



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555

JAN 14 1992

DOCKET NO: 40-3392

LICENSEE: Allied-Signal, Inc. (Allied)
Metropolis, Illinois

SUBJECT: ENVIRONMENTAL ASSESSMENT - RELEASE OF CALCIUM
FLUORIDE FOR USE IN THE STEEL-MAKING INDUSTRY

Background

By letter dated March 26, 1990, Allied requested an amendment to allow the sale of synthetic calcium fluoride (CaF_2) for use by the steel-making industry. In response to a request for additional information from NRC staff, Allied submitted a revised application on June 27, 1990. An additional request by NRC staff for more information resulted in Allied submitting a revised application dated July 1, 1991, which supersedes previous submittals. By letters dated October 28, 1991, and January 2, 1992, Allied submitted further information in support of the request.

Currently, Allied is authorized to transport synthetic CaF_2 to an Allied hydrofluoric acid (HF) production plant, where it is blended with natural CaF_2 for routine HF production. Authorization for this use was granted based on the requirements in 10 CFR 40.13(a), Unimportant Quantities of Source Material.

Proposed Action

The proposed action is to ship the synthetic CaF_2 to briquette plants where it will be blended with natural CaF_2 (fluorspar) to form briquettes used as a fluxing agent in the steel-making industry. The synthetic CaF_2 is a byproduct of Allied's uranium hexafluoride (UF_6) conversion operation and contains trace amounts of natural uranium, thorium-230, radium-226, and arsenic.

Need for the Proposed Action

This action is needed for two reasons. First, Allied produces more CaF_2 than can be used in HF production. The proposed action would authorize the recycle of the excess synthetic CaF_2 instead of Allied having to dispose of it. Second, the use of the synthetic CaF_2 will decrease the amount of natural CaF_2 , a non-renewable natural resource, currently being used in the production of steel.

Alternatives to the Proposed Action

The alternative to the proposed action would be to deny the proposed action. By denying approval of the amendment, Allied would not be able to sell the synthetic CaF_2 to the steel-making industry. While this would eliminate any possible negative impact to human health and safety due to the trace amounts of natural uranium in the CaF_2 , there would be an increased burden placed on the environment because the synthetic CaF_2 would have to be disposed of, probably in a landfill. Furthermore, the amount of natural CaF_2 currently being extracted from natural sources would not be reduced.

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Description of the Proposed Action

The synthetic CaF_2 will be transported in covered dump trucks from the Allied facility to the docks on the Ohio River in Metropolis, Illinois, in trucks used only for hauling the CaF_2 . At the docks, the CaF_2 will be loaded into a covered barge by a clamshell derrick. The barge will then either go up the Ohio River to south-central Ohio or up the Mississippi and Illinois Rivers to northern Indiana. Using a clamshell derrick, the CaF_2 is off-loaded from the barge into covered dump trucks. These are dedicated trucks used to transfer CaF_2 , briquettes, and steel mill slag to and from the loading dock, briquette plant, and steel mills. The standard, customary procedure of the company owning the barges is to steam clean the cargo area after the material being transported is off-loaded from the barge. Any runoff from the cleaning is collected into barrels, sampled for contaminants, and disposed of by an authorized waste disposal company. The Ohio briquetting facility is approximately 50 miles from the Ohio River receiving dock. The Indiana facility is about 10 miles from the river dock.

At the briquetting plant, the briquettes are formed by blending 25 percent synthetic CaF_2 , 25 percent natural CaF_2 , and 3 to 6 percent lime and molasses. The balance of the briquettes is iron oxide in the form of mill scale or flue dust which is provided for recycling by the steel mill that will consume the finished briquettes.

The finished briquettes are very hard, non-abrasive, and virtually dust free and are about the size of backyard barbeque briquettes. The briquettes are delivered by the trucks directly to the charging hoppers above each steel furnace at the steel mill. As needed, the briquettes are dropped from the hoppers into the slag that forms on top of each steel melt to condition and fluidize the slag. The amount of briquettes introduced into each steel melt depends on the amount of slag previously formed and the steel alloy being made.

Each briquette plant serves from three to seven individual steel mills in each geographical area and may deliver briquettes to an individual mill as often as five times per week. The average distance from the briquetting plant to the steel mill is 30 miles. The maximum truck delivery distance is about 100 miles.

Environmental Effects of Proposed Action

The Allied UF_6 conversion process produces approximately 4,000 to 6,000 tons of CaF_2 (dry weight basis) annually. When the CaF_2 is produced, it has a water content of approximately 20 percent. For the most recent three-year period (1988-1990), the natural uranium content of the CaF_2 has averaged 131 pCi/gm (dry weight basis). This corresponds to a uranium content of 105 pCi/gm for CaF_2 with a 20 percent moisture content.

