Form AEC-117
(4-58)

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE INSPECTION REPORT

1. Name and address of licensee

[illegible]
[illegible] Division
Attleboro, Massachusetts

2. Date of inspection

November 19, 1959

3. Type of inspection Initial

4. 10 CFR Part(s) applicable

20 - 30 - 40 - 70

5. License number(s), issue and expiration dates, scope and conditions (including amendments)

License No.	Date	Exp. Date
SNM-185	9/[illegible]/58	9/30/62

Receipt: Twenty-four (24) kilograms of U-235 contained in uranium enriched in the U-235 isotope. For the manufacture of [illegible] uranium-aluminum foil using the procedures described in the licensee's application of July 30, 1957, as amended February 5, 1958 but limited by the procedures described in the [illegible] feasibility report [illegible] concurrently submitted.

Conditions: Authorized place of use: The licensee's fuel element processing plant located on Route 152, Plainville, Massachusetts.

SNM-185, as amended	4/1/59	9/30/62

Receipt: Two hundred fifty (250) kilograms of U-235 contained in uranium enriched in the U-235 isotope.

CONT'D

6. Inspection findings (and items of noncompliance)

[illegible] of the licensee's facilities under SNM-185 revealed some work with licensed material in progress. Criticality control procedures and the [illegible] of these procedures were reviewed with the criticality [illegible] were deviations from the procedures [illegible] by the licensee for his own protection. Approximately [illegible] of U235 are stored in two storage vaults or in in-process [illegible] on the production floor. Administrative control procedures, pro[illegible], processing, and storage of nuclear material were [illegible]. Fire protection, medical and health physics programs [illegible]. The health physics program is directed by [illegible] licensee's criticality engineer. His experience in [illegible] with [illegible] the Chicago Operations Office Health and Safety Division. [illegible] of area air-sampling, radiation surveys to detect [illegible]. A medical program run by [illegible] of pre-employment and annual physicals which include [illegible] and examinations as to physical well being. [illegible] inventory, accountability, disposal, transfer, [illegible], film badge, and direct radiation surveys are maintained. [illegible] of the inspection an exposure of 2300 mr gamma and 400 [illegible]. Investigation [illegible] the exposure was made during [illegible] as to the gamma exposure was available (CONT'D)

7. Date of last previous inspection

8. Is "Company Confidential" information contained in this report? Yes [ ] No [ ]
(Specify page(s) and paragraph(s).)

DISTRIBUTION:

[illegible]
(Inspector)

Approved by:

[illegible]
(Operations office)

(Date report prepared)

If additional space is required for any numbered item above, the continuation may be extended to the reverse of this form using foot-to-head format, leaving sufficient margin at top for binding, identifying each item by number and noting "Continued" on the face of form under appropriate item.

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM.

ITEM 5 CONT'D

SNM-185, as amended — 4/1/59 — 9/30/62

Scope cont'd. (1) For the manufacture of uranium-aluminum foil using the procedures described in the licensee's application of July 30, 1957, as amended February 5, 1958 but limited by the procedures described in the D. E. Makepeace Feasibility Report NEM-2 concurrently submitted; (2) For the receipt and storage only of uranium metal ingots in accordance with the procedures described in the application dated January 13, 1959.

Conditions: #10-Authorized place of use: The licensee's fuel element processing plant located on Route 152, Plainville, Massachusetts.

SNM-185, as amended — 8/12/59 — 9/30/62

Scope: Three hundred thirty (330) kilograms of U-235 contained in uranium enriched in the U-235 isotope. For the fabrication of reactor fuel elements and related activities using the procedures described in the licensee's application of July 30, 1957, as amended February 5 and December 9, 1958 and January 13 and 30, March 3, April 9, April 17 (2), May 28 (2), June 3, and August 3, 1959.

Conditions: #10-Authorized place of use: The licensee's fuel element processing plant located on Route 152, Plainville, Massachusetts.

PART 40

C-3719 — 5/12/58 — 5/31/59

Scope: Licensed to receive possession of and title to, at the Pine & Dunham Streets location of Engelhard Industries, Inc., ten thousand (10,000) pounds of source material during the term of this license for research and development and fuel element fabrication.

Conditions: Maintain records of inventories, receipts and transfers of refined source material. Compliance with 10 CFR 20.

C-4237 — 8/19/58 — 8/31/59

Scope: Licensed to receive possession of and title to, through importation, miscellaneous aluminum, zirconium beryllium and stainless steel clad natural uranium extrusions containing approximately ten (10) pounds of uranium.

Conditions: Compliance with 10 CFR 20.

PART 30

20-5216-1 — 5/14/59 — 5/31/61

Scope: 20 mc C^{14} contained in iron for the manufacture of iron strips.

