UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE. SUITE 400
ARLINGTON. TEXAS 76011-8064

June 26, 1998

Donna L. Wichers, Manager
Environmental and Regulatory Services
COGEMA Mining, Inc.
935 Pendell Boulevard
P. O. Box 730
Mills, Wyoming 82644-0730

SUBJECT: NRC INSPECTION REPORT 40-8502/98-02

Dear Ms. Wichers:

This refers to the special, reactive inspection conducted on May 27, 1998, at the Irigaray Central Processing Facility. A final exit briefing was held with a member of your staff via telephone on June 4, 1998. The inspection consisted of a review of the events surrounding the unanticipated contamination of a site worker when a drum containing yellowcake product was opened and pressure within the drum resulted in some of the product being blown out. The enclosed report presents the results of that inspection.

No violations or deviations of NRC requirements were identified; therefore, no response to this letter is required on your part.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Robert Evans at (817) 860-8234 or Mr. Charles L. Cain at (817) 860-8186.

Sincerely,

Linda Howell

Ross A. Scarano, Director
Division of Nuclear Materials Safety

Docket No. 40-8502
License No. SUA-1341

Enclosure:
NRC Inspection Report 40-8502/98-02

cc w/enclosure:
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ENCLOSURE

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.	40-8502
License No.	SUA-1341
Report No.	40-8502/98-02
Licensee:	COGEMA Mining, Inc.
Facility:	Irigaray Central Processing Facility
Location:	Johnson County, Wyoming
Date:	May 27, 1998
Inspector:	Robert J. Evans, P.E., Health Physicist Nuclear Materials Safety Branch 1 Division of Nuclear Materials Safety
Approved By:	Charles L. Cain, Chief Nuclear Materials Safety Branch 1 Division of Nuclear Materials Safety
Attachments:	1. Supplemental Inspection Information 2. Photographs Taken at the Irigaray Facility

EXECUTIVE SUMMARY

COGEMA Mining, Inc.
NRC Inspection Report 40-8502/98-02

This reactive inspection included review of an incident involving the contamination of a site worker as a result of the opening of a drum filled with yellowcake (uranium) product. This incident occurred at the Irigaray Central Processing Facility on April 15, 1998.

Inspection of Incidents at Nuclear Materials Facilities

- Although a site worker experienced an intake of radioactive materials because of the incident, this intake was within the occupational limits provided in 10 CFR Part 20 (Section 2.3).

- The licensee reported the incident to the NRC and to the individual involved with the incident within the time limit specified by the license and regulations (Section 2.2).

- Corrective actions were taken by the licensee to prevent recurrence, including revision of a site procedure to provide a specified cooling time prior to installation of the drum lid and seal ring (Section 2.2).

- The incident demonstrated that the licensee's yellowcake product contained primarily soluble material. The licensee's decision to change the derived air concentration value in use at the site from Class Y to a hybrid of Class D and Class W was deemed an acceptable action (Section 2.3).

Report Details

1 Site Status

The Irigaray project started commercial mining operations during November 1978. The Central Processing Facility (CPF) is located at the Irigaray site, while the Christensen Ranch site is a satellite facility for the Irigaray plant. During the inspection, yellowcake material was being produced in the Irigaray CPF, while in-situ leach mining operations were in progress at the Christensen Ranch site.

2 Inspection of Incidents at Nuclear Materials Facilities (87103)

2.1 Inspection Scope

The objective of the inspection was to analyze the sequence of events leading to an incident that resulted in the internal contamination of a site worker. The NRC inspector also attempted to identify the causes of the incident, contributing factors, corrective actions to prevent a recurrence, and the safety significance of the intake of radioactive materials by this site worker.

2.2 Description of the Incident

During normal operations, resin material loaded with uranium is transferred to the Irigaray CPF from the Christensen Ranch Satellite facility. The resin is temporarily stored in tanks located in the Annex of the CPF. At this location, the uranium is stripped from the resin by a process called elution, and the stripped resin is then returned to the Christensen Ranch site for reuse.

The eluate from the resin elution circuit is then routed to the precipitation circuit. To initiate the precipitation cycle, hydrochloric acid is added to the uranium-bearing solution. Hydrogen peroxide is then added to initiate uranium precipitation from the solution. Caustic soda is added next to neutralize the remaining acid.

