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DISCUSSION POINTS REGARDING RECONSTRUCTING LOCALIZED SKIN DOSE ASSOCIATED WITH DIRECT DEPOSITION OF URANIUM OXIDE DUST AND FLAKES ON EXPOSED SKIN

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ABBREVIATIONS AND ACRONYMS

AMAD	activity median aerodynamic diameter
AWE	Atomic Weapons Employer
CFR	*Code of Federal Regulations*
cm^2	square centimeter
d/yr	day per year
dpm	disintegrations per minute
DR	dose reconstruction
ERR	excess relative risk
FEMP	Fernald Environmental Management Project
GM	geometric mean
GSD	geometric standard deviation
hr or h	hour
IREP	Interactive RadioEpidemiological Program
m^2	square meter(s)
m^3	cubic meter(s)
MeV	mega-electron volt
mg	milligram
mR	milliroentgen
mrad	millirad
mrem	millirem
m/s	meter(s) per second
NIOSH	National Institute for Occupational Safety and Health
PHS	U.S. Public Health Service
POC or PC	probability of causation
SC&A	S. Cohen and Associates (SC&A, Inc.)
Sv	sievert
TBD	Technical Basis Document

1.0 INTRODUCTION

During our Dose Reconstruction (DR) Subcommittee meeting on May 21, 2013, issues were raised regarding a mini site profile review that was performed for Bridgeport Brass (i.e., Attachment 1 to the 8th set of DR reviews). The issues pertained to reconstructing the doses to skin (i.e., Finding 3) and associated probabilities of causation (POCs), due to the deposition of particles/flakes of uranium oxide on exposed skin (i.e., hands, forearms, face, neck, and ears). The discussions addressed the plausibility of such a scenario and, given that the scenario is considered plausible, what methods would be used to derive doses for use as input to IREP. After a brief discussion of this matter, the Subcommittee concluded that this is a generic issue and is appropriately transferred to a work group dealing with overarching issues.

Subsequent to that discussion, SC&A revisited the issue, and we have a better understanding of the approach NIOSH has adopted to address localized skin dose. However, we still have some questions that warrant discussion. On May 29, 2013, SC&A sent an e-mail to our Project Officer requesting authorization to prepare a brief white paper on this matter, the objective of which would be to help expedite the resolution of these issues. On May 29, 2013, our Project Officer authorized SC&A to proceed with the preparation of a white paper on this subject. This report presents that white paper.

2.0 BACKGROUND

Issues pertaining to localized exposure of skin due to the deposition of uranium oxide flakes on bare skin were raised by SC&A during the review of numerous site profiles and DRs dealing with uranium metal machining, rolling, and general handling at Atomic Weapons Employer (AWE) facilities during the early years of the atomic weapons program, mainly the mid to late 1940s and the early 1950s. Examples of such facilities include Bethlehem Steel and Simonds Saw and Steel. Our review of these types of AWE site profiles and DRs indicates to us that such a scenario was plausible and needed to be addressed in the DRs for claimants who worked at these facilities in the early years and contracted skin cancer on the face and neck and other unprotected areas of the skin. We believe that such scenarios were inevitable because workers at that time did not wear protective clothing and were not monitored for contamination when leaving a work area. Hence, such exposures could/would have occurred on a daily basis in the workplace. We note that our reviews of numerous AWE site profiles and DRs include the assessment of skin exposures, but only from the perspective of beta exposure at a distance; e.g., skin exposures attributable to standing next to uranium metal ingots, or exposure to non-penetrating radiation as determined by the use of film badges. We have not encountered any site profiles or DRs where exposures due to direct contamination of localized areas of skin with uranium dust or uranium oxide flakes were evaluated.

During the May 21, 2013, DR Subcommittee meeting, both NIOSH and some Advisory Board members expressed concern regarding the credibility of such a scenario. SC&A agreed that, in the absence of monitoring data, we do not have the means to quantify skin doses. However, the presence of airborne radioactivity as evidenced by air sampling data leads to the conclusion that skin contaminations were inevitable.

