INSPECTION AND ENFORCEMENT

40-7102

Shieldalloy Corporation

A SUBSIDIARY OF METALLURG, INC.

NEWFIELD, NEW JERSEY 08344

TELEPHONE 692-4200 (AREA CODE 609)

TWX 510-687 8918

CABLE REGISTRATION
SHIELDALOY

1977 DEC 27, AM 11 20

December 23, 1977

Director of the Division of
Fuel Cycle and Material Safety
Office of Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Application for Renewal of NRC License No. SMB-743

Gentlemen:

Enclosed please find the original and three (3) copies of our application for the renewal of NRC License No. SMB-743.

We believe that the applications and the supporting attachments are self-explanatory, but should there be any questions or clarification necessary, please contact the undersigned at 609-692-4200, extension 209.

Very truly yours,

SHIELDALLOY CORPORATION

John B. Longaker

John B. Longaker

JBL/ljb

DOCKETED
USNRC
JAN 10 1978
NMSS
MAIL SECTION
DOCKET CLERK

C8352

FORM NRC-2
(7-77)
10 CFR 40

Approved by GAO
R0203

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR SOURCE MATERIAL LICENSE

Pursuant to the regulations in Title 10, Code of Federal Regulations, Chapter 1, Part 40, application is hereby made for a license to receive, possess, use, transfer, deliver or import into the United States, source material for the activity or activities described.

1. (*Check one*)
   - ☐ (*a*) New license
   - ☐ (*b*) Amendment to License No. ______
   - ☒ (*c*) Renewal of License No. SMB-743
   - ☐ (*d*) Previous License No. ______

2. NAME OF APPLICANT

SHIELDALLOY CORPORATION

3. PRINCIPAL BUSINESS ADDRESS

WEST BOULEVARD
NEWFIELD, NEW JERSEY 08344

4. STATE THE ADDRESS(ES) AT WHICH SOURCE MATERIAL WILL BE POSSESSED OR USED

As Above

5. *NAME OF PERSON TO BE CONTACTED CONCERNING THIS APPLICATION*

John B. Longaker

6. *TELEPHONE NO. OF INDIVIDUAL NAMED IN ITEM 5*

(609) 692-4200, ext. 209

7. DESCRIBE PURPOSE FOR WHICH SOURCE MATERIAL WILL BE USED

Production of ferro alloys such as ferro columbium, ferro vanadium, ferro boron, ferro zirconium, etc., from metaliferous ores containing not more than 0.4 percent uranium and 2 percent thorium.

8. STATE THE TYPE OR TYPES, CHEMICAL FORM OR FORMS, AND QUANTITIES OF SOURCE MATERIAL YOU PROPOSE TO RECEIVE, POSSESS, USE, OR TRANSFER UNDER THE LICENSE

(*a*) TYPE	(*b*) CHEMICAL FORM	(c) PHYSICAL FORM (*Including % U or Th.*)	(*d*) MAXIMUM AMOUNT AT ANY ONE TIME (*kilograms*)
NATURAL URANIUM	Metaliferous ores	0.4% U max.	Unlimited quantities
URANIUM DEPLETED IN THE U-235 ISOTOPE			
THORIUM (ISOTOPE)	Metaliferous ores	2.0% Th max.	Unlimited quantities

(*e*) MAXIMUM TOTAL QUANTITY OF SOURCE MATERIAL YOU WILL HAVE ON HAND AT ANY TIME (*kilograms*)

Unlimited quantities

9. DESCRIBE THE CHEMICAL, PHYSICAL, METALLURGICAL, OR NUCLEAR PROCESS OR PROCESSES IN WHICH THE SOURCE MATERIAL WILL BE USED, INDICATING THE MAXIMUM AMOUNT OF SOURCE MATERIAL INVOLVED IN EACH PROCESS AT ANY ONE TIME, AND PROVIDING A THOROUGH EVALUATION OF THE POTENTIAL RADIATION HAZARDS ASSOCIATED WITH EACH STEP OF THOSE PROCESSES.

Ore processing and potential radiation hazard evaluation in accordance with the procedures described in the attached supplements. (Chapters II and III from Technical Project Report SC-TP-0176).

10. LIST THE NAMES AND ATTACH A RESUME OF THE TECHNICAL QUALIFICATIONS INCLUDING TRAINING AND EXPERIENCE OF APPLICANT'S SUPERVISORY PERSONNEL AND THE PERSON RESPONSIBLE FOR THE RADIATION SAFETY PROGRAM (OR OF APPLICANT IF AN INDIVIDUAL).

John B. Longaker (Asst. to the Vice President)
LeRoy F. Kisi (Chief Chemist)
Jane M. Ricciuti (Radiation Safety Officer)
Walter L. Silvernail, PhD. (Consultant)

11. DESCRIBE THE EQUIPMENT AND FACILITIES WHICH WILL BE USED TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE OR PROPERTY AND RELATE THE USE OF THE EQUIPMENT AND FACILITIES TO THE OPERATIONS LISTED IN ITEM 9; INCLUDE: (*a*) RADIATION DETECTION AND RELATED INSTRUMENTS (including film badges, dosimeters, counters, air sampling, and other survey equipment as appropriate. The description of radiation detection instruments should include the instrument characteristics such as type of radiation detected, window thickness, and the range(s) of each instrument).

See attached supplement (Chapter IV from SC-TP-0176)

(*b*) METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED IN (*a*) ABOVE, INCLUDING AIR SAMPLING EQUIPMENT (for film badges, specify method of calibrating and processing, or name supplier).

See attached supplement (Chapter IV from SC-TP-0176). Film badges are processed monthly by Searle Analytical, Inc., Chicago, Illinois

11(c). VENTILATION EQUIPMENT WHICH WILL BE USED IN OPERATIONS WHICH PRODUCE DUST, FUMES, MISTS, OR GASES, INCLUDING PLAN VIEW SHOWING TYPE AND LOCATION OF HOOD AND FILTERS, MINIMUM VELOCITIES MAINTAINED AT HOOD OPENINGS AND PROCEDURES FOR TESTING SUCH EQUIPMENT.

Smelting operations are vented to the outside atmosphere as described in the supplement to Item 9.

12. DESCRIBE PROPOSED PROCEDURES TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE AND PROPERTY AND RELATE THESE PROCEDURES TO THE OPERATIONS LISTED IN ITEM 9; INCLUDE: (a) SAFETY FEATURES AND PROCEDURES TO AVOID NONNUCLEAR ACCIDENTS, SUCH AS FIRE, EXPLOSION, ETC., IN SOURCE MATERIAL STORAGE AND PROCESSING AREAS.

Periodic surveys are made in accordance with the procedures described in the attached supplement (Chapters III and V from SC-TP-0176).

(b) EMERGENCY PROCEDURES IN THE EVENT OF ACCIDENTS WHICH MIGHT INVOLVE SOURCE MATERIAL.

Not required

(c) DETAILED DESCRIPTION OF RADIATION SURVEY PROGRAM AND PROCEDURES.

See attached supplement (Chapters III, V and VII from SC-TP-0176)

13. WASTE PRODUCTS: *If none will be generated, state "None" opposite (a), below. If waste products will be generated, check here* ☒ *and explain on a supplemental sheet:*

(a) Quantity and type of radioactive waste that will be generated.

(b) Detailed procedures for waste disposal.

14. IF PRODUCTS FOR DISTRIBUTION TO THE GENERAL PUBLIC UNDER AN EXEMPTION CONTAINED IN 10 CFR 40 ARE TO BE MANUFACTURED, USE A SUPPLEMENTAL SHEET TO FURNISH A DETAILED DESCRIPTION OF THE PRODUCT, INCLUDING:

(a) PERCENT SOURCE MATERIAL IN THE PRODUCT AND ITS LOCATION IN THE PRODUCT.

(b) PHYSICAL DESCRIPTION OF THE PRODUCT INCLUDING CHARACTERISTICS, IF ANY, THAT WILL PREVENT INHALATION OR INGESTION OF SOURCE MATERIAL THAT MIGHT BE SEPARATED FROM THE PRODUCT.

(c) BETA AND BETA PLUS GAMMA RADIATION LEVELS (*Specify instrument used, date of calibration and calibration technique used*) AT THE SURFACE OF THE PRODUCT AND AT 12 INCHES.

(d) METHOD OF ASSURING THAT SOURCE MATERIAL CANNOT BE DISASSOCIATED FROM THE MANUFACTURED PRODUCT.

CERTIFICATE

(*This item must be completed by applicant*)

15. *The applicant, and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 40, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.*

BY: [signature]
(*Signature*)

Dated December 23, 1977

Charles F. Seybold
(*Print or type name*)

Vice President
(*Title of certifying official authorized to act on behalf of the applicant*)

WARNING: 18 U.S.C. Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

SUPPLEMENT TO PART 10 OF NRC-2

John B. Longaker (Assistant to the Vice President)

Graduated Cum Laude from the Pennsylvania State University with a BS degree in Meteorology concentrating in Air Pollution. Had course on radiation and its various health aspects. Presently overseeing the Shieldalloy Radiation Safety Program.

