P.O. Box 1178, Milwaukee, Wisconsin 53201, Telephone (414) 289-9800

CERAC

Cable CERAC Milwaukee, Telex 269452 (CERAC MILW)

February 18, 1981

Mr. C. Thor Oberg
Radiation Specialist
U. S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Licensee: CERAC, inc.
License No: STB-1027

Dear Mr. Oberg:

In response to your letter of December 23, 1980, and the inspection of our facility, Notice of Violation, item 1 of Appendix A, we are pleased to enclose a report by a qualified outside consultant on the Health Physics Audit of CERAC February 7, 1981.

If there are any questions regarding this inspection, please let me know by letter or call.

We appreciate your continued fine cooperation whenever we need assistance on any matter.

Sincerely yours,

Ervin Colton

Dr. E. Colton/er

Ervin Colton
President.

I affirm the above statements are true and this reply is made under oath.

Ervin Colton

Ervin Colton

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3/19/81

Office, Plant and Laboratory 407 No. 13th St. Milwaukee, Wisconsin 53233
CERAC, incorporated Metal, Alloy and Ceramic Powders . . . Hot-Pressed Parts . . . Custom Chemical Syntheses and Alloy Preparations
CERAC/PURE, inc. High Purity Inorganic Chemicals Certified by X-ray and Spectrographic Analyses

Edward J. Lipke, Ph.D.
1720 Manchester Drive
Grafton, Wisconsin 53024
(414)-377-9267

February 13, 1981

Dr. Ervin Colton, President
CERAC, Inc.
P. O. Box 1178
Milwaukee, Wisconsin 53201

Dear Dr. Colton:

HEALTH PHYSICS AUDIT OF CERAC, INC.
FEBRUARY 7, 1981

At your request, I completed a health physics audit of CERAC, Inc. on February 7, 1981. Assisting me in this audit was Mr. Paul R. Roblee, the Radiation Safety Officer for CERAC. In addition to providing CERAC with independent third-party oversight of its radiological safety program, this audit fulfills the requirement for an independent consultant on an annual basis as set forth in Material License #STB-1027, as issued by the U. S. Nuclear Regulatory Commission.

Enclosed herewith are the following:

1. The health physics audit report;

2. A table showing the thorium decay series, beginning with initially purified thorium;

3. An alternative procedure for accounting for thorium daughters in air sampling counting, obtained from Introduction to Health Physics by Herman Cember;

4. The CERAC standard operating procedures for thorium fluoride production;

5. An abbreviated resume to establish my qualifications;

6. A copy of the Murphy and Campe paper on control room ventilation; and

7. My invoice.

I understand that the standard operating procedures for the production of thorium fluoride are proprietary and have been treated as such. They have not been copied, and the copies I was given are those returned herewith. I have retained copies of the ordinary radiological procedures but can return them if you wish.

I performed a fairly comprehensive inspection of your facilities and procedures. While the effort required more time than we had originally anticipated, the report should provide you with a useable reference of independent third-party evaluation. As indicated in the report, you may wish to eliminate the consultant provision from your license when it is renewed and instead employ a consultant only when deemed necessary by you for a specific purpose. The completed audit consisted of three portions:

1. A walk-through inspection of the entire facility;

2. A review of records and procedures with the Safety Radiation Officer (Mr. Paul R. Roblee); and

3. Offsite review of all plant procedures directly or indirectly related to radiological protection.

In conjunction with the preparation of an overall emergency plan for CERAC, Mr. Roblee informs me that he needs some assistance in deriving meteorological data. The Murphy and Campe paper enclosed provides a method for deriving nearby diffusion coefficients for a single release. The techniques for calculating diffusion coefficients further away are set forth in NRC Regulatory Guide 1.145. The procedures for deriving annual average diffusion coefficients are given in Regulatory Guide 1.111. As I indicated to Mr. Roblee, meteorological procedures are substantially more complex than they were several years ago. You may wish to contact Mr. Carl Mazzola of the Stone and Webster Engineering Corporation in Boston, Massachusetts, to obtain assistance. Mr. Mazzola should be informed that you only need a very simple and brief procedure assuming several conservative conditions, including ground level release. To minimize costs, your purchase order should specify that the Stone and Webster Engineering Assurance program should not apply to this job.

Please feel free to call me if you should have any questions about this report or any of the other enclosures.