All CaF_2 produced at Allied is sampled and analyzed for uranium content. Currently at Allied, if the uranium concentration of the CaF_2 is less than 338.5 pCi/gm or (500 parts per million), the CaF_2 is added to the warehouse inventory. If the concentration is greater than 338.5 pCi/gm, then the CaF_2 is

either disposed of as low-level radioactive waste or it is blended into the warehouse inventory, as long as doing so will not cause the uranium content of the inventory to exceed 338.5 pCi/gm.

A recent comparison by Allied of synthetic CaF_2 and natural fluorspar (CaF_2) follows:

<u>Element or Isotope</u>	<u>Synthetic CaF_2</u>	<u>Natural CaF_2</u>
Natural Uranium	105 pCi/gm	18 pCi/gm
Radium-226	0.26 pCi/gm	1.4 pCi/gm
Thorium-230	1.9 pCi/gm	2.1 pCi/gm
Arsenic	483 parts per million	292 parts per million

The licensee concluded that the only impurity that may be of public or worker impact is the natural uranium. The levels of radium-226 and thorium-230 detected in the synthetic CaF_2 are comparable to levels found in the natural CaF_2 . The airborne levels of arsenic detected in Allied's synthetic CaF_2 warehouse are less than 1 percent of the Occupational Safety and Health Administration (OSHA) permissible exposure limit of 0.010 mg/m³.

The level of natural uranium is approximately six times greater in the synthetic CaF_2 than in the natural CaF_2 . However, the information supplied by the licensee shows that the synthetic CaF_2 's natural uranium concentration is comparable to the levels of natural uranium found in materials to which the general population is routinely exposed, such as Florida phosphate rocks (120 pCi/gm), Tennessee bituminous shale (50-80 pCi/gm), and cattle feed supplements (up to 122 pCi/gm).

A radiation dose assessment has been performed by Allied to determine the critical group and exposed general population doses which might result from the recycle of the synthetic CaF_2 . The following table summarizes the maximum dose expected for individuals in the critical group and for the exposed general population. Allied used the following assumptions to complete the dose assessment:

1. Natural uranium is the only radioactive material present in the synthetic CaF_2 . The concentration of the natural uranium is 105 pCi/gm. The solubility fraction of the natural uranium is 6.5 percent Class D and 93.5 percent Class W, as determined from lung fluid solubility testing. The particle size is one micron.
2. The finished briquettes are composed of 25 percent synthetic CaF_2 .
3. The concentration of total dust in the briquetting work is 15 mg/m³ of which 25 percent is synthetic CaF_2 . The briquetting plant worker wears a one-half face respirator as required by OSHA.
4. Based on the briquettes containing 25 percent synthetic CaF_2 and a distance of 1 meter, the external exposure rate to the briquette plant operator is 0.055 $\mu\text{R}/\text{hour}$.

Critical Group	Number of Persons	Total ¹ mrem/year
Truck driver - Allied to loading dock	2	5.2E-2
Clamshell operator at Metropolis dock	1	1.3E-1
Clamshell operator at Ohio dock	1	6.6E-2
Clamshell operator at Indiana dock	1	6.6E-2
Truck driver - Ohio dock to briquette plant	2	2.2E-1
Truck driver - Indiana dock to briquette plant	2	1.9E-1
Briquette plant operator	1	7.6E-1
Truck driver - Briquette plant to steel mill	2	8.3E-2
Total Critical Group Collective Dose		1.6

Exposed General Population	Number of Persons	Total mrem/year
CaF ₂ truck route - Metropolis	70	8.69E-5
CaF ₂ truck route - Ohio	700	4.51E-4
CaF ₂ truck route - Indiana	140	9.02E-5
Briquette truck routes - Ohio and Indiana	420	5.15E-4
Total General Population Collective Dose		1.14E-3

The dose assessment also evaluated two credible accidents: the overturning of a dump truck load of synthetic CaF₂ enroute to the briquette plant could produce a total effective dose commitment of 0.0004 mrem to an emergency response worker; and the overturning of a dump truck of briquettes enroute to a steel mill could produce a total effective dose commitment of 0.00001 mrem to an emergency response worker.

While the staff agrees with Allied's conclusion that the briquette plant operator is the maximally exposed individual, an independent dose assessment was performed. Most of Allied's assumptions were used in this assessment, however, no credit was given for the respiratory protection worn by the briquette plant operator, and the Th-230 and Ra-226 concentrations were included.