LeRoy F. Risi (Chief Chemist)

Graduated with a BS degree from St. Joseph's College in Chemistry. Twelve years experience in radiation program and analyses of U_3O_8 and ThO_2 at Shieldalloy Corporation. Chief function is to analyze dust surveys.

Jane M. Ricciuti (Radiation Safety Officer)

Graduated Cum Laude from Glassboro State College with a BA degree in Physical Science concentrating in Chemistry. Had a course in Radiation Science, a lab oriented course, covering principles of radioisotope methodology. Presently in charge of all aspects of the Shieldalloy Radiation Safety Program. Chief responsibility is to collect dust samples and perform calculations to determine compliance with regulations.

Walter L. Silvernail, Ph.D. (Consultant)

Holds a Ph.D. in Physical Chemistry from the University of Missouri. Was Technical Director at Kerr-McGee and one of the authors of the Encyclopedia of Chemical Technology. Chief consultant for Shieldalloy and author of the present Radiation Safety Program.

WALTER L. SILVERNAIL, Ph.D.
Technical Services
140 East Stimmel St.
West Chicago, Ill. 60185

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CHAPTERS II, III, IV, V & VII of

SOURCE MATERIAL LICENSE AND RADIATION SAFETY PROGRAM

Shieldalloy Corporation

Newfield, New Jersey

Technical Project Report

SC-TP-0176

West Chicago, Illinois

January 15, 1977

(Corrected & Revised February 21, 1977)

Chapter II

Current Plant Practices and Procedures

The principal business of Shieldalloy Corporation is the production of ferro alloys such as ferro columbium, ferro vanadium, ferro boron, etc. These are produced from various metaliferous ores by conventional alumino thermal or electric furnace smelting techniques, and because some of these ores may contain thorium and/or uranium in excess of 0.05%, the over-all operation is subject to regulation under 10CFR40 - "Licensing of Source Material", 10CFR20 - "Standards for Protection Against Radiation", and 10CFR19 - "Notices, Instructions, and Reports to Workers; Inspections". Chapter VI contains copies of these parts with the sections of particular applicability to SC's source material license being appropriately marked.

The following is a description of the materials, equipment, and processing procedures currently used at SC's Newfield operation.

1) Materials

The major ore containing source material processed at SC is pyrochlore, a sodium-calcium fluoro columbite originating primarily in Brazil, but also available from Nigeria, Norway, Canada, etc. However, because other ores are amenable to the smelting process, the license includes any metaliferous ore containing up to 2% thorium and/or up to 0.4% uranium. Other materials used in the reduction such as lime, aluminum, steel, etc. contain no radioactive constituents..

2) Equipment

The principal pieces of equipment of interest are 1) the furnace which consists of a large high magnesia-lined shell over which is mounted an array of three graphite electrodes powered by a 3000 KVA source, and 2) the dust collector. The latter, manufactured by American Air Filter Corporation is a six-compartment No. 90 Amertherm Baghouse, Model S, Design CP, containing 540 Dacron bags, each 11.5 inches in diameter by 32 feet long. Air flow to the dust collector is supplied by two fans with a combined output of 150,000 cfm. The dust handling and disposal system is a series of screw conveyors and adequate conveying ducts. The collected dust is discharged into a truck and transported to the restricted slag area for storage.

3) Processing

Processing begins by preparing the batch used to charge the furnace. A typical batch consists of the following:

Component	Wt. in Lb	Per Cent
Pyrochlore Ore	2650	56.6
Dolomite	390	8.3
Lime	390	8.3
Aluminum	840	18.0
Steel	360	7.7
Fluorspar	50	1.1
Total	4680	100.0

A prorated amount of each of the components is transferred to a tared dump-bottom skip box placed on a scale. The components are stored in drums and transferral is by means of a fork-lift truck equipped to dump barrels. A small amount of shoveling is necessary to adjust the exact weight of each component. The combination of batch weighing and bottom-dumping skip boxes supplies the mixing required thus holding dusting and exposure to a minimum. Four skip boxes are used per batch and usually four batches are prepared per shift for use on the next shift.

The reduction is carried out in the furnace described above. The total charge weighing 4680 pounds is transferred to the magnesia-lined shell and packed around the electrodes which are lowered into it. The reaction begins when power is applied. Although the reduction is exothermic, the additional power aids in starting the reaction and in keeping the slag fluid. The reaction is accompanied by considerable pyrotechnics and appropriate shielding is provided with the operator following the course of the reaction from behind a safety glass shield. A considerable amount of dust is generated which rises immediately overhead and is swept into a duct which in turn leads to the baghouse. It is apparent from the flume over the furnace that all of the dust enters the duct.

The reaction requires about one hour for completion, after which the power is shut off, the electrodes raised, and the furnace tilted to allow the metal and slag to pour into a pot. The slag floats on top of the metal and any excess overflows into a second pot. The first pot containing the metal and slag is then transferred to the cooling area and when cool (the next day), is inverted and the metal and slag removed. The metal, which is on top of the slag at this point, is broken up and transferred to trays prior to packaging, while the slag is broken up and placed in a truck for transferral to the slag dump. Analysis of the metal has shown less than 10 ppm thorium or uranium indicating that all of the thorium and uranium report to the slag. This has been confirmed by analysis of the slag.

As many as four batches may be processed during an eight-hour shift equivalent to a maximum of 21,200 pounds per day (two 8-hour shifts) of ore. At the permissable source material content of 2 per cent thorium and 0.4 per cent uranium, this would correspond to a contained maximum of 424 pounds of thorium and 85 pounds of uranium.

Ferro vanadium

Ferro vanadium alloy also is produced by SC. While the feed materials for this process do not contain any source material and are non-radioactive, nevertheless the process will be described since it is done in the same department as is the pyrochlore reduction.

The ferro vanadium process is similar to the ferro columbium process except that the feed material is a mixture of vanadium pentoxide (V_2O_5) and vanadium resulting as a by-product from the combustion of oil originating in Venezuela.

Batches are prepared in the same manner as used for the ferro columbium process. A typical batch consists of the following:

Component	Wt. in Lb	Per Cent
Oil residue	3600	46.7
V_2O_5	600	7.8
Lime	2300	29.9
Aluminum	1200	15.6
Total	7700	100.0

The reduction is carried out in a furnace similar to that used for the ferro columbium process and located next to it. The dust flume rises as in the ferro columbium process and passes into the same duct which discharges to the AAF baghouse. Four vanadium reductions per shift may be made, but the vanadium reductions and the columbium reductions are never made simultaneously. As with the ferro columbium process, the alloy is separated from the slag after the mass has cooled, and the slag transported to the slag dump.

Chapter III

Radiation Safety Program Practices at Shieldalloy Corporation

1) General Considerations

As noted in the introduction to this report, source material licensees are subject to regulations under 10CFR20 - Standards for Protection Against Radiation with the sections or particular applicability being 20.103 - Exposure of individuals to concentrations of ratio-active materials in restricted areas, and 20.106 - Radioactivity in effluents to unrestricted areas, where a restricted area is defined (20.3(a) (14)) as any area access to which is controlled by the licensee for the purpose of protection of individuals from exposure to radiation and radioactive materials. (In the discussion which follows, certain sections and paragraphs of 10CFR20 will be paraphrased or condensed. The reader is referred to the original 10CFR part in Chapter VI for the exact wording.)

Section 20.103 essentially places a limit on the concentration of airborne radioactivity material to which an individual in a restricted area may be exposed. These limits, known as the Maximum Permissible Concentration (MPC), depend on the particular radioactive isotope in question and are specified in Appendix B, Table 1, Column 1 of 10 CFR20. They are based on an exposure to the concentration specified for forty hours in any period of seven consecutive days with allowance being permissible for periods less (or greater) than forty hours. In a similar manner, Section 20.106 prohibits a licensee from releasing to the environment (unrestricted area) any radioactive material which exceeds the limits specified in Appendix B, Table II, Column 1 lf 10CFR20. In this case, the concentration may be averaged over a period not to exceed one year.

Accordingly, the species of interest are thorium, uranium, thoron (Rn-220) and radon (Rn-222). It is assumed that the thoron and radon are in secular equilibrium with their parents (thorium and uranium) and furthermore that each is released as a gas at the high temperature of the reaction. The following table gives the MPC's for these elements in air specified in Tables I and II of 10CFR20 Appendix B. All values are in microcuries per milliliter (μCi/ml) while those for natural uranium are also given in micrograms per cubic meter (μg/m^3) in accordance with Note 4 of Appendix B.