Conditions: #11-Compliance with Part 20. #12-Byproduct material shall be used by, or under the direct supervision of, Norton Weiss. #13-Byproduct material shall not be used in products distributed to the public. #14-The licensee shall possess and use byproduct material described in Items 6, 7 and 8 of this license in accordance with statements, representations, and procedures contained in his application dated April 29, 1959. #15-Written administrative instructions, entitled "Health and Safety Manual" and submitted with W. F. Mittendorf's letter dated February 5, 1958 shall be followed and a copy of these instructions shall be supplied to each individual using or having responsibility for use of byproduct material. Any changes in these administrative instructions shall have the prior approval of the Isotopes Branch, Division of Licensing and Regulation.

ITEM 6 CONT'D.

except that due to film badge contamination.

Part 40
Under license C-3719 a few operations involving source materials (PRDC) were in progress at the time of the inspection. A total of 26,093 kgs of depleted source material (59,762 lbs.) was on hand. Organization, and administrative control, procedures, procurement, receipt, transfer, disposal, security and health and safety are the same as reported for Part 70 materials. Records of inventories, receipt and transfer, disposal, air samples, urine, film badge, and direct radiation surveys are maintained. Under C-4237 the licensee,through import, is licensed to receive possession of and title to approximately 16 lbs. of miscellaneous aluminum, zirconium beryllium, and stainless steel clad natural uranium extrusions. This material had been shipped to the Geneva Exhibit under export license S-4953 and was reportedly received and transferred to Nuclear Metals, Inc.

Part 30
Under license 20-5216-1 the licensee procured and rolled into sheets 20 mc of C^{14} as contained in iron. Records indicate that the sheets had been shipped on June 1, 1959 to the Sunbeam Equipment Co., Meadville, Pennsylvania, a byproduct license material holder.

The items of noncompliance observed or noted during the course of the inspection of the Parts 70, 40, and 30 licenses are as follows:

Part 70
20.201(b) "Surveys"
- in that the licensee failed to make an evaluation of airborne contamination and direct radiation surveys at operations (i.e., melting furnace) where high concentrations of radioactive aerosols are reported present and high beta exposures were noted on film badges of employees working at this particular operation.

- in that no evaluation has been made of stack air effluent or airborne contamination in the unrestricted areas.

(See 14E(1) and (2) of report details.)

20.203(e)(1) "Caution signs, labels and signals" - "Additional requirements" - in that the entrance to the production facility was posted with a proper symbol but with an improper sign. (See item 16 of report details.)

(f)(1) and (f)(4) "Containers"
- in that cans and carboys containing 6.4 kgs and 20 grams of enriched uranium, respectively, were not labeled as to type, quantity, radiation sign or symbol. (See item 16 of report details.)

20.401(c) "Records of surveys, radiation monitoring and disposal"
- in that records of air sample results are not reported in the same units required under 20.201(b). (See item 14E(2) and 17 of report details.)

Part 40 (C-3719)

20.201(b) "Surveys"
- in that the licensee failed to make an evaluation of airborne contamination and direct radiation surveys at operations (i.e., melting furnace) where high concentrations of radioactive aerosols are reported present and high beta exposures were noted on film badges of employees working at this particular operation.

- in that no evaluation has been made of stack air effluent or airborne contamination in the unrestricted areas.
(See item 9.6 of report details.)

20.203 "Caution signs, labels and signals"
(c)(2) "Additional Requirements" - in that the entrance to the production facility was posted with a proper symbol but with an improper sign. (See item 9.4 of report details.)

(f)(2) and (f)(4) "Containers"
- in that several containers containing source material in excess of 1.5 lbs. were not labeled with the quantity, type, radiation sign or symbol. (See item 9.4 of report details.)

20.401(c) "Records of surveys, radiation monitoring and disposal"
- in that records of air sample results are not reported in the same units required under 20.201(b). (See item 9.4 of report details.)

40.10 "Restriction on Transfers"
- in that the licensee received and possesses quantities of source material in excess of the limits specified in his license. (See item 9.1 of report details.)

There were no items of noncompliance noted under License Nos. C-4237 or 20-5216pl.

PART 70 INSPECTION

Engelhard Industries
D. E. Makepeace Division
Attleboro, Massachusetts

Date of Inspection: November 19, 1959

Persons Accompanying Inspectors:

None.

Persons Contacted:

John Durant, Business Manager
G. H. Barney, Plant Manager
Norton M. Weiss, Criticality and Health & Safety

DETAILS

9. Introduction

Inspection of the activities related to the use of special nuclear material under license #SNM-185 was conducted by John R. Sears, Paul B. Klevin, NYOO, and Robert H. Engelken, SAN, at the facilities of the D. E. Makepeace Division of Engelhard Industries (DEM), Attleboro, Massachusetts.

