



Allison

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	LPAD

FILE 102

July 16, 1988
(REF:NC740b)

A. Bert Davis
Regional Administrator
Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Subj: Thirty Day Report on Incident Involving
Thoriated Magnesium Parts Manufactured Under
License SFB204

Dear Mr. Davis:

I have attached to this letter a synopsis of the Allison activities resulting from the incident first reported to you on June 18, 1988, by Patricia A. Eddy of my staff and my confirmation letter to your staff on June 30th. In the synopsis we have reviewed all of the important aspects of this incident and our efforts to ensure that like incidents will not occur in the future.

Allison and General Motors are taking this matter seriously. Mr. James Keppler has been retained to assist us in our compliance efforts from both a divisional and corporate viewpoint.

In light of the prompt and extensive actions displayed by Allison and General Motors throughout this event, we hope that NRC will mitigate the severity of any identified violations.

We sincerely hope that our efforts meet with your approval. If you note any inadequacies or omissions on our part, please contact me on (317) 230-4388.

Sincerely,

P. P. Cook, Superintendent
Environmental Sciences
Radiation Safety Officer

PPC/nc

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REG3 LIC40
STB-0204 PDC

Allison Gas Turbine Division General Motors Corporation 1

ATTACHMENT B

JUL 21 1988

cc: D. Wiedeman, NRC Region III
B. Mallett, NRC Region III
E. Sassano, Shaker Numeric
M. Klinge, Keco Engineered Coatings
J. Mahoney, Hohman Plating & Manufacturing
L. Jones, Metal Technologies
S. Brown, Euclid Disposal
J. Keppler, Consultant

THIRTY DAY REPORT
LICENSE #STB204

BACKGROUND

On Friday morning, June 17, 1988, Environmental Sciences Department received a call from the Allison Purchasing Department of General Motors Corporation alerting them to the fact that approximately 250 thoriated magnesium diffuser castings had been sent out for machining to Shaker Numeric in Cleveland, Ohio. Peter P. Cook, Radiation Safety Officer for Allison, was in Iowa at that time and not available for consultation until Sunday, June 19th. Environmental Sciences Department, recognizing a potential licensing problem, promptly began to look into the circumstances surrounding the situation. Initial contacts with outside contractors were unsuccessful. By Saturday it was found that from November of 1986 through June of 1988 a number of thoriated magnesium diffusers had been machined at Shaker Numeric plus other operations done at their sub-contractors. See Appendix 1 for the list of contractors, their addresses, phone numbers and contact personnel. See Figures 1 and 2 for photographs of the rough casting and partially finished part. Furthermore it was learned that chips from the machining process at Shaker Numeric had been disposed of as general refuse at a local landfill, Euclid Disposal Company. The alloy material of these diffusers is magnesium and 3.3% thoria (thorium 232). Based on our knowledge of the material and the manufacturing processes, there should not have been a radiological problem.

Nevertheless, based on the information gathered thus far, on Saturday morning, June 18th, General Motors sent a team of experts (P. R. Frazee, GM Industrial Hygiene, J. P. Chu, GM Environmental Activities Staff and R. F. Hill, GM Research Staff) to Shaker Numeric to assess the situation and to confirm that no radiation over-exposure or hazard existed. The team arrived at Shaker Numeric on Saturday afternoon. The initial findings of the team indicated that no radiation hazard was evident. However, wipe, bulk, and air samples were collected for future evaluation. Pictures taken at the site of pertinent machines and work areas are on file at Allison.

Although it was not clear at the time that this matter constituted a reportable occurrence under NRC regulations, General Motors decided to promptly report this matter to the Nuclear Regulatory Commission. This was reported to the Region III Hot Line (call referred to Bob Stransky of the Washington office) at 6:40 p.m. Saturday, June 18th.

RADIOLOGICAL ASSESSMENT

The following detailed activities were performed by General Motors at Shaker Numeric.

Air samples were taken at two cutting machines at the facility.

- 1) LeBlond Lathe
- 2) KMT-180 Milling Machine.

Both samples disclosed no detectable radiation. Detection limits were 1.28×10^{-13} microcuries/cc of air at the 2 sigma level.

Wipe tests were performed at the machines and at other locations throughout the facility.

- 3) LaBlond Lathe Bench
- 4) LaBlond Lathe Control Panel
- 5) KMT Bench
- 6) KMT Panel
- 7) Makino Panel
- 8) Wheelbarrow Handles
- 9) Cintimatic H-100 Bench
- 10) Cintimatic H-100 Panel
- 11) Vice at the Burr Bench
- 12) East end of Burr Bench
- 13) West end of Burr Bench
- 14) Eating Table

The results showed less than 0.001 microcuries of removable radioactive material in each case.

