challenges and would require a detailed understanding of each worker's job functions over his/her employment period.

ATTACHMENT 4.5-2A

EXCEPTS FROM ANNUAL HEALTH PROTECTION REIVEW – MAY 1964

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III. General Information on Programs Reviewed

A. Industrial Hygiene and Radiation Department (IH&RD)

ORIAD No. 0500-3 concerning posting requirements was implemented by posting the "Notice to Employees" on the bulletin boards at the two main entrances and the main locker room. Information contained in the Appendix to AEC Manual Chapter 0524 is included as a Plant Manufacturing Standard. In addition, a letter concerning the directive was sent to all division directors and holders of the Plant Manufacturing Standards Manual and the Technical Procedures Manual. Some modifications were necessary to meet the requirements of OR-0525 concerning Occupational Radiation Exposure Information. The modifications involve the preparation of a form letter for notification of visitors with exposures exceeding 50 mrem, and the compilation of required information on those Area Office personnel whose recorded yearly exposures exceed 50 mrem.

Procedures concerning the sale of contaminated scrap and/or equipment are in accordance with Manual Chapters OR-5182 and 5170. Prior to any sale, a summary letter concerning the contents thereof and certifying that contamination levels are within the specified limits is sent to the Area Office for approval. Contaminated 55 gallon drums which are no longer useable and other scrap not meeting the limits are sold to a licensee such as the Knoxville Iron Company.

Although no overexposures have been observed at NLO during the past years, records indicate a continuing increase in both number and magnitude of exposures above one rem of penetrating radiation. Since 1960, incremental yearly increases of about 300% in the number of personnel receiving exposures above one rem were reported, (1960-12, 1961-33, 1962-120, 1963-331). The highest skin exposure for 1963 was reported as 22.9 rem which includes 4.4 rem of penetrating radiation. The beta plus gamma to gamma ratio for the plant population has decreased significantly since 1960 when the ratio was 20.7 to 1 as compared to a ratio of 5.4 to 1 for 1963. NLO feels that a partial explanation of the exposure problem would be the increase in the UX_1 and UX_2 daughter build up in the uranium "feed" and the increased storage of uranium in various areas.

ATTACHMENT 4.5-2B

EXCERPTS FROM HEALTH PROTECTION APPRAISAL REPORT – SEPTEMBER 1970

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B. Forearm Exposures

NLO has performed a study of exposure to the forearms of some Plant 5 employees. The results of this study showed projected annual forearm exposures from about 14,000 to 46,000 mrem. In view of this, it is evident that AECM 0524 monitoring requirements have not been met. According to NLO estimates, about 300 employees would require extremity monitoring because of potential exposure to the hands. It appears necessary that further attention be given by NLO to this matter. Extremity dosimeters should be provided as appropriate and an evaluation of involved operations should be made to assure compliance with 0524 guides.

The study does not indicate the level of hand exposure for these employees. From previous experience at other uranium facilities, it would be expected that the hand exposure could be 2-3 times the wrist exposure.

C. IVRML

The IVRML visited NLO on two occasions during CY 1970. It was on site for two weeks, beginning March 30, and again from early July through the end of September. During the first counting period, about 24 employees were counted and during the second period 103 employees (including the 24 previously counted) were monitored. On the basis of data generated during these monitoring periods, 23 employees are calculated to have average lung burdens for 1970 equal to or greater than one-half the AEC guide. It is estimated that about 200 employees are currently working in production areas and have a generally comparable potential for uranium lung exposure. It is therefore noted with concern that only about half of those potentially subject to exposure have been monitored by IVRML during this year. It is further noted that a substantial fraction (approximately 20-25 percent) of the production work force has not received at least one IVRML count since the counter first went to NLO in 1968.

Based on the above data, it would appear that about 15-20 percent of those counted in 1970 were found to have more than 50 percent of the AEC guide criterion. Of the number exceeding the 50 percent level, one-third was counted for only the first time during the July-September IVRML visit.