The D. E. Makepeace Division facility at Attleboro which was described as their Plainville Nuclear Materials Plant, is primarily engaged in the fabrication of fuel elements and core sub-assemblies. Operations at the licensee's plant involve both licensed and contract material. At present contract (Commission owned material) operations are being performed for Argonne National Laboratory. A total of 25.486 kgs. of Contract U^{235} ($> 75\%$ enriched) are on hand at the facility. Current operations involving licensed material involve primarily the receipt of enriched uranium (25.6%) in metal form and subsequent processing operations to make PRDC type elements and core sub-assemblies. At the time of inspection several limited operations involving both contract and licensed materials were in progress.

Inspection consisted of a visual inspection of the plant, discussion of administrative organization, methods and procedures for prevention of criticality control, accountability records and control, radiological health and safety and fire protection. Records pertaining to the aforementioned were reviewed.

10. Organization

D. E. Makepeace (DEM) is a division of Engelhard Industries, Inc. W. F. Mittendorf, General Manager, has charge of two Engelhard Industries, Inc. divisions located in Attleboro, one of which is the Nuclear facility. He does not maintain his offices at the Nuclear plant but at another company plant. The following company officials maintain offices at Plainville: G. H. Barney, Plant Manager; John H. Durant, Business Manager PRDC; and Norton M. Weiss, Criticality Engineer and Health Physicist. Weiss reports to Barney. All of the other aforementioned individuals can report to the General Manager.

John Durant stated that the Plainville Plant is divided into two main sections with a three-quarter partition between the sections. One end of the plant is used for fabricating non-fissionable materials. Supercharger vanes were observed to be in the process of being fabricated. Approximately 15 people were employed here. In the nuclear section of the plant there were approximately 40 production people. The engineering, technical and office staff is about twenty-five.

11. Nuclear Safety

A. Personnel

Mr. Norton Weiss is the Criticality Engineer and the Health Physics Supervisor for Engelhard. Mr. Weiss has had no formal training in nuclear or radiation safety. He is a graduate of Tulane University with a degree in chemistry. When Engelhard first made plans to enter the fuel fabrication business, it employed Dr. Friedland of the University of Connecticut as a criticality consultant for one year. Mr. Weiss absorbed whatever basic understanding of criticality problems that he has from association with Dr. Friedland. Mr. Weiss has now been with ENH for approximately two years.

Dr. Stephen Malaker was the next consultant used by Engelhard. Dr. Malaker was formerly with Raystrom, Inc., as manager of their Nuclear Division (now defunct), then formed his own consultant organization. He is presently Professor of Nuclear Engineering at Newark Engineering College. The last use of Dr. Malaker's services by Engelhard was for a review of the feasibility report for the PRDC fuel fabrication. Mr. Weiss had written the feasibility report. He had determined batch limits after reviewing the process flow proposed by the Production Engineer. Dr. Malaker visited Engelhard for one day, toured the plant, and commented on Weiss' writing of the feasibility report.

Mr. Weiss stated that he uses the following documents in writing his feasibility reports:

LA	1623
LA	2063
TID	7016
K	1380
K	1619

He said that he uses a factor of safety of 2 in his limits and assumes fully flooded conditions. He also said that he establishes his limits on a weight basis after taking into consideration various geometries and then translates this mass limit to a number of elements of a particular geometry. For example, a batch limit for a particular operation would be labeled 10 plates rather than so many grams of U^{235}.

Engelhard has not used a consultant for independent review in any job subsequent to the PRDC. Mr. Weiss has simply written the report and presented it as an application to their license.

In the plant organization at Engelhard, Mr. Weiss answers to the General Plant Manager, Mr. Harvey. Besides being responsible for criticality and health physics, Mr. Weiss is also responsible for material control, i.e., the control of all material from a manufacturing viewpoint. The use

charges for unaccountable losses of uranium come under this phase of Mr. Weiss' job. During the inspection Mr. Weiss was also involved in an economic evaluation of continuing their own hot laundry or farming out this part of their operation to a commercial laundry.

B. Criticality Control

Criticality control during manufacturing is accomplished by the use of route cards, safe geometry carts for transportation, and a Criticality Floor Monitor whose permission is required for the movement of any special nuclear material. The route, or process flow, card for enriched special nuclear material is red. Other colors are used for cards for depleted uranium and cladding materials. The card details all the steps in a process and it is the responsibility of the operator to sign the card and tear off a perforated tab from the record card after a particular operation. These tabs then go to Quality Control and are proof that all operations have been performed and in the proper sequence.

The location of batches on the floor is the responsibility of the criticality floor monitor. He plots these locations with tacks on a large floor plan of the plant. On the completion of any step, when movement of fuel to any location is involved, permission must first be obtained from the Criticality Floor Monitor who then plots the move on the chart. All movements are made on carts of cage design so that it is impossible for two batches on different carts to be closer than 12 inches. At the end of the work day all SNM in process is returned to storage in a vault or cage. No enriched material is left on the floor overnight. The inspectors noted two inaccuracies in the plotting of material movement and the criticality floor man plot. Material plotted to be in one location was actually discovered in a different section of the plant.

