MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

301734

Licensee	
1. Tilden Mining Company L.C. Tilden Mine	3. License Number 21-26748-01
2. P.O. Box 2000 Ishpeming, MI 49849	4. Expiration Date November 30, 2001
	5. Docket or Reference No. 030-34221

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Cesium-137	A. Sealed Sources	A. See Item 9.A.
B. Plutonium-238	B. Sealed Source (Monsanto Corp. Custom Dwg. No. DOMISC-2001)	B. 2 sources not to exceed 3 grams each
C. Cesium-137	C. Sealed Source (Texas Nuclear Model Dwg. 570-57157C)	C. 2 sources not to exceed 500 millicuries each
D. Americium-241	D. Sealed Source (Harshaw Chemical Co. Model AMK312G312K)	D. 2 sources not to exceed 0.05 microcuries each

9. Authorized Use:

A. For possession and use in Accuracy Corporation (Industrial Nucleonics), Kay-Ray, Incorporated or Ohmart Corporation devices which have been evaluated and approved for licensing purposes and authorized for distribution under a license issued by the Nuclear Regulatory Commission or an Agreement State.

B., C., and D. To be used custom designated Texas Nuclear Model NOLAI Silica Analyzers for samples analysis.

License Number
21-26748-01

MATERIALS LICENSE
SUPPLEMENTARY SHEET

Docket or Reference Number
030-34221

CONDITIONS

10. Licensed material shall be used only at the licensee's facilities located at Tilden Mine, County Road PEE, Marquette County, Michigan.

11. The Radiation Safety Officer for this license is Peter Goldsworthy.

12. Licensed material shall only be used by, or under the supervision and in the physical presence of, individuals who have received the Level I training as described in application received on August 16, 1996, and have been approved in writing by the Radiation Safety Officer.

13. A. Sealed sources and detector cells shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified by the certificate of registration referred to in 10 CFR 32.210.

    B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.

    C. In the absence of a certificate from a transferor indicating that a leak test has been made within 6 months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

    D. The leak test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(b)(2), and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within 5 days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region III, ATTN: Chief, Nuclear Materials Safety Branch, 801 Warrenville Road, Lisle, Illinois 60532-4351. The report shall specify the source involved, the test results, and corrective action taken.

    E. The licensee is authorized to collect leak test samples for analysis by Texas Nuclear. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

License Number
21-26748-01

MATERIALS LICENSE
SUPPLEMENTARY SHEET

Docket or Reference Number
030-34221

14. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

15. The licensee shall conduct a physical inventory every 6 months to account for all sources and/or devices received and possessed under the license.

16. Installation, initial radiation survey, relocation, or removal from service of devices containing sealed sources shall be performed by or under the supervision and in the physical presence of individuals who have received the Level I training as described in application received on August 16, 1996, and have been approved in writing by the Radiation Safety Officer or by other persons specifically authorized by the Commission or an Agreement State to perform such services.

17. Cell removal from the Texas Nuclear Model NOLAI gauge shall be performed only by individuals who have received the Level I training as described in application received on August 16, 1996, and have been approved in writing by the Radiation Safety Officer or by other persons specifically authorized by the Commission or an Agreement State to perform such services.

18. Prior to initial use and after installation, relocation, dismantling, alignment, or any other activity involving the source or removal of the shielding, the licensee shall assure that a radiological survey is performed to determine radiation levels in accessible areas around, above and below the gauge with the shutter open. This survey shall be performed only by persons authorized to perform such services by the Commission or an Agreement State.

19. The licensee shall operate each gauge within the manufacturer's specified temperature and/or environmental limits such that the shielding and shutter mechanism of the source holder are not compromised.

20. The licensee shall assure that the shutter mechanism is locked in the closed position during periods when a portion of an individual's body may be subject to the direct radiation beam. The licensee shall review and modify as appropriate its "lock-out" procedures whenever a new gauge is obtained to incorporate the device manufacturer's recommendations.

21. Each gauge shall be tested for the proper operation of the on-off mechanism and indicator, if any, at no longer than 6-month intervals or at such longer intervals as specified by the manufacturer and approved by NRC.

License Number 21-26748-01

MATERIALS LICENSE
SUPPLEMENTARY SHEET

Docket or Reference Number 030-34221

22. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The U.S. Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

    A. Application received August 16, 1996; and

    B. Letter dated October 16, 1996.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date 15 November 1996

By William P. Reichhold
Materials Licensing Branch, Region III

COPY

CONVERSATION RECORD

TIME	DATE
Morning	12 November 1996

O VISIT　　O CONFERENCE　　TELEPHONE

INCOMING　　X OUTGOING

NAME OF PERSON(S) CONTACTED　　ORGANIZATION (OFFICE, DEPT.ETC.)
TELEPHONE NO.

Robert Clark, Tilden Mine　(906) 475-3812

Doris Bryant, Radiation Technologies, Inc.　(512) 346-7608

SUBJECT

Clarification of information in Ltr. 16 Oct. 1996

SUMMARY

I called Clark to clarify the statements in Item 1 of the letter dated 16 Oct. 1996, explaining that all installation of gauges, etc. would be done under the supervision of a Level II individual. I asked if this was a typo because all Level I training included the 40 hour training course for installation of gauges. Clark clarified that the letter was in error and that installation of gauges, etc. are to be done under the supervision of an individual who has received Level I training (the 40 hour course for gauge installations). I asked Clark if I could revise the license conditions to indicate that gauge installation, etc. was to be done under the supervision of an individual of a person who had received the Level I training. Clark agreed that this as acceptable.

ACTION REQUIRED

Phone call.

NAME OF PERSON DOCUMENTING CONVERSATION　　SIGNATURE
DATE

Bill Reichhold　　Bill Reichhold　　| 12 Nov'1996

57

(FOR LFMS USE)
INFORMATION FROM LTS

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

Program Code: _____
Status Code: 3
Fee Category: ____________
Exp. Date: 0
Fee Comments: ____________
Decom Fin Assur Reqd: _

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   - Applicant/Licensee: TILDEN MINING COMPANY, L.C.
   - Received Date: 960816
   - Docket No: 3034221
   - Control No.: 301734
   - License No.:
   - Action Type: New License

2. FEE ATTACHED
   - Amount: 1100
   - Check No.: 12780

3. COMMENTS

Signed D. Hersey
Date 8-23-96

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /✓/)

1. Fee Category and Amount: 1C 3P $1100

2. Correct Fee Paid. Application may be processed for:
   - Amendment ____
   - Renewal ____
   - License ✓

3. OTHER ____________

Signed SC 8/27/96
Date

Log	Aug 12 III
Remitter	
Check No.	12780
Amount	$1100
Fee Category	1C 3P
Type of Fee	Appl
Date Check Rec'd	8/26/96
Date Completed	8/27/96
By:	SC

1996 AUG 26 AM 11:19

SEP 03 1996

NRC FORM 313 (10-94) 10 CFR 30, 32, 33 34, 35, 36, 39 and 40

U. S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120
EXPIRES 6-30-96

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 9 HOURS. SUBMITTAL OF THE APPLICATION IS NECESSARY TO DETERMINE THAT THE APPLICANT IS QUALIFIED AND THAT ADEQUATE PROCEDURES EXIST TO PROTECT THE PUBLIC HEALTH AND SAFETY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0120), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION II
101 MARIETTA STREET, NW, SUITE 2900
ATLANTA, GA 30323-0199

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
801 WARRENVILLE RD.
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
- [X] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER ______
- [ ] C. RENEWAL OF LICENSE NUMBER ______

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip code)*
Tilden Mining Company L.C.
Tilden Mine
P. O. Box 2000
Ishpeming, MI 49849

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED
Tilden Mine
County Road PEE
Ishpeming, MI 49849

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION
Robert G. Clark
Corporate RPO

TELEPHONE NUMBER
906/475-3812

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 1C & 3P
AMOUNT ENCLOSED $ 1100.00

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE

RECEIVED
AUG 16 1996
REGION III

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

301734

PRINTED ON RECYCLED PAPER

pm: 8-14-96

5 a. Element & Mass Number	5 b. Chemical and/or Physical Form	5 c. Maximum activity to be possessed at any one time
A. Cs-137	A. Sealed sources	A. See Item 6 A.
B. Pu-238-Be	B. Sealed sources encapsulated as Pu-Be Monsanto Research Corp. Dwg. HMC-A-1047	B. Two sources not to exceed 3 grams each.
C. Cs-137	C. Sealed sources Texas Nuclear Dwg. 570-57157C	C. Two sources not to exceed 500 millicuries each.
D. Am-241	D. Sealed sources Texas Nuclear Model AMK-312	D. Two sources not to exceed 50 nanocuries each.