Finding 4.5-3: Unmonitored Shallow and Deep Dose Resulting from Skin/Clothing Contamination

Although FMPC employees were afforded **personnel dosimeters** that measured the shallow and deep dose, such a dosimeter will **not** assess shallow and deep doses that reflect exposures due to skin and clothing contamination. The likely fact that chronic skin and clothing contamination existed among production workers must be assumed for the following reasons:

(1) Workers had intimate physical contact with nearly all materials processed at FMPC.

(2) The processing of materials created high airborne levels and surface contamination levels.

(3) Anti-contamination clothing was either **not provided** or at best selectively issued. Similarly, showering at the end of a shift cannot be assumed for earlier periods of facility operations (see Attachment 4.5-3A).

(4) There were no provisions to assess skin/clothing contamination as reported in a **1985** site visit report enclosed as Attachment 4.5-3B. Among the **observations** noted in Attachment 4.5-3B include the following:

> *Observation: There are* ***no contamination survey instruments*** *kept at the work site for use in checking for* ***skin*** *and* ***clothing contamination****. Neither are there any hand and shoe counters available for use either before or after showering.*
>
> *Comment: This practice is totally* ***unacceptable****. Workers are forced to accept that the shower at the end of the day is completely effective in removing any skin contamination. Also, this practice does not provide any "triggers" for follow-up action to ascertain if the workers have taken any uranium into the body. Experience shows that skin and clothing contamination are often the first (and maybe the only) signal to loose contamination in the work area.*

The potential for high, unrecorded shallow and deep doses from chronic skin and clothing contamination must be assumed in behalf of all FMPC workers and for all periods of facility operations. However, given the complex processes and the many different tasks performed at FMPC, it is inconceivable that credible "ball-park" and bounding estimates can be derived.

Attachment 4.5-3C is enclosed to illustrate the potential magnitude of personnel contamination and the difficulty associated with quantifying the resultant dose associated with a single event/job task.

ATTACHMENT 4.5-3A

IH&R Department Monthly Report for May, 1958
J. A. Quigley, M. D.
June 4, 1958

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the drum baler in the drum reconditioning building. Only those men involved in cleaning the baler will be required to make a complete clothing change.

The Methyl Chloroform report and an information bulletin on Fluorine have been reviewed and is currently being revised and corrected. These reports are expected to be completed in time for the July safety campaign.

Fume and Dermatitis Investigations

During May, two fume inhalations were investigated as well as five cases of dermatitis. No cause for the dermatitis conditions have been determined as yet. Two of these cases were declared occupational. A meeting concerning this was held between the Assistant Director of Personnel, the Services Department Head, the porters' foreman and a representative from this department. The various compounds used by the porters were discussed and it was agreed that a check be made on the dermatological aspects of these compounds. Our preliminary investigation indicated that no new material has been recently added to the materials handled by the porters.

Urine Study Program

The remainder of Plant 6 personnel (Inspection, Transportation, Accountability, Production Records) will be tentatively scheduled for sampling during the second and third weeks of June.

Noise and Lighting Surveys

The noise level of the Swagging machine in the Development Machine Shop was analyzed and it was determined that the present enclosure is not designed to provide the maximum of efficiency in reducing the noise level to the operator. A fire hazard also exists because of the present unit. This hazard is caused by oil which is deposited on the fiber glass lining and then ignited by sparks from the machining operation. A new enclosure is being designed by Engineering which will reduce the noise level of the operator and provide him with less limitations of movement than is presently possible. The ventilation of this machine is also in the process of being improved and the oil controlled by improved splash guards so that the fire hazard will be eliminated.

Pilot Plant personnel requested that a means to reduce the noise level on the 3620 reactor vibrators be investigated. A new type of fiber piping is currently being tested by this

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ATTACHMENT 4.5-3B

SITE VISIT

February 21-22, 1985

Feed Material Production Center
National Lead of Ohio
Fernald, Ohio

Contacts: M. W. Boback, Director Health and Safety; R. B. Weidmer, Chief, Industrial Hygiene and Radiation; S. L. Hinnefeld, Technologist; T. A. Dugan, Supervisor, Bioassay Lab; W. A. Hayes, Technologist

OVERVIEW

The internal dosimetry program provided for the workers at the Fernald FMPC was reviewed in depth. The primary contacts were R. A. Weidmer and W. A. Hayes. The following elements of their program were reviewed in depth:

- Work place monitoring
- Worker monitoring
- Miscellaneous

Overall their program and practices appeared to be lacking in many aspects. These are discussed in the body of the report.

