UNITED STATES
ATOMIC ENERGY COMMISSION
DIRECTORATE OF REGULATORY OPERATIONS
REGION 1
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

Knapp

FEB 15 1974

Nuclear Metals, Inc.
Attention: Mr. W. B. Tuffin
President
2229 Main Street
Concord, Massachusetts 01742

License No. SNM-65
SMB-179
Inspection No. 70-82/73-05
40-672/73-02

Gentlemen:

This refers to the inspection conducted by Mr. Jerman of this office on December 27-28, 1973 and January 8-9, 1974 of activities authorized by AEC License Nos. SNM-65 and SMB-179 and to the discussions of our findings held by Mr. Jerman with Mr. Tuffin and to subsequent telephone discussions between Mr. Knapp and Mr. Gilman on January 18, 1974 and between Mr. Jerman and Mr. Tuffin on January 21, 1974.

Areas examined during this inspection are described in the Regulatory Operations Inspection Report which is enclosed with this letter. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, measurements made by the inspector, and observations by the inspector. In addition, your activities in response to telephone conversations on January 4 and 7 as confirmed by our letter to you dated January 7, 1974, were reviewed.

Our inspector also verified the steps you had taken to correct the violations brought to your attention in our letters dated April 23, 1973 and December 12, 1973. We have no further questions regarding Items 1.a, 1.b, 1.c, and 1.e of Enclosure 1 and Items 1.c, 2, 3, and 4 of Enclosure 2 to the April 23, 1973 letter; and Item 2 of the Enclosure to the December 12, 1973 letter. With regard to Items 1.b, 1.c, 1.d and 2 of Enclosure 1 to this letter, we note that you had taken steps to correct these violations but your evaluations were inadequate in that they failed to include provisions to cover beta and gamma radiation.

During this inspection, it was found that certain of your activities appeared to be in violation of AEC requirements, and another activity appeared to raise a question concerning the safety of operations. The items and references to the pertinent requirements and to generally accepted guidance are listed in the enclosure to this letter. This letter constitutes a notice sent to you pursuant to the provisions of Section 2.201 of the AEC's "Rules of Practice", Part 2, Title 10, Code of Federal Regulations. Section 2.201 requires you to submit to this office within 20 days of your receipt of this notice, a written statement of explanation in reply, including: (1) steps which have

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been or will be taken by you to correct the violations, and the results achieved; (2) steps which will be taken to avoid further violations; and (3) the date when full compliance will be achieved. With respect to the question concerning safety of operations, please include in your response your comments concerning this item, a description of any steps that have been or will be taken to correct it, a description of any steps that have been or will be taken to prevent recurrence, and the date all corrective actions or preventive measures were or will be completed.

During the management meeting with you on February 13, Mr. Nelson and Mr. Knapp detailed our enforcement policies and expressed our concern about the implementation of your management control systems that permitted these deficiencies to occur. Consequently, in your reply, you should describe in particular these actions taken or planned to improve the effectiveness of your management control systems as you described during the meeting.

In accordance with Section 2.790 of the AEC's "Rules of Practice", Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the AEC's Public Document Room. If this report contains any information that you (or your contractor) believe to be proprietary, it is necessary that you make a written application within 20 days to this office to withhold such information from public disclosure. Any such application must include a full statement of the reasons on the basis of which it is claimed that the information is proprietary, and should be prepared so that proprietary information identified in the application is contained in a separate part of the document. If we do not hear from you in this regard within the specified period, the report will be placed in the Public Document Room.

Should you have any questions concerning this inspection, we will be pleased to discuss them with you.

Sincerely,

Paul G. Nelson for

James P. O'Reilly
Director

Enclosure:
Description of Violations
RO Inspection Report No. 70-82/73-05 and
40-672/73-02

bcc: (w/encls)
RO Chief, FS&EB (2)
RO:HQ (4)
L:D/D for Fuels & Matl's
RO Files
DR Central Files
PDR
NSIC
State of Massachusetts
RO:I Reg Rdg Room

ENCLOSURE NO. 1

DESCRIPTION OF VIOLATIONS

Nuclear Metals, Incorporated
2229 Main Street
Concord, Massachusetts 01781
Docket No. 40-672

Certain activities under your license appear to be in violation with AEC regulations. The following apparent violations are considered to be of Category II severity.

1. 10 CFR 20.201(b), "Surveys", requires that surveys be conducted as may be necessary to comply with the regulations contained in each section of Part 20. A "survey", as defined in Paragraph 20.201(a), means "an evaluation of the radiation hazards incident to production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive materials present".

   a. Contrary to this requirement, you failed to make such surveys as were necessary to assure compliance with 10 CFR 20.101(a), "Exposure of individuals to radiation in restricted areas", a regulation which, in part, establishes a quarterly limit for dose to the hands. Specifically, you failed to conduct adequate evaluations of the hand exposures to all forms of radiation incurred by your employees through use of gloves contaminated with beta-gamma emitting material and through direct handling of uranium-238.

   b. Contrary to this requirement, you failed to make such surveys as were necessary to assure that employees exposed to airborne uranium-238 and associated alpha, beta and gamma emitting daughters were not exposed to concentrations exceeding those specified in 10 CFR 20.103, "Exposure of individuals to concentrations of radioactive material in restricted areas". Specifically, the surveys you conducted did not measure alpha and beta-gamma concentrations in workers' breathing zones. This is an uncorrected violation.