Tilden Mining Company L. C. will restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d) that would require financial assurance for decommissioning.

6. **Purpose for which licensed material will be used:**

A. For possession and use in Accuray Corporation (Industrial Nucleonics), Kay-Ray, Incorporated, Texas Nuclear or Ohmart Corporation devices which have been evaluated and approved for licensing purposes and authorized for distribution under a license issued by the Nuclear Regulatory Commission or an Agreement State. These devices are currently installed at Tilden Mine and previously possessed under NRC License No. 21-03076-01.

B. To be used in Texas Nuclear Corporation NOLA systems for sample analysis and previously possessed under NRC License No.21-03076-01.

C. To be used in a Texas Nuclear Corporation Model 5176 density gauge as a component part of the Texas Nuclear NOLA Systems for sample analysis and previously possessed under NRC License No. 21-03076-01.

D. To be used for internal calibration of the Texas Nuclear Corporation NOLA systems and previously possessed under NRC License No. 21-03076-01.

7. Individual(s) responsible for the radiation safety program and their training experience.

An organizational chart is attached reflecting the corporate structure as it relates to radiation safety and the radiation safety duties and responsibilities.

Peter Goldsworthy, Radiation Protection Officer

Mr. Goldsworthy's resume outlining education, training and experience is included in Appendix A.

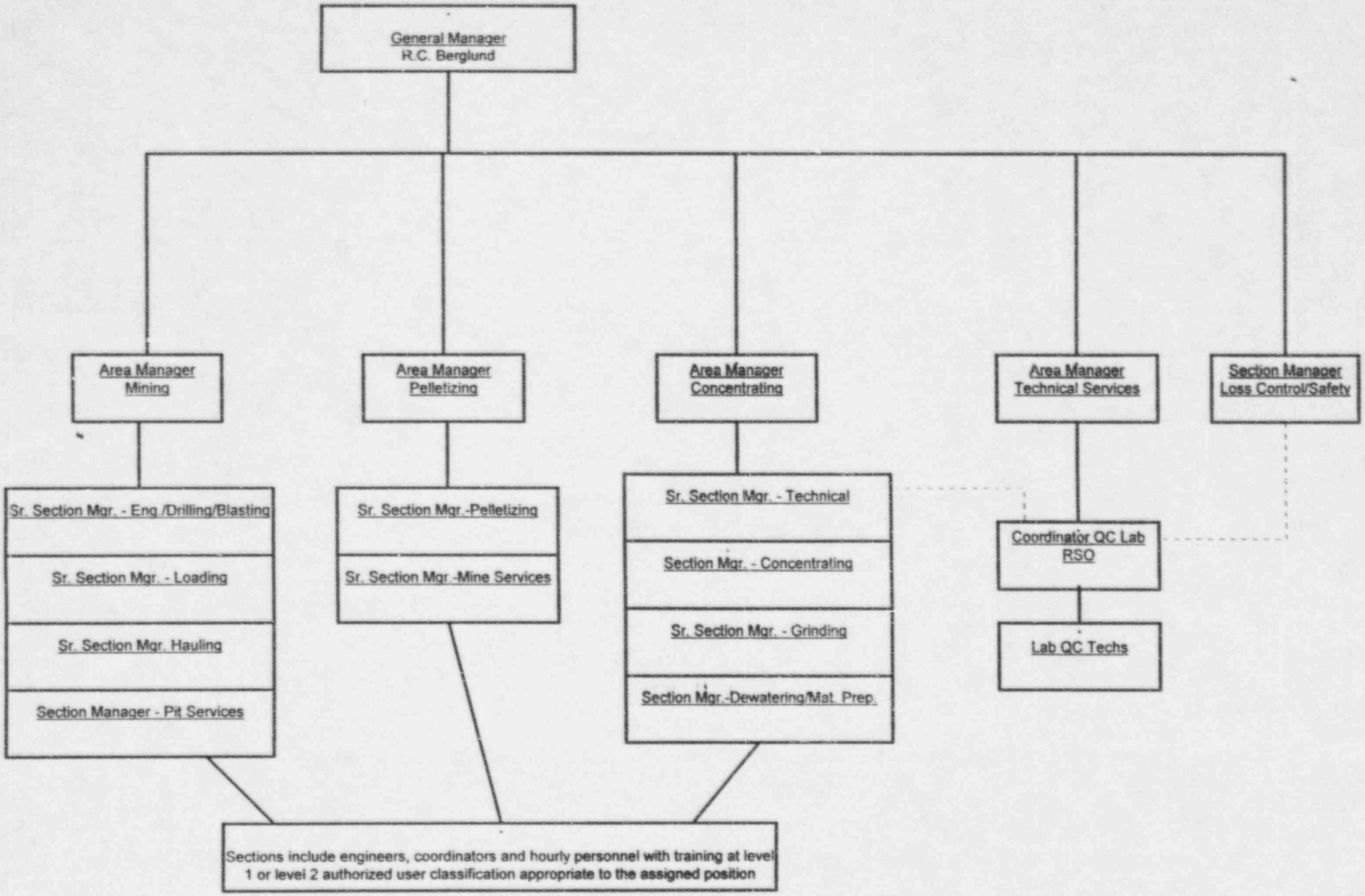
His duties and responsibilities will include those listed in Appendix C of Draft Regulatory Guide DG-0008 (see Appendix D of this submission) and he retains final authority over all activities involving radiation and the uses of radioactive material at Tilden Mining Company.

In addition to the work experience at Tilden Mine with both fixed devices and laboratory analyses systems containing radioactive material, Mr. Goldsworthy has successfully completed the following training courses and documentation is included as Appendix A.

8-Hour Basic Radiation Safety Including Site Procedures presented by Radiation Technology, Inc., December 9, 1994.

40-Hour Radiation Safety Officer Course presented by Radiation Technology, Inc., December 12-16, 1994.

Tilden Mining Co. L.C.
General Management Structure - RSO



PTG 4-25-96

8. **Training For Individuals Working in or Frequenting Restricted Areas**

The current license authorizing activities at Tilden Mine (21-03076-01) does not list authorized users by name, but rather authorizes the Radiation Protection Officer to approve individuals who have completed a prescribed training criteria. We request that the new license be written in the same manner as described below.

LEVEL I.

In addition to the Radiation Protection Officer, Tilden Mine has a number of individuals on site who have successfully completed a Forty-Hour Radiation Safety training course and periodic refresher training courses of from eight hours to twenty-four hours. All training has been presented by the gauge manufacturer or by fully qualified consultants. These individuals have performed and supervised licensed activities, and each is employed in a professional position. They are currently authorized to perform the requested activities under NRC license number 21-03076-01.

We request that our license conditions be broadened so that, based upon proper training and experience, the Radiation Protection Officer could designate individuals without having to request a license amendment. To support this request, we have:

1. Developed a training criteria for those individuals who would be performing or supervising licensed activities, including training on all appropriate procedures. The RPO would then be able to delegate tasks to individuals certified as having successfully met the training criteria. Records of both the training and the RPO's authorization would be maintained on file.

2. Developed specific procedures for performing desired activities. As stated above, individuals would be trained on these procedures.

Our training criteria and procedures have been developed with the assistance of Radiation Technology, Inc. Future forty-hour courses and refresher training for Level I personnel will be conducted by Radiation Technology, Inc. Their courses have been evaluated and approved by the State of Texas and are well known throughout all Agreement States and the NRC. They have supplied us with a copy of the agenda and a final examination with answers which are enclosed. In addition to the final exam, there are four graded daily quizzes, copies enclosed without answers, in-class exercises and hands-on sessions using survey meters, plus surveying and leak testing actual devices containing radioactive material.