Contamination tests for thorium were run on machine chips and coolants. The LeBlond Lathe chips showed 0.013% thorium. The KMT-180 milling machine chips showed 0.0007%, the wheelbarrow chips (used to haul chips) 0.003%, and the cutting fluid from the LeBlond Lathe was non-detectable. All of these values are well below the 0.05% NRC exemption (10 CFR Part 40). The Cintimatic H-100, which still held chips from the part in question, showed 3.3% thorium as you would expect. Those chips were collected and returned to Allison (See Figure 3). See Appendix 2 for details on the calculations for the above results.

Magnesium is almost always machined under liquid coolant conditions. This industry-wide practice is utilized to minimize fire hazards associated with machining of this material. The inspection at Shaker Numeric confirmed that they also machined the parts wet, as did Allison pursuant to the conditions of its NRC permit. The burring operations at Shaker were handled with a simple burr knife and file rather than rotary burr guns. This procedure should not have created any dust. Shaker Numeric has advised us that one employee may have on occasion used a small hand grinder to remove stubborn burrs. This activity happened on a very intermittent basis for short durations. From an industrial hygiene viewpoint, the dust generated from like operations, when taken on a time weighted average basis, usually amount to concentrations of less than 1 milligram per cubic meter.

Assuming worst case conditions during dry machining operations, where 5 milligrams per cubic meter total dust could be generated and a two hour contact period per employee for 26 weeks (typical in-house residence time), we calculated the worst possible exposure would have been 0.22×10^{-5} microcuries per cubic meter of air, or

approximately 4% of the NRC limits. See Appendix 3 for details on the calculations. Please bear in mind that at all other operations these parts were machined under wet conditions, and we can see no reasonable situation where the employees would have been exposed to such high concentrations of dust.

Shaker Numeric, in addition to the work performed at its own facility, subcontracted some of the coating operations to other companies. Keco Engineered Coatings performed a painting operation on these parts. Hohman Plating and Manufacturing performed a glass bead peening operation and applied a dichromate corrosion protective coating before Keco applied the final paint coat. We also discovered that Metal Technologies of Westfield, Indiana had one of these parts as a model to determine tooling needs.

We have retrieved all of the parts from Shaker Numeric and we have the single part back from Metal Technologies. Hohman Plating returned their parts to their contractor, Keco. We are presently negotiating with Keco to return the remaining parts, approximately 88 pieces, to Allison.

On Monday, June 27th, GM Industrial Hygiene and Allison Environmental Sciences went to Shaker and provided the information we obtained from our detailed investigation to all of the employees present at Shaker on that day. Allison also offered to pay for any physical examinations to alleviate their concerns. To date, no employee has come forward and requested a medical examination.

In addition to exploring the potential radiation levels at Shaker Numeric, Allison's Environmental Sciences Department contacted each of the companies mentioned above, explained the health aspects and radiation hazards involved with the material and offered to perform wipe tests, etc. to assure contamination did not occur. This was done even though the potential exposure at these other companies was much lower than that which existed at Shaker Numeric.

On Thursday, June 21, Allison Environmental Sciences and Industrial Hygiene functions went to Keco to inform them of the situation. Keco's management felt that no significant employee exposure could have occurred at Keco due to the fact that they only performed a simple painting operation on the pieces. Therefore, Keco felt that sampling, wipe tests, etc. were not needed. The same day Allison went to Metal Technologies and informed their management of the situation. Metal Technologies had not worked on the part at all. Consequently, no contamination testing needed to be done.

On June 30th, Allison Environmental Sciences and Industrial Hygiene functions went to Hohman Plating and Manufacturing Company in Dayton and informed their management of the situation. Wipe samples of hooks which previously held the parts showed less than the detection limit of 0.0001 millicuries. (12 hooks were wiped in 3 lots of 4 each).

With respect to the chips from Shaker Numeric that had been sent to Euclid Disposal along with the other materials in Shaker's trash, the landfill and Ohio EPA were notified. We calculated that a maximum of 0.44 millicuries of thorium would have been deposited in the landfill over the period of Shaker's involvement (approximately 80 weeks). This would have resulted in 0.0206 millicuries per week at a production rate of 10 parts per week, Shaker's maximum production rate. (See Appendix 2).

