth approximately at the point where the AEC Survey shows Pu con-

centration to decrease to 40 pCi/g. The total volume according to these estimates is about 120,000 cubic meters (157,000 cubic yards). As such quantities might exhaust resources available, contaminated areas will be ranked following their initial definition. The ranking will consider factors such as the depth of burial, Pu distribution in each area, range and absolute values of concentrations, time and efforts required to perform soil removal, location of areas, etc, and will be negotiated with the ERDA Representative. The areas will be cleaned up according to their ranking.

III. DEBRIS CLEANUP

A. GENERAL

1. The AEC Task Group recommended that "all radioactive scrap metal and contaminated debris now or later identified" should be removed from Enewetak Atoll as part of Cleanup. Holmes & Narver, Inc, made the initial identification (H&N-1348) based on radiation measurements made during a brief two-week period of the Engineering Survey (12 Oct-21 Dec 72) by monitorings from the EPA working under the direction of the AEC. The Cleanup EIS estimates that materials identified as contaminated in H&N-1348 occupy a total volume of 7,262 cubic yards.

2. The two-week contaminated debris survey was limited to the detection of gamma contamination (alpha and beta contamination were not sought) present on the ten islands which had either surface ground zeros or heavy, close-in fallout. Additionally, only structures and scrap which were on the surface, visible and accessible were inspected, and no

attempt was made to search for structures not shown on as-built drawings. Thus, although H&N-1348 lists about 400 items of debris for the ten islands, the AEC (in report NVO-140) reports radiation measurements for only half of them (about 190 items).

3. The AEC did not establish any criteria for designating debris as contaminated. NVO-140 merely reports a single gamma exposure rate (presumably the highest) for the general area of an item of debris. Thus, for example, a "scattered junkpile" on Alice is given a value of 120mR/h and without any indication of the quantity of junk which has that exposure rate or whether any of the junk should be labeled as contaminated or noncontaminated. Cleanup will make the differentiation by comparison against specific criteria.

B. CRITERIA

1. No material is totally devoid of radioactivity. However, not every material should be considered as a radioactive pollutant worthy of decontamination. Some level of radioactivity below which a material should not be regarded as "contaminated" is proper. This is particularly appropriate at Enewetak since the general background to remain after Cleanup will in many places be greater than the radiation level from any individual item. No Federal or International rules and regulations are directly suitable for Cleanup, so this Radiological Plan will promulgate criteria for Cleanup.

2. The AEC Task Group and the Cleanup EIS note that materials which might be used by people in place or removed for use elsewhere are the ones of concern. Since there are post-Cleanup constraints on use of

"contaminated" organic materials (plants and animals), the Cleanup materials available for differentiation (contaminated or noncontaminated) are metal and concrete. These materials will collectively be called "debris."

OK

3. The radioactivity of debris can be removable surface contamination or fixed (nonremovable) contamination either on the surface or distributed throughout, as might result from activation. Cleanup will assume that any alpha radioactivity is present only as removable contamination, beta radiation is the predominant fixed contamination of concrete debris, and gamma radiation is the predominant fixed contamination of metallic debris.

NO!

4. Debris will be considered as contaminated and programmed for radiological Cleanup if it gives either:

Cleanup of Enewetak must be at least as good as at Bikini.

See paper 3+25 SWRHL 111r

(a) to a filter-paper swipe over a 100cm^2 area, an alpha radiation disintegration rate $\geq$20 dpm;

where did this come from? Page

(b) an absorbed dose rate $\geq$100 μrad/h when measured at a one cm distance through not more than seven mg/cm^2 absorbing material; or

(c) an exposure rate $\geq$15 μR/h at a 30 cm distance.

C. PROCEDURES

1. Cleanup will assume that the only islands which might have contaminated debris are those listed in Enclosure 2. (Approval of this Plan by ERDA is tantamount to a certification that the islands excluded from Enclosure 2 do not have contaminated debris.) These islands comprise about 900 acres including the 150 acres to be investigated for soil Cleanup. The entire 900 acres will be searched for debris, and all which is found will be monitored for classification according the above contamination criteria. The search will include thinning over-grown areas as necessary to permit a visual search for concrete and metallic debris. The only buried debris to be investigated will be at locations reported to be radioactive material burial sites.