The passing grade is 70 and individuals not achieving this passing score are failed. Additionally, individuals are trained on specific procedures for licensed activities they may perform, and supervised by more senior individuals for whatever period

8. (Continued)

of time necessary. If an individual should fail the training course exam, they are allowed to study the training manuals for an additional period of time (usually two weeks) and an alternate final exam is administered proctored by the individual's supervisor, and returned to Radiation Technology for grading.

LEVEL II.

Properly trained occupationally exposed personnel (technicians, electricians, etc.) are periodically used to perform activities such as mounting gauges, taking gauges down for placement into storage, opening and closing shutters, etc. We want these individuals to be able to perform the activities for which they have been trained under the supervision of the Radiation Protection Officer or any of the approved authorized users without the requirement that one of these individuals be physically present. The requirement that an authorized user be physically present is operationally burdensome, and these activities can be accomplished very safely by following established procedures.

Again, we request that the Radiation Protection Officer be able to designate authorized individuals based upon training and experience. To support this request, as with Level I personnel, we have developed a training criteria including appropriate procedures. This training is eight hours, including a hands-on session with gauges and survey instrumentation. Initial training may be provided by Radiation Technology, Inc., the RPO, , or a Level I authorized user. Successful completion will be evaluated by the instructor based upon oral discussions of the material presented. Records of both the training and the RPO's authorization will be maintained on file.

Annual refresher training (2-4 hours) will be presented by the RPO or a Level I authorized user. Records will be maintained on file.

9. Facilities and Equipment

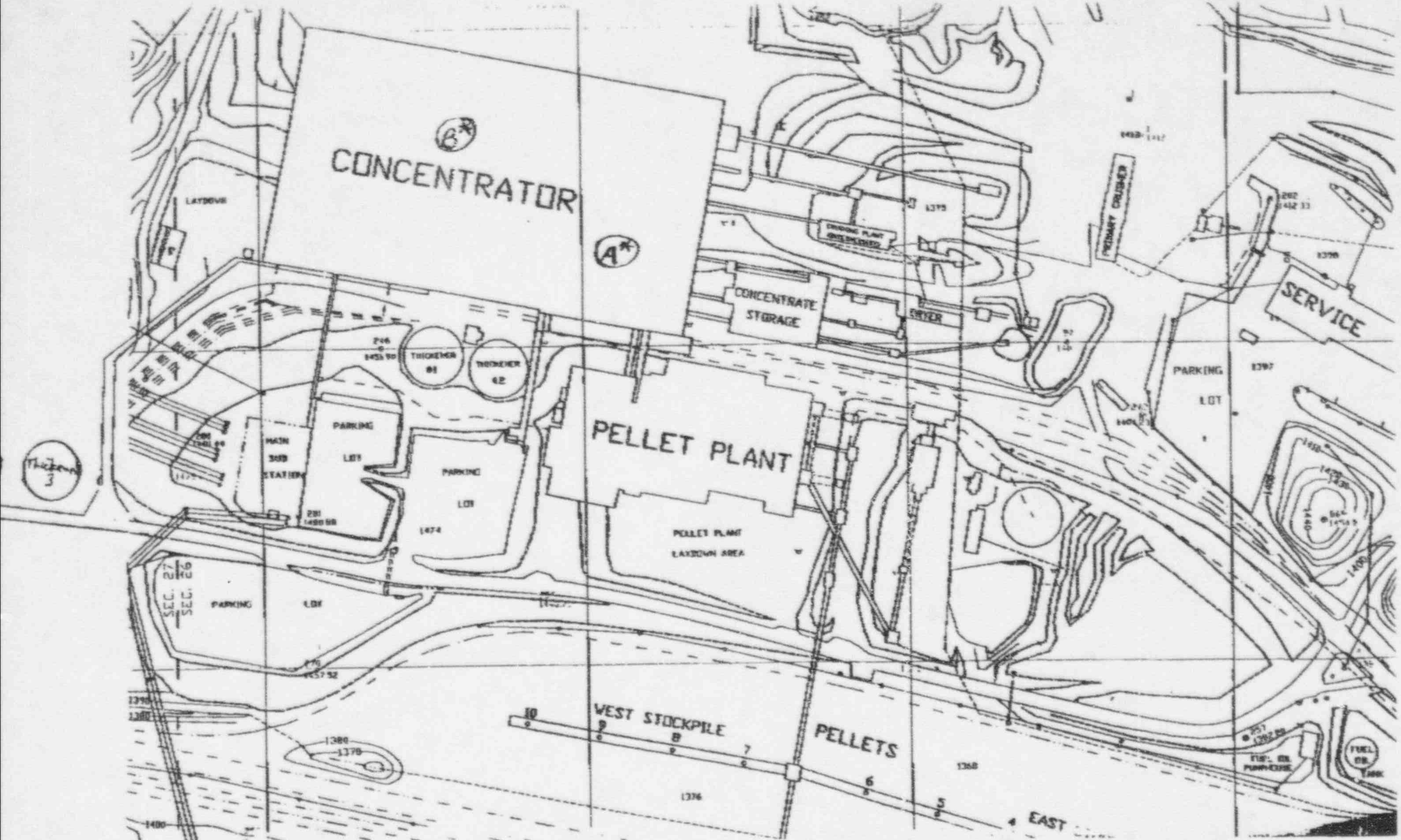
The structural facilities of Tilden Mining Company are located on County Road PEE just outside of Ishpeming, MI and have been in existence for many years. The devices possessed and used have also been on site for many years.

Most of the devices containing radioactive material are installed on pipes throughout the plant and are used to make density measurements of product passing through the pipes. Several gauges are located on material transfer chutes and measure level within the chutes. The two Texas Nuclear NOLA systems are located in a laboratory. Enclosed is a simplified drawing showing the building locations within the property where the density and level gauges are located , and the location of the laboratory where NOLA systems are located. Exact location of each fixed gauge is maintained on our Radiation Gauge Inventory Sheet. Both the drawing and the inventory location record are available to emergency personnel.

These sources are located in areas not considered working areas and are oriented so the open shutter beam minimizes radiation on walkways. These walkways are not for constant traffic, but are used only to reach other equipment during maintenance periods. These devices are located in areas with a temperature range of 50 degrees F to 100 degrees F, a dust laden noncorrosive atmosphere, and minor vibration. All conditions meet the vendor's recommendations.

If gauges need to be taken down for placement into storage, they are moved to a designated storage site called out on the enclosed sketch. Access doors to this storage area are secured when not manned by authorized personnel and the area is appropriately marked.

Tilden Mine - General Plant Layout



(A*) = NOLA I & NOLA II Location - Concentrator Q.C. Lab Room #57

(B*) = Device Storage Location - Concentrator 3rd Floor Warehouse

PTG
6-20-96

10. Radiation Safety Program

It is the philosophy of Tilden Mining Company management to conduct all activities involving the use of radiation or radioactive material in such a manner as to maintain exposures to all individuals As Low As Reasonably Achievable. Likewise, it is the practice of Tilden Mine workers to perform all assigned duties in accordance with established procedures, and to immediately cease any activity which may appear to compromise good work or health and safety practices. Any such situation shall be immediately reported to the Radiation Protection Officer or his designee.

10.1 Personnel Monitoring

We have provided personnel monitoring devices to individuals engaging in activities involving work on or near devices containing radioactive material for a number of years and have historical data showing minimal (<10 mrem/yr) exposures. However, we have done this for our own benefit and at our own discretion and do not believe it is necessary to do so from a regulatory standpoint for the following reasons:

a. All of our gauges have been on site for many, many years. We have a history of radiation levels around the gauges and frequency of activities directly involving work with or in the vicinity of the source heads and/or systems: e.g., installation, relocation, etc.

Those individuals with the potential for highest exposure would be the occupationally exposed authorized users who would occasionally install, take down for storage and/or relocate gauges. As assessment of this activity reveals the following:

Maximum radiation level in the work field	5 mR/h
Maximum time to complete the activity	30 minutes
Maximum activities per year/per employee	3

Therefore:

5 mR/h x 0.5 x 3 = 7.5 mR x QF 1 = 7.5 mrem/yr. worst case.

b. Neutron monitoring for the NOLA systems is not necessary for the same reasons. Neutron radiation levels are so low, <1 mrem/h everywhere around the surface of the tank, and occupancy so infrequent, exposures would not be measurable on a neutron badge.

c. Based upon known facts and history then, we can confidently say that no individual would approach 10% of any applicable limit requiring personnel monitoring as set out in 10 CFR 20.1502.