Very truly yours,

Edward J. Lipke, Ph.D.

Attachments

February 13, 1981

BIOGRAPHICAL SKETCH

Edward J. Lipke, Ph.D.

Dr. Edward J. Lipke is Superintendent of the Regulatory Affairs Division within the Nuclear Power Department of a major midwestern utility. The Company is the owner and operator of a two-unit PWR nuclear power plant. Dr. Lipke's Division has responsibility for radiological engineering, health physics, waste disposal, licensing, and regulatory affairs. Dr. Lipke joined the Company as a Project Engineer, Radiological Design, in 1974. He meets the qualifications of Regulatory Guide 1.8 and is available for consulting on a limited basis.

Dr. Lipke earned his doctoral degree in radiological health at the University of Michigan. He holds Master of Science degrees in radiological health from the University of Michigan and Wayne State University and a Bachelor of Science degree in biology from the University of Detroit. In addition to various courses in radiological health, his studies included courses in biology, chemistry, physics, nuclear engineering, mathematics, statistics, and computer science.

While a graduate student, Dr. Lipke spent a summer working for Battelle Northwest at the Hanford atomic energy site in the State of Washington. Prior to joining his current employer, he worked for two years as a Radiological Engineer at Genreal Electric's Vallecitos Nuclear Center in Pleasanton, California, and for a year as Senior Scientist at the Westinghouse Electric Corporation's Bettis Power Atomic Laboratory in West Mifflin, Pennsylvania.

Dr. Lipke is married and has three children. His main outside interests include home maintenance and do-it-yourself projects, gardening, photography, and radio control airplanes. He also serves as organist and choir director at his Church.

THORIUM DECAY SERIES
(ACTIVITY)

Assume time of purification of natural thorium is t = o.

Initial activities: Th-232 - 1.000 Ci
Th-228 - 1.000 Ci

Time	Th-232	Ra-228	Ac-228	Th-228	Ra-224	Rn-220	Po-216	Pb-212	Bi-212	Tl-208
0	1.000	0	0	1.000	0	0	0	0	0	0
1 wk.	1.000	0.002	0.002	0.993	0.730	0.730	0.730	0.694	0.690	0.248
1 mo.	1.000	0.009	0.008	0.970	0.972	0.972	0.972	0.973	0.973	0.350
0.5 yr.	1.000	0.050	0.050	0.838	0.843	0.843	0.843	0.843	0.843	0.304
1 yr.	1.000	0.098	0.098	0.712	0.715	0.715	0.715	0.715	0.715	0.256
2 yr.	1.000	0.187	0.137	0.540	0.541	0.541	0.541	0.542	0.542	0.195
5 yr.	1.000	0.404	0.404	0.394	0.394	0.394	0.394	0.394	0.394	0.142
10 yr.	1.000	0.645	0.645	0.540	0.539	0.539	0.539	0.539	0.539	0.194
50 yr.	1.000	0.994	0.994	0.992	0.992	0.992	0.992	0.992	0.992	0.357
100 yr.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.360

THORIUM DECAY SERIES
(LUNG BURDENS)

Isotope	Effective Energy
Th-232	41.0
Ra-228	Negligible
Ac-228	0.74
Th-228	56.0
Ra-224, Rn-220, and Po-216	194.0
Pb-212	0.24
Bi-212 and Po-212	83.0
Tl-208	Negligible

TIME	TOTAL EFFECTIVE ENERGY*	MPLB (nCi)**	MPLB (mg)***
0	97	8.66	79.2
1 wk.	296	2.84	26.0
1 mo.	365	2.30	21.0
6 mo.	322	2.61	23.9
1 yr.	279	3.01	27.5
2 yr.	221	3.80	34.7
5 yr.	173	4.86	44.4
10 yr.	221	3.80	34.7
50 yr.	372	2.26	20.7
100 yr+	375	2.24	20.5

*From all isotopes present at time t
**These lung burdens are expressed as Th-232 activity.
***mg of natural thorium, i.e., Th-232 + Th-228.

HEALTH PHYSICS AUDIT OF CERAC, INC.