After precipitation, the yellowcake solution is washed, filtered, and then allowed to settle prior to entering the drying and product packaging circuit. Drying is performed in batches at Irigaray using a propane-fired dryer. The slurry is dried at 1000 degrees Fahrenheit, resulting in a uranate of peroxide ($UO_4 \cdot 2H_2O$) material. The dried uranium product is then packaged in drums for shipment offsite. Following removal of the yellowcake product from the drums at the destination company, the empty drums are normally returned to Irigaray for refilling.

On April 15, 1998, at 4:30 a.m., routine drying and drumming operations were in progress. The operator who was on shift at that time noted that Lid 38 had been installed on Drum 37. (The lids and the drums are sequentially numbered for each lot.) The operator decided to install the correct lid on Drum 37. Roughly three hours after filling Drum 37, the operator attempted to loosen the seal ring on the drum. Once the

seal ring was sufficiently loose, pressurized gases in the drum were relieved. The force of the release blew yellowcake material out of the drum and onto the worker as well as into the drum room. The pressure relief was great enough not only to bend the drum lid but to cause yellowcake material to be ejected from the drum room through the two access doors. (The doors were normally closed but were not secured with any sort of latching assemblies.) The pressure release resulted in the ejection of about a fourth of the drum's contents, or roughly 200 pounds of yellowcake material.

Immediately after the incident, the operator attempted to decontaminate himself by removing his protective clothing and by showering. The dryer feed system was secured on an interim basis until the area could be decontaminated. Decontamination of the spill area was performed later the same day by a second Irigaray operator in accordance with the instructions provided in a radiation work permit. Some of spilled material was recovered during cleanup, and the area was washed down using high pressure water. However, roughly 120 pounds of yellowcake product was not recovered.

An investigation was performed by the licensee to ascertain why the drum was pressurized because this type of incident had not occurred before. The licensee's investigation concluded that the incident was apparently caused by oxygen buildup in the drum. The oxygen was generated by the decomposition of hydrogen peroxide into water and free oxygen. (The licensee used hydrogen peroxide in the precipitation of the yellowcake product.) The operator inadvertently released this pressured oxygen following the removal of the drum seal. The actual pressure buildup in the drum could not be determined, but subsequent testing demonstrated pressure buildups in the range of 9-15 pounds per square inch.

After the incident occurred, three other drums of the same batch were observed by the licensee to have domed lids, most likely the result of excessive internal pressures. The licensee carefully opened these drums many hours after the incident, but no excessive pressure buildup was observed in these additional drums. The internal gases had apparently dissipated by the time these drums were opened.

The licensee's review of the incident also revealed that these four drums had new gasket seals and metal seal rings. The licensee typically recycled the drums, including the drum seals, and replaced the rubber seals and seal rings only on an as-needed basis. The new seals apparently sealed the drums in a more efficient manner than the old, recycled seals. The new seals apparently inhibited the dissipation of the internal gas, preventing reduction in drum pressures more effectively than old seals.

The licensee tried to recreate the pressure buildups using a test drum with a pressure gauge installed in the drum lid. The drum pressure reached a maximum pressure between 3-4 hours after filling, with the greatest rise observed within the first hour. Drum pressure started to subside after about 5 hours. The licensee concluded that the excessive pressure in the drums was relieved by gas leakage through the drum lid seals. The licensee also speculated that the incident may not have occurred if Drum 37 had

been installed with a recycled seal because the older seals would not inhibit gas dissipation as effectively as new seals.

The licensee also obtained two air samples from filled test drums. The sample results revealed that the drum free space contained air consisting of about 62 percent oxygen, 38 percent nitrogen, and traces of carbon dioxide. The licensee concluded that air in the drum free space was not ambient air, but was primarily oxygen created from the chemical breakdown of hydrogen peroxide that is entrained in the yellowcake material. The licensee initially thought that the drying process would eliminate the excess hydrogen peroxide from the product, but apparently it does not.

Corrective actions taken by the licensee included revising the drum filling procedure to include a delay time prior to installation of the drum lid and associated seal. Revision 3 to Standard Operating Procedure IR-12, "Drypack - Yellowcake Drying and Drumming," added the instruction to not bolt the lid onto the drum for a minimum of three hours to avoid a pressure buildup in the drum. The licensee speculated that this revised method of drum filling and sealing should prevent a recurrence of the incident.

The licensee's corrective actions appeared adequate, including revision of the operating procedure to delay installation of the drum lid seal until several hours after filling. This procedure change was consistent with operational controls currently in place at other uranium recovery facilities in Texas.