10.2 Radiation Detection Instruments

We currently have on site three Texas Nuclear Model 2650 Geiger-Mueller survey meters, with both thin end window (1-2 mg/cm^2) and side window probes available for surveying. These are alpha/beta/gamma survey meters with a sensitivity range up to 100 mR/h. The survey meters will be calibrated at intervals not to exceed one year, or anytime maintenance or repair is required, by an organization licensed by the U. S. Nuclear Regulatory Commission or an Agreement State to perform this service.

No activity requiring a survey meter shall be commenced without an operable, properly calibrated meter at the site. All work shall be in accordance with appropriate procedures contained in Appendix C to this application.

10.3 Leak Testing

Leak testing for all gamma devices will be conducted at intervals not to exceed three years. Leak testing for the NOLA systems will be conducted at intervals not to exceed six (6) months.

Leak testing will be performed by utilizing a mailable kit and instructions supplied by a vendor licensed by the U. S. Nuclear Regulatory Commission or an Agreement State to provide these services; or by individuals specifically authorized to perform leak testing for others under a license issued by the U. S. Nuclear Regulatory Commission or an Agreement State. Wipe samples will be collected by a properly trained individual approved by the Radiation Protection Officer.

10.4 Inventories

Tilden Mine will conduct inventories, at intervals not to exceed six (6) months, to account for all sealed sources and devices received and possessed under this license. Inventories will be conducted in accordance with RS-011 contained in Appendix C of this submission. Records will be maintained by the RPO for a period of two (2) years from the date of each inventory and will be available for inspection.

10.5 Installation and Relocation of Fixed Gamma Devices Containing Radioactive Material

We request continued authorization to be able to mount new devices containing radioactive material according to manufacturers' instructions. Additionally, we request continued authorization for the Radiation Protection Officer, or properly trained individuals designated by the Radiation Protection Officer to perform or supervise the performance of selected licensed activities according to appropriate procedures in Appendix C. These activities shall include:

a. Radiological commissioning of devices including survey and leak test;
b. Take down of devices for placement into storage;
c. Relocation of devices containing radioactive material;
d. External maintenance and minor repair of devices as outlined in procedure titled Device Inventory and Inspection contained in Appendix C;
e. Checking the operability of the device ON/OFF mechanism.

Any maintenance or repair involving an internal shutter or removal and/or replacement of the radioactive material will be performed by the device manufacturer or by other persons specifically authorized by the Commission or an Agreement State to perform such services.

10.6 <u>NOLA Systems</u>

Initial installation and radiological commissioning of the NOLA Systems were performed by the device manufacturer, and this would be the case should additional systems be purchased.

Due to the nature of the NOLA systems, in order to accomplish required maintenance resulting from a number of circumstances, it is occasionally necessary to perform irradiate cell check and removal. This activity has been authorized under NRC license 21-03076-01 for many years and we request that the authorization be incorporated into this license as well. We have updated the comprehensive step-by-step procedure by which this activity can be safely performed by properly trained and authorized individuals (see Silica Analyzer (NOLA) Servicing Procedure RS-006 in Appendix C).

Even though detailed technical data for the NOLA system has previously been submitted for the issuance of 21-03076-01, since we want this license to be a stand alone submission, we have attached a brochure describing the NOLA system and its operation to the Silica Analyzer (NOLA) Servicing Procedure RS-006. We hope you will find this helpful in your review.

10.7 Transportation of Devices

Devices containing radioactive material are not generally transported by Tilden Mine personnel. Should we need to ship a device for repair, maintenance or transfer, we will follow the instructions provided by the consignee and ensure the shipment is in compliance with all applicable Federal or State regulations.

10.8 Operating and Emergency Procedures

Operating and emergency procedures are included with this submission in Appendix C. They are available to all affected employees, and these employees have received training on procedures which are relative to their assigned job duties. Additionally, emergency contacts and phone numbers are posted and are readily available in case of an emergency involving radioactive material.

10.9 Annual Audit of the Radiation Safety Program

Tilden Mining Company has developed and implemented a Radiation Safety Program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the regulations and our license conditions. We believe the program is also sufficient to achieve occupational doses and doses to members of the public that are As Low As Reasonably Achievable.

We commit to an annual audit of the Radiation Safety Program to be conducted either by an internal team or by an outside Radiation Safety Consultant. The audit will include, at a minimum, those items set forth in Appendix I of Draft Regulatory Guide DG-0008 (see Appendix D of this submission).

The results of the audit, including any recommendations for change, will be reviewed by Tilden Mining Company management who will take action to ensure any deficiencies are corrected. Records of the annual audits will be maintained in the Radiation Protection Officer's office for a period of three (3) years after the record is made.

10.10 Financial Assurance and Recordkeeping for Decommissioning

Tilden Mine will restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d) that would require financial assurance for decommissioning.

We have, however, established a Decommissioning file which will be kept current and include the following:

* Location where radioactive material has been used or installed (this may be a site map or copy of the inventory);

* Information related to spills, leaking sources, or other unusual incidents;

* Any other information deemed relative to site decommissioning.

These records will be maintained in the Radiation Protection Officer's office until the license is terminated.

11. Waste Management

No radioactive waste is generated by the material possessed or used at Tilden Mine. When the devices containing sealed sources are no longer needed, they will be transferred to the manufacturer or to other persons specifically authorized by the Commission or an Agreement State to perform such services. Records of all transfers will be maintained in the Decommissioning file.

APPENDIX A

TRAINING DOCUMENTATION FOR ITEM 7

RSO RESUME

Name: Peter Goldsworthy Date: 04-27-96

[redacted]

Employer: Tilden Mine, L.C. Seniority Date: 02-21-74

Education: B.S. Industrial Technology, Northern Michigan University, 1972

Prior Employment: Metallurgist, 1972-74
Chevrolet Central Labs/Chevrolet Gear and Axle
Detroit, Mich.

Tilden Resume:

1974-1975 Hourly- Gen. laborer, Flot. Attendant

02-20-75 Salary- Concentrator Met. Tech
Duties: Concentrator Process Control

10-01-89 Salary- Assistant General Foreman, Concentrator
Duties: Filtering Operations, Outside Gribben Operations, Reagent Area Operations

Present Salary- Day Coordinator, Q.C. Laboratory
Duties: Q.C. Lab Operation and supervision of 20 hourly personnel to include vacation and crew scheduling, payroll, union concerns, safety meetings, maintenance, supply and equipment ordering, and training.

Daily operations include interfacing with pit, concentrator, pellet plant, and Research to address sample processing needs; environmental sampling; development and monitoring of Lab equipment calibrations to certified standards; special sample processing for customers and other mining properties; cargo sample monitoring and reporting; continued activities from District Chem Lab decentralization; Advocate duties; Quality Assurance team member; quality/customer audits.

Tilden Nuclear Device exposure:

Familiarity with all device locations; supervise NOLA and X-ray Flouresence unit operations in Q.C. Lab.

ptg\resume

CERTIFICATE OF COMPLETION

PETER GOLDSWORTHY

has successfully completed a comprehensive radiation safety training course (40 hours) conducted by radiation technology, inc.

W. Hendrick

Health Physicist

Date December 16, 1994

radiation technology, inc.