On February 7, 1981, an audit of CERAC, Inc. was conducted by Edward J. Lipke, Ph.D., at the request of Ervin Colton, Ph.D., President of CERAC, Inc. In addition to providing CERAC with independent third-party oversight of its radiological safety program, this audit fulfills the requirement for an independent consultant on an annual basis as set forth in CERAC's Material License #STB-1027 (Docket 040-08040) as issued by the U. S. Nuclear Regulatory Commission (NRC).

The audit consisted of three portions: (1) a walk-through inspection of the entire facility; (2) a review of records and procedures with the Radiation Safety Officer, Mr. Paul R. Roblee; and (3) an offsite review of plant procedures directly or indirectly related to radiological protection.

This audit did not address the industrial health aspects of non-radiological chemicals or processes at CERAC.

I. WALK-THROUGH INSPECTION

First Floor

The first floor consists of shipping and receiving facilities, storage, and some manufacturing facilities. Source material storage is provided in the electrical substation area for thorium nitrate, thorium oxide and waste materials. Safe occupancy is delimited within the locked substation area by a red line on the floor and a sign.

Spill covering is provided on the floor in the vicinity of the induction furnaces. A sign on the fusion shed provides directives for use of protective clothing. The sign needs clarification, since it implies that boots are required for entry only during the fusion process.

A sandblaster for radioactive materials is also provided on this floor. It is equipped with HEPA filters and appears to be satisfactory. All postings on the first floor are appropriate.

Second Floor

The second floor consists of offices, the packing area, a stock area, and the health physics office. The main stored material is thorium fluoride. Some natural or depleted uranium products are present. The Radiation Safety Officer was unable to clearly state whether most uranium products consisted of depleted uranium or natural uranium. While the difference is relatively small for radiological purposes, it would be well to clarify this situation. The distinction

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is primarily of importance in alpha counting. Since CERAC's production involving thorium is substantially greater, the uranium issue was not pursued further.

There are two primary storage areas for radioisotopes, both were in good order, and proper postings were present on the walls. Gamma radiation levels resulting from thorium and uranium storage are very low. Appropriate monitoring is performed in monthly instrument surveys and by personnel badging. The shelf stock is individually labelled with small radiation stickers of a nonstandard color (orange/purple). The auditor was advised that approval of the stickers had been obtained from the NRC.

A five-gallon can of thorium oxide was noted in one of the storage areas with a yellow III DOT label; the lid was unfastened. It is recommended that a hold-down device be provided for the lid.

A locked and posted area is provided for storage of radioactive wastes; the entry was posted properly and the drums were labelled LSA. CERAC separates storage of source material and waste material in the first and second floor storage areas in order to minimize radiation levels.

Solid thorium oxide rods being prepared for shipment were lying open on a table near filing cases for old records just outside the entry to the main office area. A large sign called attention to the presence of radioactive materials. This casual establishment of the radioactive materials area is not strictly unacceptable from the regulatory standpoint but is not conducive to overall contamination and radiation control.

A large empty decontaminated container among other empties were noted to have a yellow II DOT sticker; upon decontamination, containers should have radioactive labels removed.

Third Floor

The third floor contains the pilot plant for the processing of thorium nitrate. Only one employee generally operates this facility; the process involves all wet chemistry except for the first loading step, and the potential for airborne contamination is small, except for the first loading step. Posting in the area is generally appropriate, except that the demarcation of the step-off area is weak; the line consists primarily of a demarcation line between two types of floor coating. One pair of botts was available on the control side of the line. An empty plastic bag was left lying on the floor. Complete protective clothing is required in the pilot plant. During the loading step, a type half-face respirator or a supplied-air respirator is required.

Also on this floor is a furnace area in a shed for the processing of thorium fluoride. The shed is vented and is equipped with a scrubber for ammonium bifluoride fumes. Several hoods for various manufacturing steps are also provided on this floor. A notice regarding the switching of ducts to the thorium shed is confusing and should be improved.

II. RECORDS AND PROCEDURE REVIEW WITH RADIATION SAFETY OFFICER

CERAC, Inc. is a manufacturer of rare earth chemicals. Its most important radioisotopic products contain natural thorium (Th-332 and Th-228). The company employs 46 persons of which 41 are badged. Only five manufacturing personnel and two health physics personnel performed most of the work with radioactive materials.

1. Records and Personnel Dosimetry

Dose records were inspected on a spot-check basis. The updating of badge results on individual dose records was two or three months behind. The Radiation Safety Officer (RSO) stated that his assistant had been injured in a fall and that some of the paperwork was not up to date; he further stated that his assistant had returned to work and would be attending to these details shortly.