3.0 DESCRIPTION OF THE ISSUES

During the May 21, 2013, meeting, some progress was made in exploring this issue before the Subcommittee determined that this subject is generic and is best transferred to an overarching issues work group. As such, it is appropriate to describe the technical discussions that took place at the meeting before those discussions were terminated.

During the meeting, NIOSH described and provided written material explaining how they would go about reconstructing localized skin doses at facilities such as Bridgeport Brass and Harshaw Chemical Company, which, in turn, would be used as input to IREP for the purpose of deriving POCs. The following is the description provided by NIOSH for reconstructing the skin dose for Bridgeport Brass:

> *An assessment was made to determine the skin dose from routine skin contamination associated with uranium operations. Based on the Technical Basis Document: An Exposure Matrix for Bridgeport Brass: Havens Laboratory and Adrian Plant (ORAUT-TKBS-0030 Rev. 01)* [ORAUT 2013]*, the geometric mean of the Table 3-5 individual daily weighted-average air concentration is 250 dpm/m^3 with a geometric standard deviation of 2.2. This results in a 95th percentile air concentration of 915 dpm/m^3. Assuming a terminal settling velocity of 0.00075 m/s and 8 hours of operations, a constant air concentration of 915 dpm/m^3 would result in a surface contamination level of 1.98 dpm/cm^2. One could assume that the skin of the head, neck, and hands were re-contaminated at the same level of general surfaces every workday (250 workdays) of the year. The skin on the head, neck, and hands represent about 14% of the total body skin area. A maximizing skin dose rate of 40 mrem per 10,000 dpm/cm^2 per hour can be applied to determine the skin dose to the affected area (Technical Basis for Beta Skin Dose Calculations at the Y12 Plant, SRDB 19821)* [Thomas and Bogard 1994]. *This would result in a dose to the affected skin of about 16 mrem. Per guidance in Interpretation of Dosimetry Data For Assignment of Shallow Dose (ORAUT-OTIB-0017 Rev. 01)* [ORAUT 2005]*, the 16 mrem to the affected skin could be converted to the dose to the skin based on the described approach for non-uniform exposures, resulting in a geometric mean annual skin dose of about 2 mrem with a geometric standard deviation of 8. As a note, this is a bounding estimate using a maximizing skin dose rate and contamination levels. A more realistic skin dose rate and the use of the geometric mean air concentration would result in an exposure of less than 1 mrem.*

During the meeting, SC&A questioned this approach for deriving annual skin dose for a scenario where the exposed skin is contaminated by the settling of 5 micron AMAD particles on surfaces during the course of a working day. SC&A also questioned the scenario involving the deposition of large flakes of uranium oxide on bare skin. This scenario is somewhat different than that described and modeled by NIOSH, in that the particles could be much thicker and deliver a relatively high dose rate to very small areas of the skin. For example, a flake of uranium oxide could deliver a skin dose approaching 240 mrem/hr beneath the flake. Notwithstanding the plausibility of such a scenario, we explained that we were uncertain how the input to IREP would be defined that yields a claimant-favorable POC. It is at this point where it was agreed to transfer the issue to an overarching issues resolution work group.

4.0 SC&A'S CURRENT POSITION ON NIOSH'S PROPOSED DOSE MODELS

Following the meeting, SC&A had an opportunity to further assess NIOSH's approach, as described above. It appears that NIOSH's strategy for deriving skin dose from the settling of fine particles on skin may be incomplete, as well as underestimate potential doses. We have several questions/concerns that we would like to introduce at the next work group meeting where this topic is on the agenda. The following presents SC&A's questions/concerns regarding (1) the exposure scenario where a fine dust settles on exposed skin during the course of a work day, (2) the deposition of a single large flake of uranium oxide on exposed skin, and (3) is NIOSH's approach to deriving POCs for this class of problem appropriate given IREP in its current form?