Species		Table I Col 1	Table II Col 1
Th-232	S	$3x10^{-11}$	$1x10^{-12}$
Th-232	1	$3x10^{-11}$	$1x10^{-12}$
Th-nat	S	$6x10^{-11}$	$2x10^{-12}$
Th-nat	1	$6x10^{-11}$	$2x10^{-12}$
U-238	S	$7x10^{-11}$	$3x10^{-12}$
U-238	1	$1x10^{-10}$	$5x10^{-12}$

U-nat	S	$1x10^{-10}$	$5x10^{-12}$
U-nat	I	$1x10^{-10}$	$5x10^{-12}$
U-nat		75*	3*
Rn-220		$3x10^{-7}$	$1x10^{-8}$
Rn-222		$3x10^{-8}$	$3x10^{-9}$

*micrograms per cubic meter

Moreover, for purposes of calculation, the following relationships will be taken:

Species	Ci/g	g/Ci	Ci/lb	lb/mCi	µCi/lb	lb/µCi
Th-232	$1.09x10^{-7}$	$9.17x10^{6}$	$4.94x10^{-5}$	20.2	49.4	0.0202
Th-nat	$2.18x10^{-7}$	$4.58x10^{6}$	$9.90x10^{-5}$	10.1	99.0	0.0101
U-238	$3.32x10^{-7}$	$3.00x10^{6}$	$1.51x10^{-4}$	6.64	151	0.0066
U-nat	$6.77x10^{-7}$	$1.48x10^{6}$	$3.02x10^{-4}$	3.31	302	0.0033

Note that the specific activity for Th-nat is twice that of Th-232 and that of U-nat is twice that of U-238. This comes about from the definition of a curie of natural thorium as being one curie of Th-232 plus one curie of Th-228 while a curie of U-nat is defined as one curie of U-238 plus one curie of U-234 plus a small amount arising from U-235. Also, inasmuch as thorium frequently is analyzed as ThO_2 and uranium as U_3O_8, ThO_2 = 87.9% Th and U_3O_8 = 84.8% U.

2) Exposure of individuals to concentrations of radioactive materials in restricted areas - 20.103

Consider now the situation that exists in a typical restricted area where the operation generates dust, e.g. the area where the pyrochlore ore is blended with the other ingredients. The solution to this problem lies in establishing the MPC for the dust and then, if in excess, to effect controls through proper ventilation.

The two species in question are thorium and uranium. For Th-232, the MPC is $3x10^{-11}$ µCi/ml and the specific activity is 0.109 µCi/g, while for Th-nat the MPC is $6x10^{-11}$ µCi/ml and the specific activity is 0.218 µCi/g. In either case, the MPC in g/ml will be

$$\frac{3x10^{-11}\ \mu Ci/ml}{0.109\ \ \mu Ci/g} = \frac{6x10^{-11}\ \mu Ci/ml}{0.218\ \ \mu Ci/g} = 2.75x10^{-10}\ g\ Th/ml$$

Or since the maximum allowable concentration of thorium in the pyrochlore ore is 2%, the MPC in terms of the ore is

$$\frac{2.75x10^{-10}\ g\ Th/ml}{0.02\ g\ Th/g\ ore} = 1.38x10^{-8}\ g\ ore/ml$$

The General Metal Works Model 2000 air-sampler is rated at 55 cfm. Therefore

$$55\ ft^3/min \times 28{,}317\ ml/ft^3 = 1.56\times10^6\ ml/min$$

Or in one minute the sample filter will collect

$$1.38\times10^{-8}\ g\ ore/ml \times 1.56\times10^6\ ml/min = 2.15\times10^{-2}\ g\ ore/min$$

if the concentration is at the maximum permissible level.

If it is assumed that the sample on the filter can be weighed accurately to one mg, then a 100 mg sample will give a value correct to 1%.

Or $$\frac{0.100\ g\ ore}{2.15\times10^{-2}\ g\ ore/min} = 5\ minutes$$

In other words, the General Metal Works air sampler drawing 55 cfm can sample a sufficient volume of air in less than one half hour to determine whether the MPC for thorium in the pyrochlore ore is being exceeded.

In a similar manner, the MPC for the dust based on the uranium content may be calculated. In this case, the problem is slightly different since Note 4 of Appendix B limits the airborne concentration of U-nat in a restricted area to 75 micrograms per cubic meter or

$$75\times10^{-6}\ g/m^3 \times 10^{-6}\ m^3/ml = 7.5\times10^{-11}\ g\ U\text{-}nat/ml$$

Again, since the maximum allowable concentration of uranium in the ore is 0.4%, the MPC in terms of the ore is

$$\frac{7.5\times10^{-11}}{0.004\ g\ U\text{-}nat/g\ ore} = 1.88\times10^{-8}\ g\ ore/ml$$

Or, if collected with the General Metal Works air sampler at 55 cfm, the filter would collect

$$1.88\times10^{-8}\ g\ ore/ml \times 1.56\times10^6\ ml/min = 2.93\times10^{-2}\ g\ ore/min$$

Then $$\frac{0.100\ g\ ore}{2.93\times10^{-2}\ g\ ore/min} = 3.5\ minutes$$

Thus the sampler could collect sufficient sample in 10 minutes to determine whether the MPC was being exceeded if only uranium at a concentration of 0.4% were present in the ore.

In practice, however, 10CFR20, Appendix B, Note 1 requires that if more than one radioactive nuclide is present, the MPC for the mixture must be determined by prorating each according to its concentration. Accordingly, if the thorium concentration is taken as 2% and the uranium concentration as 0.4%, then

$$\frac{0.02\ \text{g Th/g ore}}{2.75\text{x}10^{-10}\ \text{g Th/ml}} + \frac{0.004\ \text{g U/g ore}}{0.75\text{x}10^{-10}\ \text{g U/ml}} \geq 1$$

which reduces to $0.79\text{x}10^{-8}$ g ore/ml as the MPC.

If collected with the General Metal Works air sampler at 55 cfm, the filter could collect

$$0.79\text{x}10^{-8}\ \text{g ore/ml} \quad \text{x} \quad 1.56\text{x}10^{6}\ \text{ml/min} \quad = \quad 1.23\text{x}10^{-2}\ \text{g ore/min}$$

Or $$\frac{0.100\ \text{g ore}}{1.23\text{x}10^{-2}\ \text{g ore/min}} = 9\ \text{minutes}$$

Thus the General Metal Works air sampler drawing 55 cfm can collect in about 10 minutes sufficient sample to determine whether the combined MPC for thorium and uranium in the pyrochlore ore is being exceeded. Moreover, this is the maximum value with respect to thorium plus uranium. In practice, the combined weights of thorium and uranium would be expected to be less than in the ore since in a normal blend the pyrochlore ore only constitutes 53% of the total.

It also should be pointed out that the pyrochlore that has been processed over the past years has averaged about 1.70% thorium and 0.05% uranium. If the MPC of the dust is prorated using these values, it becomes:

$$\frac{0.017\ \text{g Th/g ore}}{2.75\text{x}10^{-10}\ \text{g Th/ml}} + \frac{0.0005\ \text{g U/g ore}}{0.75\text{x}10^{-10}\ \text{g U/ml}} \leq 1$$

which reduces to $1.46\text{x}10^{-8}$ g ore/ml as the MPC.

To collect 100 mg with the General Metal Works air sampler at 55 cfm would then require about 5 minutes.

In making actual surveys, the method for determining whether the MPC is being exceeded may be used in a slightly different manner. In this alternative method, the air sampler is allowed to run in the selected area for a given period of time. This time multiplied by the rated capacity (nominally 55 cfm or $1.56\text{x}10^{6}$ ml/min for the General Metal Works Model 2000) then gives the total volume of air sampled. The weight of sample collected, measured by subtracting the weight of the filter from the weight of the filter plus the sample, divided by the total volume of air, then gives the average concentration in grams of ore containing 2% Th and 0.4% U per milliliter. If this value is less than $0.79\text{x}10^{-8}$, then the MPC is not exceeded. Or if the ore contains less than 2% Th and 0.4% U, the value can be proportionately higher.

The above method is predicated on the fact that if it can be shown that the MPC cannot be exceeded, knowledge of the specific concentration is not necessary to assure compliance with 10CFR20.103. On the other hand, it is conceivable that the MPC can be exceeded, in which case corrective measures are required. However, the observation that the average concentration of dust as determined above exceeds the values given does not necessarily mean that the MPC's for thorium and uranium are being exceeded inasmuch as dust from the non-radioactive components of the batch (lime, dolomite, etc. which comprise nearly half) may contribute to the total weight of the sample collected. In this case, then, the collected sample must be analyzed for thorium and uranium. After the composition of the collected sample is determined, a simple calculation based on the considerations above, will show whether the MPC is exceeded. If the concentration still is greater than the MPC, corrective measures such as installing a fume hood over the blending area may be required, or requesting an exemption based on the effective use of dust masks

3) Radioactivity in effluents to unrestricted areas - 10CFR20.106

Section 20.106 places a limit on the concentration of radioactive materials released to unrestricted areas, that is, to the environment. As in the case of 20.103, these limits are expressed as MPC and are specified in Appendix B, Table II, Column 1 for airborne materials. For the particular species in question, they are given in the table on page III-2 of this report.

a) Particulates: In Chapter II, the general reduction was described and it was noted that the dust flume over the furnace was swept into a duct leading to the AAF dust collector. Past experience has shown the dacron bags in the dust collector, described in Section 2, Chapter II, to be quite efficient in removing particulates. It is estimated that less than 1% of the charge in the furnace passes to the dust collector. This would correspond to about 25 pounds of ore or about 0.5 lb. of thorium and 0.1 lb. of uranium per batch, which in turn would represent about 50 uCi of Th-nat and about 4.5×10^{7} μg of U-nat. The maximum amount per day (2 eight hour shifts) would then be about 400 μCi of Th-nat and about 3.6×10^{8} μg U-nat.