Nope

2. Each item of debris will be filter-paper swiped and large items will be swiped at least once for every 10 m^2 of exposed surface. The swipes will be counted for alpha radiation. Exposed surfaces of concrete debris will be monitored for beta/gamma radiation according to criterion in para III.B.4(b) at a frequency of at least one reading for every square meter. Metallic debris will be thoroughly monitored for gamma radiation according to criterion in para III.B.4(c). All debris which qualified as "contaminated" will be uniquely marked for disposal.

The noncontaminated debris will also be marked but disposed of only if it poses a physical hazard or is an obstruction to intended use of the site on which it is located. Records will be maintained of radiation readings for each item.

3. Contaminated debris will be collected and loaded in open-bed trucks for transport by barge to the disposal site. The trucks will be monitored to assure that the absorbed dose rate at no point on the external surface exceeds 0.5 mrem/h. Any contaminated debris which might cause this limit to be exceeded will be separated and safely packaged for transport. Debris for Cleanup that is not contaminated as defined herein will be disposed of as noncontaminated debris regardless of any residual contamination it might possess.

what is the disposal method for noncontaminated debris.

IV. RADIATION SAFETY

A. GENERAL.

The level of radioactivity at Enewetak Atoll, as reported in the AEC Radiological Survey, is sufficiently low that persons may visit almost every location there without ~~fear~~ concern of being exposed to radiation in excess of established radiation protection guides. Cleanup is needed, however, because these guides would be exceeded if persons were to dwell throughout the Atoll. Cleanup itself needs radiation safety precautions because possibilities exist that previously undetected contamination will be uncovered, stockpiling of contaminated debris will enhance local radiation intensity, and cleanup activities will make plutonium more readily available for assimilation before it is contained. The safety precautions will result from a cleanup radiation safety policy which complies with the established guides, as well as makes every reasonable effort to maintain radiation exposure as low as is reasonable achievable taking into account the state of technology and the economics of improvements in relation to benefits to health and safety, and other societal and socioeconomic considerations.

B. APPLICABILITY.

1. Cleanup is a responsibility assigned to the Department of Defense and delegated to the Defense Nuclear Agency (DNA). Army engineer personnel will be assigned to perform the physical and radiological cleanup for, and under the overall management of, a DNA Joint Task Group. Although support will also come from other military services, federal agencies, and contractors, the Cleanup will be primarily an "Army Job." Accordingly, radiation safety will comply with Army Regulations insofar as is practical.

2. The Army Regulations will apply to all individuals who are at Enewetak Atoll during the period of Cleanup. Personnel not under control of DNA shall comply in all respects with the regulations or be denied access to Enewetak Atoll. The Cleanup Commander may permit variances however, if, in his judgement, an essential task cannot otherwise be accomplished. In such cases, adequate alternate safety procedures will be established.

C. CONTROLLED AREAS.

A "controlled area" is a defined area in which the exposure of personnel to ionizing radiation is under the supervision of an individual responsible for radiation protection. Initially, islands listed in Enclosure 2 will be designated as controlled areas. Controls will not be removed until the ERDA representative issues a certification acknowledging that ~~the defined area is rid of contaminated debris and soil as~~ defined in Parts II and III of this Plan.

D. RADIATION PROTECTION STANDARDS.

1. A "radiation worker" is an individual who might be exposed to more than 10 percent of the basic radiation protection standards (See Enclosure 3) as a result of his employment or duties in a controlled area. An "occasionally exposed individual" is one whose work is not normally performed in a controlled area and whose duties do not normally involve exposure to ionizing radiation; however, the individual may have reason to enter a controlled area in the performance of duties. Occasionally exposed individuals will not receive an exposure to ionizing radiation in excess of that allowed for any individual in the population at large.

2. Essentially all of cleanup can be accomplished by personnel categorized as occasionally exposed individuals; accordingly, the majority of the workforce will be treated as such insofar as radiation limits are concerned. If, on the other hand, radiation areas (See IV G.4) should be established, they will be assigned to personnel having the most experience with radiation, and qualifying as radiation workers.

E. MEDICAL EXAMINATIONS.

1. Preplacement and termination medical examinations will be given to all cleanup personnel. The examinations will include a review of prior occupational exposure and a description of any unusual exposure resulting from previous occupations, accidents, incidents, or therapeutic procedures, for the purpose of evaluating an individual's acceptability into the cleanup operation. Also, the examinations will include a lung count for any individual who may have worked with plutonium at some previous time.

2. Plutonium represents the greatest radiation hazard facing Cleanup workers. Although plutonium at Enewetak is harmless while it remains outside the body, it could cause deleterious effects if it enters the body. Precautions will be taken to prevent the inhalation or ingestion of plutonium, but a bioassay program will be prescribed to monitor the effectiveness of the precautions.