5.0 CONCERNS RELATED TO NIOSH'S DOSE MODEL FOR CHRONIC DEPOSITION OF FINE PARTICLES ON BARE SKIN

5.1 Selection of Model Parameters

As summarized in the above-stated quotation, NIOSH's model for deriving skin doses at Bridgeport Brass employs the following values and assumptions for deriving skin dose and cancer risk:

- A geometric mean (GM) of a daily weighted-average air concentration of 250 dpm/m^3 with a geometric standard deviation (GSD) of 2.2 yielding a 95th percentile air concentration of 915 dpm/m^3;
- A terminal settling velocity of 0.00075 m/s;
- An 8-hour per day facility operation;
- A 250 days per year work schedule during which daily recontamination takes place on the head, neck, and hands, representing 14% of the 18,000 cm^2 of total skin for males (or 16,000 cm^2 of total skin for females); and
- A skin contamination conversion factor of 40 mrem per hour per 10,000 dpm/cm^2.

5.2 Dose to Exposed Skin

$$\text{Daily Skin Contamination} = (915\ \text{dpm/m}^3)(0.00075\ \text{m/s})(\text{m}^2/10{,}000\ \text{dpm/cm}^2)(3{,}600\ \text{s/h})(8\ \text{h}) = 1.98\ \text{dpm/cm}^2$$

$$\text{Skin Dose Rate} = (1.98\ \text{dpm/cm}^2)(40\ \text{mrem/h}/10{,}000\ \text{dpm/cm}^2) = 7.92 \times 10^{-3}\ \text{mrem/h}$$

$$\text{Yearly Skin Dose} = (0.008\ \text{mrem/h})(8\ \text{h/d})(250\ \text{d/yr}) = 16\ \text{mrem/yr}$$

For a "non-uniform" skin contamination exposure that involves 14% of the skin, NIOSH reduced the 16 mrem/yr skin dose to 2 mrem/yr for deriving a POC value. The purpose of this 8-fold dose reduction is to offset the radiation skin cancer risk coefficient used by IREP, which is based on **total** (i.e., 100%) skin exposure.

5.3 SC&A's Response

The derived dose of 16 mrem/yr to bare skin is based on unsupported and unrealistic assumptions, which include the following:

(1) Daily skin contaminations for each of the 250 workdays per year that only persist for **8 hours**;

(2) Implication that after 8 hours, each skin contamination is 100% removed by a standard daily shower; and

(3) Only bare skin is subject to contamination and resultant radiation exposure.

Exposure Duration. While select facilities may have provided end-of-shift showering facilities for their workers, others may not; but even for facilities with showering facilities, there is no assurance that workers would have consistently made use of such a facility. A more conservative assumption may involve a daily morning (i.e., before work) shower, which would imply that **daily** skin contamination would remain up to 24 hours instead of the 8 hours assumed by NIOSH.

Decontamination Efficiency. The assumption that skin contamination is **readily** and **completely** removed by a routine shower is unrealistic. Experience shows that skin contaminations commonly require multiple and focused washings with specific agents before significant reduction of contaminants is observed. For chronic exposures/contamination events, a buildup to a steady-state of residual skin contaminants must reasonably be expected.

Skin Contamination Other than to Bare Skin. NIOSH's assumption that only bare skin (representing 14% of total skin) is subject to contamination/radiation exposure from the deposition of airborne activity is unrealistic. This is particularly true for work environments involving heavy physical activity, worker perspiration, and damp clothing. Thus, any deposition of airborne contaminants (as well as contact with existing contaminated surfaces in the workplace) by clothing worn by a worker must reasonably be assumed to become contaminated, and that, at a **minimum, the level of contamination is comparable to that of bare skin**. In Section 6.3.4.2 of **Feed Materials Production Center site profile** (ORAUT 2004), NIOSH provides the following guidance for determining the skin dose under clothing from exposure to uranium.

> *Results of tests of FEMP dosimeters used during the 1960s (Heatherton 1960) included the conclusion that the half-value thickness of absorption of UX-2 (^{234}Pa) beta energy was approximately 110 mg/cm^2. It was determined that "the combined dose rate from the surface of uranium metal in equilibrium with its two daughters, UX-1 (^{234}Th) and UX-2 (^{234}Pa), is about 240 mrad/hr." It was also*

determined that approximately 95% of the surface dose rate, or approximately 228 mrad/hr, originated from the UX-2 in the metal . . . ***It was also determined that coveralls worn by workers (about 30 mg/cm²) reduced uranium beta exposure to the skin by approximately 20%****. Figure 6-6, at the end of this TBD, summarizes these data.* [Emphasis added.]