At the current time, only whole-body dosimetry is employed; doses are quite low due to the nature of the radioisotopes encountered. The RSO stated an interest in performing some extremity monitoring; this procedure would be wise, although it could again be discontinued if results are demonstrated to be substantially below the limits. It may be possible, furthermore, to develop a relatively consistent ratio for extremity to whole-body dose.

A single Eberline check source (30,500 dpm Th-230) is used for calibrations. The check source is a secondary standard traceable to NBS standards; appropriate documentation is available.

Portable instrumentation is calibrated on a six-month basis. Based on the serial numbers and contents, the files containing calibration certifications and related materials were mixed up. The RSO stated that his assistant would be asked to straighten these files.

2. Instrumentation and Calibration

Total plant instrumentation consists of two portable Eberline PAC-4 alpha survey meters, two Eberline-120 beta/gamma survey meters, and one Eberline alpha

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scintillation counter for smears, personal samples, and air filters. These instruments are checked daily with Th-230 check sources, except for the beta/gamma survey meters which are checked witb a check source prepared by CERAC and consisting of a vial of thorium nitrate powder. The latter check source is expected to give a reading of 0.8 to 1.2 mr/hour according to the RSO or 0.8 mr/hour according to the written procedure. Some variation of course should be anticipated at this very low dose rate level, and it would be advisable to procure a small check source with a slightly higher gamma dose rate for more accurate checks. An exempt source such as the Eberline CS-7A, consisting of approximately 8 uCi of Cs-137 would be ideal; the 1980 cost of this source is $35.00.

The laboratory scintillation counter is calibrated daily with the Th-230 source. The four portable instruments are calibrated every six months on a staggered basis so that at least one portable alpha survey instrument and one portable beta/gamma survey instrument is available at any time.

The auditor found one alpha survey meter malfunctioning, apparently due to a poor cable or cable connector. The RSO stated that he would procure a new cable.

3. Ventilation and Effluent Sampling

There are five radioactive effluent release points for the building. Backdraft protection is provided on all vent lines except on the scrubber line from the thorium shed; in this case, semiannual sampling has been negative. It is recommended that further sampling be performed during adverse weather (gusty winds). The scrubber line from the pilot plant was determined to be negative in 1978 and 1979; no further verification is needed at this time.

Sampling is conducted as follows on five stacks:

a. Sandblast Stack - Provides vent for radioactive and nonradioactive sandblasting operations; the blowers function whenever the sandblasting operation is in progress; sampling is continuous whenever the operation is in progress.

b. #3 Stack - This vent services the induction furnace (melt-to-ingot operation). The furnace is vented through a Torit filter. The blower runs continuously, although continuous sampling is performed only on a Monday-through-Friday basis when operations may be in progress.

c. #4 Stack - Services the vent lines from the sizing, and thorium fluoride shed and also receives the vent from the scrubber. The scrubber is run whenever operations are in progress. The remaining vents operate continuously from Monday through Friday. Sampling is performed continuously whenever the vent blower is operating.

d. #9 Stack - Vents the hot press furnaces. Blower operates whenever the furnaces are being used. Sampling is continuous during pressing and intermittent thereafter.

e. #1 Stack - Vents the burnoff operation. The blower runs continuously on a Monday-through-Friday basis. Sampling is continuous while the blower is operating.

Sampling of effluent vent stacks is adequate for the purpose of determining the quantity of effluents from the plant. However, it is recommended that airborne sampling be performed in the building in logical areas, e.g., in the vicinity of the thorium fluoride shed, in order to determine whether any significant buildup of airborne radioactive materials occurs within the plant when all these ventilation systems are shutdown over the weekend. Such sampling should be performed especially during windy weather in order to also determine the adequacy of backdraft protection. If, after two or three episodes of such sampling, negative results continue to be obtained, further sampling can be discontinued.

All sampling probes used for determining stack effluents are isokinetic; procedures for the selection and calibration of probes are generally excellent.

Ventilation changeout is generally adequate for the vent stacks. The sandblaster filter is changed monthly; filters for stacks 1, 4, and 9 are changed out based on pressure differential, usually every six months; and the Torit which services the induction furnace vent is equipped with a shaker to dispose of particulates into a hopper. The filter is changed out completely if air sampling results indicate filter failure.