3. The principal bioassay method will be urine analysis. Urine samples will be taken on a periodic basis from all workers who at

any time are in the vicinity of plutonium contamination. Urine samples will be analyzed for plutonium to a sensitivity of at least 0.3 pCi. If positive readings should be obtained, additional bioassays; e.g., fecal analysis or lung counts, will be prescribed.

F. TRAINING.

All personnel who may at any time frequent or work in any controlled area will be informed by such means as lectures, briefings, handouts and notices, of:

(a) Health hazards associated with exposure to radioactive material or radiation,

(b) precautions or procedures to minimize exposure,

(c) purposes and functions of protective devices employed,

(d) decontamination purposes and procedures,

(e) responsibility of each individual to promptly report any condition which may lead to or cause a violation of radiological safety regulations and procedures or unnecessary exposures,

(f) radiation exposure reports which will be maintained on each person, and

(g) management's commitment to keep occupational exposures as low as is reasonably achievable.

Such training will be sufficient to ensure that the workers can correctly answer questions on radiation protection as it relates to their job.

G. PERSONNEL DOSIMETRY.

1. The primary dosimetry device will be the film badge, and the Army Photodosimetry Service shall be employed. The film badge contains one or more photographic emulsions and is designed to differentiate between beta particles, gamma rays, and x-rays.

2. A film badge will be worn by all personnel upon entering a controlled area. It will be worn on the front surface below the shoulders, above the hips, and on the outside of clothing, except where contamination of the badge could occur, or in difficult working conditions where the film badge might be lost or damaged. In such cases, the film badge will be worn under protective clothing.

3. The film badge wearer will be responsible for his badge and the contained film and will take care to avoid its exposure to excessive heat, humidity or moisture.

4. A self-reading pocket dosimeter will be worn, in addition to the film badge, at all times when an individual is in a radiation area; i.e., in any area in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 2 mrem or in any five consecutive days a dose equivalent in excess of 100 mrems. Radiation areas will be identified during the initial radiological reconnisance of each island. Exposure accumulated by the pocket dosimeters will be documented.

H. PROTECTIVE CLOTHING.

1. Plutonium is the only radiological threat of Cleanup which requires a protective-clothing response. As previously noted, Pu in the

ground is not a hazard, but if the ground is disturbed, personnel may come into contact with the Pu and be harmed. Persons operating in the vicinity of the disturbed ground might either inhale resuspended Pu directly, or become externally contaminated and susceptible to subsequent internal contamination of themselves or others. All Cleanup operations which disturb Pu-contaminated soil will thus be performed by personnel adequately protected.

2. The protective clothing prescribed for Pu operations may range from shoe covers and a surgical mask to a full compliment of shoe covers, coveralls, gloves, head covers and facepieces with either filters or air lines. Although it is proper to don adequate protective clothing, there are numerous reasons for not overdressing. For example, full-suiting may be intolerable when worn for extended periods in the warm, humid climate indigeneous to Enewetak. The "protection" provided by the clothes could in fact cause harm by leading to heat injuries. Thus, there is an incentive to wear just what is necessary and no more. The proper and minimum clothing will only be known precisely following an evaluation of on-site monitoring (e.g., air samples and nose swipes) against permissible contamination limits (See Enclosure 3); nevertheless, some initial protective-clothing requirements are described below.

3. With perhaps the exception of Pu suspect areas on Runit, no surface locations at Enewetak Atoll have a sufficiently high Pu concentration that they pose a hazard to persons merely walking on them; i.e., ordinary "foot traffic" is assumed to not create any resuspension prob-

lems and accordingly it requires no protective clothing. Likewise, the vegetation-thinning operations with minimum disturbance to root structures (to permit surveying and soil sampling) will be performed without protective clothing. In the case of Runit, air sampling results reported in the AEC Survey indicate that some caution should always be observed; therefore, the minimal precautions prescribed in the FCDNA Interim Quarantine for Runit Island will continue to be observed on Runit.

4. Personnel who collect surface soil samples from Pu suspect areas conceivably could come into intimant contact with Pu or cause slight local resuspension; consequently, they will wear gloves and surgical masks while performing such tasks.

5. Operations which are likely to stir up dust, such as profile soil sampling in Pu suspect areas, soil excavation, loading and sampling in Pu cleanup areas and contaminated soil disposal, will be performed by personnel fully suited. Further, since any resuspended Pu might be spread downwind from these operations, all personnel in the immediate downwind area will also be fully suited.