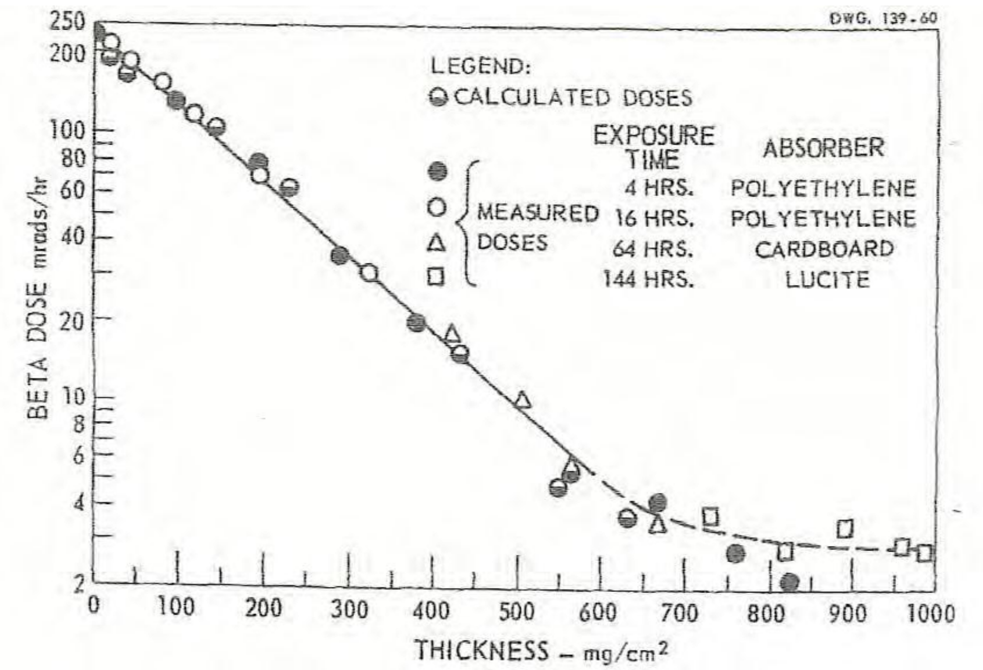

Figure 6-6. Beta Dose vs. Skin Depth

On the assumption that contamination on clothing equals the contamination level on bare skin, the "**NIOSH-derived**" dose of 16 mrem/yr for bare skin would yield a dose of about 13 mrem/yr for the balance of the 86% of "clothed" skin. It may further be argued that skin dose to clothed areas of the body may actually be higher than bare skin for the likely reason that workers may have worn contaminated clothing for multiple days before such clothing was subjected to the limited decontamination provided by home laundering.

In support of SC&A's assertions about the limited effectiveness of even focused efforts to decontaminate skin and clothing apparel, empirical data are provided in the enclosed Appendix. These data were originally reported by Robert Sharp and William Chapman in the 1957 report titled, *Exposure of Marshall Islanders and American Military Personnel to Fallout*, and summarized by SC&A in a report to the Nuclear Claims Tribunal of the Republic of the Marshall Islands in 2000 (SC&A 2000).

Although activity levels associated with BRAVO fallout and those associated with airborne concentrations at AWE facilities differ by orders of magnitude, the issues raised by SC&A are, nevertheless, similar between the two scenarios.