A. WORK PLACE MONITORING

A.1 Observation

There are no fixed area air samplers installed in the process facilities. Some lapel samplers are assigned to workers performing jobs with higher release potential.

Comment: Area air sampling is an essential element of an effective work place monitoring program. Criteria for placement of samplers, the installation of samplers, and a study to assure that samplers are not located in a dead-air pocket are essential for a good program since the airborne contamination is not uniformally distributed throughout the entire work area.

Recommendation: A study should be performed to chart air movement. Criteria for the placement of area air samplers should be documented and air samplers should be installed.

A.2 Observation: There are no contamination survey instruments kept at the work site for use in checking for skin and clothing contamination. Neither are there any hand and shoe counters available for use either before or after showering.

Comment: This practice is totally unacceptable. Workers are forced to accept that the shower at the end of the day is completely effective in removing any skin contamination. Also, this practice does not provide any "triggers" for follow-up action to ascertain if the workers have taken any

Attachment 4.5-3B (Continued)

uranium into the body. Experience shows that skin and clothing contamination are often the first (and maybe the only) signal of loose contamination in the work area.

Recommendation: Appropriate contamination survey equipment should be installed and maintained in the work place and at selected locations for exit surveys.

A.3 Observation

Routine contamination surveys are made of the higher potential areas on a quarterly basis.

Comment: This would seem to be adequate, assuming recommendation A.2 is implemented.

A.4 Observation

Most of the enriched uranium is handled in Building 1; however, there is some movement between the buildings. There were no procedures for keeping enriched (up to 20% ^{235}U) uranium physically separated from normal or depleted uranium (<5% ^{235}U).

Recommendation: Enriched uranium should be isolated from normal uranium. Otherwise it is extremely difficult to distinguish which is which using portable survey instruments.

B. WORKER MONITORING

B.1 Observation

The routine surveillance program to monitor internal exposure of workers consists of both in-vivo and excreta measurements. The frequency of the examination depends on the job assignment but is generally at least once per year.

Comment: This combination provides the basis for a good program, provided their air sampling program is upgraded per recommendation A.1.

B.2 Observation

The detection level for the in-vivo counter which is provided by Oak Ridge is as follows:

depleted uranium	4 mg
normal uranium	47 µg
enriched uranium (>5% ^{235}U)	110 µg

The counter is located near the administration building and workers are instructed to shower before being counted.

ATTACHMENT 4.5-3C

Cleaning Under Burnout Oxide Conveyors · Plant 5
R. H. Starkey
December 7, 1960

Page 2

Breathing zone sample results were:

	α - d/m/M³			
	High	Low	Average	X MAC
[redacted]	3,100,000	500,000	1,300,000	18,000

Up to about one year ago, the operator had to position himself under the inspection plate to remove it for access under the oxide conveyor. This caused much of the oxide to come down upon him. Breathing zone sample results of this operation were found to be:

α - d/m/M³			
High	Low	Average	X MAC
9,300,000	4,600,000	6,800,000	97,000

At the present time the inspection plates are held in place by metal poles propped up against them before removing the bolts. A rope is then tied to the poles holding up the inspection plates. The operator can then pull the rope which allows the inspection plates and oxide fall without anyone below. This way the operators are out of the area where contamination is greatest. After the dust has subsided behind the canvas enclosure, cleaning under the burnout conveyor begins.

Frank J. Klein
F. J. Klein

FJK:mjs

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Finding 4.5-4: Inability to Properly Account for Neutron Doses

The FMPC TBD acknowledges that at no time were workers monitored for neutrons even though neutron exposures must clearly be assumed; and Section 7.3.4.2 of NIOSH's ER states that:

> *. . . The **only** likely sources of neutron exposure were those areas of the site where **large quantities** of fluorinated uranium compounds, such as uranium fluoride or uranium hexafluoride, were processed or stored.* [Emphasis added.]