The principal control of criticality starts with the first operation, vacuum melting. The melters must obtain the raw material from the Accountability Representative. He issues the material on a strict weight basis and thus the control is established right at the beginning. Mr. Weiss stated that in order to achieve the proper purity and homogeneity in the FRDC ingot they had found it necessary to use a crucible and mold for each ingot. As a consequence there is no carry over of SNM from one melt to another.

Control in the pickle bath is achieved by weighing material in ingot or rod form both before and after immersion in the tank. The volume of solution in the ingot bath is approximately three gallons. The weight loss in a 36 kg ingot during pickling averages 20 grams, with a maximum of 40 grams. All of this loss is assumed to be alloy. Since the alloy is 10% molybdenum, 90% uranium of 26.5% enrichment, this amounts to approximately 10 grams of U^{235} for one ingot. Three ingots are pickled in one bath. The maximum amount of U^{235} allowed in a bath solution is 50 grams. The solution is then transferred to a 5 gallon carboy.

The bath for pickling zirconium clad rods was observed to contain between 6 and 7 gallons of solution. The bath is kept at a one-inch depth by means of an overflow. Three rods are pickled at one time. Weight losses during pickling average 3 grams of alloy per rod. Thus, approximately .7 grams of U^{235} is lost to the solution per rod. Between 25 and 30 rods are bathed in one solution resulting in approximately 20 grams in 6 gallons. The solution is then stored in 5 gallon carboys.

Analytical samples of the solutions in the carboys are sent to Baker Chemical Co. Weiss stated that a carboy containing solution from ingots E-03, E-04, E-05, was analyzed to contain .49643 grams of U^{235} per liter of solution.

The inspectors examined the records of materials in carboys. The reference point in the record is the letter and number designating the particular ingot. At the time of inspection all used pickle solutions containing amounts of U^{235} were still stored in polyethylene carboys. Approximately 1 dozen carboys were observed under a bench in the pickling room. Mr. Weiss stated that as soon as the PRDC job started flowing through the shop at full production, that these carboys of solution would be transferred to 30 gallon polyethylene lined drums with a maximum of 200 grams of U^{235} in any drum.

C. Storage

All special nuclear material is stored in either of two storage vaults or in-process cages on the floor. One vault contains cubicles which hold six derbies of U^{235}. Each derby weighs approximately 4.16 kg of 25.6% enriched uranium. Thus each cubicle contains approximately 6.4 kgs of U^{235}. The feasibility report for the PRDC had stated that five derbies of the same mass would be stored in each cubicle. Mr. Weiss stated that he had made the decision to store six derbies in the cubicle on the basis that the weight of the six as delivered was the same as that of five derbies as originally proposed.

In one vault an open frame aluminum bird cage was observed. Inside the framework of this bird cage was stored a red one gallon can which contained broken derbies. The inspectors pointed out to Weiss the inadvisability of such storage practices. Weiss replied that the broken derbies in the can had come from the derbies in the bird cage. Weiss stated that storage may become a serious problem. Fabrication of PRDC elements has struck a snag in that design changes are being studied in the method of swaging zirconium end caps on to the fuel pins. During this hiatus raw material for the job is still arriving from Davison Chemical Co. Weiss said that there is presently about 330 kg enriched special nuclear material in the plant.

D. Radiation Monitoring System

Four Eberline radiation monitoring stations have been installed in the plant, one in each storage vault, one in the general manufacturing area and one in the final assembly area. Mr. Weiss said that these units were not presently hooked up to an alarm system because there had been trouble with false alarms. They are ordering a constant voltage transformer which they hope will cut down the number of spurious signals. The alarm lights a light and energizes a klaxon horn. The monitors will be set at 15 mr/hr. Weiss said that when the first false alarm occurred, people ran into the plant to find out what was the trouble rather than evacuate the area since, as he said, there was no special nuclear material in the area in which the monitor was installed.

The inspectors noted that one centrally located monitor was mounted on a concrete pillar which afforded some shielding to this unit from the area behind the pillar. This was pointed out to Mr. Weiss who then volunteered to move the monitor away from the pillar so that it could see the whole floor.

12. Inventory Records

The following licensed SNM material was reported to be on hand as of November 19, 1959:

PRDC (25.6%)	421.139 kg U^{235}
Clevite (93%)	0.747 kg U^{235}
Watertown Arsenal (93%)	5.043 kg U^{235}
WAPC (93%)	6.328 kg U^{235}
SRE (10%)	5.321 kg U^{235}

The material totalling 428.578 kg U^{235} was stored in either of two storage vaults or in-process cages on the floor.