At a flow rate of 150,000 cfm, the total volume of air in 24 hours is

$$1.5\times10^{5}\ \text{ft}^{3}/\text{min} \times 1440\ \text{min/day} \times 28{,}317\ \text{ml/ft}^{3} = 6.12\times10^{12}\ \text{ml/day}$$

Or

$$\frac{400\ \mu\text{Ci Th-nat/day}}{6.12\times10^{12}\ \text{ml/day}} = 6.5\times10^{-11}\ \mu\text{Ci Th-nat/ml}$$

compared to an MPC of 2×10^{-12} μCi Th-nat/ml. Thus, the bags would have to remove only about 97% of the particulates in order not to exceed the MPC for natural thorium.

For natural uranium, the MPC for release to unrestricted areas is 3 micrograms per cubic meter. Under the conditions given above, the actual concentration would be

$$\frac{3.6\times10^{8}\ \mu\text{g U-nat/day}}{6.12\times10^{12}\ \text{ml/day}} \times 10^{6}\ \text{ml/m}^{3} = 59\ \mu\text{g U-nat/m}^{3}$$

Thus, the bags would have to be about 95% efficient in order not to exceed the MPC for natural uranium.

Because for release of effluents to unrestricted areas annual averaging is allowed, the above values for the dust collector efficienty may be multiplied by the factor 250/365 = 0.68. Moreover, further dilution factors are applicable since the dust collector exit ducts are 400 feet from the nearest fence line, as well as the fact that analysis of the dust shows it to consist largely of calcium, magnesium, and aluminum oxides (see Chapter V, Section 4).

b) Gases: While the dust collector effectively removes the particulates, the radon and thoron gases released at the high temperature of the reaction cannot be retained and pass through the bags and then into the environment. The problem, then, becomes one of calculating the maximum average concentration of these gases and establishing whether their combined concentrations exceed the MPC. If so, suitable adjustments must be made such as limiting the number of reductions, increasing the air flow to the baghouse, etc.

At the time of the reaction, all the thorium and uranium in the ore may be considered to be in secular equilibrium with their daughter products, having undergone no prior chemical separations. Accordingly, the curies of thoron (Rn-220) will be equal to the curies of throium, and the curies of radon (Rn-222) will be equal to the curies of uranium.

Consider now a series of heats (reductions) the total number being denoted by "a" each using a specified weight of ore "b" containing a given percentage of thorium "c", with the effluent gas exiting through the dust collector at a flow rate "d". The concentration of thoron gas (Rn-220) in "C" μ Ci/ml, will be given by the expression.

$$C = \frac{a\ \text{ht/shift} \times b\ \text{lb/ht} \times c\ \%\text{Th} \times 10^{-2} \times \text{SpA-Th}\ \mu\ \text{Ci/lb}}{d\ \text{ft}^3/\text{min} \times 60\ \text{min/hr} \times 8\ \text{hr/shift} \times 2.832\text{x}10^4\ \text{ml/ft}^3}$$

or $$C = \frac{a \times b \times c}{d} \times 3.63\text{x}10^{-8}\ \mu\ \text{Ci/ml}$$

where the specific activity of thorium is taken as 49.4 μ Ci/lb.

If "a" is taken as one heat/shift; "b" as 1000 lb/ht; "c" as 1% thorium; and "d" as 100,000 cfm, then

$$C = \frac{1 \times 1000 \times 1}{100{,}000} \times 3.63\text{x}10^{-8}\ \mu\ \text{Ci/ml}$$

$$= 3.63\text{x}10^{-10}\ \mu\ \text{Ci/ml}$$

Or since the MPC for Rn-220 from Appendix B, Table II is $1\text{x}10^{-8}$ μ Ci/ml, the percent MPC for the above is

$$C = \frac{3.63\text{x}10^{-10}\ \mu\ \text{Ci/ml}}{1 \times 10^{-8}\ \mu\ \text{Ci/ml/MPC}} \times 10^2$$

$$= 3.63\%\ \text{MPC}$$

For conditions other than the above, the percent MPC may be obtained by prorating the appropriate values. For example, if four heats per shift were made using 2,650 lbs. of ore per heat containing 2.0% thorium with the dust collector drawing 150,000 cfm, the concentration of Rn-220 would be

$$C = \frac{4 \times 2.65 \times 2}{1.50} \times 3.63\% \text{ MPC}$$

$$= 51.3\% \text{ MPC}$$

Since the maximum number of heats per shift is four, the maximum amount of ore per heat is 2,650 lbs, and the maximum concentration of thorium 2%, it is evident that the maximum release of thoron to the environment is well below the MPC. Moreover, 10CFR20.106 allows the MPC to be averaged on an annual basis. Such averaging would lower the above value by a factor of about 5, that is, taking 365 vs. 250 days per year and 24 vs. 8 hours per day,

$$51.3\% \times 250/365 \times 8/24 = 11.7\% \text{ MPC}$$

Consider now the uranium in the ore and assume the radon (Rn-222) to be in secular equilibrium with U-238. Using the same basis of calculation as above and taking the specific activity of the uranium as 151 μ Ci/lb. and the MPC for Rn-222 as 2×10^{-9} μ Ci/ml,

$$C = \frac{a \times b \times c}{d} \times 1.11 \times 10^{-7} \ \mu \text{ Ci/ml}$$

Or, if "a" is taken as one heat/shift; "b" as 1000 lb/heat; "c" as 1% U; and "d" as 100,000 cfm,

$$C = \frac{1 \times 1000 \times 1}{100,000} \times 1.11 \times 10^{-7} \ \mu \text{ Ci/ml}$$

$$= 1.11 \times 10^{-9} \ \mu \text{ Ci/ml}$$

which is

$$\frac{1.11 \times 10^{-9} \ \mu \text{ Ci/ml}}{3 \times 10^{-9} \ \mu \text{ Ci/ml/MPC}} \times 10^2$$

$$= 37.0\% \text{ MPC}$$

Again, taking the maximum number of heats per shift as 4; the maximum weight of ore per heat as 2,650 lbs.; the maximum uranium concentration as 0.4%; and the dust collector air volume as 150,000 cfm,

$$\frac{4 \times 2.65 \times 0.4}{1.50} \times 37.0\% \text{ MPC} = 105\% \text{ MPC}$$

However, as in the case of thoron, if this value is averaged on an annual basis, the concentration would be reduced to

$$105\% \times 250/365 \times 8/24 = 24.0\% \text{ MPC}$$

Moreover, in practice, since the uranium concentration in the ore averages less than 0.05%, the actual release would be

$$24.0\% \text{ MPC} \times 0.05/0.4 = 3.0\% \text{ MPC}$$

When two radionuclides are present, the total MPC may be expressed as the combined percents MPC for each. Accordingly,

11.7% MPC (Rn-220) + 24.0% MPC (Rn-222) = 35.7% MPC (Total)

Again, it is evident that even with the plant operating at maximum capacity, the combined release of thoron plus radon is well below the maximum permissible limit.

4) Exposure to external radiation

The two preceeding sections have described the regulations governing the exposure of individuals in restricted areas to radioactive materials and the release of radioactive effluents to the environment. These are primarily concerned with control of ingested radioactive materials which could give rise to internal radiation effects. Also of concern is the effect of external radiation and this is regulated by Section 20.101 - Exposure of individuals to radiation in restricted areas, and by Section 20.105 - Permissible levels of radiation in unrestricted areas.

With respect to the radiation safety program as SC, the only external radiation of concern is gamma-radiation and individuals in restricted areas are limited to 1.25 rems per calendar quarter. This is essentially 100 mrems per week equivalent to 2.5 mrems per hour for a forty-hour week. In order to monitor the exposure of individuals to gamma-radiation, the levels of radiation are measured with a gamma-survey meter (Radgun) and individuals wear film badges.

a) Gamma-radiation: The principal areas monitored with the gamma-survey meter are the ore storage area and the slag dump area.

1) Ore storage area: The ore in the form of a granular powder is stored in steel drums on pallets in Warehouse "D". Surveys with the Radgun have shown the following:

DISTANCE IN FT.	mr/hr SINGLE BAYS	mr/hr ADJACENT BAYS
0	3.5	4.5
1	3.0	3.5
3	2.5	3.0

These values are only slightly higher than the permissible level in restricted areas of 2.5 mr/hr. Because the pallets are moved with towmotors, operators do not come in immediate contact with them, nor are the operators in the vicinity more than one hour per day or five hours per week. For this reason, no special precautions are taken other than having the operators wear film badges.

2) Slag storage or disposal area: The slag resulting from the smelting process is stored above grade in a designated area. As previously noted, all the thorium and uranium in the ores, except for a very small amount carried to the baghouse, concentrates in the slag.

Measurements of the ferro columbium slag piles at a distance of three feet show a radiation level of 2.0 mr/hr while at seven feet (the center of the vehicle roadway), the value is 1.5 mr/hr, both values being less than the allowable 2.5 mr/hr in restricted areas. This area is fenced and signs posted reading "Any area within this plant may contain radioactive materials." The slag pile also is posted with a sign reading "Ferro Columbium Slag."