NIOSH Model. Section 6.3.5.1 of the TBD addresses the need to account for unmonitored neutron doses by means of a default neutron-to-photon dose ratio. The default η/γ ratio of 0.23 was based on empirical data cited in a 1995 study, which paired the neutron dose rate to the photon dose rate for 56 individual canisters containing UF_4. The 95^{th} percentile η/γ ratio value for the 56 paired measurements of single UF_4 canisters, as opposed to multiple or stacked canisters, was 0.23.

While the use of a 95^{th} percentile default value gives the appearance of a claimant-favorable approach for assigning unmonitored neutron exposure, it must also be acknowledged that this value was based on an unrealistic source term defined by one individual UF_4 canister. In reality, exposure to UF_4 source terms would most likely involve much larger source terms and in variable geometries/configurations. Due to the differential attenuation of neutrons and photons, the neutron-to-photon ratio will vary significantly based on the geometric configuration of the source term.

For example, SC&A performed a neutron-to-photon ratio calculation in behalf of a UF_4 source term that is defined by 81 drums that are stacked as follows: 9 drums in a line, 3 rows deep and 3 drums high (see Attachment 4.5-4.A). The η/γ ratio for this configuration yielded a **deterministic value of 0.4**, which is 4 times higher than the **geometric mean value of 0.10** cited in Table 6-10 of the FMPC TBD (ORAUT-TKBS-0017-6).

Other Unaccounted Neutron Sources. In addition to unmonitored neutrons associated with the alpha, neutron reactions of UF_4, UF_6, ThF_4, etc., the TBD makes no reference to other potential neutron sources. Identified below are two neutron sources that have **not** been acknowledged by NIOSH.

Attachment 4.5-4B is a Health Protection Review of FMPC dated May 19-21, 1964, which contains the following recommendation:

> *Completion of a detailed survey of the **Neutron Generator** is needed for formulating adequate health and safety operational procedures prior to routine operations. The detailed survey should consider the need for **additional personnel monitoring** (e.g., neutron film, etc.), potential air contamination problems from tritium in target and control room, radiation levels in and around target room, interlocks, and similar matters unique to such a facility.* [Emphasis added.]

In a Health Protection Appraisal Report dated August 1972 (enclosed herein as Attachment 4.5-4C), the following information is provided:

> *A* ***^{252}Cf source*** *has been added to the* ***neutron activation facility****. The 153 microgram source is currently in storage; use is planned in 4-5 months. The procedures, interlocks, etc., in use for the* ***Cockroft-Walton machine*** *will also apply to the ^{252}Cf source. So radiation hazard exists at present, as verified by survey performed by the IH&R Department.* [Emphasis added.]

ATTACHMENT 4.5-4A

Analysis of Neutron-to-Photon Dose Ratios from UF_4 at Fernald

In Section 6.3.5.1, "Development of the Neutron-to-Photon Ratio," Faust (2004) calculated ratios of neutron-to-photon doses from UF_4, commonly known as "green salt," based on a series of disparate measurements.

Faust relied on what appears to be a single measurement of the neutron dose rate from canisters of low-enriched uranium, described as 1.25% – 2%. Although Faust (2004, Table 2-6) lists measurements at locations "3" and "4," the values, listed to four significant figures, are identical. The cited reference is: Baker, A., (1995) "Fernald Interoffice Memorandum entitled: Area Neutron Monitoring in the 4B Warehouse." Since this reference was not available at the time of this review, we do not know the exposure geometry under which the measurement(s) was/were taken, nor is this information presented by Faust.

To develop the neutron-to-photon ratio, Faust relied on photon dose rate measurements on 56 drums of UF_4. It is not clear whether the measurements were made on individual drums, isolated from the others, or if all 56 drums were in close proximity to one another, so that the dose rate was produced from the aggregate of all of the drums. The cited reference is: Fernald (2001), "Radiation Surveys of Bldg 38A (Chemical Warehouse). Survey # 01-10-07-0186." Like the Baker memo, this reference was not available at the time of this review. We can speculate that the photon dose rate was from a larger mass of UF_4 than the neutron dose rate. Even if single drums, presumably with capacities of 55 gallons, were the radiation sources for the photon measurements, these may have contained much larger masses of UF_4 than the canisters that were the source of the neutron doses. Although the term "canister" does not appear elsewhere in either the Faust report or in "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Site Description," ORAUT-TKBS-0017-2 (Chu 2004), it is most likely synonymous with "can." Chu (2004) cites two types of containers: 55-gal drums and 10-gal (38 L) cans. If the neutron dose measurements were performed on a 10-gal can, the comparison to photon dose rates from one or more 55-gal drums is invalid. Photons are much more strongly self-shielded by UF_4 than are neutrons. Thus, the neutron dose rate outside a container of UF_4 increases much faster with increasing mass of material than does the photon dose rate.