   c. Contrary to this requirement, you failed to make such surveys as were necessary to assure that effluents released from your stacks did not contain concentrations exceeding those specified in 10 CFR 20, 106, "Concentrations in effluents to unrestricted areas". Specifically, the surveys you conducted did not include analysis for beta-gamma emitting materials resulting from your process. This is an uncorrected violation.

d. Contrary to this requirement, you failed to make such surveys as were necessary to assure compliance with 10 CFR 20.106, "Concentrations in effluents to unrestricted areas", a regulation that in part, limits the yearly average concentration of radioactive material contained in liquids discharged from your plant to the unrestricted areas. Specifically, the surveys which you did conduct of your liquid waste, resulting from the dissolution of copper from uranium-238, prior to its disposal to a bag on your property, did not include measurement of beta-gamma emitting materials which may have been present. This is an uncorrected violation.

2. Condition 8 of the license requires that material possessed and used in accordance with procedures submitted with your license application dated February 26, 1969. Section II of these procedures is entitled "Health and Safety". It specifies, among others, the requirement shown below:

> Environmental water and soil samples will be collected and analyzed annually.

Contrary to this requirement, the environmental water and soil samples collected were not analyzed for the concentration of beta-gamma emitting materials which may have been present. This is an uncorrected violation.

ENCLOSURE NO. 2

DESCRIPTION OF SAFETY ITEM

Nuclear Metals, Inc.
2229 Main Street
Concord, Massachusetts 01742
Docket No. 40-672

Accepted radiological safety practices dictate that radioactive contamination be controlled to the lowest level practicable. For example, the National Council on Radiation Protection and Measurements in its Report 30 "Safe Handling of Radioactive Materials", clearly advocates this principle.

Contrary to this generally accepted practice, you failed to identify and control contamination and particularly that due to beta and gamma emitting radionuclides associated with your depleted uranium operation. This failure lead to the spread of contamination outside the confines of the immediate work area into office and other non-manufacturing areas. In a few cases, contamination was carried out of the plant on the personal clothing of employees.

Among other things, you failed to routinely survey individuals to determine that they were free of alpha, beta and gamma contamination upon leaving the work area and before undertaking such activities as eating or smoking. This situation was noted on our last inspection.

To assure an acceptable contamination control program, one must:

1. Establish an area of control.

2. Implement procedures (including the use of protective clothing and instruments) for entering, conducting operations, and exiting from the controlled area.

3. Routinely monitor uncontrolled areas at a frequency adequate to detect significant contamination spread.

4. Monitor by appropriate methods and frequency to assure that employee ingestion is not occurring.

FEB 15 1974

P. J. Knapp, Senior, Facilities Radiation Protection Section, RO:I

INSPECTOR EVALUATION

Nuclear Metals, Inc.
2229 Main Street
Concord, Massachusetts 01742
License Nos. SNM-65 and SMB-179

The licensee's SNM program is being deactivated. It may be reactivated in about seven years. No significant problems were apparent.

An inspection conducted in March 1973 indicated a beta-gamma contamination problem in association with the depleted uranium program. Apparently, we failed to impress the licensee concerning the problem and it was not brought under control. Consequently, the licensee is again being cited for the whole gamet of survey violations.

I blame the safety office (Franks) primarily for the deplorable situation of this plant. He was made well aware of beta-gamma contamination problems on the previous inspection. Either he ignored it or he didn't get the message. Until about a year ago he was a technician with no knowledge of health physics and he doesn't appear to have improved his knowledge since he was made Safety Officer. A. Gilman appears to be quite knowledgeable but was not directly involved in the previous inspection. He is now Manager, Health and Safety and also Manager, Quality Control. I get the impression he doesn't want to be bothered with radiation safety. Both he and Sam Levin, Consultant from MIT, were aware that uranium-238 daughter products were concentrated in the impurities resulting from melting the uranium.

It will take more than Franks to straighten out this operation. He can't conduct a decent survey. Let's give the licensee a month to straighten things out and then inspect them again to see how well they have done.

Phillip C. Jerman
Radiation Specialist

U. S. ATOMIC ENERGY COMMISSION

DIRECTORATE OF REGULATORY OPERATIONS

REGION I

RO Inspection Report No.: 70-82/73-05 and 40-672/73-02 Docket No.: 70-82, 40-672, SNM-65

Licensee: Nuclear Metals, Incorporated License No.: SMB-179

2229 Main Street Priority: 1 and 3

Category: A (1)&E

Location: Concord, Massachusetts

Type of Licensee: Fuel Fabricator and Product Manufacturer

Type of Inspection: Routine, Unannounced

Dates of Inspection: December 27-28, 1973 January 8-9, 1974

Dates of Previous Inspection: November 15-16, 1973
March 14-16, 1973

Principal Inspector: Phillip C. Jerman, Radiation Specialist — Date 2/1/74

Accompanying Inspectors: _____ Date

January 8-9, 1974 Fred N. Brandkamp, Radiation Specialist

_____ Date

Other Accompanying Personnel: January 8-9, 1974
G. M. Swible
Dept. of Public Health, Commonwealth of Mass.
R. P. L'Heureux, Dept. of Labor and Industries, Commonwealth of Mass.