6. Transportation of soil from excavation sites to the disposal sites will not require protective clothing as the contaminated soil will be under adequate cover.

I. DECONTAMINATION

1. In addition to making the Atoll safe for re-inhabitation, an objective of cleanup is to prevent contaminated debris from becoming available on the world market. Since decontamination of contaminated debris (See II.B) is not a viable alternative, all such debris which is collected will be encrypted along with contaminated soil in the burial crater. Cleanup equipment, on the other hand, may possess a residual value which merits decontamination. Thus, all equipment deemed worthy will be decontaminated to permissible levels (See Enclosure 3) before they are returned to use in contamination free sites (on or off the Atoll). If the permissable levels cannot be achieved following thorough decontamination efforts, the equipment will either be transferred safely to users having appropriate licenses or disposed of in the same manner as contaminated debris. All unworthy contaminated equipment will likewise be encrypted.

2. To prevent the spread of contamination by personnel, each person will be thoroughly monitored and decontaminated as necessary prior to exiting from any controlled area.

J. DOCUMENTATION AND REPORTS.

Bla..Bla...Bla

1. Monthly reports - progress - distribution to DNA, EKDA, DOI.
2. Final report - Complete review of operations, methods, criteria and their implementation. Fail-Safe results. Debris Disposal. Rad status of atoll. Remaining tasks.
3. Records - maintained by DNA - medical results - original copies of field data - lab notebooks, data and reports. Files on personnel involved. Records on debris disposal.

SCHEDULE OF INITIAL SOIL SAMPLING FOR ENEWETAK CLEANUP

ISLAND	SURFACE SAMPLES[a] (pCi/g)	PROFILE SAMPLES[a] MAX CONC (pCi/g)	PROFILE SAMPLES[a] DEPTH MAX CONC (cm)	PROFILE SAMPLES[a] DEPTH CONC EQUALS 40 (cm)	PU SUSPECT AREAS	NUMBER OF SAMPLES TO BE TAKEN	CLEANUP VOLUME ESTIMATE (m^3)
Alice	68	170	3.5	9	Samples were from a field approximately 100 m by 100 m near the center of the island. The field will be sampled to a depth of 5 cm at 20 m intervals.	36	$1.5X10^3$
		120	1.0	3			
		100	1.0	3			
Belle	48	200	3.5	14	All but one sample was from a field approximately 120 m by 400 m covering about half of the island. The field will be sampled to a depth of 5 cm at 20 m intervals. The isolated sample (100 pCi/g) was from the lagoon-side beach. Ten samples will be collected from that general area.	157	$7.2X10^3$
	70	110	1.0	2			$.1X10^3$
	43	220	1.0	4			
	46						
	94						
	56						
	100						
Clara	45	65	12.5	16	All but one sample (55 pCi/g) was from a field approximately 140 m by 22 m, toward the northeast end of the island. The field only will be sampled to a depth of 5 cm at 20 m intervals along 4 equally-spaced rows running the length of the field.	32	$.5X10^3$
	55	96	3.5	8			
	88	85	1.0	6			
	44						
Daisy	54	64	12.5	15	All samples were from the southwest side of the island, in two fields approximately 120 m X 180 m and 120 m X 80 m. Both fields will be sampled to a depth of 5 cm at 20 m intervals.	105	$3.1X10^3$
	51	46	30	none[b]			$1.4X10^3$
	90	190	1.0	4			
	98						
Edna	0	0	0	0	None.	0	0

[a] AEC Report NVO-140 "ENEWETAK RADIOLOGICAL SURVEY" Oct 73, concentrations $\geq$40 pCi/g.

[b] Increases to max depth sampled (30 cm).