In light of these uncertainties in the neutron-to-photon dose ratio developed by Faust (2004), we performed our own analysis of this ratio, using the MCNP5 computer code (LANL 2004). The neutron and photon doses were calculated for three exposure geometries. The source material was powdered UF_4, containing either natural or 2% enriched uranium. The neutron yields and energy spectra were calculated by use of the SOURCES-4C computer code (LANL 2002), a code system that determines neutron production rates and spectra from (α,n) reactions, spontaneous fission, and delayed neutron emission due to radionuclide decay. The results were reported in terms of H*(10) dose rates: the dose in an ICRU sphere at a depth of 10 mm.

Attachment 4.5-4A (Continued)

In geometry 1, the source is a 55-gal drum full of powdered UF_4, situated in a room with a concrete floor, walls, and ceiling. The doses are calculated at a point 1 m above the floor and 1 m from the outer surface of the drum. In geometry 2, the source is a collection of 81 drums. The drums are stacked in three horizontal layers, each layer being nine drums wide and three drums deep. The dose point is again 1 m above the floor, 1 m away from the central drum. Figure 1 shows an elevation of the three layers of drums in a concrete room, while Figure 2 shows a plan view of the drums and the dose point. In geometry 3, the UF_4 powder is in a right circular cone, 10 m in radius and 10 m high, on a concrete slab. The dose point is 1 m above the slab and 1 m from the edge of the cone.

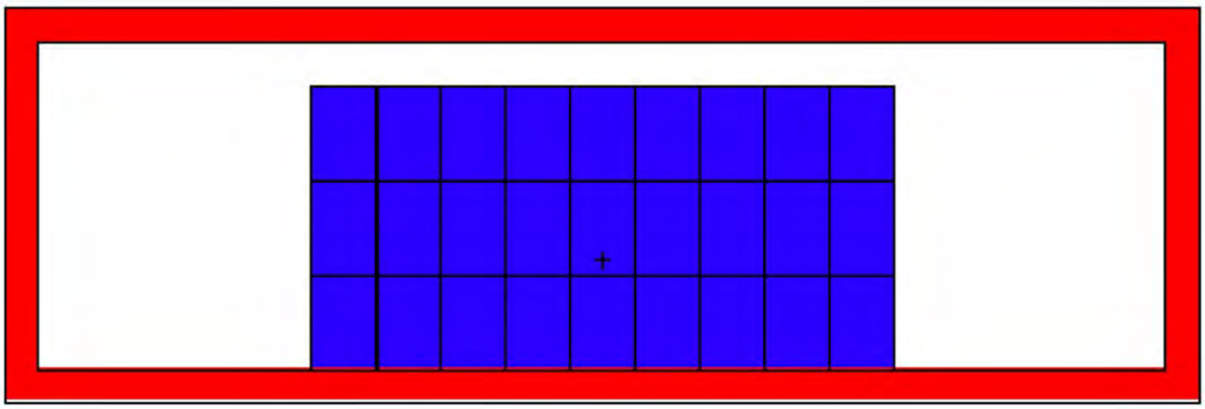

Figure 1. Front View of Array of Drums of UF_4 in Concrete Room

The results of the analysis are presented in Table 1. As shown in the table, the neutron:photon dose ratio varies from 0.13 for a single drum of natural uranium to 0.42 for an 81-drum array of 2% enriched uranium. Although Faust (2004) does not present neutron:photon dose ratios for natural uranium, we note that the geometric means of the distributions are 0.07 and 0.10 for depleted and low-enriched uranium, respectively. The lowest value in Table 1 thus exceeds this range, while the highest value is over four times higher than the value for enriched uranium presented by Faust. We therefore conclude that the neutron:photon dose ratios presented by Faust are neither scientifically correct nor claimant favorable.