The radiation emitted from the ferro vanadium slag piles and the residue from the dust collector, also stored in this area, is less than the permissible limit of 0.6 mr/hr in unrestricted areas, being respectively, 0.5 mr/hr and 0.4 mr/hr.

Also of interest is the possibility of the source material in the slag being dissolved by rain water. Measurements made by Ledoux and Co. in which a sample of powdered slag was contacted by water maintained at a pH of 5 (with H_2SO_4) for a period of three weeks, showed the thorium was solubilized to the extend of 0.3 ppm, while the uranium value was only 0.01 ppm. Both of these are less than the MPC in water for release to unrestricted areas as specified in Appendix B, Table II, Column 2. This is in keeping with the refractory properties of the slag.

b) Film badge program: The current film badge program was initiated on 5/1/70. All operators in restricted areas are required to wear badges which are processed on a monthly basis by Searle Analytical Inc. Data accumulated over the past three years have shown the maximum average yearly whole body exposure to gamma-radiation to be 270 mR with an average whole body exposure of 94 mR per year for 36 operators. The average yearly whole body exposure to beta radiation was 10 mR, or essentially negligible.

It is evident that exposure to gamma-radiation is minimal, being only 1.9 percent of the allowable yearly permissible dose.

5) Caution signs and labels

Section 20.203 requires that certain caution signs and labels be used to designate radiation areas and containers holding in excess of allowable quantities.

a) Signs: Radiation areas, that is, areas in which an individual could receive a dose in excess of 5 mr/hr, are to be posted with signs bearing the radiation symbol and the words "Caution - Radiation Area."

Signs are to be in place at all entrances to Dept. 111 reading "Positively No Eating or Drinking in this Building" and "Respirators required for all employees working in this building."

Large signs are to be placed on the Slag Dump reading "Ferro Columbium Slag."

Large signs are to be in palce at all entrances to the plant reading "Any area within this plant may contain radioactive materials."

The Radiation Safety Officer should from time to time double check that all of the above signs are in place.

b) Labels: Containers containing natural thorium or natural uranium in excess of ten times the applicable quantities listed in Appendix C, 10CFR20, are required to carry a label reading "Caution - Radioactive Material." For natural thorium or uranium, the applicable amount is 100 μCi, or for labeling purposes, 1000 μCi. This may be translated into pounds of ore as follows.

Consider one pound of ore containing 2% thorium and 0.4% uranium, the allowable quantities under the license. The contained quantity of thorium would then be 0.02 lbs.; equivalent to 1.98 μCi while the contained amount of uranium would be 0.004 lbs., equivalent to 1.21 μCi. Thus, 1 lb. of ore would contain a total of 3.19 μCi of Th+U, or 1000 μCi would represent 313 lbs.

Similarly, if the ore contains 1.7% thorium and 0.05% uranium (more nearly approximating the composition of pyrochlore ore), the amount containing 1000 μCi would be 469 lbs.

The figures may be used as guidelines to determine whether containers of ore need to bear precautionary labels.

It should be noted that labels are not required for containers only accessible to individuals authorized to handle them, provided the contents are identified to such individuals by a readily available written record.

In order for the above guidelines to be used, it is important that assumed percentages of throium and uranium in the ore are correct. For this reason, the Radiation Safety Officer must be sure that the ore is analyzed at least three times a year to affirm that the percentages are correct. An up to date record of the analysis must be kept.

The Radiation Safety Officer is also responsible for seeing that all precautionary labels are in place if and where they are needed.

Chapter IV

Instruments, Calibration, Procedures

The following is a description of the instruments used in the radiation safety program at Shieldalloy Corporation. Only the pertinent equipment is described. Conventional laboratory apparatus such as analytical balances, glassware, etc., is omitted.

1) Gamma Survey Meter: The gamma survey meter is a Model AGB-10 KG-SR Radgun Survey Meter manufactured by the Victoreen Instrument Company. This meter is calibrated every seven months and leak tested every three months. In practice, readings are generally taken at distances of zero, one and three feet from the source on a monthly basis.

2) Air Samplers: The air sampler used at Shieldalloy is a General Metal Works Model 2000. It is described in Appendix A, this chapter. The Model 2000 is rated at 55 cfm. It comes complete with calibrator and sheets of filter media. In practice, the air sampler is operated in the area of interest for a specified period of time. The air flow rates at the start and finish of the collection period are read on the calibrated flow meter and the average values calculated. The average concentration of collected particulates is obtained by determining the net weight on the filter and dividing this value by the total volume of air drawn through the sampler. If necessary, the collected sample is analyzed for thorium or uranium content by conventional techniques.

Dust samples are run monthly for a duration of one week to achieve an accurate sample.

The air sampler is recalibrated every six months as recommended by the manufacturer.

3) Analytical Techniques: The principal analytical method for the determination of thorium and uranium used at SC is by X-ray fluorescence employing a Phillips Model PW 1410/70 X-ray unit fitted with a lithium fluoride cyrstal. Thorium is measured using the LA_1 line at a 2-theta angle of 27.47 degrees, while uranium is measured using the LA_1 line at a 2-theta angle of 26.14 degrees.

4) Radiometric Measurements: When required, these are run by Eberline Instrument Corporation using conventional techniques.

Chapter IV

Appendices

A) Manufacturer's Literature Concerning GMW Air Sampler

MODEL GMWT 2200

Portable Tripod Hi-Vol Air Sampler

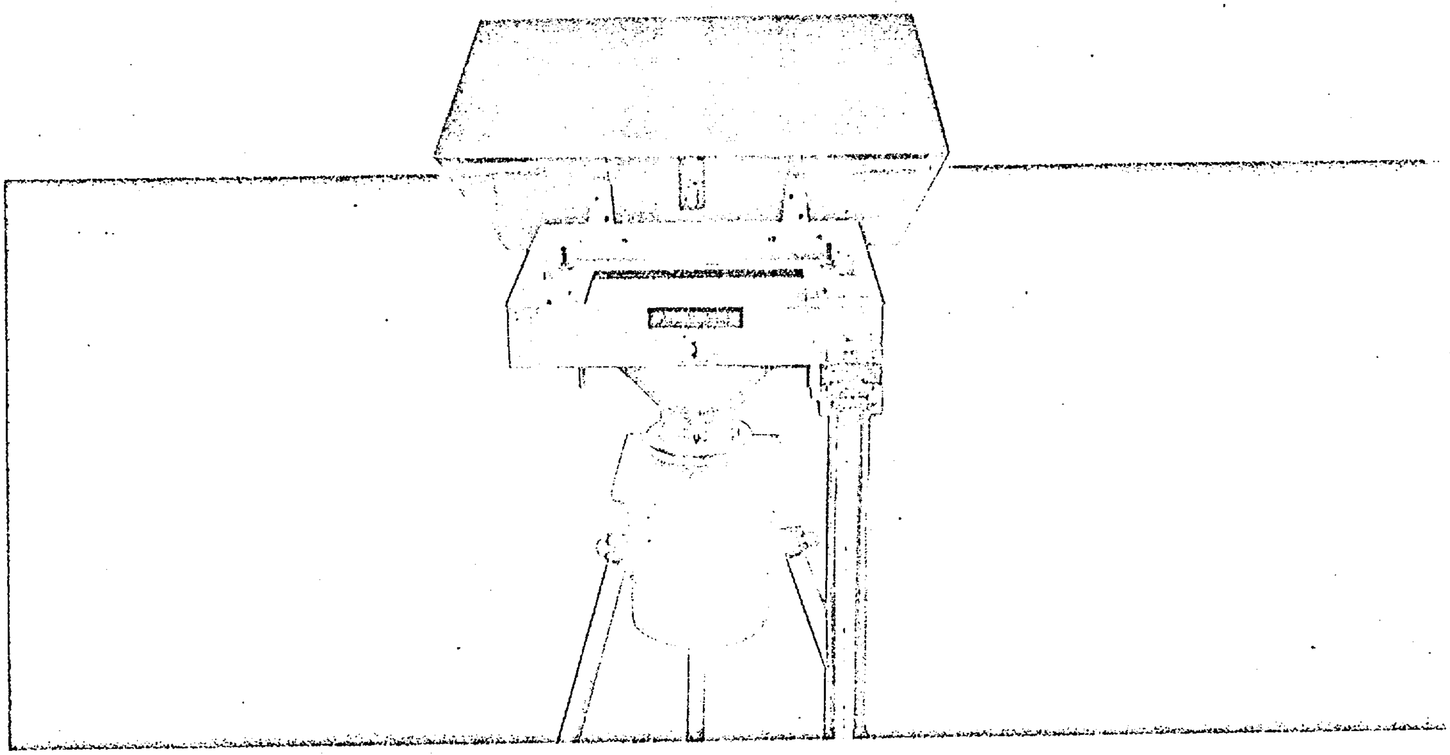
The GMWT-2200 Tripod Hi-Vol is especially suited for line sampling verification or compliance measurements requiring frequent relocation from site to site. As these measurements are usually of short duration, timers, programmers, recorders, etc., are not required.