Irene	280	74	80	84	Samples were from an annular field about 600 m long surrounding the Seminole crater and extending landward about 80 m and from a field approximately 100 m X 350 m on the southern coast. The annulus gave a single very-high value (670 pCi/g) sample from the northern end. An area approximately 60 m X 100 m, enclosing this sample location, will be sampled to a depth of 30 cm in 10 cm increments, at 20 m intervals (384 samples). The remainder of the annulus will be sampled to a depth of 5 cm at 40 m intervals (48 samples). The rectangular field will be sampled every 10 cm to a depth of 40 cm at 50 m intervals (96 samples).	528	4.8×10^{0}
	95	100	30	57			6.0×10^{0}
	210	170	30	none[c]			14.0×10^{0}
		670	12.5	none[d]			
		170	30	43			
Janet	41	65	1.0	2.0	Samples were from two fields: 720 m X 220 m and 180 m X 540 m. A qualifying sample outside of these fields was from a 12-acre site which ERDA is using for experimental purposes and has claimed to have no significant Pu contamination. Thus, that sample will be ignored. Samples will be collected from the fields to a depth of 5 cm and at 20 m intervals.	686	2.4×10^{3}
	45	55	2.5	9.0			1.5×10^{3}
	170	110	3.5	8.0			
	41						
	51						
	46						
	67						
	48						
	52						
	120						
	66						
	40						
	57						
Kate	50	62	1.0	2.0	Samples were from opposite sides of the island and suggest that no significant hot spots are present. However, as there is a paucity of data for locations closely surrounding the two sampled-points, ten 5 cm deep samples will be collected from the general area of each.	20	$.1 \times 10^{0}$
							$.1 \times 10^{0}$

[c] Essentially 110 to max depth sampled (60 cm).

[d] 115 at max depth sampled (37 cm).

Lucy	0	48	1.0	1.5	Samples were from opposite sides of the island and suggest that no significant hot spots are present. Since all analyses are nominally the same as the lower Guideline, the island will be considered to have no Pu suspect area; no samples will be taken.	0	0
Percy	0	43	7.5	8.0	The single analysis which exceeds 40 pCi/g is sufficiently close to that limit that no additional samples will be taken. The island will be considered to have no Pu suspect area.	0	0
Mary	0	55 40	3.5 3.5	5.0 3.5	Both analyses are close to the 40 pCi/g Guideline and in each case the samples were from locations within 20 m of locations which gave Pu concentrations less than 40 pCi/g. The island will be considered to have no Pu suspect area; no samples will be taken.		
Nancy	0	42	7.5	8.0	The sole sample exceeds 40 pCi/g by a small margin, and it was from a location near to ones which gave Pu concentration less than 40 pCi/g. The island will be considered to have no Pu suspect area; no samples will be taken.	0	0
Olive	0	85 85 47	1.0 1.0 3.5	2.0 2.5 4.0	Samples were from a field approximately 120 m X 180 m toward the northern end of the island. The field will be sampled to a depth of 5 cm at 20 m intervals.	70	1.4×10^3

Pearl	170 530 63 55 83 85 81 50 83 89 100 170	410	1.0	5.0	All but one sample was from a field running north-to-south, approximately 160 m X 340 m. The field will be sampled to a depth of 5 cm at 20 m intervals. The isolated sample (170 pCi/g) was taken from the lagoon-side beach toward the western end of the island. Ten samples will be collected from that general area.	172	$.8X10^3$ $.1X10^3$
Ruby	0	0	0	0	None.	0	0
Sally	44 130	40 64 68	130 1.0 1.0	130 2.0 2.0	Samples reading 44 and 64 pCi/g were from the islet (often called "Sally's Child") which is approximately 60 m X 220 m. Ten additional samples will be taken from the general area toward the center of the islet. The remaining samples were from locations spaced along the lagoon-side beach. Ten samples will be taken from the area toward the western trip which gave the 130 pCi/g value.	20	$.1X10^3$ $.1X10^3$
Tilda	0	0	0	0	None.	0	0
Ursula	0	0	0	0	None.	0	0
Vera	0	0	0	0	None.	0	0
Wilma	0	0	0	0	None.	0	0
Yvonne A		75 180 54 150	5 15 55 25	14 19 & 108 58 44	Samples were from a field approximately 80 m X 300 m toward the north-western periphery of the island. The field will be sampled to a depth of 60 cm at 10 cm increments and at 50 m intervals (84 samples).	84	$14.4X10^3$