Reviewed By: _____ Date

P. J. Knapp, Senior, Facilities Radiological Protection Section

SUMMARY OF FINDINGS

Enforcement Action

A. Violations

1. Failure to evaluate the dose to hands of individuals handling uranium-238 and wearing gloves contaminated with uranium-238 and its daughter products. (Details, Paragraph 12a and b)

B. Continuing Violations

The material presented below is organized in the following order: (1) The violation as contained in the Region I letter dated April 23, 1973; (2) The corrective action reported in the licensee's reply dated May 15, 1973; and (3) a brief statement of the inspector's findings.

1. "... you failed to make such surveys as were necessary to assure that employees at risk of exposure to airborne uranium-238 were not exposed to concentrations exceeding those specified in 10 CFR 20.103, 'Exposure of individuals to concentrations of radioactive material in restricted areas'. You did make surveys that were intended to achieve this objective but these surveys did not measure the airborne concentrations in the workers' breathing zones."

"Corrective Action Taken

Our method of continuous inplant monitoring as described in our license application has been in effect for several years. Our sampling heads are located from six to eight feet above the floor, and sample air just above the breathing level of personnel. Program of air monitoring will continue, under new schedule/calendar control. Special air samples will be taken during June to provide data for correlation with normal sampling stations. This will be done periodically with portable air samplers."

The inspector examined the corrective action taken and noted that the air sampling performed measured only alpha activity and did not measure workers' breathing zone air. (Details, Paragraph 9)

2. "Filters from stack air monitoring samplers will be collected monthly and analyzed to assure compliance with requirements of 10 CFR 20.106 'Concentrations in effluents to unrestricted areas'.

   Contrary to this requirement, your air sample filters were collected and analyzed only once between March 29 and August 16, 1972."

"Corrective Action Taken

Stack air monitoring samples have been taken, analyzed, and recorded each month since 8/16/72."

The inspector examined the corrective action taken and noted that the stack samples were taken at the indicated intervals but were counted only for alpha radiation. (Details, Paragraph 10)

3. "You failed to make such surveys as were necessary to assure compliance with 10 CFR 20.106, 'Concentrations in effluents to unrestricted areas', a regulation that limits the yearly average concentration of uranium-238 contained in the liquids discharged from your plant to the unrestricted areas. Specifically, no surveys were made of liquid wastes, resulting from the dissolution of copper from uranium-238, prior to its disposal to a bog on your property."

"Corrective Action Taken

Our inplant plumbing system directs all liquid wastes to our acid house disposal area. Our two-tank system allows the treatment of wastes prior to dumping in the bog at the rear of the disposal facility. Samples of the contained effluent are taken as the waste is treated from an acid to an alkaline condition. This was achieved by adding lime in sufficient amount to accomplish the appropriate PH reading.

Under this method, uranium content in the effluent is precipitated, and remains on the bottom of the holding tank. The tanks are flushed, on reaching the proper PH level, above the level of precipitates.

We will take additional samples for analysis to supplement our normal PH tests.

No dumping can take place without the approval of the Safety Department, after appropriate analyses have been made."

The inspector examined the corrective action taken and noted that the samples were analyzed only for uranium. (Details, Paragraph 16a.)

4. "Environmental water and soil samples will be collected and analyzed annually.

Contrary to this requirement, the only samples collected since November 10, 1970 were collected December 28, 1971 and these samples were not analyzed."

"Corrective Action Taken

Samples taken 12/28/71 were analyzed and report submitted by our consultant on 4/18/73. Samples taken 3/20/73 were analyzed and report submitted by our consultant on 4/18/73."

The inspector examined the corrective action taken and noted that samples were evaluated only for uranium. (Details, Paragraph 11)

C. Safety Item

"10 CFR 20.201(b), 'Surveys', requires you to make such surveys as may be necessary for you to comply with all sections of Part 20.

Contrary to this requirement, you failed to survey individuals to determined that they were free of contamination before eating, smoking or leaving the plant."

"Corrective Action Taken

As a matter of company policy for many years, all employees have been given a five minute clean-up period before the lunch break, and before quitting time. This policy remains in effect.

New "NO SMOKING" signs are on order and will be posted appropriately, accompanied by a reaffirmation of company policy on the subject.

We have ordered a new electronic "frisking" device, as specified by our radiation consultant, to suit our needs. The unit is a Model RM-15-Radiation Monitor with Alpha Scintillation Probe Model AC-3B.

This unit will be installed at our employees' entrance in Building B, which is also near the factory first floor washroom. The unit will be available at all times during work hours to allow for self-analysis before coffee breaks, lunch periods, and a final check on the way home for factory and engineering personnel."

The inspector examined the corrective action taken and noted that although the instrument had been obtained, it had not been installed as indicated nor were employees required to use it and no arrangement for beta-gamma surveys had been made. (Details, Paragraph 12a.)

D. Corrected Violations

The following violations contained in the Region I letter dated April 23, 1973 were found corrected.