The unit provides complete portability yet incorporates standard size components utilized in stationary models including standard 8" x 10" filter media. The tripod legs are removable to facilitate transporting.

An integral orifice meter with dual pressure taps is located in the throat of the filter holder. Flow rate is measured by manometer readings taken across the orifice meter.

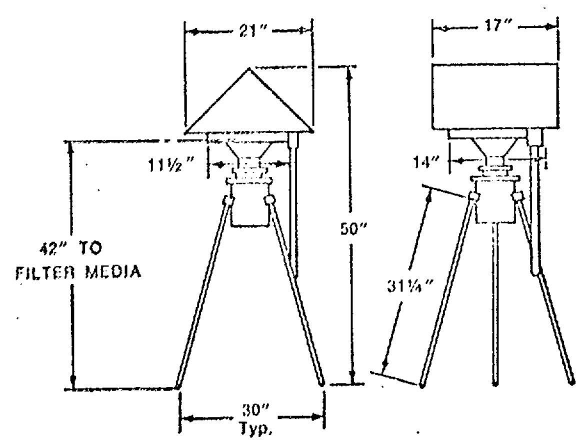
The unit consists of a model GMWL-2000 sampler complete with an FH-2100 seamless stainless steel filter holder. The filter holder bolts to the underside of the shelter roof support. The gable style roof is hinged to facilitate filter paper replacement.

The sampler unit is assembled ready for operation and is packaged complete with manometer, tripod adapter and legs. Filter paper cartridge GMW-3000 is optional at extra cost.



Specifications:

Motor HP — 0.6
Speed — 18,250 RPM
Amperage — 6.25
Wattage — 745
Max. Flow Rate — 60 C.F.M.
Min. Flow Rate — 20 C.F.M.
Power Source — 115V, 1 phase, 60 Hertz (other electrical characteristics available on request)
Net Weight — 34 lbs.
Shipping Weight — 40 lbs.
Complies with Federal Register Vol. 36, No. 84 dated April 30, 1971



Chapter V

Surveys, Records, Reports

1) Surveys

As described in Chapter III, Radiation Safety Program Practices at SC, three main types of surveys are required to assure compliance with 10CFR20. These are concerned with 1) exposure of individuals to concentrations of radioactive materials in restricted areas; 2) radioactivity in effluents to unrestricted areas; and 3) waste disposal.

Concerning the first, a rationale was developed in Section 2 of Chapter III for monitoring the exposure of individuals to concentrations of radioactive materials in restricted areas. Essentially, the procedure involves collecting a sample of known composition by means of a calibrated air sampler fitted with a filter, and showing that the MPC is not exceeded if the sample collected on the filter in a given period of time weighs less than a calculated amount; or alternatively, by showing that the average concentration determined by dividing the weight of sample collected by the volume of air passed through the samples, is less than 0.79×10^{-8} gm/ml for ore of composition 2% Th and 0.4% U or 1.46×10^{-8} gm/ml for ore of composition 1.70% Th and 0.05% U. Allowance is made for the fact that surveys may show that the apparent MPC in a given area is being exceeded in which case analysis of the collected sample is required to determine whether the actual MPC is being exceeded. In the event of the latter, then corrective measures must be taken.

Surveys with respect to 10CFR 20.103 are primarily done in Dept. 111 where the operations described in Chapter II, Section 3 are carried out. In particular, there are two areas of interest; the blending area where the batch ingredients are combined, and the furnace area where the reduction takes place. These are referred to as locations 1 and 2 respectively.

Surveys in both areas are done using the General Metal Works Model 2000 air sampler in the manner described. Data are recorded on Forms A and B, copies of which are shown in Appendix A, this chapter. Their use is self-explanatory. They also serve as permanent records.

Gamma surveys with the Radgun described in Chapter IV are made in Dept. 111 as well as in the warehouse where the pyrochlore ore is stored and at the slag dump. Data are recorded on Form C, Appendix A, this chapter. Workers in these areas also wear film badges as described in Section 4, Chapter III.

Calculations based on the considerations discussed in Section 3, Chapter III, show that the highest concentrations of thoron (Rn-220) and radon (Rn-222) released to the environment cannot exceed the MPC allowed by 10CFR20.106. Therefore, surveys to determine their actual concentrations are unnecessary. Surveys to determine the concentration of particulates released to the environment would be very difficult to make due to the inaccessibility of the exit ducts located on top the building housing the bags. However, as shown in Section 3, Chapter III, under the processing conditions employed, the maximum concentration of particulates passing through the bags would be considerably less than the MPC.

2) Records and Reports

Parts 19, 20 and 40 of 10CFR require the keeping of certain records and the filing of certain reports. Sections of 10CFR40 of pertinent interest to the SC license are:

a) Section 40.61(a) which requires that records be kept showing the receipt of source material.

b) Section 40.63, which requires that tests be made on a) the source material (analysis for Th and U): b) facilities; c) radiation detection and monitoring instruments; and d) other equipment and devices used in connection with utilization and storage of source material.

c) Section 40.64, Reports, which requires that suitable records be kept with respect to the above tests. In particular, these should include periodic analysis of incoming ore shipments; any routine tests or repairs on processing equipment such as the AAF dust collector; and cailbration and leak testingof the Radgun and calibration of the air samplers. Note that under 40.64 (d) (1), SC is exempt from submitting Form NRC-741, inasmuch as the processed ores contain less than five percent of uranium plus thorium. With respect to 10CFR20, pertinent sections are: Section 20.401 (a) which requires that records be kept showing the radiation exposures of all individuals for whom personnel monitoring is required. This will be satisfied by the radiation exposure reports supplied by Searle Analytical, Inc.; and Section 20.401 (b) which requires that records of surveys be maintained. Forms A, B and C of Appendix V-A are used to satisfy this section. In the very unlikely event of an incident (See 20.403), the NRC must be notified as required by Sections 20.403 and 20.405.

SC is exempt from filing reports required by 20.407 and 20.408 by not falling in any of the four categories identified in 20.407(a).

With respect to 10CFR19, pertinent sections are discussed in Chapter VII.

4) Analyses

Analyses of the pyrochlore ore and dust generated in Dept. 111 are necessary to establish whether the specific concentrations exceed the maximum permissible concentrations. As noted in Chapter 1, Section 5, over the past 3.5 years the mean thorium content was 1.69% while the mean uranium content was 0.0448%. These values were for Araxa pyrochlore obtained from Brazil. Recently, SC has begun to process Niobec pyrochlore obtained from Canada.

To compare the relative radioactivity of these ores, gross alpha counts were determined by Eberline Instrument Corporation, Midwestern Facility, West Chicago, Illinois, with the following results:

SAMPLE	pCi/gram	α dpm/gram	Est (Th+U) %
Araxa Pyrochlore	4900 ± 500	1.09×10^4	0.74
Niobec Pyrochlore	600 ± 60	1330	0.09
Dust from AAF Baghouse	70 ± 12	155	0.010

In terms of gross alpha emission both natural thorium and natural uranium have essentially the same specific activity, namely about 1.48×10^6 dpm per gram. Therefore, an estimate of their combined percentages may be made by dividing the measured gross alpha activity by their combined specific activities. This is shown in the table above.

Because the value for the Araxa pyrochlore is less than the values previously determined by direct analysis, the specific samples will be analyzed to determine whether there is a discrepancy. Nonetheless, it is evident that from a relative standpoint, the radioactivity of the Niobec ore is only about one-eighth that of the Araxa ore, further justifying the rationale developed in Chapter III.

Also of interest is the low activity of the dust from the AAF Baghouse. This is in keeping with the observation that the true density of the dust, measured with a Beckman Air-comparator Pycnometer was 2.44 g/cc compared with values of 4.45 s/cc for Araxa pyrochlore and 4.23 g/cc for Niobec pyrochlore. Of related interest are the relative average particle sizes, (measured with the Fisher Sub-sieve Sizer) respective values being: AAF dust 2.0 μ; Araxa ore, 9.0 μ; and Niobec ore, 24.0 μ, suggesting that the dust consists largely of calcium and magnesium carbonates and oxides, and aluminum oxide.