AGENDA
RSO FORTY-HOUR
INDUSTRIAL RADIATION SAFETY COURSE

Radiological
- Atomic Structure
- Isotopes
- Types of Radiation
- Decay
- Half-Life

Radiation Interaction With Matter
- Ionizing Radiation
  - Electromagnetic
  - Charged Particle
- Non-ionizing Radiation

Concepts of Units and Dose
- Units and Dose Determination
- Quality Factor
- Gamma Exposure Rate
- Beta Exposure Rate
- Neutron Exposure Rate

Shielding
- Inverse Square Law
- Time, Distance, Shielding
- Half-Value Layer
- Calculating Shield Thicknesses

Biological Effects
- Radiosensitivity
- General Cell Structure
- Radiation Exposure
  - Chronic
  - Acute
  - Organ & Tissue Effects
- Radiation Damage
  - High Dose Effects
  - Low Dose Effects
  - Long Term Effects
- Natural Background Radiation
- Estimated Loss of Life Expectancy

Radiation Protection Guides
- Occupational Dose
- Members of the Public
- Declared Pregnant Female

Personnel Monitoring Requirements

Instrumentation
- Fundamentals of Detection
- Characteristics and Uses
- Selection, Uses, Calibration
- Survey Techniques

Personnel Dosimetry
- Film Badges
- TLD
- Pocket Chambers

Industrial
- Posting
- Device Installation, Relocation
- Survey & Documentation
- Leak Test Procedures & Calculations
- Hands-on Exercises
  - Survey Device
  - Leak-Test & Count Swabs
  - Prepare Documentation

Radiation Protection Program
- Licensing - General & Specific
- Agreement State/NRC
- User Responsibilities
- ALARA Policy
- Operating Procedures
- Emergency Procedures
- Incident Reporting
- Recordkeeping
- Inventory Requirements
- Decommissioning Records
- Posting Requirements
- RSO Responsibilities
- Training Requirements
- Violations

Pertinent Federal and State Regulations

Shipping Radioactive Material

Note: Homework is assigned each night during the course and graded the following day. This homework and class discussions require an additional 4-5 hours.

A comprehensive closed book exam on lecture material and homework assignments is administered on the last day.

radiation technology, inc.

Austin, Texas (512) 346-7608

radiation technology, inc.

The purpose of this letter is to provide certification of training completed for Cliffs Mining Company, Tilden Mine personnel. An eight hour radiation safety training course were conducted in Ishpeming, Michigan on December 9, 1994 for employees listed on the following page.

Topics covered during this session included the following:

Radioactive Materials
- A. Isotopes
- B. Decay
- C. Half-Life

Characteristics of Radiation
- A. X and Gamma Rays
- B. Neutrons

Radiation Dosimetry
- A. Units & Dose Determination
- B. Gamma Exposure Rate
- C. Neutron Exposure Rate

Fixed Gauge Safety Considerations
- A. Source Design and Construction
- B. Source Head Design & Construction
- C. Shutter Design & Maintenance

Shielding
- A. Inverse Square Law
- B. Half Value Thicknesses

Radiation Protection Guides

Biological Response to Radiation

NOLA System
- a. Design and Construction
- b. Shielding
- c. Cell Removal and replacement
- d. Potential exposure
- e. Dosimetry requirements

Participants received materials providing supporting information for the covered topics. Lectures were supplemented with visual aids and demonstration models.

Radiation Technology, Inc.

Doris C. Bryan

Doris C. Bryan
Instructor
June 28, 1996

P.O. Box 27637 • Austin, Texas 78755 • (512) 346-7608 • Fax (512) 795-8718
8407 Skyline Avenue • Odessa, Texas 79764 • (915) 550-9701

BASIC RADIATION SAFETY TRAINING
PRESENTED FOR CLIFFS MINING COMPANY
TILDEN MINES PERSONNEL
DECEMBER 9, 1994

The following personnel participated in this class:

James F. Anderson, Training Coordinator
Peter T. Goldsworthy, QC Lab Supervisor
Richard Johnson, Electronic Repairman
William D. Juchemich, Electronic Repairman
Donald Lohman, Electronic Repairman
Gerald Millimaki, Electrical Foreman
Gary Paveglio, Electronic Repairman
Richard Rintala, Electronic Repairman
Donald Roberts, Electronic Repairman
Jeffrey D. Talsma, Electronic Repairman
Michael Tipolt, Electronic Repairman
Anthony Walimaa, Electronic Repairman

APPENDIX B

TRAINING DOCUMENTATION FOR ITEM 8

RESUME

William G. (Jack) Hendrick
8002 Greenslope Drive
Austin, Texas 78759
512/345-0585

Radiation Technology, Inc.
P.O. Box 27637
Austin, Texas 78755
512/346-7608

EDUCATION:

Jefferson High School	Roanoke, VA	June 1953	
Roanoke College	Salem, VA	June 1963	B.S. Physics
University of Tennessee	Knoxville, TN	June 1968	M.S. Physics

EXPERIENCE SUMMARY:

1992 -Present	Consultant - Radiological Services
1986 - 1991:	Director of Environmental and Technical Services, TN Technologies, Inc. (TN)
1978 - 1986:	Manager of Personnel and Technical Services, TN
1974 - 1978:	Health Physicist/Sr. Research Scientist, TN
1968 - 1974:	Health Physicist/Research Scientist, TN
1965 - 1968:	Chief Health Physicist, Space Radiation Effects Laboratory, Newport News, Virginia
1963 - 1965:	Health Physics Fellow, University of Tennessee and Oak Ridge National Laboratory
1963:	Instructor, Mathematics, Roanoke College, Roanoke, Virginia
1959 - 1963:	Roanoke College
1953 - 1959:	U.S. Air Force

FIELDS OF EXPERIENCE:

1992 - Present: Mr. Hendrick, a health physicist, is president of Radiation Technology, Inc., a radiological services company.

1986 - 1991: Mr. Hendrick, as Director of Environmental & Technical Services, had responsibility for radiation and occupational safety; health physics services; chemically and radiologically hazardous material; regulatory compliance; record keeping; and waste disposal. In addition, this operating group with its diverse areas of expertise provides services to major customers world-wide.

1978 - 1986: As Manager of Personnel and Technical Services, Mr. Hendrick organized and administered areas of radiological occupational safety; and all personnel related activities, including benefits, insurance, salary schedules and training programs. Facilities maintenance responsibilities also fell under this jurisdiction.

1974 - 1978: In 1974, Mr. Hendrick moved into the position of Senior Staff Scientist with responsibilities shifting from research to areas of radiation and occupational safety as OSHA came to the fore. The need to develop, organize and implement programs in these area resulted in the expansion of a group responsible for rather diverse technical functions.

1968 - 1974:	Mr. Hendrick participated in R&D contract work and the early design, shield calculations and performance specifications for a new line of nuclear gauging devices. As this product line grew, Mr. Hendrick assumed more and more of the responsibility for the in-house health physics program with the attendant record keeping, customer interactions and consulting, both in-house and for customers.
1966 - 1968:	The Space Radiation Effects Laboratory: Mr. Hendrick accepted the position of Chief Health Physicist on the staff of the Space Radiation Effects Laboratory in January 1966 where he assumed responsibility for the Health Physics Program.
1963 - 1966:	University of Tennessee and Health Physics Division of Oak Ridge National Lab (ORNL)
1959 - 1963:	Roanoke College
1953 - 1958:	Military Service, U.S. Air Force

Honors and Publications:

Academic Honors: Dean's Honor Roll, Phi Beta Kappa, AEC Fellowship, election to Sigma Phi and Sigma Pi Sigma.

Industrial Honors: Mr. Hendrick has served on five American National Standards Institute committees over the years in areas involving his expertise. He has been a consultant to the FDA, DOT, and NRC. In addition, Mr. Hendrick has been an invited guest lecturer for the International Atomic Energy Agency, domestically and internationally.

There have been twenty-two publications for peer review, copies of which are available upon request. Mr. Hendrick has spoken before numerous trade associations.

RESUME

DORIS C. BRYAN
3702 Terrina Road
Unit #14
Austin, TX 78759

EDUCATION:

University of Kentucky, Lexington, Kentucky
University of Texas, Austin, Texas
St. Edwards University, Austin, Texas
Summa Cum Laude
B.S. Industrial Management

WORK HISTORY:

August, 1994 - Present:

Manager, Licensing & Regulatory Affairs, Radiation Technology, Inc.

Major responsibilities include:

- Ensuring regulatory compliance for Radiation Technology, Inc.;
- Maintaining a thorough working knowledge of regulations and guidelines relating to radiation safety;
- Writing training programs and conducting customer training both in Austin and at customer job sites;
- Consulting with and assisting customers with radiation or regulatory problems, on-site auditing of radiation safety programs and records, setting up safety programs; writing procedures, licenses, etc.;
- Performing any licensed activities authorized by the Radiation Technology, Inc. license.

November, 1986 - August, 1994:

Manager, Environmental & Technical Services, TN Technologies, Inc.