1. Quarterly meetings and training sessions for fire brigade members; the licensee stated quarterly meetings would be held. The inspector verified the corrective action taken. (Details, Paragraph 3)

2. Periodic health and safety meetings; the licensee stated periodic meetings would be held. The inspector verified the corrective action taken. (Details, Paragraph 4)

3. Operational checks of hoods and sucker hoses; the licensee stated that records of checks would be maintained. The inspector verified the corrective action taken. (Details, Paragraph 5)

4. Periodic direct measurement surveys with gas proportional counters; the licensee stated that periodic measurements would be made. The inspector verified the corrective action taken. (Details, Paragraph 6a.)

5. Records of transfer and disposal; the licensee stated that records of transfer and disposal would be maintained. The inspector verified the corrective action taken. (Details, Paragraph 13b.)

   The following violation contained in the Region I letter dated December 12, 1973 was found corrected.

6. Posting of notices to employees; the licensee stated that notices would be posted stating where the regulations and license could be examined. The inspector verified the corrective action taken. (Details, Paragraph 14b.)

Unusual Occurrences

Measurements made by the inspector revealed that significant amounts of undetected beta-gamma contamination existed in the work area. As a result of this finding and management's statement that it could not be guaranteed that employees always changed into uncontaminated personal clothing before leaving the plant, two inspectors revisited the plant and the residences of affected employees on January 8 and 9, 1974 to further evaluate the extent of contamination spread. (Details, Paragraph 18)

Other Significant Findings

A. Current Findings

The licensee has fulfilled its current contract with Argonne National Laboratory for fabrication of CP-5 reactor fuel elements. The last production run was completed in November 1973 and all fuel elements have been shipped. This had been the licensee's sole enriched uranium fuel element fabrication activity, and renewal of the contract is not anticipated for several years.

B. Status of Previously Reported Unresolved Items

Not applicable

Management Interview

At the conclusion of the inspection on December 28, 1973, a management meeting was held with the following persons in attendance:

Nuclear Metals

W. B. Tuffin, President
R. Robie, Director of Administration and Comptroller
B. McKay, Director, Manufacturing
A. Gilman, Director, Quality Assurance and Industrial and Radiation Safety

AEC

P. C. Jerman

The following subjects were discussed:

A. The violations found were discussed. Many existed because the licensee failed to identify the existence of beta-gamma emitting radionuclides associated with the foundry operation. Mr. Jerman reiterated the violations to Mr. Tuffin in a phone conversation on January 21, 1974.

B. The use of lapel air samplers for determining exposure of individuals to airborne concentrations of radioactive material was discussed.

C. The need to survey for both alpha and beta-gamma emitters was discussed.

At the conclusion of the inspection on January 9, 1974, a management meeting was held with the following in attendance:

Nuclear Metals

W. B. Tuffin, President
R. Robie, Director of Administration and Comptroller
A. Gilman, Director, Quality Assurance and Industrial and Radiation Safety
R. Franks, Safety Officer
S. Levin, Massachusetts Institute of Technology, Consultant

State of Massachusetts Department of Health

G. M. Swible

AEC

P. C. Jerman
F. N. Brandkamp

The following subjects were discussed:

A. Results of residence and auto surveys

B. Whole body counts for foundry employees. Mr. Tuffin agreed that whole body counts would be made on the five foundry employees.

C. The need to establish full contamination control. The inspectors pointed out that they observed actions on the part of employees which raised questions concerning the adequacy of the training they had received. Licensee management agreed further training was needed.

DETAILS

1. Individuals Contacted

W. B. Tuffin, President
A. Gilman, Director, Quality Assurance and Industrial and Radiation Safety
R. Robie, Director of Administration and Comptroller
R. Franks, Safety Officer
S. Levin, Consultant

2. Scope of Operations

a. A licensee representative stated that the final fabrication of CP-5 Reactor fuel elements under the current contract with Argonne National Laboratory was completed in November 1973. This has been the only enriched uranium fuel fabrication conducted by the licensee. There will be no additional need for fuel of this type for several years. The uranium used in fuel element fabrication was fully enriched metal. It was extruded with aluminum to make tubular elements up to three inches in diameter.

b. Depleted uranium is melted in induction furnaces and molded into shields for radioactive sources and into penetrators.

3. Fire Brigade Meetings

The record of fire brigade meetings held was examined. The record shows that meetings were conducted on May 14, 1973; August 1, 1973 and October 10, 1973.

4. Health and Safety Meetings

The record of health and safety meetings held was examined. The record showed that conventional safety meetings during 1973 were conducted on May 23, June 19, and July 31. Radiation safety meetings were conducted on May 18, August 6, 19 and 20, and November 22, 23 and 24.

5. Hood and Sucker Hose Checks

The record of hood and sucker hose checks made was reviewed. The record showed that checks were made on September 23 and October 30, 1973. The face velocity at all hoods and sucker hoses ranged from 1000 to 4500 lf/m.

6. Direct Reading Surveys

a. Records were examined and showed that 14 locations were routinely surveyed directly with an alpha detection instrument (Eberline Model RM-15). The survey was conducted monthly. Readings up to 360 d/m were recorded. Records of a special survey conducted on August 4, 1973 showed 4500 d/m alpha on the foundry podium floor. A licensee representative stated that no beta-gamma measurements were made.

b. The inspector surveyed the foundry area using a Model E-120 Eberline instrument with a GM end window probe with about 2 mg/cm^2 absorber. Dose rates up to 5 mR/hr at 1 cm were measured on the floor. Hoods showed up to 25 mR/hr. The instrument was calibrated with cobalt-60. Calibration of the same model instrument with a uranium (natural) slab showed that a correction factor of 6 should be applied for measuring dose rates from uranium. (Refer to footnote 4 of table 3 for a discussion of instrument response.)