13. Facilities and Operations

The licensee possesses a building comprised of approximately 50,000 square feet of space, 25,000 of which is devoted to the processing area. The building has cement floors, tile walls and a concrete slab roof with a transite ceiling. The building is equipped with a change room facility which includes dirty and clean lockers, a shower and washroom area, and several laboratories which include a health physics, quality control, and non-destructive testing laboratories. The fuel manufacturing area itself contains two storage vaults and several in-process storage cages and machining, extrusion, press, melt, rolling, fabrication, cleaning and inspection areas. The operations conducted in the fuel manufacturing area include vacuum induction and arc melting, hot and cold rolling, hot bonding by rolling, forging, vacuum annealing, machining, pickling and cleaning, etc., high power corrosion testing, welding X-raying, inspection, and packaging.

Local ventilation exhaust hoods are provided for those pieces of equipment requiring control. These include the various pieces of equipment in the machine shop which are drill presses, etc. The air from any operation is passed through a roughing filter (fiber frox) and then to a Flanders Mill, Series D filter and then exhausted to the outside environment above roof level. The facility has three ventilation systems with a total exhaust of approximately 32,000 cubic feet per minute.

14. Radiological Health and Safety

A. Organization

As noted prior in the report Norton M. Weiss serves as both Criticality Engineer and Health Physics supervisor. His experience in health physics was primarily gained through on-the-job experience and contacts with Drs. Friedland and Malaker and through contacts with Chicago Operations Office Health & Safety Division personnel. He has been at NDM for two years and has one female technician assisting him in the laboratory analysis of smear and liquid samples.

B. Instructions

Weiss stated that all employees of the nuclear department have been given an indoctrination lecture in both radiological health and safety and nuclear criticality and that new employees will be given a similar indoctrination lecture.

Written health safety procedures for personnel of the nuclear department were noted posted in the locker room. A copy of the procedures which are included in the licensee's file

were reported to be given to plant employees. These procedures include specific instructions for daily procurement of film badges, acquisition and dispensing of work clothes, locker room procedures, and decontamination check. Included in these procedures are instructions relative to no eating or smoking in areas, areas of restriction and disciplinary action to be taken in case of violation of instructions.

Written emergency evacuation procedures included in the licensee's file contain evacuation instructions to personnel, monitoring of personnel, area air and direct radiation monitoring by HP officer, reporting of incident, counting of neutron dosage from activation of sulfur tablets located on walls, outside air monitoring, decontamination procedures and acquisition of urine samples and requirements of complete incident report to AEC and state authorities.

Also included in the licensee's file is a copy of H-S procedures for maintenance, supervisory and engineering personnel containing requirements for film badge, rubbers and protective shop coat for these people prior to entering the restricted production area.

C. Medical Program

All employees receive a pre-employment physical in which blood, urine, chest X-rays, and physical well being are checked. Annual physicals which include the aforementioned items are provided for all production, technical, and engineering personnel every six months.

Spot urine samples are submitted every six months by every employee working in the nuclear plant. Urine samples are analyzed for total U by Nuclear Science & Engineering Co., Pittsburgh, Pa. Weiss reported that 24-hour urine samples are taken and analyzed isotopically if a spot sample is found to exceed 19 micrograms U/liter. Records checked from 1958 show that the maximum urine concentration found was 36 micrograms U/liter. The average concentration found was 3 micrograms U/liter. The highest U in urine concentration in 1959 showed that one individual received 100 micrograms U/liter. It was found that this particular sample was contaminated and a re-check was made. A concentration of 9 micrograms U/liter was found on the re-checked sample. The average concentration for 1959 ranged between 2 and 4 micrograms U/liter.

D. Personnel Monitoring

A bi-weekly film badge program is in effect for all employees working in the restricted areas. A total of approximately 40 people are issued film badges which are provided by Nucleonic Corporation of America, Brooklyn, New York. Visitors are also provided film badges prior to entering the restricted areas. The film badge records reviewed for 1958 showed a range of gamma and beta exposures for a two week period to be no greater than 90 mr gamma and 950 mrep beta. Weiss stated that no minors are employed by the company and that he maintains cumulative records for 13 weeks, 26 weeks, and 52 week periods. This was verified by inspection of the records. A review of 1959 film badges revealed that a melters helper, R. Nadeau, received an exposure of 2300 mr gamma and 400 mrep beta for the 2-week period commencing 10/30/59. Weiss stated that he was notified of the high film badge reading by Nucleonic Corporation and that he, in turn, notified Mr. Dave Smith of the Health and Safety Laboratory of the Chicago Operations Office. He stated that he did not notify New York inasmuch as he was under the impression that notification of Chicago was sufficient. Nadeau, a melters helper, had been employed in that job since 10/2/59. Records following are a compilation of his beta - gamma exposures to date:

Period	beta (mrep)	gamma (mr)
10/2/59 - started job	0	0
10/16/59	550	410
10/23/59	750	65
10/30/59	400	2300

The two-week period following the receipt of the overexposed badge was received by the licensee at the time of inspection. Weiss was informed of the requirement of Section 20.105. Contact was made with Nucleonic Corporation of America with regard to the overexposed badge which is included as Exhibit A to this report. Analysis was also made of the film badge and wrist badge of Nadeau by Keran O'Brien, HASL. O'Brien reported that there was definitely a gamma exposure to the badge and corroborated the density measurement made of N.C.A. However, he noted that there was some fogging which was possibly due to heat.