Waste water sampling for radioactive effluents is performed by obtaining a monthly composite of daily 500 ml samples from the manhole drain from the settling tank. The disposal of liquids which may contain radioactive materials is restricted to those sinks/drains which lead to the holdup tank. Sampling of the effluents from the tank is coordinated to the extent practicable with those operations which might be expected to contribute to radioactive effluents. Of the total monthly composite, a 1,000 ml sample is shipped to the Eberline Instrument Corporation for analysis. In general, liquid effluent sampling was found to be adequate. It is understood that the NRC has been urging CERAC to assemble an annual summary of gaseous and liquid effluents. Such a summary may not be undesirable; in fact, CERAC may find the documentation useful for ready reference for both legal and public relations purposes. The practice is common for nuclear power plants and for major radioisotope handling facilities.

4. License Documentation

Materials License #STB-1027 has been issued to CERAC, Inc. The license provides for the possession of a maximum of 100 pounds of natural uranium and 15,500 pounds of natural thorium. The license has been amended by a number of letters since the original issue as follows: February 4, 1975, January 12, 1976; January 28, 1976; February 27, 1976; March 29, 1976; December 5, 1977; March 14, 1978; August 17, 1979; and April 10, 1980. The license is due for renewal shortly. It is recommended that all the provisions contained in amendments be cleaned up by consolidation into a single new application for renewal. The fact of the totally new application should be pointed out to the NRC to avoid future reference to these numerous past documents.

There are a number of conditions which may be outdated in the amended letters. For example, the letter of February 4, 1975, implies that CERAC will only receive thorium powder from the W. R. Grace Company, thereby implying a restriction on choice of suppliers. Nuclear Associates Instrumentation is similarly mentioned, and R. S. Landower is specified as the badge supplier. "Outside specialists" are mentioned for decontamination. Similarly, the letter of March 14, 1978, references an intended consolidation of certain areas. It is now understood that the intended consolidation has been completed; but the vague references in this letter could cause a misunderstanding, since certain radioactive operations still remain scattered throughout the plant.

In the application for renewal, it is recommended that the following principles be employed:

a. Avoid the specification of procedural details and avoid the inclusion of verbatim procedures. The intent here is to retain the flexibility to implement minor changes without applying for a license amendment. Commitments to sampling, personnel protection provisions, and similar aspects should be committed to on a generic basis to the extent possible.

b. Avoid the mention of specific names in the license application, again for the purposes of retaining maximum flexibility.

c. Eliminate the provision that a consultant be called in on a specified periodic basis. The consultant requirement on a regular basis is artificial and inappropriate. Since CERAC now has a full-time radiation protection department, the NRC may be willing to renew the license without the provision. Alternatively, a proposal could be made to commit to retain a consultant only on an as-needed basis.

5. Bioassay and Personal Sampling (Air)

Personal air sampling is required by written procedure for a number of provisions at CERAC. This sampling is accomplished by the use of personal, portable MSA air sampling equipment with 0.8 μ filters and a dispersion attachment. The personal sampling program is judged to be quite good.

Bioassay is conducted on a periodic basis for the two employees who have the greatest potential for exhibiting body burdens of thorium, namely the plant manager and the pilot plant technician. Although thorium is extremely difficult to quantify in vivo, whole body counting and radioisotopic breath analysis is performed on these individuals on an annual basis. This program is judged to be adequate.

6. Surveys

Direct beta/gamma monitoring is performed on a periodic basis specified by procedure. Similarly, extensive contamination monitoring is performed on a periodic basis according to procedure which establishes monthly, quarterly, and annual surveys depending on the area. The survey forms used at CERAC are excellent. A single exception is that swipe or smear results as opposed to direct readings of fixed contamination are not clear on the forms. In addition, it is suggested that increased emphasis in contamination surveys be placed on passage ways leading to building exits, such as stairways, landings, and doorways.

Air sampling in the building is generally scheduled at 21 locations on a semiannual basis. Consideration should be given to increasing the frequency of these surveys, although the personal sampling program together with the very low results obtained in the semiannual building survey (mostly on the order of 0.002 MPCs for occupational exposure) does not indicate the need for daily or weekly surveys. However, a monthly frequency at selected locations, not necessarily all 21 scheduled for semiannual review, should be considered.