Chapter V

Appendices

A) Forms A and B, Dust Surveys
   Form C, Gamma-radiation Survey

B) Plot Plan, Shieldalloy Corporation Plant, Newfield, New Jersey

C) Floor Plans, Department 111

Form A - Dust Survey

Ref.	Date	Dept.	Loc.	Elapsed Time, min.	Vol. ml	Net Wt. Sample, grams	Conc., g/ml	Type Ore	% Th	% U	% MPC		

Form B - Dust Survey

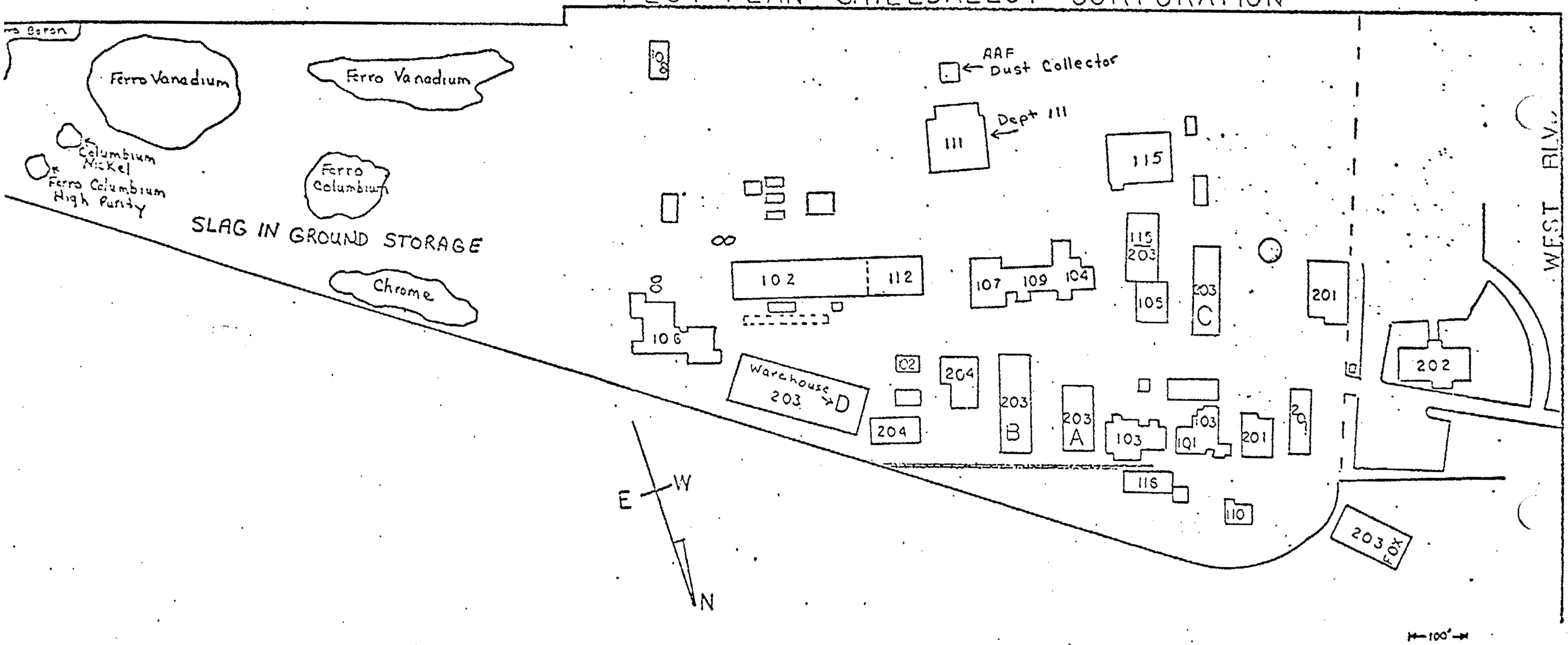
Ref.	Date	Time Start	Time End	Elapsed Time	Flow start, cfm	Flow end, cfm	Ave. flow, cfm	Total flow, cf	Total flow, ml	Wt, S + F	Wt, F	Wt, S	Conc, S/V
		a	b	t=a-b	c	d	$f=\frac{a+b}{2}$	v=fxt	m	n	s= m-n		