2.3 Radiological Significance of the Intake of Uranium in a Site Worker

a. Urine Sample Results

About eleven hours after the incident occurred, the operator submitted a bioassay (urine) sample for offsite analysis. The operator then submitted subsequent urine samples in roughly one day increments. The sample results were as follows:

(See table on next page)

Sample Date	Micrograms of Uranium per Liter of Urine
April 15, 1998	846
April 16, 1998	17.6
April 17, 1998	9.7
April 18, 1998	< 5
April 19, 1998	9.3
April 21, 1998	< 5
April 23, 1998	< 5
April 25, 1998	7.7
April 26, 1998	7.9
April 27, 1998	< 5
April 28, 1998	< 5

In accordance with License SUA-1341, Condition 48D, the licensee was required to notify the NRC of the incident because the individual's first urine sample result exceeded the action level of 130 micrograms per liter. Furthermore, 10 CFR 19.13 states that when a licensee is required to report to the NRC any exposure of an individual to radiation or radioactive material, then the licensee shall also provide the individual a report on his or her exposure data included therein. This report must be transmitted at a time not later than the transmittal to the NRC.

The licensee submitted the report to the NRC on the 30th day after the incident (May 15, 1998). The licensee's paperwork revealed that it also provided the individual involved with a copy of the report at the same time it was submitted to the NRC. Therefore, the licensee fulfilled all license and regulatory requirements related to submittal of the 30-day report to the NRC and to the individual.

In their report dated May 15, 1998, the licensee included a bioassay evaluation and dose calculation that was performed by a third-party contractor. The dose assessment was calculated using guidance provided in NRC Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program." The report concluded that the Irigaray operator, based on the urine sample results listed above, experienced an intake of about 2.1 milligrams of uranium. This intake resulted in an internal dose of about 7 millirems. The intake did not exceed either the

10 CFR 20.1201(e) limit of 10 milligrams of soluble uranium per week or the total effective dose equivalent limit of 5000 millirems per year provided in 10 CFR 20.1201(a).

A review of this document by the NRC inspector did not reveal any technical flaws that would render the report conclusions inaccurate. NRC Regulatory Guide 8.22, "BIOASSAYS AT URANIUM MILLS," Section 6, states in part: "Routine and special urine specimens for analysis of uranium compounds pertinent to mill operations should usually be collected at least 36 hours after the most recent occupancy in the mill. The 36-hour delay is necessary to avoid uranium that is eliminated without intake in kidney tissues." If the licensee had waited 36 hours prior to taking the first urine sample, then the sample result would have been similar to the second sample result (17.6 micrograms per liter) and would not have been reportable to the NRC in accordance with the conditions of the license.

b. Air Particulate Sample Results

Continuous sampling for airborne uranium particulates is normally performed by the licensee at five locations during Irigaray dryer operations. Three of the five locations were situated outside of the dryer room. These three locations were normally averaged together and were referred to as the "control room" location because the dryer operating controls were located just outside of the dryer and packaging areas at different building elevations. The other two sample locations were inside of the dryer area (the furnace room) and the yellowcake packaging area. The licensee routinely changed the filters in each of these five areas at least three times per week. Weekly concentration averages were calculated, and internal doses were assigned to workers based on these sample results.

The air sample results for the period that included the yellowcake spill were reviewed by the NRC inspector. The drum room sample that was in service during the spill, the first of three filters for that work week, measured 6.22 E-9 microcuries per milliliter (µCi/ml) of airborne uranium. This sample result was 311 times the Class Y derived air concentration (DAC) value (2 E-11 µCi/ml) listed in 10 CFR Part 20, Appendix B, Table 1. This area of the plant was routinely posted as an airborne radioactive materials area and respirators were required for entry. Although the operator was wearing a respirator with an assigned protection factor of at least 50, the respirator was temporarily dislocated from the worker's face during the incident which allowed an intake of yellowcake material to occur.

(As of May 11, 1998, the licensee stated that it was using a hybrid DAC value based on the results of previous investigations which revealed that the dried yellowcake product was actually 85 percent Class D material and 15 percent Class W material. The product is not dried at a temperature high enough to produce U_3O_8 which is Class Y material. This new fractionalized DAC value was 4.7 E-10 µCi/ml. If the new DAC value had been in place on April 15, 1998, then the sample result of 6.22 E-9 µCi/ml was only 13 times this site-specific DAC value.)