ANALYSIS AND CORRECTIVE ACTION

The root cause of this problem was that the Purchasing Department did not understand that a part discontinued for approximately four years required a license for its renewed production. This part was made for a civil and military helicopter engine until the mid 1970's when it was discontinued. A supply of spare service parts were manufactured and the tooling subsequently dismantled. However, in 1986, a large, unexpected order was received from the military for these parts. Upon learning that the tooling was no longer available, the Purchasing Department, without realizing that the parts were radioactive and manufacturing operations required an NRC license, found a sub-contractor to manufacture the parts for Allison. This is the only radioactive production part manufactured at Allison Gas Turbine.

In order to ensure this cannot happen again, the Purchasing Department has been informed and is now aware that this part is not to be outsourced to a subcontractor without a NRC license. Should outsourcing be considered in the future, the following safeguard has been instituted:

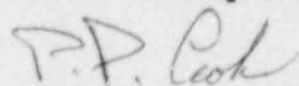
The blueprints for part #6875797, the only Allison product containing thoriated magnesium, are to be marked as follows:

"Do not out-source this part under any circumstances without express written permission and coordination by Environmental Sciences Department".

See the attached internal memo from F. P. Cook to C. W. Emerson and G. H. Mayo. We have also instructed our process engineering to modify the routing sheets for this part with the same information. This should prevent any future recurrence of the situation. Allison Gas Turbine plans to finish production in-house.

General Motors and Allison recognizes the seriousness of the inadvertent outsourcing of the radioactive castings to non-licensed contractors. Mr. James Keppler has been retained to assist in the correction of this problem at Allison Gas Turbine and to provide advice on maintaining corporate-wide compliance with the NRC regulations.

Please do not hesitate to contact me on (317)230-4388 should any questions arise or further information be required from Allison.

A handwritten signature in dark ink, appearing to read "P. P. Cook". The signature is written in a cursive style with a large, stylized "P" and "C".

P. P. Cook, Superintendent
Environmental Sciences
Radiation Safety Officer

ppc/nc

APPENDIX 1

Shaker Numeric Manufacturing Co.
1080 E. 222nd Street
Cleveland, Ohio 44117

Contact: Ernest Sassano

Keco Engineered Coatings
1030 S. Kealing Street
Indianapolis, IN 46203
(317) 356-7279

Contact: Mike Klinge

Hohman Plating & Manufacturing
814 Milrose Avenue
Dayton, Ohio
(513) 228-2191

Contact: Jim Mahoney

Metal Technologies
325 W. Park
Westfield, IN 46074
(317) 896-9308

Contact: Leon Jones

Euclid Disposal
38303 Airport Parkway
Willoughby, Ohio 44094
(216) 942-5556

Contact: Steve Brown

APPENDIX 2

SHAKER NUMERICS CLEVELAND, OHIO

I. HEALTH ASPECTS $\gamma_{1/2} = 1.41 \times 10^{10} \text{ y}$

$$\frac{dn}{dt} = \lambda N \quad N = \frac{wa}{m} \quad \frac{dn}{dt} = \frac{\lambda wa}{m}$$

$$\frac{Ci}{g} = \frac{dn/dt}{w} = \frac{0.693 \times 6.023 \times 10^{23}}{1.41 \times 10^{10} \times 365 \times 24 \times 60 \times 232 \times 2.2 \times 10^{12}}$$

$$= 1.1 \times 10^{-7} \text{ Ci/g} \quad = 0.11 \text{ } \mu\text{Ci/g}$$

Part 20 Thorium exempt quantity $100 \text{ } \mu\text{Ci}$

Part 20 Airborne level for natural Thorium in a restricted area
(Appendix B, Table 1, Column 1) $6 \times 10^{-11} \text{ } \mu\text{Ci/cc}$ of air

Part 40 Unimportant quantity 0.05 wt percent
or $5 \times 10^4 \text{ g Th/g material}$

II. AIRCRAFT ENGINE PARTS

Magnesium Alloy

Magnesium plus 3.3% Th; 2.1% Zn

Machined 211 parts between Nov. 86 to June 88
Maximum rate of 10 parts per week.

Weight of part as received	5 1/4 lbs.
Weight of finished part	4 lbs.
Weight of chips	1 1/4 lbs.

$211 \times 1 \text{ } 1/4 = 264 \text{ lbs. of chips}$
Over 1 1/2 years (80 weeks)

Since Mg scrap has no reclaim value, the chips were disposed
of in a local landfill.

$264 \times 0.033 \times 455 = 3964 \text{ g of Th (8.7 lb)}$
 0.44 mCi of Th

Maximum rate in any week
 $10 \times 1.25 \times 0.033 \times 455 \times 1.1 \times 10^{-7} \times 1000 = 0.0206 \text{ mCi/week}$

III. CALIBRATION STD.

Chips machined from casting were used to establish a calibration standard.