Major job responsibilities included:

- Ensuring regulatory compliance for TN Technologies as a manufacturing/distributing entity, and for customers purchasing Texas Nuclear gauging devices;
- Evaluating new products from a radiological safety standpoint and preparing technical data for submission to regulatory agency;
- Maintaining a thorough working knowledge of regulations and guidelines relating to radiation safety, licensing and shipping radioactive material;
- Developing methods or programs, writing procedures and conducting training for personnel performing regulatory related duties;
- Developing departmental expense and revenue budgets, ensuring adherence to approved budgets by approval and monitoring of expenditures;
- Selecting and supervising departmental personnel;
- Writing training programs and conducting customer training both in Austin and at customer job sites;
- Consulting with and assisting customers with radiation or regulatory problems, on-site auditing of radiation safety programs and records, setting up safety programs; writing procedures, licenses, etc.

November 1982 to October 1986:
Assistant Manager, Personnel and Technical Services, Texas Nuclear Corporation.
October 1980 to November 1982:
Supervisor, Personnel and Technical Services, Texas Nuclear.
December 1978 to October 1980:
Administrative Assistant, Personnel and Technical Services, Texas Nuclear.
December 1977 to December 1978:
Senior Technical Assistant, Health Physics, Texas Nuclear.
January 1975 to December 1977:
Technical Assistant, Health Physics, Texas Nuclear.
April 1972 to January 1975:
Senior Technical Secretary, Health Physics, Texas Nuclear.
October 1970 to April 1972:
Technical Secretary, Health Physics, Texas Nuclear.

PROFESSIONAL ORGANIZATIONS:
South Texas Chapter, Health Physics Society
American Management Association
National Association of Female Executives
Conference of Radiation Control Program Directors

PUBLICATIONS:
Industrial, Licensing, Shipping Radioactive Material, and Regulatory Sections of Texas Nuclear Safety Training Course Manual.

"Industrial Uses of Radioisotopes," presented to American Society of Safety Engineers, February 1984.

"Industrial Uses of Radioisotopes for Gauging, Measuring and/or Analytical Applications," presented to Society of Process Engineers, May 1985.

"Safety in Design & Testing of Gauging Devices" and "Safety in Installation and Servicing Gauging Devices," co-authored with W. G. Hendrick and P. Zelewski; presented to IAEA Training Forum, Argonne National Laboratories, May 1989 and May 1990; and in Mexico City, September 1991.

HONORS:

Academic:
Alpha Sigma Lambda
Kappa Gamma Pi

Industrial:
In April 1993 Ms. Bryan was selected and appointed by Governor Ann Richards to serve as a member of the Texas Radiation Advisory Board (TRAB). TRAB members serve as advisors to the Texas Bureau of Radiation Control, Water Commission, Railroad Commission and Low-Level Radioactive Waste Authority in matters involving radiation and radioactive materials.

RESUME
PAMELA J. ZELEWSKI
16702 Black Kettle Drive
Leander, TX 78641

EDUCATION AND TRAINING:

Lincoln School of Commerce
Associates Degree
40-Hour Industrial Radiation Safety Training
Radiation Safety Principles Refresher Training
OJT on numerous industrial plant sites

EXPERIENCE:

August, 1994 - Present
Radiation Technology, Inc.
Safety & Regulatory Compliance
- Consult with customers to provide licensing & regulatory compliance assistance.
- Assist with design of radiation safety training programs for industrial users of radioactive material.
- Provide radiation safety training for industrial licensees.
- Perform on-site inspection and consulting services.

September, 1987 - August, 1994
TN Technologies, Inc., Round Rock, TX
Administrative Assistant and Training Coordinator
- Provide on-site services and training for customers.
- Market, coordinate and facilitate radiation safety training provided for customers.
- Provide administrative support to Director of Environmental & Technical Services, and Manager of Licensing & Regulatory Affairs.
- Administer workers' compensation program for company employees.
- Represent company at legislative hearings and industry meetings..

January, 1985 - August, 1987
PC Associates Secretarial Service, Schaumburg, IL
Owner/Operator

March, 1977 - May, 1985
Xerox Learning Systems, Division of Xerox Corporation, Schaumburg, IL
Secretary to Manager of Training and Development
Secretary to Manager of Field Organization Development
Regional Secretary
Sales Secretary

May, 1976 - February, 1977
BPO Elks, Lincoln, NE
Executive Secretary

March, 1974 - June, 1976
Metro-Mail Advertising Co., Lincoln, NE
Secretary to Vice President of Marketing

December, 1968 - March, 1974
Derby Refining Company, Lincoln, NE
Executive Secretary

April, 1967 - December, 1968
Bruning Company, Lincoln, NE
Secretary to Manager of Marketing

AGENDA
RSO FORTY-HOUR
INDUSTRIAL RADIATION SAFETY COURSE

Radiological
- Atomic Structure
- Isotopes
- Types of Radiation
- Decay
- Half-Life

Radiation Interaction With Matter
- Ionizing Radiation
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- Non-ionizing Radiation

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- Units and Dose Determination
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- Beta Exposure Rate
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- Calculating Shield Thicknesses

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- Radiosensitivity
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- Members of the Public
- Declared Pregnant Female

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- Characteristics and Uses
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- Survey Techniques

Personnel Dosimetry
- Film Badges
- TLD
- Pocket Chambers

Industrial
- Posting
- Device Installation, Relocation
- Survey & Documentation
- Leak Test Procedures & Calculations
- Hands-on Exercises
  - Survey Device
  - Leak-Test & Count Swabs
  - Prepare Documentation

Radiation Protection Program
- Licensing - General & Specific
- Agreement State/NRC
- User Responsibilities
- ALARA Policy
- Operating Procedures
- Emergency Procedures
- Incident Reporting
- Recordkeeping
- Inventory Requirements
- Decommissioning Records
- Posting Requirements
- RSO Responsibilities
- Training Requirements
- Violations

Pertinent Federal and State Regulations

Shipping Radioactive Material

Note: Homework is assigned each night during the course and graded the following day. This homework and class discussions require an additional 4-5 hours.

A comprehensive closed book exam on lecture material and homework assignments is administered on the last day.

radiation technology, inc.
Austin, Texas (512) 346-7608

40-Hour Course

Final Exam

Name: ____________________________

Date: ____________________________

1.2 The primary process of adding or removing one or more electrons from a neutral atom is called ____.

2.4 The term "isotope" is used to denote atoms with the same________________ but different __________________________.

3.4 Name four types of ionizing radiation that are emitted as components of nuclear decay.

______________ ______________ ______________ ______________

4.2 Name two types of ionizing radiation which are electromagnetic in character.

____________________ ____________________

5.2 What do we call a type of ionizing radiation emitted in a nuclear decay that is described as being identical to a helium nucleus?

____

6.2 The atomic number (symbol Z) is used to denote the ________________________ of an atom.

7.2 ____________________ particles are emitted from some nuclei with discrete energies, but ____________________ particles are emitted with continuous energies up to some maximum value.

8.4 (a) The half-life of a radioactive isotope refers to the time required for one-half of the radioactive atoms to decay.

TRUE __________ FALSE __________

(b) When evaluating the decay of a large number of radioactive atoms, we find that although the same number of atoms do not decay in each interval of time, the same ______________ of the radioactive atoms present decay during each unit of time.

9.2 Which type of ionizing radiation has the highest specific ionization at a particular kinetic energy? ______________

10.2 A unit used for quantifying X or γ radiation exposure is:

____

11.2 The unit used to express absorbed dose from any ionizing radiation is:

____

12.2 Consider only alpha or beta particles at the same kinetic energy. Which has the greater range in material? ____________________

13.2 Radiosensitivity refers to (a) different ability of some cells to absorb energy, (b) a temporary injury, (c) greater response of some cells to the same amount of radiation.

14.3 One can make a close approximation of the exposure rate at one foot from a point source of Cs-137 by using the formula: (3.4)XmCi = mR/h. Calculate the exposure rate of a 100 mCi Cs-137 source at 6 inches; 2 feet; and 10 feet.

(a) 6 inches __________ (b) 2 feet __________ (c) 10 feet __________

15.2 The "rem" is a unit used to express dose equivalent. Rem dose is usually the product of _______________ multiplied by _______________.