The licensee decided to not include the air sample obtained during the spill in the weekly average concentration (5.24 E-10 µCi/ml) for the drum room for several reasons. First, the only individual who was in the drum room during the time of the incident was the operator who experienced the intake of material, and the licensee did not want to assign elevated DAC values to all uninvolved CPF workers. Next, in lieu of the air sample result, the licensee assigned an internal dose to the worker exposed to the yellowcake spill based on his urine sample results. The license assumed that the urine sample results were more accurate than the air sample results for estimating an internal dose.

Based on the licensee's records, the site worker involved with the yellowcake spill was assigned an internal exposure of 4.43 DAC-hours, including 2.9 DAC-hours based on the bioassay sample results and 1.53 DAC-hours from other sources. Further, the licensee assigned to the worker a uranium intake of 2.14 milligrams for the week, 2.09 milligrams based on the bioassay sample results and 0.05 milligrams from other sources. Both of these dose assessments were well below the NRC limits of 2000 DAC-hours per year and 10 milligrams per week, respectively.

The NRC inspector also estimated the worker's exposure using all three drum room air filter sample results for the week of April 13-19, 1998, in lieu of the urine sample results. The drum room average concentration would have been 2.42 E-9 µCi/ml instead of 5.24 E-10 µCi/ml. Using the Class Y DAC value which was in effect at that time, and assuming a respiratory protection factor of 50, then the CPF operator could have been assigned a recorded exposure of about 3.8 DAC-hours for that week. This value was comparable to the licensee's calculated value of 4.43 DAC-hours and was still well below the annual limit of 2000 DAC-hours listed in 10 CFR 20.1201 and 20.1204.

In summary, based on the air sample results, the site worker who experienced the intake of yellowcake material did not ingest a quantity of material that exceeded the NRC's annual limit of intake. Actual internal exposures assigned to the individual were well below 10 percent of the NRC's occupational exposure limits.

4.9 Conclusions

A site worker experienced an intake of radioactive materials within the occupational limits provided in 10 CFR Part 20. The incident was reportable because the first urine sample result exceeded the action level of 130 micrograms of uranium per liter of urine. The licensee reported the incident to the NRC and to the individual involved within the time limit specified by the license and regulations. The NRC inspector also noted that had the licensee waited 36 hours to take the first sample, an action that was recommended in an NRC Regulatory Guide, then the incident most likely would not have been deemed reportable.

The incident demonstrated that the licensee's yellowcake product contained primarily soluble uranium material, based on how quickly the material exited the body of the worker. This conclusion substantiated the technical adequacy of the licensee's decision

to change the DAC value from Class Y to a hybrid, fractionalized value of Class D and Class W material.

Corrective actions were taken by the licensee to prevent a recurrence, including revision of a site procedure to provide a time limit prior to installation of the drum lid. The procedure revision should give the product time to cool, and release any of volatile gases, prior to the installation of the lid and drum seal on the drum.

7 Exit Meeting Summary

The inspector presented the preliminary inspection results to the representatives of the licensee at the conclusion of the inspection on May 27, 1998. Licensee representatives acknowledged the findings as presented. Also, a followup exit briefing was held with the licensee via telephone on June 4, 1998. The licensee did not identify anything reviewed by the inspector as proprietary.

Attachment 1

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Everhart, Irigaray Foreman
J. Vaselin, Radiation Safety Officer
D. Wichers, Manager, Environmental and Regulatory Services