6.0 CONCERNS RELATED TO HOW IREP DERIVES POC AND ITS RELEVANCE TO HOW DOSE IS ASSIGNED

Given that a skin dose only occurs to a limited area, SC&A has concerns regarding the relationship between the derived dose and how IREP uses this dose to derive a POC. It is our understanding that a POC is derived by evaluating the probability that a given cancer was caused by a given exposure to ionizing radiation, as opposed to being caused by the myriad other factors that might be responsible for causing that cancer. Hence, in its simplest form, as described in 42 CFR Part 81, the equation used to derive POC is as follows:

$$RadRisk/(RadRisk + BasRisk) \times 100\% = PC$$

RadRisk refers to the probability that a given dose of radiation to an organ can cause a given type of cancer, and BasRisk refers to the baseline probability of that type of cancer. The actual equation is a lot more complicated because it takes into consideration the age at time of exposure, the age at time of diagnosis, gender, the number of annual exposures up to the time that the cancer is diagnosed, and other factors, as appropriate, such as race in the case of skin cancer and smoking in the case of lung cancer. To further complicate matters, the entire calculation is performed using probability distributions as input, so that the POC can be reported in terms of the 99% confidence level. Fortunately, all these complications do not come into play with respect to SC&A's questions. SC&A's questions have to do with the linkage between the organ doses that are used as input to IREP and the baseline risk that is imbedded in IREP for the purpose of deriving the POC associated with a given skin exposure.

Under most circumstances when skin exposure is of concern, the exposure occurs at a distance. An example would be standing close to a slab of uranium where, more or less, the entire body is exposed to both penetrating and non-penetrating radiation. Hence, the dose that is input to IREP for the purpose of deriving the POC for a skin cancer is the dose experienced by the individual to all the skin and, under these circumstances, the baseline risk is the baseline risk of developing a given type of skin cancer.

Given this understanding, let us return to the NIOSH explanation of the approach used to derive the POC for a scenario where a portion of the skin is exposed. NIOSH explains that, in order to derive the POC, it is necessary to average the exposure over the entire area of the skin. Specifically, the skin on the head, neck, and hands represents about 14% of the total body area of the skin area. Hence, the derived localized skin dose of 16 mrem/yr is reduced to a GM of 2 mrem/year with a GSD of 8 for the entire area of the skin. This approach is used by NIOSH as a means to deal with the fact that the baseline risk of cancer imbedded in IREP is the baseline risk of cancer for the entire area of the skin, not just the baseline risk for skin on the head, neck, and hands. For example, Table 2 of NIOSH 2002 presents the excess relative risk (ERR)[1] of skin cancer per Sv and Table 3 presents the age-adjusted skin cancer incidence. Given this

[1] Excess relative risk (ERR) is the ratio of the excess risk of a specified stochastic effect to the probability of the same effect in the unexposed population, i.e. the relative risk minus one. In theory, this should be equal to the attributable risk from the exposure received by the exposed group, but ERR is normally used in the context of observed numbers of effects, whereas attributable risk normally refers to a figure calculated on the basis of a known or estimated exposure.

understanding, we have the following questions. If IREP did include the baseline risk to the head, neck, and hands, wouldn't that baseline risk be lower than the baseline risk attributed to the entire area of the skin? Also, if the baseline risk is lower, doesn't that mean that the POC would increase, as derived using the above equation? Further, if IREP included the baseline risk for the head, neck, and hands, it would not be necessary to reduce the dose, resulting in a considerably higher POC.

We believe that these are reasonable questions, because page 8 of NIOSH 2002 states that skin dose should be calculated for the location where the skin cancer occurred, and, if the body location is unspecified, the maximum skin dose at any location should be used as input to IREP.

7.0 CONCERNS RELATED TO NIOSH'S DOSE MODEL FOR LARGE URANIUM FLAKES ON SKIN

Assuming that this exposure scenario is plausible, at least for some AWE facilities in the early years, we have the same basic questions as described above, except now we are dealing with a very small area, perhaps 1 cm^2, and relatively high dose rates (e.g., 240 mrem/hr). In this case, it seems that the baseline risk should be expressed in terms of ERR per Sv per cm^2 for the general area where the exposure might have occurred. We acknowledge that this issue is complicated by the fact that in most circumstances, where a person is diagnosed with a cancer on an exposed area, there is likely no evidence that a localized exposure had, in fact, occurred, except to the extent that we might consider it plausible that such an exposure could have occurred given the operational circumstances at the time. We further acknowledge that we have no way of knowing how often such events occurred or how long the particle remained on the skin before it was washed off. Nevertheless, we believe that this subject merits some discussion.