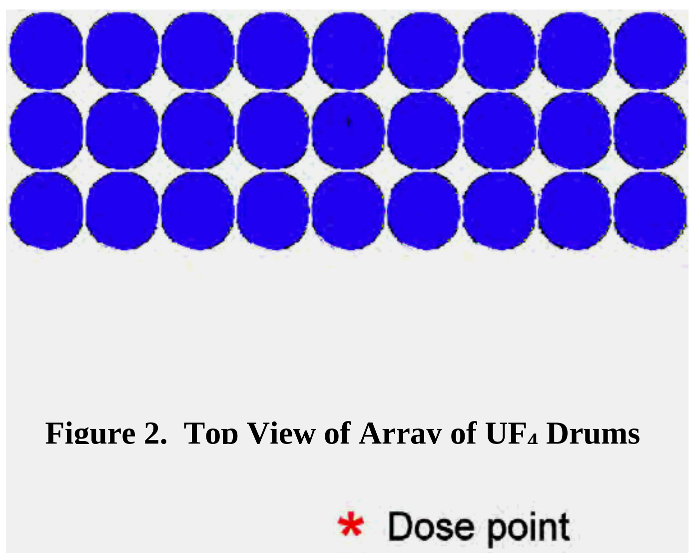

Figure 2. Top View of Array of UF_4 Drums

Attachment 4.5-4A (Continued)

Table 1. Dose Rates (mrem/h) from UF_4

Material	Geometry	Neutron	Photon	n/p
Natural uranium	Single drum	0.015	0.114	0.13
	Drum array	0.286	1.372	0.21
	Conical pile	0.163	1.240	0.13
2% enriched U	Single drum	0.026	0.119	0.22
	Drum array	0.601	1.445	0.42
	Conical pile	0.316	1.322	0.24

References

Chu, S. L. T. 2004. “ORAU Team NIOSH Dose Reconstruction Project: Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Site Description,” ORAUT-TKBS-0017-2. http://www.cdc.gov/niosh/ocas/pdfs/tbd/frnld2.pdf

Faust, L. G. 2004. “ORAU Team NIOSH Dose Reconstruction Project: Technical Basis Document for the Fernald Environmental Management Project – Occupational External Dose,” ORAUT-TKBS-0017-6. http://www.cdc.gov/niosh/ocas/pdfs/tbd/frnld6.pdf.

Los Alamos National Laboratory (LANL). 2004. MCNP5: Monte Carlo N-Particle Transport Code System, Version 1.30, RSICC Code Package CCC-710 [Computer software and manual]. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

Los Alamos National Laboratory (LANL) and Texas A&M University. 2002. SOURCES-4C: Code System For Calculating alpha,n; Spontaneous Fission; and Delayed Neutron Sources and Spectra, RSICC Code Package CCC-661. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

ATTACHMENT 4.5-4B

Health Protection Appraisal Report Dated May 19-21, 1964

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exposures are within recommended limits, it is felt that some exposures in excess of AEC manual chapter limits would occur if this trend continues for a few years. Also, such a continuing trend would indicate a need for modification of basic health physics controls for maintaining exposures as low as practical.

E. Considerable amounts of re-cycle material from GE-HAPO are being processed in several plant areas. This material may contain impurities (e.g., increase in alpha, beta and/or gamma emitters) which are not found in other feed materials processed at this facility. The concentrations of such impurities could change depending on the number of cycles and other considerations concerning the process at GE-HAPO. Therefore, criteria and/or limits currently used for air and/or water concentrations may not be applicable for processes involving re-cycle material.

F. The following items were not reviewed in detail but are considered worthy of NLO study:

1. Completion of a detailed survey of the Neutron Generator is needed for formulating adequate health and safety operational procedures prior to routine operations. The detailed survey should consider the need for additional personnel monitoring (e.g., neutron film, etc.), potential air contamination problems from tritium in target and control room, radiation levels in and around target room, interlocks, and similar matters unique to such a facility. The initial survey by IH&RD indicated health physics problems minimal and facility design excellent.