On December 9 Weiss reported by phone that Nadeau's badge for the period 11/2 - 11/14/59 showed 210 mrep beta and 580 mr gamma. This badge was reported by Nucleonics to be damaged and spotted significantly with contamination. Weiss also stated that Nadeau had been removed from the melting job and on November 2nd left the employ of the company to take a job closer to his home. Weiss stated that the badges worn by plant personnel were showing relatively high betas (up to 1700 mreps beta) at the melting operation. He was under the impression that the exposures to beta were due to cleaning out the furnaces after use. He noted that other personnel performing the same duties as Nadeau were being exposed to fairly high betas (up to 1700 mreps) and little or no gamma. He felt that inasmuch as the operation entailed wire brushing and wiping of the uranium oxide which is retained on the furnace shell after the melting operation and that the operation was a "dusty one", there was a strong possibility of badge contamination due to the uranium dust, inasmuch as the Nucleonic Corporation badges were not enclosed in any polyethelene bags. He stated that he would request a polyethelene bag cover for all badges. On the December 9th phone call, Weiss stated the film badges sent to him by Nucleonic Corp. were enclosed in polyethelene bags. Weiss was informed of the requirements of 20.403 and stated he would send a letter to DLAR. A copy of this letter dated November 23rd is attached as Exhibit B. As noted in Exhibit B, Weiss is running some tests with the old type badges to determine the effect of contamination of film badges by uranium oxide. He has been advised to forward the results of his tests to this office. No results were reported to be available as of December 9th. He also provided the inspector with a copy of a letter dtd. October 15th to D. M. Gardner, Director of Health & Safety Division, Chicago Operations Office, which is attached as Exhibit C.

E. Survey Programs

(1) Smears

Smear samples taken over a 1 square foot area in the production area on December 23, 1957 showed a maximum of 1 d/m/square foot for approximately 15 samples. On January 3rd, when operations were in progress, 8 smear samples taken revealed the rolling mill forge press and enriched vault to be contaminated with 3900 alpha d/m/ft^2, 3850 alpha d/m/ft^2, and 1700 alpha d/m/ft^2, respectively. A smear sample in the hall outside the restricted area showed 10 alpha d/m/ft^2. During February 1958, a smear sample of the inspection bench in which natural uranium was being inspected showed a 12,750 alpha d/m/ft^2. At the rolling mill area, a smear of 11,500

alpha d/m/ft^2 was also found. The range of contamination after cleanup of these and other areas was between 10 and 500 alpha d/m. The majority of smears ranged between 10 and 150 d/m/ft^2. It was observed that Weiss' method of collecting smears was not being done in accordance with good HP practice. Smears to be counted were noted to be stored on a dirty and dusty fibre board in the HP laboratory. This situation was called to Weiss' attention.

(2) Air Surveys

Periodic air samples were taken in the restricted area. A sample obtained during 1958 showed as much as 20 times the maximum. During a review of the air sample records it was found that relatively few air samples were taken by Weiss in the restricted areas. In 1959 only one air sample was obtained and a measurement of 120 alpha d/m/M^3 was recorded.* It was pointed out to Weiss that the results should be noted in the records as uc/ml and not in d/m/M^3. No current detailed evaluation of personnel exposure to radioactive dusts, fumes, mists, have been made by Weiss. As noted under item 14D, Weiss stated that melt furnace operation was a "dusty one". He added that respirators were worn by the furnace operators during the dusty operations. Information as to how to evaluate an employee's occupational exposure to dust was made available by the inspector. No stack effluent surveys or evaluation of airborne concentrations in the unrestricted areas of the plant were reported to be made by Weiss. No air samples were taken in the unrestricted areas of the facility, i.e., offices, labs, and the adjacent non-nuclear facility. This was confirmed by the inspector of the air sample records maintained by Weiss.

(3) Water Samples

Liquid wastes from the plant are treated through a series of hold-up tanks and then released to a septic tank system. Weiss stated he has used 7 x 10^{-6} uc/ml as the level to be released to the unrestricted area. A review of the records in 1958 showed the effluent released averaged 2.7 x 10^{-6} uc/ml. The highest sample is 7 x 10^{-6} uc/ml. 1959 records show that the range of the water effluent released was between 0.2 and 6 x 10^{-6} uc/ml. Weiss also noted that in 1958 liquid wastes from NAC Nuclear was processed by DEM through an ion exchange system in order to recover waste material. Recovered enriched uranium was returned to NAC.

(4) Radiation Surveys

Some radiation surveys have been performed in the operations area as well as on protective clothing and shoes worn by visiting personnel and protective plant employees to determine the extent of direct radiation contamination.