8.0 REFERENCES

42 CFR Part 81. 2002. *Guidelines for Determining the Probability of Causation Under the Energy Employees Occupational Illness Compensation Program Act of 2000*; Final Rule; Department of Health and Human Services. May 2002.

Heatherton, R.C., 1960. *Estimation of Depth Dose from UX2 Beta Rays*.

NIOSH (National Institute for Occupational Safety and Health) 2002. "NIOSH-Interactive RadioEpidemiological Program (NIOSH-IREP) Technical Documentation," Final Report. June 18, 2002.

ORAUT 2004. *Technical Basis Document for the Fernald Environmental Management Project – Occupational External Dose*, ORAUT-TKBS-0017-6, Rev. 00. Oak Ridge Associated Universities Team, Cincinnati, Ohio. April 20, 2004.

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[Redact] 2000. U.S. Army, Aberdeen Proving Grounds, Maryland, personal communications (e-mail) on February 8, 2000.

PHS (U.S. Public Health Service), 1970. *Radiological Health Handbook*, Rockville, Maryland.

SC&A 2000. "Reassessment of Acute Radiation Doses Associated with BRAVO Fallout," Prepared by Hans Behling, John Mauro, and Kathleen Behling of S. Cohen & Associates for William Graham, Public Advocate, Nuclear Claims Tribunal, Republic of the Marshall Islands, May 2000.

Sharp, R., and W.H. Chapman, 1957. *Exposure of Marshall Islanders and American Military Personnel to Fallout, Operation CASTLE, Project 4.1 Addendum*, Naval Medical Research Institute, Report #WT-938 EX (March 1957). Online at http://worf.eh.doe.gov/data/ihp2a/0283_a.pdf.

APPENDIX A: EXCERPT FROM THE REPORT, *REASSESSMENT OF ACUTE RADIATION DOSE ASSOCIATED WITH BRAVO FALLOUT*

Prepared by Hans Behling, John Mauro, Kathleen Behling, May 2000 for the Nuclear Claims Tribunal, Republic of the Marshall Islands

4.1.5 Additional Radiation Doses Associated with External Body Contamination

Fallout deposited on skin, clothing, and hair of the Marshallese represents a complex mixture of radionuclides that emit alpha, beta, and gamma radiations of variable energies. Depending on the type of emission, radiation exposure may include the entire body or only select tissues.

Alpha-emitting radionuclides with their extremely short range in tissue would pose little or no harm as long as they remained outside the body. With the limited range of most beta particles, the primary concern for external exposure is the dose that may be received by the skin. However, if skin contamination includes highly energetic betas [e.g., yttrium-90 releases betas with an average energy of 0.90 MeV and a maximum energy of 2.27 MeV (PHS 1970)], tissues just below the skin such as the thyroid gland may also be exposed. For the radionuclide mix associated with BRAVO, the penetrating beta component was illustrated in the Sharp and Chapman Report (1957) by the following passage (p. 31), which refers to the observation made by U.S. Service personnel on Rongerik:

> *"Men at the radiostation collected fallout material. This material when placed on the surface of a cathode-ray tube (part of ionosphere equipment), caused that portion of the tube to glow."* [Emphasis added.]

Dose Rate Measurements of External Contamination

The 1957 Report by Sharp and Chapman provides a substantial body of data pertaining to contamination of the Rongelapese that had been evacuated. Chapter 4 of their Report provides a timeline for decontamination efforts and Chapter 5 summarizes physical measurements of residual contamination at various times.

The 16 Marshallese who had been evacuated by plane arrived at Kwajalein at noon on 3 March (i.e., H+55 hours). Upon arrival, these individuals showered and bathed several times in an emergency decontamination area.

The 66 Marshallese evacuated by destroyer (48 from Rongelap and 18 from Ailinginae) had taken several showers and ". . . prolonged washings with salt-water hose sprays while aboard the destroyer that was enroute to Kwajalein.