In addition, as mentioned in the earlier discussion of ventilation and effluent sampling, some attention should be given to the potential for increased airborne concentrations over the weekend when most ventilation systems are shut off, especially during adverse windy weather.

7.. Training

Provisions for training were discussed with the RSO, and the checkoff form used for training was reviewed. Designated topics are appropriate and the coverage seems to be generally adequate. Unstructured safety talks are given to employees on approximately a monthly basis. While the detailed facts and materials used in the training sessions have not been reviewed, the general training effort appears to be quite adequate.

8. Posting

Posting was evaluated during the walk-through inspection described earlier in Section I. The observed signs and markings conformed with the minimum requirements set forth in 10 CFR 20. A few examples were discussed earlier in Section I.

9. Waste Disposal

This area was reviewed only briefly. However, drums scheduled for shipment are properly stored and labelled, and the CERAC procedures for radioactive waste shipment and disposal are appropriate. Complete documentation of the Chem-Nuclear licenses for the Barnwell site is kept in good order, and all pertinent other correspondence with Chem-Nuclear is available in the files.

10. Emergency Planning

Most operational procedures for plant processes have a section devoted to minor emergencies and exigencies which may result in an unexpected, but not unanticipated, loss or spillage of radioactive material. Attention to these features is judged to be excellent.

CERAC does not at the present time have a general emergency plan for major disasters, such as fires, explosions, or other events which have the potential for resulting in significant releases of airborne radioactive materials. At the present time, key personnel are trained on an informal basis in order to ensure a working knowledge of liquid, gaseous, and electrical shut-off points throughout the plant, first-aid procedures, fire-fighting techniques, and notification schemes. The RSO maintains liaison with the local fire department.

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It is understood that the RSO has committed to assemble a written emergency plan by October 1981. The present arrangements appear to be good and should be included in the final written version. Two aspects also need to be addressed in the final version: environmental monitoring and sampling during the course of a major emergency and procedures for evaluation of potential resulting airborne concentrations and subsequent doses to the public.

11. General Health Physics Rules, Housekeeping, and Contamination Control

General health physics rules in the plant are appropriate. Smoking, eating, or drinking are only permitted in office areas and in the lunchroom. The rules for personnel monitoring are generally adequate. However, general housekeeping throughout the plant should be improved in the interests of careful contamination control. Because of the earlier use of the building as a machine shop, the floor consists of rough embedded wooden blocks and is not amenable to decontamination. Hence, as portions of the plant are upgraded from time to time, smooth floor coverings should be considered.

As evidenced by the smear or swipe survey records, most surfaces in the plant exhibit low-level alpha contamination. Stepoff procedures, while often referenced in process procedures, seem to be poorly carried out. Stepoff areas throughout the plant are casual and poorly marked. In no instance is a removable or replaceable stepoff pad procedure implemented as extra protection against the spread of contamination.

The NRC does not establish surface contamination limits by regulation; hence, the current condition of surface contamination at CERAC cannot be regarded as noncompliance of the regulations. At the same time, the significance of surface contamination levels is difficult to assess in the case of thorium, since bioassay procedures are not particularly sensitive or conclusive for this radioisotope. Surface contamination limits employed at CERAC are higher than those encountered at other nuclear facilities, particularly for clean or unrestricted areas.

While ALARA (as low as is reasonably achievable) procedures have not yet been imposed on source material and byproduct material licensees, ALARA has been imposed on nuclear power plant licensees, and the NRC has indicated their intention of imposing such procedures on materials licensees in the future. It is recommended that an ALARA program be implemented at CERAC with the goal of eventually reducing general contamination levels throughout the plant.

Recommended modifications to the survey and contamination control program at CERAC are discussed in the section on procedures later in this report.

III. REVIEW OF PLANT PROCEDURES

1. Half-face and full-face respirators and air-line supplied respirators are used at CERAC. At the present time, only a qualitative fitting program has been implemented, thereby precluding credit for protection features and calculating MPC exposure levels. Continuance of the qualitative fitting program is adequate as long as it continues to be acceptable to NRC; conscientiously applied qualitative techniques undoubtedly assure substantial protection. However, it is recommended that the half-face respirators eventually be eliminated, since this type has been shown to be most susceptible to leakage and therefore affords unreliable protection. A gradual replacement with full-face respirators is recommended. The latter have the advantage of providing a built-in eye protection.