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

None

Closed

None

Discussed

None

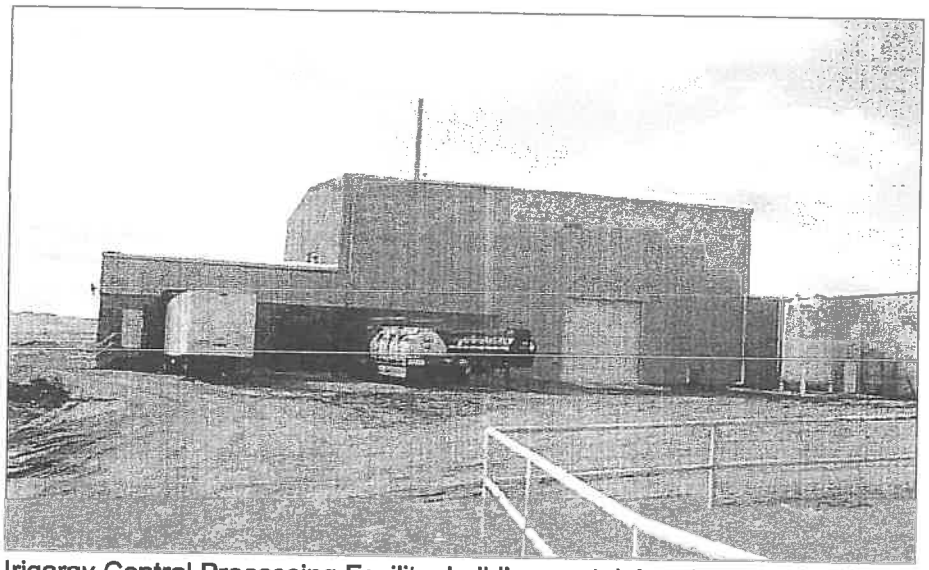
LIST OF ACRONYMS USED

CFR	Code of Federal Regulations
CPF	Central Processing Facility
DAC	derived air concentration
µCi/ml	microcuries per milliliter

Attachment 2

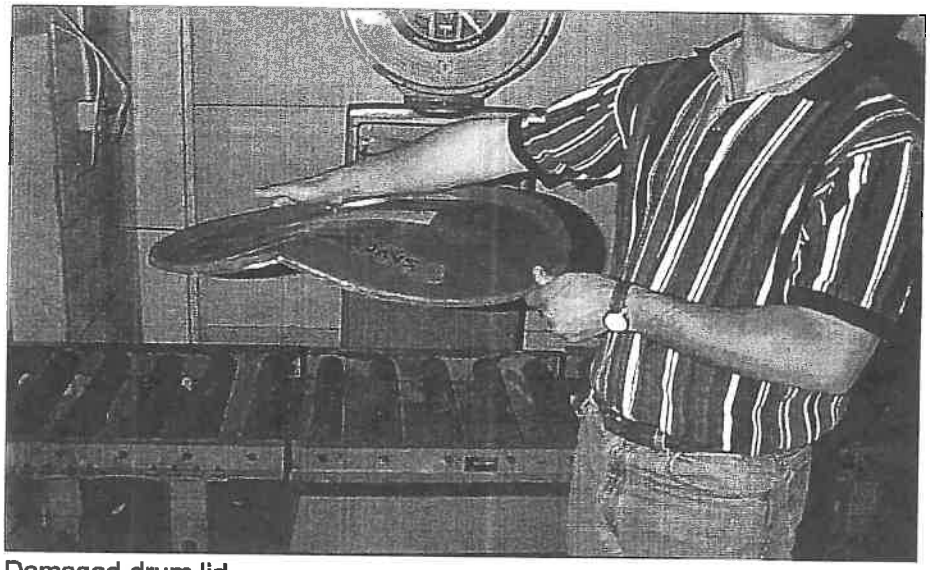
THE IRIGARAY CENTRAL PROCESSING FACILITY

Irigaray Central Processing Facility.

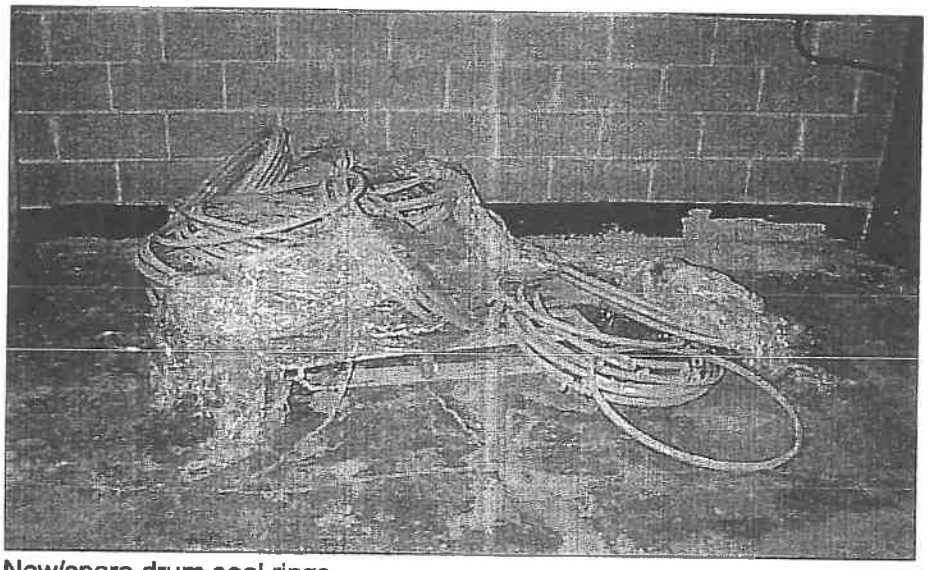


Irigaray Central Processing Facility; building containing dryer and yellowcake packaging equipment.