*It was noted during the course of the inspection that an air flow measurement at one particular jacket stripping hood revealed a face velocity of zero. This was called to the attention of Weiss who upon investigation found the filter to be fully clogged. Weiss stated that he does not have any set procedures to determine when the filters require replacement. He did state that many filters have not been changed since the system has been installed and that the filters are presently being stored in the plant confines while awaiting disposal.

F. Protective Clothing

Respirators are supplied to plant personnel working in the operations room, i.e., furnace melt operation. Individual lockers are provided for plant production personnel as depositories for personal belongings, such as clean socks, shirts, undershorts, coveralls, etc., which are provided to these personnel working in the restricted areas. The laundry facility, which is comprised of a 50 lb. washer, a 50 lb. extractor, and two 50 lb. gas dryers for contaminated clothing, is available. Weiss stated that the economics of the plant operating a laundry facility has been questioned and he presently is collecting information as to whether or not NFM should supply their own laundry or obtain the service of a commercial laundry. Clothing, according to Weiss, at present, is monitored to determine whether it is contaminated sufficiently for laundry and then reconitored after washing to determine the extend of residual contamination.

G. Waste Disposal

(1) Liquid Wastes

Liquid wastes are disposed through a sewerage system providing sampling of the waste solution is less than 7×10^{-6} uc/ml. The nuclear facilities have four drainer systems. These include the sewerage system which connects directly to a septic tank and then to a leaching field and three other systems which are as follows: Each area within the facility is equipped with drains to carry off water for decontamination purposes. All of the drainage facilities except the laundry shower and laboratory system connect to either of two main drainage systems, one system for enriched and the other system for normal uranium operation. Laundry shower and laboratory water are connected to the remaining drainage system.

According to Weiss, water from each system is discharged into a separate sump tank, a sump pump passes water through a filter through two filters, one to remove particles of 50 microns or larger and the other to remove particles of 5 microns or larger. Effluent from all systems discharges into a 2500 gallon tank. When the first tank is filled the effluent is exhausted to a second 2500 gallon tank. The filled tank is then connected to a pump and the solution recirculated for homogeneity. A sample is then taken and checked for radioactivity. If the sample contains 7×10^{-6} uc/ml, the solution is discharged to a leaching field. If the activity is found to be in excess of 7×10^{-6} uc/ml, the solution is pumped through an ion exchange column and the effluent retained in the third 2500 gallon tank. This solution is then recirculated, sampled, and checked as noted above. If the waste solution is found to meet Part 20 requirements, it is released. Weiss stated that the filtering media is combustible so that through incineration the bulk would be reduced to a minimum. He added that the incinerated material is sampled for accountability purposes.

(2) Solid Wastes

Weiss stated that no solid wastes have been disposed to date. He added that he intends to dispose of waste material to a commercial waste disposal outfit. Present solid wastes consist of broken crucibles, molds, etc.

(3) Incineration

Weiss stated that he has periodically incinerated contaminated waste material in an outdoor incinerator. These include filtering media, kim-wipes contaminated with both enriched and source materials and contaminated wooden boxes. Records maintained by Weiss show that wastes were incinerated on August 13, 19, 20, 26, 27, 31, September 2, 8, 9, 14, 23, 24, 25, 28, 29, 30, October 14, 15, 16, 20, 21, 22, and 26 thru 30, November 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 16, and 17. Several air samples taken during the incineration of waste showed a maximum reading of 236 $d/m/M^3$. It was noted that SNM-185 as amended August 12, 1959 permits incineration of the above mentioned contaminated wastes.

14. Instrumentation

The following operable instrumentation was noted to be on hand:

2 proportional flow counters
2 portable GM survey meters
1 portable alpha survey meter
2 air samplers with 1-1/8" holders for watt 41 filter paper

15. Fire and General Safety and Security

Evacuation procedures noted under Radiological Instructions were made available to all personnel. Weiss stated that contacts have been made with local fire departments. The Chief of the Attleboro Fire Department has visited the plant and has been made cognizant of the operations involved and locations in which radioactive materials are stored. He added that he invited the Plainfield Fire Department and the North Attleboro Fire Department to visit the plant but that to date they have not accepted his invitation. Containers of C-1 and metal X powders were noted to be installed at various locations throughout the production facility. Other fire fighting extinguishers were noted to be located in several of the laboratories and in the general office area. Weiss stated that in the case of fire and accident, it is his responsibility to determine whether or not an area can be entered.

A guard force is employed by DEM on a 24-hour day basis. Guards are stationed at the entrance to the production facility. A receptionist checks all visitors entering the office area.