16.4 The "rad" is defined as (numerical value) _______________ per _______________.

17.6 Match the following items:

(1) Compton Effect	(A) Relates absorbed dose to dose response.
(2) Curie	(B) Electromagnetic radiation formed external to the nucleus.
(3) QF	(C) Gamma in - Electron out - reduced gamma energy.
(4) GM Tube	(D) Unit of energy deposited per mass of material.
(5) Rad	(E) 3.7 E 10 disintegrations per second.
(6) X-Ray	(F) X - gamma detector

18.1 A radiation dose delivered to the whole body is more damaging than the same dose delivered to a smaller part of the body.

TRUE ______________ FALSE ______________

19.2 Per rad dose, are alpha particles or gamma rays more effective in producing biological damage? ______________

20.2 The primary mechanism of biological damage from ionizing radiation is: (a) heat production, (b) absorption of energy from electrons, (c) infection.

21.2 One Roentgen is considered to be equal to one rad for ______________ or ______________ radiation.

22.2 Draw the international radiation symbol and designate its colors.

23.2 The potential for radiation damage from alpha emitting isotopes is more probable when the alpha emitter is (a) on the skin, (b) inside the body, (c) in the air.

24.2 Biological half-life is a term used to describe the time required for a biological system to expel ____________________ of the radioactive material due to natural processes.

25.2 Radiation effects produced in an exposed individual are termed __________________ effects. Radiation effects which may be transmitted to future generations are termed __________________ effects.

26.2 The median lethal dose is that dose of radiation which will produce death within 30 days in approximately half of those receiving that dose. Which of the following total effective dose equivalents is approximately the median lethal dose for man due to ionizing radiation?

250 rem   380 rem   550 rem   750 rem

27.2 Once radioactive material is taken into the body, it will never leave.

TRUE __________   FALSE __________

28.2 Of the following four types of ionizing radiation: α, β, γ, and η, an ordinary book will usually absorb two. Which two? _______________

29.2 Nerve cells are much more radiosensitive that lymphocytes.

TRUE __________   FALSE __________

30.5 The annual total effective dose equivalent limit for occupationally exposed employees is _______________. The annual limit for "members of the public" is ____________________. Of this limit, each licensee can contribute ____________________.

31.2 If a person received a total effective dose equivalent of 15 rem from ionizing radiation over a year, would he exhibit any ill effects?

YES __________ NO __________

32.1 Of the types of ionizing radiation considered, which is more hazardous when located internal to the body?

____

33.3 Three factors which affect the total exposure one may receive in a given radiation field are: ______________, ______________, and ______________.

34.2 Radiation intensity from a gamma emitting point source will vary inversely as the square of the distance from the source.

TRUE __________ FALSE __________

35.2 All regulating agencies require that most sealed sources be tested periodically for leakage. The amount of removable radioactive material which will cause the source to be removed from use is ______ ________ microcuries.

36.2 Many survey meters used for monitoring the intensity of x and γ radiation are rate meters and read in milliroentgens per hour.

TRUE __________ FALSE __________

37.4 "Radiation Area" means any accessible area in which there exists radiation such that an individual could receive a dose equivalent in excess of ______________ in one hour at a distance of ____________________ from the radiation source or from any surface that the radiation penetrates.

38.2 The half-value thickness of a shielding material refers to the thickness of material required to absorb 1/2 the incident radiation.

TRUE __________ FALSE __________

39.2 A room or area need not be posted due to the presence of a sealed source, if the radiation level does not exceed __________ at a distance of __________ .

40.2 Two half-value thicknesses of a material will stop all incident gamma radiation.

TRUE __________ FALSE __________

41.3 There are several specific events whose occurrence must be reported to a regulatory agency. Three of these events are:

(a)

(b)

(c)

FINAL EXAM ANSWER KEY

1. ionization

2. atomic number, atomic weight

3. gamma, alpha beta+, beta-

4. X-ray, gamma

5. alpha

6. number of protons

7. alpha, beta

8. (a) True (b) percentage or fraction

9. alpha

10. Roentgen

11. Rad

12. beta

13. (c)

14. 1360 mR/h, 85 mR/h, 3.4 mR/h

15. rad, quality factor

16. 0.01 J/kgm or 100 ergs/gm

17. (1) = (C)
    (2) = (E)
    (3) = (A)
    (4) = (F)
    (5) = (D)
    (6) = (B)

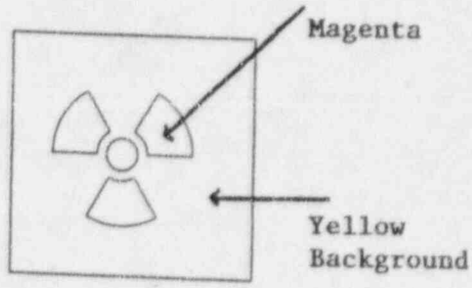
18. True

19. alpha

20. (b)

21. X, gamma

22.



23. (b)

24. 1/2 or 50%

25. somatic, genetic

26. 550 rem

27. False

28. alpha, beta

29. False

30. 5 rem
    500 mrem
    100 mrem

31. No

32. alpha

33. time, distance, shielding

34. True

35. 0.005

36. True

37. 5 mrem, 30 centimeters

38. True

39. 5 mR/h, 30 centimeters

40. False

41. List any three from regulations studied. For example:

- Theft or loss of licensed material.
- Exposures of individuals to radiation exceeding regulatory limits.
- Leak test results exceeding 0.005 microcuries.
- Planned special exposures.
- Dose to embryo/fetus exceeding regulatory limit.
- Failure of device ON/OFF mechanism.

QUIZ 1

Name: ________________

Company: ________________

Date: ________________

1. Sketch the Bohr model of an atom for:

   (a) Hydrogen, $^{1}_{1}H$:

   (b) Lithium, $^{7}_{3}Li$:

   (c) Carbon, $^{12}_{6}C$:

   (d) Carbon, $^{14}_{6}C$:

2. List the three fundamental components of the Bohr model of an atom <u>and</u> indicate their electrical charge.

   A. B. C.

3. Define the term "atom."

4. The term <u>atomic number</u> designates the ____________________________ of an atom, and the letter ___________ is used as the symbol.

5. The term <u>mass number</u> designates the ____________________________ of an atom, and the letter _________ is used as the symbol.

6. The word "isotope" describes an element with the same ____________ ____________ but different __________________ ______________.

QUIZ 1

7. Some isotopes are not stable, and release energy by the process of _______________. These are called ____________ isotopes.

8. Write the chemical symbols of the following isotopes: (a) cesium-one hundred thirty seven, (b) cobalt-sixty, and (c) tritium. How many neutrons, protons, and electrons would be associated with an atom of these isotopes?

   (a)

   (b)

   (c)

9. List three physical properties of an "alpha particle."

10. List three characteristics of a "beta particle."

11. List three characteristics of X and γ radiation.

12. Define the "half-life" of a radioactive isotope.

13. In radioactive decay of a given isotope, the same number of atoms do not decay in each period of time. However, the same __________________________ of atoms decay in each unit of time.

QUIZ 1

14. The isotope Cs-137 has a half-life of 30 years. Its initial activity was 250 mCi in January 1983. What is its activity in July 1993? Show your work.

15. The isotope Co-60 has a half-life of 5.5 years. Its initial activity was 1000 mCi in July 1985. What is its activity in June 1994? Show your work.

16. (A) Define the process of ionization.

(B) Distinguish between ionizing and non-ionizing radiations.

(C) Give three examples of each type of radiation.