2. The bio-assay sampling frequency is important in obtaining good estimates of internal uranium deposition. Recent publications indicate that the quarterly sampling frequency may be inadequate for evaluating some exposure potentials. It is also noted that a method for estimating internal deposition of thorium is needed before thorium is again processed in significant quantities.

3. The method of spot air sampling on a periodic basis used for estimating the general and breathing zone air concentration is good. However, there are no continuous samples of the general air, and such samples could provide meaningful information for those areas of greater hazard potential.

ATTACHMENT 4.5-4C

Health Protection Appraisal Report Dated August 1974

F. Irradiation Facilities

A ^{252}Cf source has been added to the neutron activation facility. The 153 microgram source is currently in storage; use is planned in 4-5 months. The procedures, interlocks, etc., in use for the Cockroft-Walton machine will also apply to the ^{252}Cf source. No radiation hazard exists at present, as verified by surveys performed by the IH&R Department.

G. Training

The professional staff of the IH&R Department participates in periodic seminars and technical sessions offered by universities and professional societies.

Plant employees attend monthly safety meetings. Health physics and industrial hygiene topics are occasionally presented at these monthly meetings. Subjects covered recently include noise and respirators. The IH&R Department distributes appropriate phamplets and booklets pertaining to safety and also informs supervision by letter of selected hazardous materials or operations. This training program is considered to be satisfactory.

H. Noise

Major noise areas within the NLO plant have been identified. Those areas which exceed the Occupational Safety and Health Standard have been evaluated in terms of providing engineering solutions to correct the problem. Several of these engineering changes have been incorporated while others require further evaluation. Protective equipment is utilized where necessary. During this review only one operator was noted as not wearing the required ear protection. NLO should continue to stress the importance of wearing ear protection when it is required. None of the areas which have been determined to require ear protection was posted as such. It is recommended that these areas be posted. NLO should continue to resolve noise problems through the application of engineering design solutions. Where these are not feasible, exposure should be reduced through the use of administrative control and the use of protective equipment.

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Finding 4.5-5: Unmonitored Female Workers

Female workers at FMPC were not monitored for external exposure (and assumedly for internal exposure) for the years 1951–1960 and 1969–1978). Section 6.6.3 of the FMPC TBD acknowledges this deficiency and states the following:

> *For unmonitored workers, 500 mrem per year will be assigned as an upper bound limit. This is several times above the mean doses observed for monitored workers.*

The range of job tasks performed by female workers is largely unknown. Thus, a comprehensive evaluation of their potential exposures, in context with the 500 mrem per year default dose, cannot be assessed. However, it is known that female workers were responsible for operating the laundry facility. Among the items subject to laundering were heavily contaminated **dust collector bags** used throughout the FMPC facilities.

Attachment 4.5-5 provides a glimpse of potential dose rates to which female workers may have been exposed while physically handling dust collector bags and other items. For a 2,000-hour work year, the default dose of 500 mrem per year is unlikely to represent a bounding value. Moreover, the default dose of 500 mrem does not address the following: (1) the shallow dose to the skin, (2) the extremity dose to the forearm/hands, and (3) potential internal exposure from airborne contamination created by handling contaminated items. (It is reasonable to assume that in the absence of external exposure monitoring, these female workers were also excluded from internal monitoring during these time periods.)

ATTACHMENT 4.5-5

IH&R Department Monthly Report for May, 1958
J. A. Quigley, M. D.
June 4, 1958

Approximately 25 tons of K-65 drums have been baled preparatory to a test melt at Knoxville, Tennessee. Contact readings of the bales range from 1 to 5 mr/hr. Estimates of the radium content indicate there will be 25 to 50 mg Ra in the 50 tons necessary for the melt. This indicates that there will be little, if any, radiation hazard associated with the metal recovery operation at Knoxville.

Monitoring service is currently being provided the Residue Committee Chairman in the preparation for disposal of thorium-contaminated wastes at FMPC.

A wrist film badge, inadvertently left near some radium-containing samples in the Radio Chemical Laboratory, showed 480 mr gamma. This occasioned a radiation survey of the laboratory and special film badges were placed about the area for confirmatory data. Instrument readings indicated a gamma exposure of 1 to 10 mr/hr at working distance below the waist, due to materials on cabinet shelves below bench tops. Film data will be reported later.