16. Posting and Labeling

The area to the production facility was posted with a proper symbol but with an inadequate sign ("Radioactivity"). This sign was posted on the entrance to the facility which contained over 900 kgs of material. The vault areas were properly posted with proper radiation signs and symbols. Within the vault storage area several red cans each containing 6.4 kgs of enriched U were noted not to be labeled with any radiation caution sign or symbol, type and quantity of material. In the pickling area several acid solutions containing from 15 to 20 grams of enriched U in carboys were not posted to indicate type, quantity, radiation sign or symbol.

17. Records

Records of purchase, procurement, inventory, transfer, air smears, and direct radiation surveys, disposal, and film badges were reviewed. Records of air samples were noted to be recorded in $d/m/M^3$ and not in uc/ml as required by 10 CFR 20.

PART 40 INSPECTION

ENGELHARD INDUSTRIES
D. E. Makepeace Division
Attleboro, Massachusetts

Date of Inspection: November 19, 1959

Persons Accompanying Inspectors:

None.

Persons Contacted:

John Durant, Business Manager
G. H. Barney, Plant Manager
Norton M. Weiss, Criticality and Health & Safety

DETAILS

9.1 Source Material License C-4237

Inspection on the activities related to the use of source material under License C-4237 and C-3719 was made. Under License C-4237 the licensee is authorized to receive possession of and title to, through importation, miscellaneous aluminum, zirconium beryllium and stainless steel clad natural uranium extrusions containing approximately ten (10) pounds of uranium. This material was issued by DEM for the Geneva Industrial AEC Exhibit in Geneva, Switzerland. Export License No. S-4953 was obtained by DEM to ship the samples to the exhibit. The C-4237 license, according to John Durant, was obtained in order to ship the material back to the States. Durant said that the 10 pounds uranium extrusions were transferred to Nuclear Metals, Inc., Concord, Massachusetts. No record of this transfer was available. Durant looked for the record for several hours but was unable to find same.

9.2 Source Material License C-3719

Under License C-3719 DEM is licensed to receive possession of, and title to, 10,000 pounds of source material for research and development and fuel element fabrication. Records made available by Durant indicated that DEM has on hand approximately 26,893 kgs (59,762 pounds) of depleted source material which is to be used to make PRDC fuel elements. PRDC has title to the depleted source material. Durant was informed that his license condition stated that he only can receive and possess 10,000 pounds and also that the license had expired on May 31, 1959. He said he would ask for an amendment to the license to permit his possession of additional source material and extend the license expiration date.

9.3 Control (C-3719)

Organization, administration, radiological health and safety, source security, and control, and records are the same as noted for the Part 70 inspection.

9.4 Posting and Labeling (C-3719)

The entrance to the production facility which contained approximately 60,000 lbs. of depleted source material was posted with a sign "Caution - Radioactivity", and the proper symbol. Several containers containing depleted PRDC fuel pins in excess of 1-1/2 lbs. was noted not to be labeled with any radiation caution sign or symbol or type and quantity of material.

9.5 Records (C-3719)

Under License C-3719, records of procurement, receipt, and inventory were available. As noted under Part 70 Details, air samples made for source operations were reported in d/m per cubic meter instead of uc/ml. As noted under Part 70 Details, boxes contaminated with source material, filtering media, and wipes contaminated with source material had been incinerated during the period August through November 1959. Other records were maintained for source material as described under Part 70 inspection.

9.6 Surveys (C-3719)

As noted under Part 70 no air surveys were made in the unrestricted areas. No stack effluent surveys of airborne concentrations in the unrestricted areas of the plant were reported to have been made by Weiss. Specifically,no air samples were taken in the unrestricted area of the facility or plant. No evaluations of the furnace melting operation where high concentration of uranium aerosols are present during cleanup, etc., were reported by Weiss to have been made. He said he thought these studies should be made in order to determine the hazard in this and other production operations. Smears taken during February 1958 show contamination of up to 12,750 alpha $d/m/ft^2$ on an inspection bench. Some direct radiation measurements have been taken in the production area and results recorded.

PART 30 INSPECTION

ENGELHARD INDUSTRIES
D. E. Makepeace Division
Attleboro, Massachusetts

Date of Inspection: November 19, 1959

Persons Accompanying Inspectors:

None.

Persons Contacted:

John Durant, Business Manager
G. H. Barney, Plant Manager
Norton M. Weiss, Criticality and Health & Safety

DETAILS

9.11 Byproduct Material License 20-5216-1

Under License No. 20-5216-1, the licensee procured 20 mc of C^{14} contained in iron for the manufacture of iron strips. The material, consisting of two half-pound ingots of iron each containing 10 mc of C^{14}, was received from Isotopes Specialties, Inc. and forged and cold rolled to sheet approximately 0.005" thick and the sheet was slit into strips from 1/32 to 1/64" in width. Records indicate that the sheets which contained approximately 20 mc of C^{14} had been shipped on June 1, 1959 to the Sunbeam Equipment Company in Meadville, Pennsylvania on instructions from the Isotopes Specialties, Inc. The Sunbeam Equipment Company has a current valid license to receive the byproduct material.