Based on the staff's independent assessment, the briquette plant operator will receive a committed effective dose equivalent of 12.35 mrem per year and a deep-dose equivalent of 0.11 mrem per year. The total effective dose equivalent is 12.46 mrem per year. However, if the concentration of natural uranium in the synthetic CaF₂ is 338.5 pCi/gram, then the briquette plant operator's total effective dose equivalent will be 40.17 mrem per year, which exceeds the 25 mrem per year limit found in 40 CFR 190. Therefore, to ensure the dose received shall be within all federal limits, the staff recommends that the concentration of uranium in the synthetic CaF₂ released to each briquette manufacturer not exceed the average of 212 pCi/gram for any consecutive 12-month period.

¹Total dose = Deep Dose Equivalent plus the Committed Effective Dose Equivalent times the number of persons exposed.

In addition, the staff calculated the dose to the briquette plant operator if only the natural CaF_2 was used to manufacture the briquettes. Many of the same assumptions Allied used to calculate the dose from synthetic CaF_2 were used except that the natural uranium, Ra-226, and Th-230 concentrations in natural CaF_2 , listed on page 3 of this document, were used, no protection factor was allowed, and all CaF_2 used in the briquette was natural CaF_2 . From this dose assessment, it was determined that the briquette plant operator would receive a committed effective dose equivalent of 45.48 mrem per year. The committed dose effective equivalent that the briquette plant operator would receive using 25 percent synthetic CaF_2 and 25 percent natural CaF_2 would drop to 35.20 mrem per year, of which 12.46 mrem would be from the synthetic CaF_2 and 22.79 mrem would be from the natural CaF_2 . Therefore, by manufacturing the briquettes with 25 percent synthetic CaF_2 and 25 percent natural CaF_2 , the dose to the briquette plant operator would be lower than if only natural CaF_2 was used. Based on lung solubility tests performed by the licensee, the uranium in the synthetic CaF_2 is more soluble in the body than the uranium in the natural CaF_2 . Therefore, the biological clearance rate of the uranium in the synthetic CaF_2 is more rapid, thereby resulting in a lower committed effective dose equivalent.

After the briquettes are charged into the slag on the top of the steel melt, the amount of uranium contained in the briquettes is not transferred to the steel but remains in the slag.^{1,2} Members of the general public working with the finished steel products will receive no radiation exposure as a result of the synthetic CaF_2 being used in the briquettes.

The licensee calculated that the briquettes will comprise not more than 5 percent of the total slag weight. The final uranium content in the slag will be 1.6 pCi/gram. Based on this uranium content, Allied estimated that the dose to a member of the public from any foreseeable use of the steel mill slag will not exceed an effective dose equivalent of 0.02 mrem/year.

Over 90 percent of the slag generated by the steel mills is stored at the mills in U.S. Environmental Protection Agency (EPA)-approved storage areas with both dusting and leaching conditions monitored. Occasionally, steel mill slag is used as a minor constituent in cement manufacturing or as road fill for highway construction where drainage, subsoil, and paving circumstances permit. The level of uranium contained in the slag is so small that any environmental effects from storage, road fill, or cement manufacturing would be insignificant.

Conclusion

The staff's dose assessment performed for the proposed action demonstrates that the doses received by members of the critical group and the exposed general population are well below the dose limits of 100 mrem/year and 25 mrem/year, as specified in 10 CFR 20 (56 FR 23360-474) and 40 CFR 190, respectively. The environmental impact from using the synthetic CaF_2 is insignificant. To ensure the dose limits are not exceeded, the staff recommends that the uranium concentration of the synthetic CaF_2 shall not exceed 212 pCi/gram, averaged over any consecutive 12-month period. The uranium content in the slag will be less than the 10 pCi/gram limit for unrestricted release of natural uranium set

¹Mautz, E. W., et.al., "Uranium Decontamination of Common Metals by Smelting - A Review," Document No. NLC0-1113, February 1975.

²Cavendish, J. H., "Treatment of Metallic Wastes by Smelting," Document No. NLC0-1157, September 1978.

JAN 14 1992

in Option 1 of the staff's Branch Technical Position, "Disposal and Onsite Storage of Thorium or Uranium Wastes from Past Operations" (46 FR 52061-63). With Allied limiting the concentration of natural uranium in the synthetic CaF_2 to be sold to the steel-making industry to less than 338.5 pCi/gram, then the limit set in 10 CFR 40.13(a) for unimportant quantities of source material will also not be exceeded. Therefore, the staff concludes that there will be no significant environmental impacts associated with the proposed action.

Original Signed By

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Approved by: **Original Signature:**
George H. Bidinger, Section Leader

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