2. Decontamination of certain hoods and other equipment after use for radioactive materials is cited in a number of instances in the procedures. Consideration should be given to reserving hoods for radioactive materials use, thereby reducing decontamination efforts to that required for general cleanliness rather than absolute radiological removal.

3. A number of the procedures reference the use of a vacuum cleaner for cleanup of radioactive materials. It is recommended that HEPA filters be provided on the exhaust of each vacuum cleaner if not already so equipped.

4. On page 5 of 7 in the procedure for "X-Ray Analysis of Fused Thorium Fluoride" at step 3.5, the visibility of powder is used as a criterion for contamination. This criterion is inappropriate and contradicts one of the general radiological procedures which points out that visual contamination is already excessive. In the x-ray procedure, the paper should be simply discarded as radioactive waste.

5. A number of procedures reference Eberline Instrument Corporation; some reference the late Mr. M. Trautman in particular. For the same reasons as discussed under License Documentation, names should be omitted from procedures.

6. In the procedure for "Waste Water for Radiochemical Analysis" on page 2 of 7, the reference to a portion of 10 CFR 20 should be "Appendix B, Table II Column 2" (corrections underlined).

7. In the procedure on "Personal Air Sampling", reference is made to an IATA regulation which is not reasonable justification for using 1×10^{-10} as an MPC instead of 7×10^{-11}; however, 1×10^{-10} is probably satisfactory because there will usually be some U-235 and U-234 in depleted uranium.

8. In the same procedure, the use of the 0.75 factor (25% correction) for thoron and its daughter decay may not be uniformly true and may err in a nonconservative direction. In general, this factor may be more or less constant for thorium at a particular age. If in fact the primary source of activity on a filter turns out to be either uranium or natural thorium particulate material, the 0.75 factor will be definitely nonconservative. The behavior of the thorium decay chain can be further deduced from the table enclosed with this report.

9. In the procedure for "Self-Monitoring for Alpha Contamination", a caution is needed to indicate that personal surveys or "frisking" should proceed at an extremely slow pace because of the naturally slow response of alpha survey instruments.

10. In the procedures for contamination control, the following limits are given for surface contamination per 100 cm^2:

	Aver. Fixed	Max. Fixed	Removable
Th-nat	1,000 dpm	300 dpm	200 dpm
U-depl	5,000 dpm	15,000 dpm	100 dpm

As indicated in the discussion on contamination in the preceding section, some changes in contamination control would be advisable. It is suggested that limits for depleted uranium be eliminated, since such limits could never be employed at CERAC with absolute certainty that no thorium is present. Secondly, it is recommended that the distinction between average and maximum fixed contamination levels be eliminated and that the value used for average fixed contamination be adopted as a single value for all fixed contamination, namely 1,000 dpm. The removable contamination limit should remain at 200 dpm for restricted areas of the plant.

Areas exhibiting contamination levels in excess of these limits should either be decontaminated or strict stepoff pad procedures should be implemented.

In addition to these restricted area limits, clean area limits should be adopted at CERAC. These limits should be "nondetectable" for removable contamination and about 50 cpm as indicated by the PAC-4 survey meter for fixed contamination. These clean area limits should be used

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for the main office area, for the lunchroom, for restrooms, and for general entry/exit points at the plant. Some clean up of the stairways may be advisable.

As a longer-term goal, perhaps with future reorganization of working areas, it would be desirable to consolidate all radioactive materials operations into a single restricted area with only one or two normal entry points, each entry/exit being equipped with monitoring instrumentation for use by each employee prior to leaving the control or restricted area. As indicated earlier, the contamination control program at CERAC is not unacceptable from a regulatory standpoint; however, a number of improvements are desirable as longer-term goals from the standpoint of good health physics practice. In the meantime, decontamination of those areas recommended above for designation as clean areas should be continued on a frequent basis. The improved demarcation of stepoff areas by painted lines or radiation warning tape would be helpful.

IV. CONCLUSIONS

The CERAC, Inc. radiation protection program is judged to be generally adequate, in compliance with NRC requirements, and reflective of recognized good health physics practices. Some minor improvements in surface contamination control are recommended.

E. J. Lipke

Edward J. Lipke, Ph.D.