Survey Instrument Used to Assess Contamination

The instrument used to survey Marshallese for body contamination was the AN/PDR-27c, a standard military issue that was in general use at the time. The AN/PDR-27c is a beta/gamma survey meter that used two Geiger-Mueller tubes in a single probe. It was powered by 6 D-cell batteries and could be operated at four scales with the following ranges: 0–0.5; 0–5; 0–50; and 0–500 mR/hr. The AN/PDR-27c has been replaced in the Army by the AN/VDR-2, but can still be found in the National Guard ([Redact] 2000).

The most highly contaminated areas of the body were the head and areas of the skin not protected by clothing. Natural folds of the skin and areas of the skin where perspiration accumulated were also found to have elevated levels of contamination. A particular problem for decontamination was the hair/scalp areas since Marshallese used a coconut-oil hair dressing.

Table 4.1-10 summarizes "contamination measurements" taken on 3 March. Columns #2, #3, and #4 cite dose rate measurements in behalf of 15 of the 16 persons evacuated by plane. Data in column #2 provide the most useful information, since these readings were taken before there were any attempts to decontaminate personnel and, therefore, provide a technical basis for assessing residual skin contamination levels at about H+55 hours. The average "dose rate" readings for the 15 persons monitored for contamination corresponds to about 175 mR/hr. After two successive showerings, average dose rate readings on 3 March were reduced to 51 mR/hr and 31 mR/hr, respectively, for these individuals.

Columns #6, #7, and #8 identify a single dose rate reading on 3 March for each of 52 persons who were among the 66 persons evacuated by destroyer (U.W. Phillip). For these individuals, the average 3 March reading was 19 mR/hr. However, it must be recalled that these individuals had previously been subjected to decontamination efforts aboard the destroyer that included several salt-water hosings and showering. For this reason, contamination levels for all evacuees at H+55 hours will assume the average value 175 mR/hr that had been determined prior to the first showering for the 15 individuals who were evacuated by plane.

Contaminated Clothing. Contaminated clothing that had been worn by the 15 Marshallese who had been evacuated by plane was sequestered but had not been laundered. When surveyed, these articles of clothing still yielded dose rate readings of about 100 mR/hr on 18 March. The Report states that *". . . Repeated washings by Kwajalein laundry failed to lower the counts appreciably. The addition of citric acid to laundry water facilitated decontamination."* On the basis of the standard decay formula, the dose rate reading of clothing at H+12 hours (H+12 hours approximates the end of fallout on Rongelap) would have corresponded to about 7,400 mR/hr.

Table 4.1-10. Contamination Measurements of Individual Evacuees from Rongelap and Ailinginae by Means of Radiac Set No. AN/PDR-27c Survey Instrument (Readings in mR/hr)

Data for 15 Rongelapese Evacuated by Plane				Data for Rongelapese Evacuated by Destroyer			
Individual	Before 1st Shower	2nd Reading	3rd Reading	Individual	Reading	Individual	Reading
#1	200	30	12	#1	22	#27	22
#2	200	25	20	#2	20	#28	15
#3	80	70	45	#3	25	#29	10
#4	80	30	20	#4	20	#30	12
#5	200	80	40	#5	34	#31	40
#6	200	10	---	#6	10	#32	10
#7	200	20	15	#7	10	#33	15
#8	100	30	10	#8	40	#34	30
#9	200	30	25	#9	10	#35	25
#10	80	70	70	#10	30	#36	30
#11	80	50	20	#11	27	#37	10
#12	200	100	50	#12	10	#38	5
#13	200	100	30	#13	27	#39	20
#14	200	100	60	#14	15	#40	10
#15	400	20	15	#15	25	#41	10
				#16	15	#42	10
				#17	20	#43	24
				#18	12	#44	30
				#19	20	#45	15
				#20	23	#46	25
				#21	34	#47	35
				#22	20	#48	5
				#23	10	#49	7
				#24	24	#50	5
				#25	16	#51	27
				#26	25	#52	15