7. Wipe Surveys

a. Records were examined for the period from April 1 to December 15, 1973 and showed that wipes were taken monthly at 14 locations in the plant area. The wipes were counted only for alpha contamination. The maximum wipe showed 28.5 d/m alpha/$100cm^2$. It was taken on the floor near the large door in the foundry area.

b. The inspector took wipes at ten locations as indicated in Table 1. The wipes were counted on January 2, 1974 using an Eberline Model SAC-4 for alpha counting and Eberline Model LCS-1 with Eberline Model RD-14 Beta Detector for beta counting. Figure 1 shows the location of the wipes by number.

TABLE 1

INSPECTOR SMEAR SAMPLE RESULTS

(For Locations See Figure 1)

SMEAR NUMBER	LOCATION	d/m alpha	d/m beta-gamma
1	Floor near tower (Foundry)	78	10,105
2	Inside side wall crucible hood (Foundry)	270	11,224
3	Step to tower (Foundry)	78	17,559
4	Floor of tower hood (Foundry)	189	5 mR/hr (1)
5	Inside paint hood, side wall (Foundry)	34	705
6	Floor near hack saw (Foundry)	25	4,256
7	Floor near exit to hall (Main shop area)	6	686
8	Tower counter top (Foundry)	40	5,331
9	Floor near entrance to shipping and receiving area(Main Shop Area)	6	335
10	Floor in hall at reception room	9	148

(1) Footnote 4 of Table 3

8. In-Plant Air Monitoring - Special Nuclear Material

In-plant air sampling records for fuel element fabrication operations were reviewed. The records showed that samples were collected and analyzed monthly from the eight in-plant stations. The maximum concentration shown on the records was noted to have been 8.5×10^{-13} uCi/ml. Results for samples taken after October 30, 1973, had not been received from the contractor who supplies the analytical service.

9. In-Plant Air Monitoring - Source Material

The inspector observed that two air sample stations in the foundry area were in the same locations as observed during the inspection conducted in March 1973. One was located at the side of the hood canopy (outside of the canopy air flow pattern), on the furnace platform and the other was about 8 feet above the foundry floor, remote from where source material was processed. The air sample records examined showed that samples were collected and analyzed for alpha monthly. The maximum concentration shown on the records was noted to have been 8.0×10^{-13} uCi U-238/ml. The MPCa for insoluble U-238 is 1×10^{-10} uCi/ml. Records also showed that on two occasions a series of three air samples was taken with a portable air sampler in the vicinity of work performed in the foundry area. The first of these was on June 6, 1973 when samples were taken at the furnace while lifting the furnace cover, while manipulating the crucible, and "while burning". The second series was on September 7, 1973. The maximum sample showed a concentration of 3.0×10^{-12} uCi/ml. A licensee representative stated that the samples were only analyzed for alpha activity, with no analysis for presence of beta or gamma radiation.

10. Surveys of Airborne Effluents

Examination of the stack air sampling records showed that samples had been collected from all stacks monthly since March 1973. Analyses showed the maximum concentration to be 9.4×10^{-12} uCi alpha/ml from the E-30 stack during the period from March 2 to April 4, 1974. The MPCa for soluble uranium-238 is 3×10^{-12} uCi/ml. The average concentration for this stack and each of the other stacks for the twelve month period ending October 29, 1973 was less than 3×10^{-12} uCi/ml uranium-235 or uranium-238. Results for samples removed at the end of November, 1973 had not been received from the vendor. A licensee representative stated that the stack air samples were analyzed only for alpha radiation.

11. Environmental Monitoring

Examination of environmental monitoring records showed that water and soil samples collected from wells on the plant property on March 30, 1973 and from nearby streams and ponds on December 28, 1971 and March 20 and 21, 1973, were analyzed for uranium content. The maximum concentrations of uranium found in well samples were

0.075 ugms/ml of water and 8.9 ugms/gram of soil. The maximum quantity of uranium found in samples taken from locations off the plant property were 0.020 ugms/ml of water and 8.3 ugms/gram of soil.

12. Personnel Surveys

a. A licensee representative stated that an Eberline Model RM-15 alpha detector had been procured which the company intended to install so that employees could monitor their persons before eating, smoking or leaving the plant. Instructions were given to employees concerning proper use of the instrument. However, the instrument was not installed and there was no requirement that the employees use it. The instrument was used for direct reading surveys in the entire plant area. Records examined showed that on September 7 and October 18, 1973 personnel in the foundry area working with U-238 were spot checked for clothing and hand contamination. As much as 1560 and 8400 d/m alpha were found on clothing and gloves, respectively. No hand contamination was found. The shop employees continued to use plant issue shirts, trousers, shoes, socks, and gloves but did not check their persons before eating, smoking or leaving the plant. No beta-gamma surveys of personnel were conducted.