Form C - Gamma Survey

Ref.	Date	Dept	Loc.	Dist., ft	Reading mr/hr	Type Ore	% Th	% U					

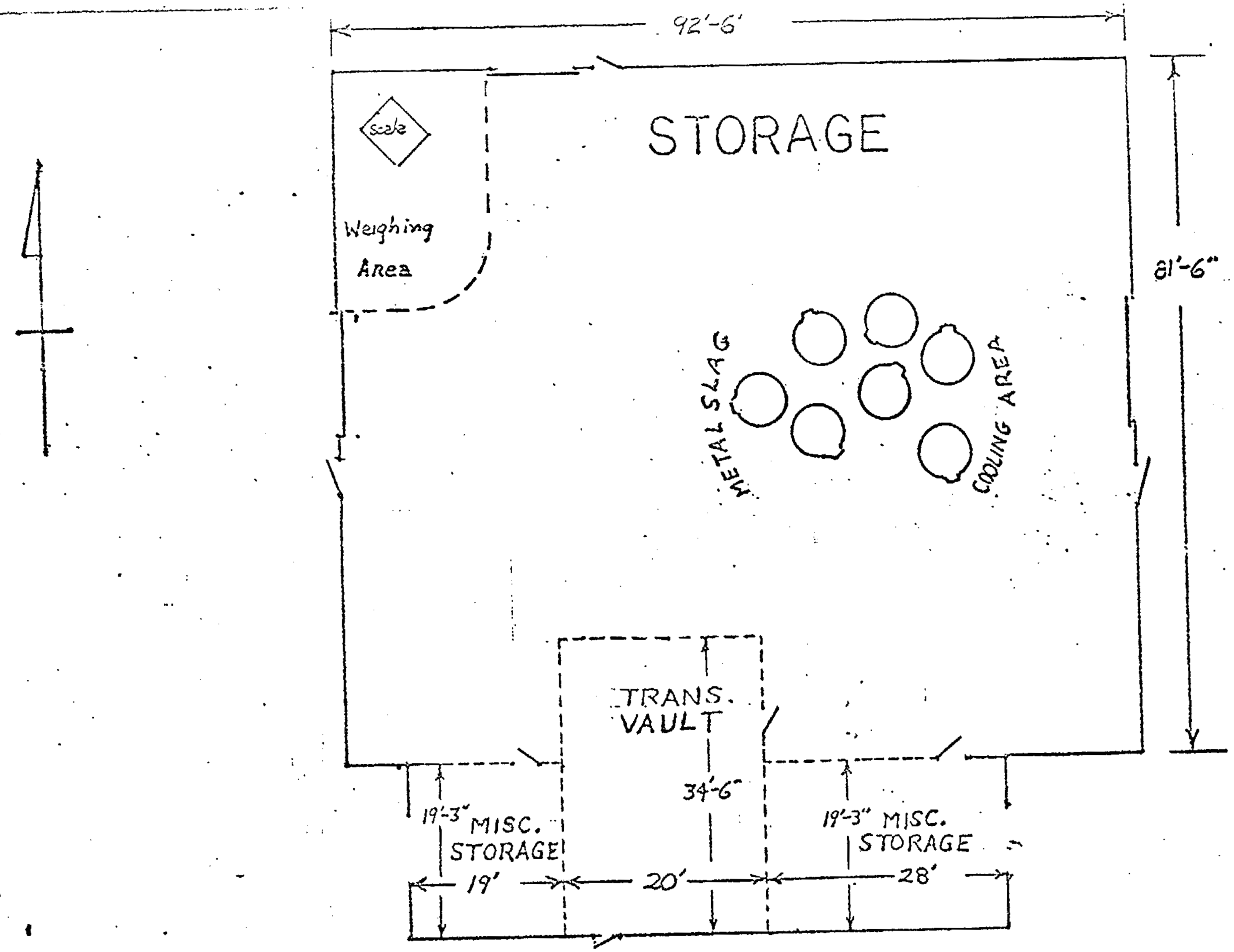
Appendix V-B

PLOT PLAN SHIELDALLOY CORPORATION



Scale approximate

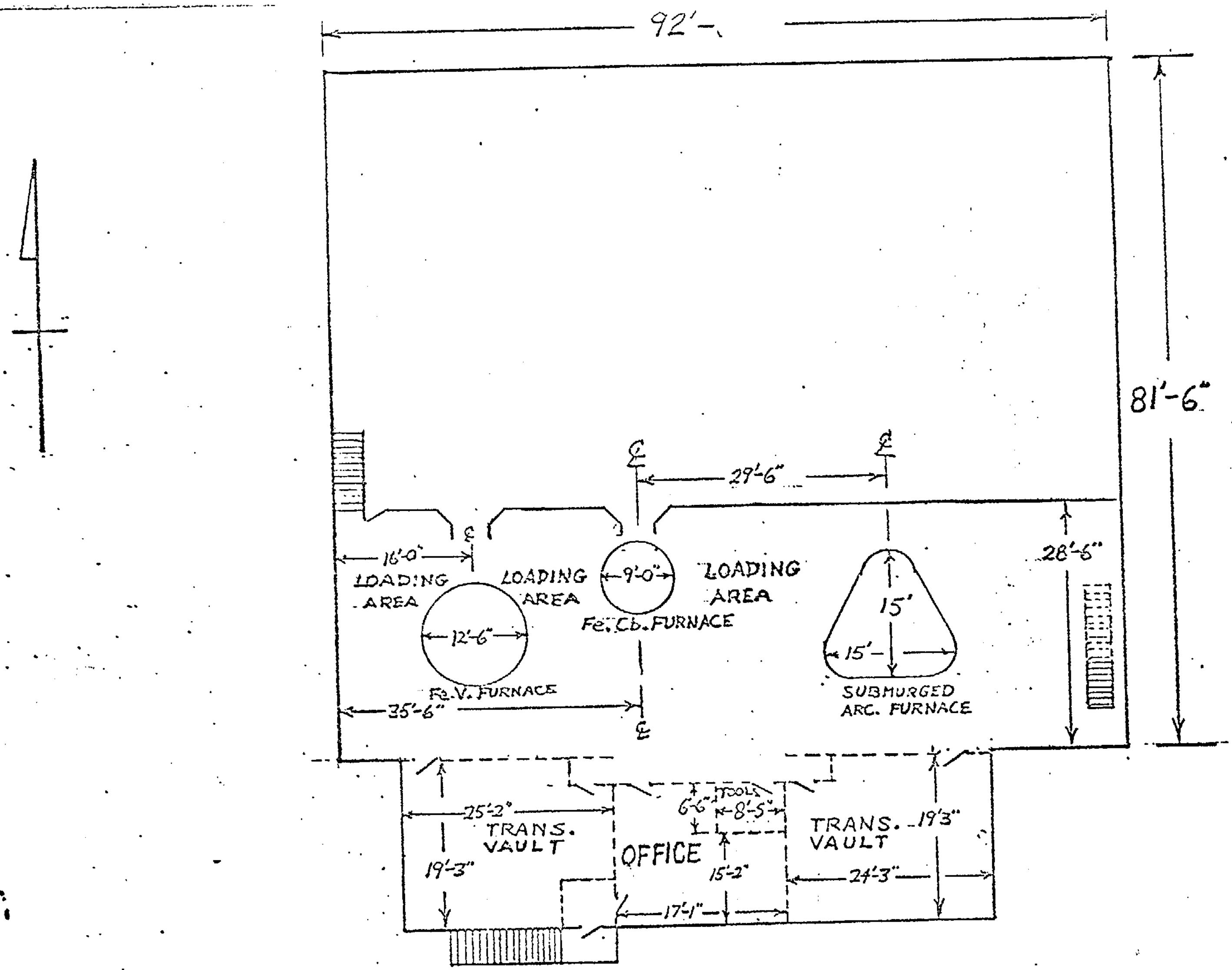
2-4-77



Appendix V-C-1

D111 LOWER LEVEL

SCALE: 1" = 20'	APPROVED BY:	DRAWN BY WTG
DATE: 2Feb77		REVISED 8Feb77
		DRAWING NUMBER



Appendix V-C-2

D-1.11 UPPER LEVEL

SCALE: 1" = 20'	APPROVED BY:	DRAWN BY
DATE: 2 Feb 77		REVISED 8 Feb 77
		DRAWING NUMBER

Chapter VII

INSTRUCTIONS TO EMPLOYEES - 10CFR19

Section 19.11 of 10CFR19 requires the posting of certain documents associated with the source material license and also that workers frequenting restricted areas be instructed in various aspects of the use of these materials particularly as they relate to health protecting problems.

Concerning 10CFR19.11 - Posting of notices to workers - the notice in Appendix A, this section, is to be posted in various conspicuous places in the plant in keeping with 10CFR19.11 (b). A copy of Dr. Silvernail's report and this report should also be made available in the Personnel Office for inspection by any interested employees. Also, a copy of Form NRC-2, "Notice to Employees," is to be posted with the notice in Appendix A as required by 10CFR19.11 (c).

In addition to the above, each employee is required to read and sign a copy of the notice shown in Appendix B of this section. This signed copy should be kept in the employees personnel file and can be used to satisfy the requirements of 10CFR19.12.

In addition to the signed letter, yearly in-plant instruction of the employees with respect to radiation and radiation safety should be made by a Department 111 supervisor. Subjects to be discussed will be drawn up by the Radiation Safety Officer. Records of the instruction must be kept and maintained. The records should include date, employees name, name of instructor. This record will include names of all permanent and temporary employees assigned to Department 111. The Radiation Safety Officer also should make periodic visits to Department 111 to insure that the workers are wearing their dust masks and otherwise maintaining good hygiene.

It is also necessary that we post any notice of violation involving radiological working conditions, imposition of civil penalty or orders issued, and any response from the licensee. These notices must be posted within two working days of receipt and remain posted for a minimum of five working days or until corrected.

Finally, 10CFR19.13 requires that we furnish a copy of his exposure record at any time on request, and that reporting of any overexposure to both the individual and the NRC is mandatory.

The Radiation Safety Officer is to be sure that the above steps are carried out by the Personnel Department.

APPENDIX VII-A

Shieldalloy Corporation

A SUBSIDIARY OF METALLURG, INC.
NEWFIELD, NEW JERSEY 08344
TELEPHONE 692-4200 (AREA CODE 609)

TELEX NO. 845129
CABLE REGISTRATION
SHIELDALOY

October 29, 1976

NOTICE

TO: All Employees:

Shieldalloy Corporation holds a License No. SMB-743, from the U.S. Nuclear Regulatory Commission, to process certain low level radioactive metaliferous ores containing traces of Throium and/or Uranium which are called "Source Materials."

Section 10 CFR 19.11 (a) and (b) of the Code of Federal Regulations (CFR) requires that current copies of Part 19, Part 20, the License, License conditions, documents incorporated into the License, License amendments and operating procedures be posted or that a notice describing these documents and where they may be examined, be posted.

The above cited documents may be examined in the Personnel Office by contacting Mr. Walter Heydolph, Personnel Manager.

The following is a brief description of each document:

1. PART 19. Part 19, Title 10 CFR explains Notices, Instructions and Reports to Workers; Inspections.

2. PART 20. Part 20, Title 10 CFR explains Standards for Protection Against Radiation.

3. THE LICENSE. Shieldalloy's License is No. SMB-743, issued January 24, 1973, which gives the company the authority to process radioactive source materials.

4. LICENSE CONDITIONS. The conditions of Shieldalloy's License are written on the License under CONDITIONS.

5. DOCUMENTS INCORPORATED INTO THE LICENSE. The documents incorporated into our License are the application for a Source Material License which is attached to the License.

6. AMENDMENTS TO LICENSE. There have been several amendments to the earlier licenses, however, all currently valid amendments have been incorporated into the present license.

7. OPERATING PROCEDURES. This is a description of Shieldalloy's method for conversion of the ores to their respective alloys.

LeRoy F. Risi
CHIEF CHEMIST

Louis A. Magliocco
PLANT MANAGER

Appendix VII - B

Radioactivity Statement

The following Radioactivity Statement is furnished to all employees in keeping with the regulations in 10CFR19.12 - Instructions to Workers. After reading the statement, each employee is required to sign it and it is made part of his personnel file.

Radioactivity Statement
Shieldalloy Corporation

Employees of Shieldalloy Corporation at Newfield, New Jersey are hereby informed of the occurrence of radioactive materials and radiation in the Newfield plant, and that the Corporation is required by law to explain the safety problems associated with handling such materials.

The exact levels at which radioactivity becomes harmful have not yet been determined, if indeed there are such exact levels. Nonetheless, much experience accrued over many years has shown that as radiation levels are increased, harmful effects can result. Accordingly, the Nuclear Regulatory Commission (NRC) of the United States Energy Research and Development Administration (ERDA) has been commissioned to establish the rules and regulations governing the possession, use, etc. of such materials. Under these regulations, known as Title 10, Code of Federal Regulations, the Corporation is required to have a license to receive, possess, use, etc. ores containing thorium and uranium (Part 40, 10CFR); to maintain certain standards for protection against radiation associated with these materials (Part 20, 10CFR); and to provide instructions to workers involved in their processing (Part 19, 10CFR). Copies of these rules and regulations are on file in the Personnel Office and are available for inspection by any employee. Also available for inspection in the Personnel Office are copies of other documents pertinent to the radiation safety program at Shieldalloy Corporation. These include a description of current plant practices and procedures, the rationale in support of the radiation safety program, methods assuring compliance with NRC regulations, and records pertaining to surveys.

In order to ensure the safety of individuals handling radioactive materials, the NRC has set very low levels of radiation and of airborne concentrations of radioactive materials to which such individuals may be exposed. The Corporation provides equipment and has established procedures such that no employee exercising common sense should ever receive radiation in excess of the permissible levels. Indeed the actual levels are so low that even under the most adverse conditions, overexposure is unlikely. Nonetheless some simple rules should be followed.

1) Avoid any dust unnecessarily. This is good practice whether the dust is radioactive or not.

2) Wear a dust mask on the operations and at the times required. Your foreman will instruct you on when to wear, how to wear, and how to care for your mask.

3) Do not make unauthorized visits to dusty areas.

4) Do not eat or drink in restricted areas, that is, those marked with signs reading "Caution - Radioactive Area".

5) When leaving your work station, wash your hands thoroughly, especially before eating.

6) Your radiation badge measures the radiation you receive from external sources. Wear your badge as instructed to by your foreman. Always leave it in the proper storage rack when not wearing it.

Should you ever be exposed to more radioactivity in this plant than permitted by NRC regulations (very unlikely), you and the NRC will be so informed in writing by the Corporation as required by law. Such notice will not indicate that you have been injured in any manner. The limits have purposely been set very low (by the NRC) and the notifications serve as checks on the efficiency of our radiation safety program.

Shieldalloy Corporation

I have read and understand the above statement concerning radioactivity in the Newfield plant.

Date________________ Signature__________________________