Yvonne B	150	800	95	112	Samples were from a field centered in the island (portion) approximately 140 m (from lagoon to ocean) by 520 m. Although many high readings are near the air-ground interface, concentrations at depths up to 140 cm are significant. Except for four locations, clustered near the "right-side" of the field, profiles decrease to less than 40 pCi/g within about the top 35 cm. Samples will be taken to a depth of 40 cm at 10 cm increments and at 20 m intervals (864 samples). A the high-value area (140 m X 200 m), samples will be taken to additional depths of 100 cm (880 additional samples).	1744	$29.2X10^3$
		520	15	23			$28.0X10^3$
		820	70	140			
		480	35	55			
		75	75	77			
		110	35	48			
		95	25	30			
		100	15	20			
		450	5	32			
		220	5	8			
		730	5	9			
		310	5	32			
		320	5	9			
		370	5	23			
		62	5	6			
		52	2.5	4			
		52	5	6			
		300	5	30			
		62	5	7			
		160	5	11			
		150	or 15 ?	?			
Yvonne C	50	62	14	15	Samples were from widely separated locations, each with adjacent analyses that did not exceed 40 pCi/g, which suggests that no extended hot spots are present. The one high reading, from the middle, northern side of the runway, will be investigated. Samples at 10 cm increments to depths of 100 cm will be collected from 10 locations in an area approximately 50 m X 80 m encompassing the high value.	100	$4.0X10^3$
	40	290	75	93			
					TOTALS	3754	$120.8X10^3$

ENEWETAK ISLANDS TO BE SEARCHED

FOR CONTAMINATED DEBRIS

ISLAND	TOTAL AREA* (acres)	PU SUSPECT AREA (acres)	OVERGROWN AREA** (acres)
Alice	22	3	15
Belle	30	12	12
Clara	7	1	5
Daisy	21	8	2
Edna	10	-0-	-0-
Irene	45	20	6
Janet***	291	63	100
Kate	16	-0-	14
Lucy	20	-0-	18
Percy	2	-0-	-0-
Mary	12	-0-	9
Nancy	11	-0-	11
Olive	41	5	36
Pearl	54	13	36
Ruby	4	-0-	-0-
Sally	99	-0-	50
Tilda	52	-0-	45
Ursula	40	-0-	36
Vera	38	-0-	38
Wilma	-0-	-0-	12
Yvonne	94	25	38
	909	150	480

*from TABLE 5-16, EIS

**Pu suspect areas excluded

***Approximately 12 acres under experimental cultivation by ERDA will be excluded from Cleanup

Encl 2

RADIATION PROTECTION STANDARDS FOR CLEANUP

A. Control of Occupational Exposure to Ionizing Radiation (AR 40-14)

(1) The accumulated dose equivalent of radiation of the whole-body, head and trunk, active blood-forming organs, gonads, or lens of the eye will not exceed--

(a) 1.25 rems in any calendar quarter,

nor

(b) 5 rems in any 1 calendar year.

(2) The accumulated dose equivalent of radiation to the skin of the whole-body (other than hands and forearms), cornea of the eye, and bone will not exceed--

(a) 7.50 rems in any calendar quarter,

nor

(b) 30 rems in any 1 calendar year.

(3) The accumulated dose equivalent of radiation to the hands and wrists or the feet and ankles will not exceed--

(a) 18.75 rems in any calendar quarter,

nor

(b) 75 rems in any 1 calendar year.

(4) The accumulated dose equivalent of radiation to the forearms will not exceed--

(a) 10 rems in any calendar quarters,

nor

(b) 30 rems in any 1 calendar year.

(5) The accumulated dose equivalent of radiation to the thyroid, other organs, tissues, and organ system will not exceed--

(a) 5 rems in any calendar quarter, nor

(b) 15 rems in any 1 calendar year.

(6) Individual(s) under 18 years of age, females known to be pregnant, and occasionally exposed individual(s) will not be exposed to a whole-body dose equivalent of more than--

(a) 2 millirems in any 1 hour, nor

(b) 100 millirems in any 7 consecutive days nor

(c) 500 millirems in any 1 calendar year,

(d) nor more than 10 percent of the values in (2), (3), (4) and (5), above, for other areas of the body.

(7) Individuals over 18 years of age, but who have not yet reached their 19th birthday, may be occupationally exposed to ionizing radiation provided that they do not exceed 1.25 rems dose equivalent to the whole-body in any calendar quarter, nor 3 rems in the 12 consecutive months prior to their 19th birthday.

B. Permissible Contamination Levels

(1) Soil:

Less than 40 pCi (Pu)/g (AEC Task Group)

(2) Debris, vehicles and other equipment released after any cleanup:

(a) Transuranic alpha emitters--less than 20 dpm/100 cm^2 (NRC Regulatory Guide 1.86)

(b) Beta/Gamma emitters--less than 0.1 mrad/hr at 1 cm (ERDA Property Management Instruction 109-45 and NRC Regulatory Guide 1.86)

(3) Personnel:

No removable contamination (AR 700-64)

(4) Air:

Less than 4.4 dpm (Pu-239)/m^3 (10 CFR 20)