b. The inspector examined the foundry area where uranium-238 is processed. The shoes and clothing of two technicians were checked with an Eberline Model E-120 with an end window GM probe containing about 1.8 mgr/cm^2 end window. Readings up to 5 mR/hr* and 2 mR/hr were found on shoes and clothing, respectively. One technician stated he had used the canvas gloves he was wearing for about five days. The reading on the inside surface of the palm of the right glove (turned inside out) was greater than 50 mR/hr at 2 cm. He produced a pair of leather gloves which he stated he wore for one or two days. The palm of the right glove (turned inside out) showed 30 mR/hr at 2 cm. A licensee representative stated that finger TLD's had been used during June, July and August, 1973. Ten dosimeters were received for use each month. The only positive result was for dosimeter #148 used during June, 1973. It showed 270 mrem. The individual who wore it was not identified. The licensee representative stated that the finger TLD's had not been used by personnel who worked in the foundry area. It was noted by the inspector that uranium-238 shields for which the theoretical surface dose rate is 240 mrads/hr, were directly handled by personnel with and without the use of gloves. The licensee had done no other evaluation of the radiation doses to employee's hands.

*See footnote 4 to table 3

13. Use of Licensed Materials

a. The licensee's records of receipt, inventory and transfer of licensed source material were examined. It was found that source materials had been used for purposes authorized by the license and that quantities possessed had not exceeded the quantities authorized.

b. Examination of the records of transfer of source material showed that the quantity of material transferred was always listed. A licensee representative stated that each customer to whom source material products were transfered had been contacted to determine that the customer was authorized to receive the material. Examinations of this correspondence file showed that each customer to whom source material was transfered was authorized to receive it.

14. Posting and Labeling

a. It was noted that the areas in which depleted uranium shields were stored at which dose rates in excess of 5 mR/hr at 18 inches were measured, were posted with signs bearing the radiation caution symbol and the words "Caution Radiation Area".

b. It was noted that notices were posted both in the lunch room and the shop area which informed personnel a copy of the regulations and a copy of the license could be obtained for examination.

15. Personnel Monitoring

a. The licensee's records of whole body radiation exposure for 1973 through November 30 were examined. The maximum exposure received by any employee as indicated by film badge results was 1170 mrem, whole body exposure and 5970, skin of whole body exposure.

b. A licensee representative stated that film badges were checked for the presence of contamination each time they were collected for exchange of the film packets. No contamination was found. It was observed when examining film badge records that the processor indicated the possibility of contamination on a few badges. In no case was the film not read. The maximum reading reported for film showing the contamination notation was 60 mrem. It was observed that no contamination notation appeared for film used during the month of November 1973.

16. Liquid Effluent Released to Unrestricted Areas

a. Records showed that the acid used to dissolve the copper sheath from melted uranium was drained to a bog on plant property on August 7 and August 8, 1973. The 2000 gallons released on August 7, 1973 showed 0.68 ugms U-238/ml and the 5000 gallons released on August 9, 1973 showed 3.85 ugms U-238/ml. The MPC is 119.2 ugms U-238/ml. A licensee representative stated that the samples of neutrilized acid taken were not analyzed for the concentration of radioactive material other than U-238 such as the beta-gamma emitting uranium daughter products.

b. Soil samples were taken from the bog area. Records examined showed the following results:

TABLE 2

BOG SAMPLE ANALYSIS RESULTS

	ug Uranium/gm Soil	
	August 6, 1973	August 14, 1973
Soil from bog depression	1550	38
Soil from edge of bog	440	188
Soil 30' east of bog	325	38
Soil 30' south of bog	138	363

17. Bioassay

Examination of bioassay records revealed that seven employees submitted urine samples on April 18, 1973 and that eleven employees submitted urine samples on August 23, 1973 all of which were analyzed. The maximum results determined by the radiometric method and the flourometric method were 81 and 25 dpm alpha/liter, respectively. The previous urine samples were submitted on May 31, 1972. It appears possible, based on the degree of contamination control exercised by the licensee, that many of the samples submitted were contaminated. This coupled with the inability to determine when an uptake was received, if received, makes it apparent that it would be impossible to establish the degree of internal deposition which occurred in any case.

18. Status on January 8 and 9, 1974

In the Region I letter to the licensee dated January 7, 1974, understandings regarding immediate actions taken by the licensee were listed. The actions stated in the letter are shown below together with the findings of the inspectors.

a. "You ceased uranium melting and casting operations on January 3, 1974 and do not intend to restart until the situation has been resolved to your satisfaction and ours."

The inspectors observed that no uranium melting and casting operations were being performed.

b. "You have surveyed the foundry area and undertaken extensive cleanup operations. A restricted area has been established and contamination control procedures have been implemented."

The inspectors observed that the only activities conducted in the foundry area were cleanup operations. A rope boundary had been established for the foundry area with appropriate signs. Shoe covers and lab coats were supplied for assigned employees. A step off procedure had been implemented. A thin end window GM survey meter was provided at the boundary exit point.

c. "You have instructed all involved employees in personnel contamination control methods and performed contamination surveys on them."

1. A licensee representative stated that meetings had been held with involved employees to instruct them in personnel contamination control method and that contamination surveys had been performed on them. A memo in regard to personnel contamination control methods had been issured to employees and was examined by the inspector. The following observations were made by the inspectors in regard to this item.