Weight of chips 21.33 - 18.27 = 3.06 g
Gross counts 3656 cpm
Bkg 254

$$\frac{3656 - 254}{3.06 \times 0.033} = 3.37 \times 10^4 \frac{\text{cpm}}{\text{g of Th}}$$

IV. EVALUATION OF SAMPLES

#0 Background 254 cpm

#1 air filter sample at lathe
60 cfm for 1h 253 cpm (1hr count)

no detectable activity

Minimum detection limit = $1.28 \times 10^{-13} \mu\text{Ci/cc}$ at
the 2 sigma level.

#2 Air filter sample at 180 mill
60 cfm for 1h 254 cpm

$$(60 \times 60 \times 2.83 \times 10^{-2}) = 102 \text{ m}^3 = 1.02 \times 10^8 \text{ cc}$$

$$\frac{(254 - 254) \times 0.11}{1.02 \times 10^8 \times 3.37 \times 10^4} = 0 \quad \text{No detectable activity}$$

Minimum detection limit = $1.28 \times 10^{-13} \mu\text{Ci/cc}$ at
the 2 sigma level.

#3 Chips from lathe
23.05 - 18.29 = 4.76g 275 cpm
 $\frac{(275 - 254)}{4.76 \times 3.37 \times 10^4} = 1.31 \times 10^{-4} \frac{\text{gTh}}{\text{g chips}} \quad (0.013\%)$

#4 Chips from 180 mill
38.35 - 18.3 = 20.05 g 259 cpm
 $\frac{(259 - 254)}{20.05 \times 3.37 \times 10^4} = 7.4 \times 10^{-6} \frac{\text{gTh}}{\text{g chips}} \quad (7.4 \times 10^{-4}\%)$

#5 Chips from wheelbarrow
28.18 - 18.48 = 9.7g 264 cpm
 $\frac{(264 - 254)}{9.7 \times 3.37 \times 10^4} = 3.06 \times 10^{-5} \frac{\text{gTh}}{\text{g chips}} \quad (0.0031\%)$

#6 Chips from horizontal mill
 $21.33 - 18.27 = 3.06g$ 3656
 $\frac{(3656 - 254)}{3.06 \times 3.37 \times 10^4} = 3.3 \times 10^{-2} \frac{gTh}{g \text{ chips}} (3.3\%)$

#7 Cutting fluid
 $39.00 - 18.46 = 20.54$ 238
 No detectable activity

APPENDIX 3

WORST CASE DUST CALCULATIONS TRY MACHINING

FINDINGS:

Assuming 0.6 mR/hr, employee contact 2 hours per day, 5 days per week, for 26 weeks per year:

BODY CONTACT (WORST POSSIBLE CASE)

At contact, i.e., surface of part, 0.6 mR/hr were measured. This substantiates previous measurements taken at Allison in conjunction with the manufacture of these diffusers.

$$0.6 \text{ mR/hr} \times \frac{2 \text{ hr}}{\text{day}} \times \frac{5 \text{ days}}{\text{week}} \times \frac{26 \text{ wks}}{\text{year}} = 156 \text{ mR/yr}$$

Therefore, the maximum employee contact would have been 156 mR/yr. Comparing these values with the NRC whole body & extremity limits of 5,000 mR/yr and 18,750 mR/yr, we have:

$$\frac{156}{5000} = 0.03 = 3\% \text{ of the NRC limit}$$

$$\frac{156}{18,750} = 0.008 = 0.8\% \text{ of the NRC limit}$$

RESPIRABLE DUST EXPOSURE (WORST POSSIBLE CASE)

Assume - 5.0 mg/m³ Total Dust

$$5.0 \text{ mg/m}^3 \times 0.033 \text{ mg Thoria/mg Total Dust} = 0.165 \text{ mg Thoria/m}^3$$

$$0.165 \text{ mg/m}^3 \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{0.11 \text{ } \mu\text{Ci}}{\text{g}} = 1.8 \times 10^{-5} \text{ } \mu\text{Ci/m}^3$$

$$1.8 \times 10^{-5} \text{ } \mu\text{Ci/m}^3 \times \frac{2 \text{ hrs}}{8 \text{ hrs}} \times \frac{26 \text{ wks}}{52 \text{ wks}} = 0.22 \times 10^{-5} \text{ } \mu\text{Ci/m}^3$$

$$\frac{0.22 \times 10^{-5} \text{ } \mu\text{Ci}}{6 \times 10^5} \text{ per cubic meter} = 4\% \text{ of NRC limit.}$$