Laundry studies of dust collector bags are currently in progress. Bags reading up to 30 mrep/hr before cleaning show readings of 0.5 to 5.0 mrep/hr after cleaning. The wool type is usually under 1.0 mrep/hr after cleaning, while the canvas material reads higher. Further report will follow upon completion of study.

Miscellaneous Special Studies

Investigations were continued this month in an effort to ascertain the cause of the chlorine releases in Plant 8. These particular releases occur when the caustic scrubber is dropped into a digestion tank and hydrochloric acid is added. A more frequent dropping of the scrubber was recommended as desirable in alleviating the problem. Adding the acid more slowly and the use of a digestion tank close to the scrubber for better ventilation was also suggested. Plant 8 personnel are investigating the possibility of removing the scrubber liquor directly to the sump, as uranium analyses are usually low.

A rough draft of Health and Safety specifications for solvents is nearly completed. This will be reviewed by Dr. Birmingham of the USPHS before being submitted to the division director for final approval. This same degree of completion is applicable to the specifications for powdered hand soaps.

An investigation was made concerning the clothing change requirements for subcontractor personnel involved in relocating

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5.0 CONCLUSIONS

After a thorough review of SEC Petition-00046 and the large number of relevant/support documents, SC&A questions NIOSH's conclusion that exposures to **all members** of the proposed class of workers at FMPC can be reconstructed in compliance with the requirements of 42 CFR 83.

It is SC&A's opinion that dose reconstruction for most, if not all, workers (including non-production workers) would pose a myriad of challenges along with questionable results. This conclusion is not based on whimsical issues or subjective interpretation of data, but is largely based on facts and information contained in the large number of historical FMPC documents– only a few of which were enclosed herein as attachments.

These documents consistently characterize a facility that was deficient in the most basic engineering designs, radiological control practices, and worker monitoring programs. While the existence of these documents was acknowledged by NIOSH, their content and impacts on dose reconstruction were either grossly minimized or completely ignored.

In total, SC&A identified 29 findings. Collectively, the findings describe issues that adversely affect all significant components that contribute to internal and external dose. While some findings pertain to deficiencies that impact the accuracy and/or completeness of dose estimates, a large fraction of findings reflect the total absence of essential data and preclude any credible attempt to establish upper-bound value(s). For example, data for Th-230 and Ra-226 for high grade ores and for RU residues are incomplete and inadequate and sometimes internally inconsistent. Equally, there is documented evidence that unmonitored workers (notably women during certain time periods) were exposed to significant levels of radiation that were, in some cases, recognized to be unexpectedly high, as shown in Attachment 4.1-3. NIOSH has not specified an appropriate way to bound their dose.

Nowhere is the deficiency of data more apparent than for workers exposed to Th-232/Th-228 and their decay products. At no time were workers ever routinely monitored for thorium by means of in vitro/urinalysis methods; and in vivo/lung counting did not begin until 1979, which marked the end of thorium production (but not the end of thorium exposure). Equally, air sampling (including BZ air sampling) prior to 1986 was confined to spot sampling at select work locations. Beside their obvious limitations, these BZ spot air samples cannot be linked to any given worker. Collectively, findings in Section 4.3 of this report point to the fact that, for most workers, exposures to thorium can neither be estimated nor bounded. Equally important is the fact that a large component of thorium workers (representing roving maintenance/repair/operating personnel or members of the Project Labor Pool) cannot be identified as such. Lastly, due to lost records, time periods and locations for thorium processing, redrumming, and repackaging are incomplete and unknown.

It should further be noted that residual thorium/uranium contaminants are likely to have persisted long after processing ceased. Ironically, concern for residual contamination and the need for worker protection are amply demonstrated by the vastly improved radiological control practices and worker monitoring programs that were instituted only after FMPC ceased all production activities in 1989 and became the Fernald Environmental Management Project (FEMP). The need for post-1989 changes provides a clear indicator of a failed and deficient worker protection program during the 38-year production period at FMPC.

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APPENDIX A: PETITIONER/WORKER INTERVIEW

To be provided at a later date.