2. A foreman (employee C listed in Table 3 below) was working in the foundry area when he was informed that the AEC inspectors located in the plant conference room, a non-controlled area, wished to see him. The purpose was to initiate a home survey. His response was to go directly to the Conference Room in the "work clothes" he was wearing at the moment, despite the fact that he knew these clothes were possibly contaminated. He was monitored by an inspector who found up to 3* mR/hr on the soles of his shoes, up to 1 mR/hr on most of the exterior of the waist length jacket he was wearing. The cuffs of the shirt he was wearing protruded from the sleeves of the jacket. The edges of these cuffs measured 0.5 mR/hr.

3. When four employees were requested to open their autos for survey, they proceeded to the plant parking lot in plant issued clothing and shoes, and personal outer clothing. Three sat is their autos awaiting survey because of cold wind.

*See Footnote 4 TO Table 3

4. Members of licensee management witnessed the matters reported in Paragraphs 2 and 3 above. The inspectors pointed out that this behavior on the part of the employees was not in accord with good contamination control practices.

d. "You will undertake all other steps necessary to prevent contamination spread outside the plant confines and to prevent the possible ingestion of radioactive material by personnel"

1. A licensee representative stated that wipes had been taken of the floor inside and outside of each entrance door to the plant building. The wipes showed less than 50 d/m for both alpha and beta-gamma emitters.

2. Surveys of the second floor of the building were conducted by the inspector. Nine wipes taken on tables in the lunch room showed no indication of contamination. A crack in the tile of the floor in the hall just outside the lunch room read 0.3 mR/hr at 1 cm*. Particles which collected on the floor at door jams in the hall read up to 0.5 mR/hr at 3 cm. Three dry mops used exclusively in halls and rooms outside the shop area showed dose rates from 0.3 to 0.8 mR/hr at 2 cm. A licensee representative stated the mops surveyed had been used January 7-9, 1974 after contamination control procedures had been instituted in the foundry area. The licensee stated that the dry mops in question had not been taken into the controlled foundry area. A janitor's shoes were surveyed and showed no indication of contamination.

e. "You will assist in arranging for a survey of the homes of appropriate employees to assure that there has been no significant transfer of contamination."

1. The licensee had arranged for surveys of homes and autos. The inspectors surveyed the residences of five employees whose work assignments were primarily in the foundry area where uranium-238 was processed. The automobiles of four of these employees were also surveyed. The other employee rode to and from work with one of the four employees. The automobile of Employee F which was used frequently by some of the five employees mentioned above during lunch periods was also surveyed. Results of the survey were as follows:

*See Footnote 4 to Table 3

TABLE 3

RESIDENCE AND AUTO SURVEY RESULTS

Employee	Residence Survey[3]	Auto Survey
A	No contamination found	0.25 mR/hr on front floor, drivers side
B[1]	Trousers-0.3[4] mR/hr	No auto to survey
C	Boots - 0.1 mR/hr	0.2 mR/hr on front floor, drivers side
D	2 shirts - 0.2 mR/hr at cuffs Boots - 0.3 mR/hr Jacket - 0.3 mR/hr	0.2 mR/hr on rear right floor
E	Boots - 0.5 mR/hr	0.1 mR/hr on front floor mat
F	No residence survey	1.0 mR/hr on back floor hump 0.5 mR/hr on right rear floor[2]

(1) Residence was in New Hampshire. All other residences were in Massachusetts.
(2) Licensee reported survey of auto showed no contamination.
(3) All clothing listed was personal clothing, not plant issued.
(4) Measurements on clothing and autos were made with radiation passing through the thin end window of a portable G.M. Survey Instrument, (Eberline E120), which is calibrated against cobalt 60 gamma radiation. Contamination measured was independently determined to be predominately beta. The instrument used in this survey has been calibrated with beta radiation from depleted uranium passing through the thin end window and for this case mR/hr readings must be multiplied by a factor of 6 or slightly more to obtain true mrad/hr readings.

2. All contaminated items found in residences were immediately returned to the licensee's plant except the boots of Employee C and one shirt of employee D. A licensee representative stated these articles would be returned to the plant and all articles would be decontaminated at the plant or by an authorized laundry. A licensee representative notified RO:I by phone on January 11, 1974 that all contaminated autos had been decontamined to background level. (<0.1 mR/hr).

19. Subsequent Action by the Licensee

a. On January 18, 1974, in a telephone call, the licensee's management representative reported that whole body counts had been done on the five employees for whom home surveys were conducted. He stated that the preliminary report from MIT, based on 20 minute counts, showed no abnormal activity in the individuals counted.

b. He also reported that his radiation consultant had been to the plant twice during the week, that a ventilation consultant had been to the plant once and that extensive phone consultation had been conducted with both of them. He said that decontamination operations were continuing and that as of the time of his telephone call, surveys conducted with his thin window portable GM counter revealed no detectable contamination up to the entrance of the work area.