PHOTOGRAPHS TAKEN AT THE IRIGARAY FACILITY

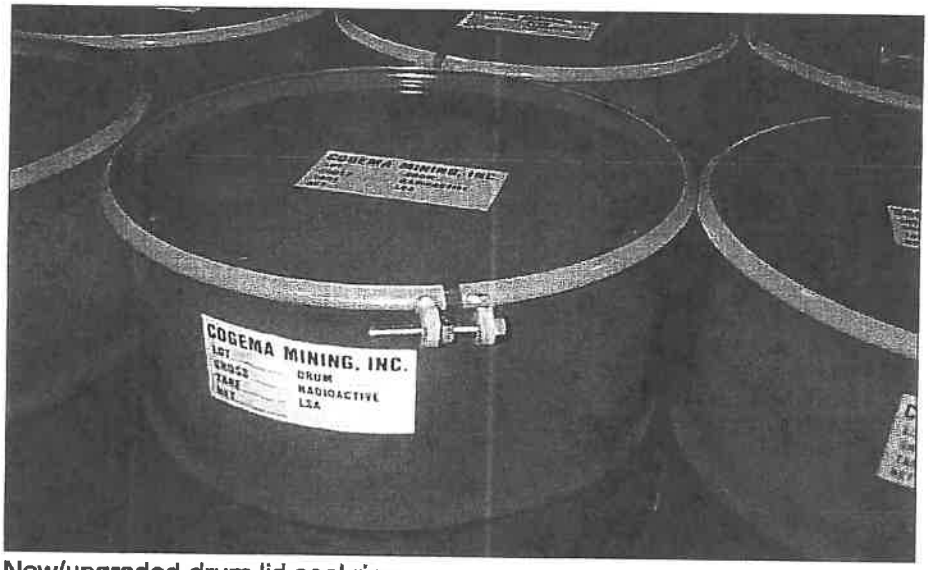


Damaged drum lid.

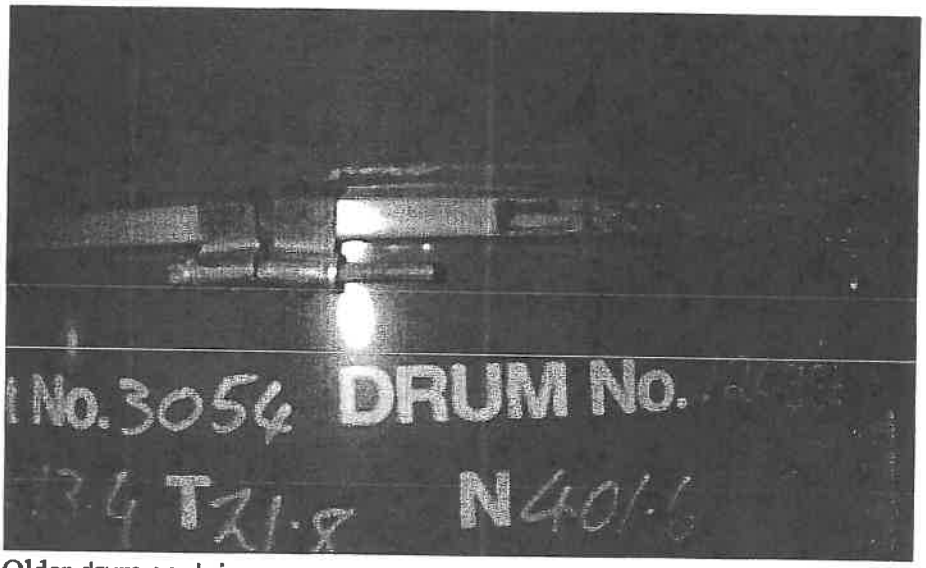


New/spare drum seal rings.

PHOTOGRAPHS TAKEN AT THE IRIGARAY FACILITY



New/upgraded drum lid seal ring.



Older drum seal ring.