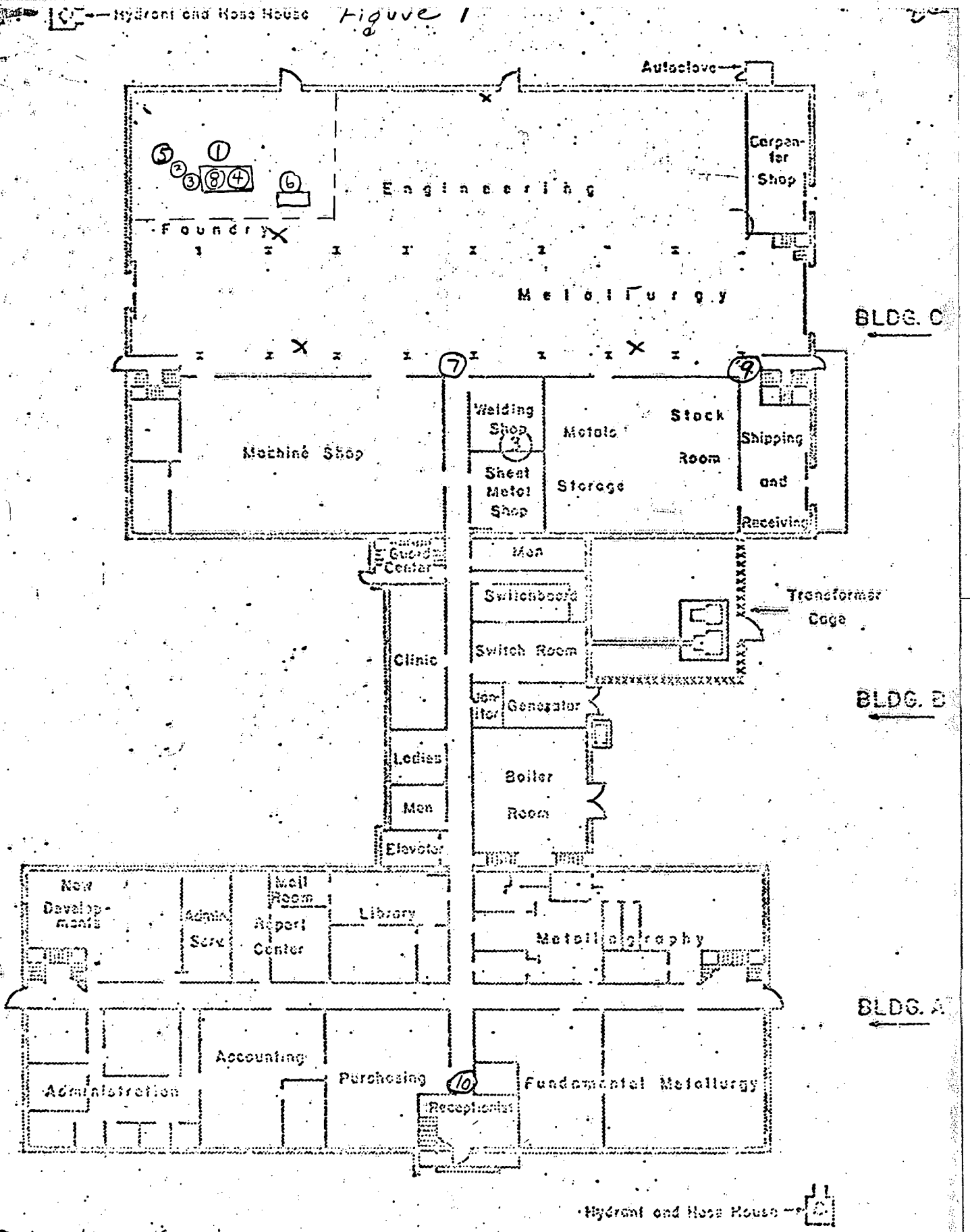
He stated that there was what he referred to as a buffer zone between the entrance to the work area and the platform on which the melting is accomplished. He reported that in this buffer zone, instrument readings never exceeded 0.4mR/hr including a background of 0.2 mR/hr.

c. The management representative then requested approval to begin melting operations again and outlined a plan under which the procedure would be undertaken. He stated that every step of the operation would be monitored in the following manner. Initially, contamination and smear surveys would be made of the work area. During the operation, breathing zone air samples would be taken and upon completion of each step of the operation smear and instrument surveys would be done to determine whether contamination spread was taking place. In the event that it was, decontamination would be undertaken as necessary.

d. He reported that the first melt would be typical of their smallest batch, consisting of a 96 pound charge which produces two of the smallest shields weighing 30 pounds each with the remaining material recaptured as waste. The management representative agreed to notify RO:I in the event of any unusual occurrence during the operations. He stated that rough checks of smears and air samples would be made with a thin end window GM detector as a screening process and that the samples then would be sent immediately to their consultant for processing and stated that he expected results back within a couple of days. If the first melt went well, he then planned to go on to a larger melt using the same steps as previously outlined. In the event this permitted them to fully delineate and control their contamination problems he indicated that they intended to resume normal operations.

e. Based on the information provided in this phone call, RO:I gave its approval to resume melting operations.

Figure 1


Hydrant and Hose House
Autoclave
Engineering
Foundry
Carpenter Shop
Metallurgy
BLDG. C
Machine Shop
Welding Shop
Sheet Metal Shop
Metals Storage
Stock Room
Shipping and Receiving
Guard Center
Men
Switchboard
Switch Room
Transformer Cage
Clinic
Generator
BLDG. B
Ladies
Men
Elevator
Boiler Room
New Developments
Admin. Serv.
Mail Room
Report Center
Library
Metallography
BLDG. A
Accounting
Administration
Purchasing
Receptionist
Fundamental Metallurgy
Hydrant and Hose House
Location of wipes
FIRST FLOOR PLAN