QUIZ 1

17. The three major processes by which electromagnetic radiation interacts with matter are: (Briefly describe each process)

18. Beta decay results in: (Mark all that are accurate.)

   a. Decrease in atomic number
   b. Increase in atomic number
   c. Increase in atomic number and decrease in atomic mass
   d. Increase in atomic number and mass number

19. One millicurie equals:

   a. 3.7E7 dps
   b. 3.7E10 dps
   c. 2.22E6 dpm
   d. 2.22E9 dpm

20. The decay constant equals:

   a. 0.963/T
   b. Activity/Number of atoms
   c. $0.693/T_{1/2}$
   d. $\ln(\sqrt{2})$

21. Gamma rays interact with matter by:

a. Ionization and excitation
b. Compton scattering
c. Pair production
d. Photoelectric effect
e. All of the above

22. A charged particle interacts with matter by:

a. Compton scattering
b. Photoelectric effect
c. Ionization and excitation
d. Pair production

23. The unit of activity is:

a. Roentgen
b. Rem
c. Curie
d. Rad

24. Linear Energy Transfer (LET) is defined as: ______________________________

____

____

____

QUIZ 2

Name: ____________________

Company: ____________________

Date: ____________________

1. State and define the unit of absorbed dose. Give its numerical equivalents.

2. State and define the unit of exposure. Give its numerical equivalents.

3. State and define the unit for dose equivalents.

4. Calculate the Dose Equivalent received from each of the following radiation exposures:

   (a) 15 Roentgen exposure =

   (b) A dose of 20 Rads from 5 MeV neutrons =

   (c) A dose of 5 Rads from 1 MeV protons =

   (d) Calculate the Total Effective Dose Equivalent:

   (e) State any assumptions necessary:

5. Using the short formula, calculate the exposure rate from an unshielded point source of Cs-137 with an activity of 500 mCi, at 1 foot, 2.5 feet, 5 feet and 9 feet.

6. (a) Calculate the exposure rate from a 200 mCi Cs-137 point source at a distance of five feet.

(b) Calculate the exposure rate from a 200 mCi Co-60 point source at a distance of five feet.

(c) How do you explain the higher exposure rate from the Co-60 source?

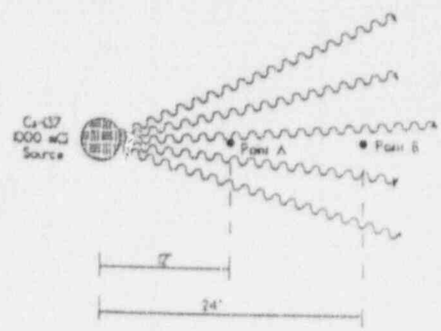
QUIZ 2

7. The following diagrams illustrate a gamma radiation field from a 1000 mCi Cs-137 point source with and without shielding. Calculate the exposure rate at points **A** and **B** without shielding; then calculate the exposure rate at point **B** with 1 inch of lead as a shield. You may use any formula, method or table, but show your work.

INTENSITY WITHOUT SHIELDING

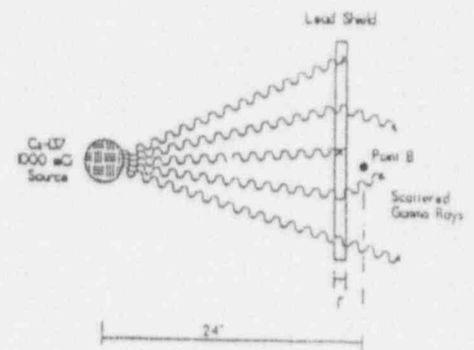
I_A =

I_B =



INTENSITY WITH SHIELDING

I_B =



QUIZ 2

8. (a) If one has a 10 μCi Cs-137 point source, how many gamma rays are emitted per second? (Hint: Cs-137 has a gamma emission efficiency of 0.85 at 0.662 MeV.)

(b) What is the exposure rate from this 10 μCi Cs-137 point source at a distance of 2 inches?

(c) What is the exposure rate from this same source at 0.1 centimeters? (2.54 cm = 1 inch)

QUIZ 2

9. An exposure to a mixed radiation field of 1 mR gamma, 10 mrad beta, and 5 mrad fast neutron will give a dose equivalent of:

    a. 16 mrem
    b. 16 μCi
    c. 61 mrad
    d. 61 mrem

QUIZ 3

Name: ________________

Company: ________________

Date: ________________

1. The annual total effective dose equivalent for occupationally exposed employees is ______________. The annual total effective dose equivalent for members of the public is ___________. Of this limit, each licensee may contribute __________________.

2. Briefly explain the difference between acute and chronic exposures.

3. Would blood changes be detectable in an individual who had received a **chronic** absorbed dose of 130 rem TEDE spread over his 20 years of employment? Explain.

4. Would blood changes be detectable in an individual who had received an **acute** absorbed dose of 130 rem TEDE? Explain.

5. There are four principal physical factors which must be determined in assessing somatic effects due to radiation exposure. Identify and briefly explain each one.

6. Compare ranges in air for the following radiations:

   A. Alpha:

   B. Beta:

   C. Gamma:

7. Give material recommendations for shielding the following types of radiation:

   A. Beta

   B. X and Gamma

   C. Neutron

8. List three physical factors to be considered when determining the total exposure one receives in a given radiation field.

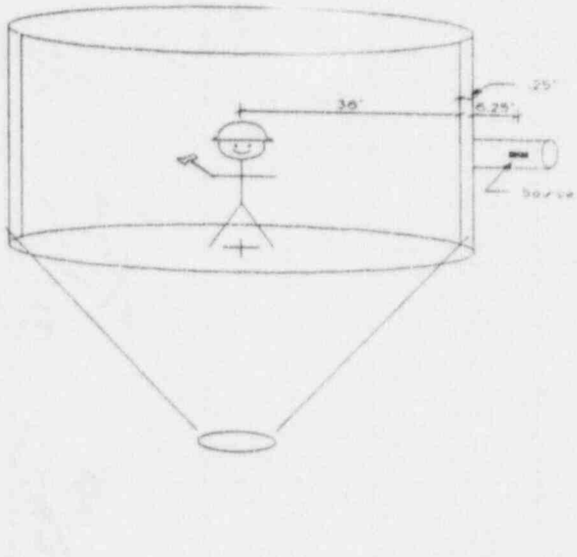
   ____________________ ____________________ ____________________

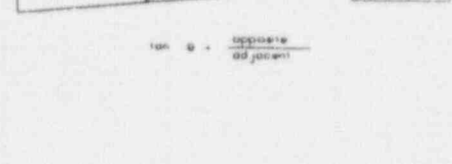
QUIZ 3

9. An individual gains access to a tank being monitored with a level gauge, without closing the shutter. The isotope is Cs-137 and the activity is 2 Ci. Investigation reveals:

   (a) The individual was in the tank for 3 hours.
   (b) He was working on the lining around the edges of the vessel and so to be very conservative, we assume he was at the center line of the tank, in the radiation for the full three hours.
   (c) The center line of the tank is 3 feet from the tank side wall, which is manufactured from ¼ inch thick steel.
   (d) The gauge was mounted outside the tank and measurements show the source to be 6¼ inches from the tank side.
   (e) Density and point level gauges have a beam angle approximately 13° (6.5° either side of center line).

Calculate his exposure
using the above assumptions.





$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

QUIZ 3

Question 9. (Con't)

Convert exposure to dose equivalent.

What is the approximate beam diameter at the point of interest?

Will he need medical care? If yes, what do you say to the doctor?

Will he suffer long term effects?

Will you see obvious biological response?

Circle all the correct answers for the following questions

10. Which of the following is an important factor of the Law of Bergonie and Tribondeau:

    A. Degree of differentiation of a cell
    B. Age of the cell
    C. Size of the cell
    D. Shape of the cell

11. Which of the following is the most radiosensitive:

    A. White blood cells
    B. Red blood cells
    C. Muscle tissue
    D. Nerve tissue

QUIZ 3

12. Free radicals are:

A. Electrically neutral
B. Have an odd number of electrons with an excess charge
C. Are usually responsible for indirect effects of radiation
D. All of the above

13. Which two of the following are characteristics of GM counters:

A. You can identify the radionuclide with a GM detector
B. The entire GM tube becomes ionized during the process of detection of radiation
C. The GM tube operates at a very low voltage (< 200 volts)
D. GM counters operate at a voltage that is near the discharge region

14. Scintillation counters have which of the following characteristics

A. You can identify the radionuclides with the detector and electronics of the counter
B. You can identify alpha emitters
C. Scintillation detector assemblies convert radiation to light and amplify it as an electrical signal
D. Scintillation detectors can be made out of NaI(Tl)

15. If the HVL of a shielding material for a given isotopic emission is 0.178 cm, the amount of material that must be used to reduce the exposure rate from a radioactive source from 32 mR/h to 2 mR/h is:

A. 7.1 cm
B. 0.71 cm
C. 71 cm
D. 710 cm

16. The purpose of filters in a personnel monitor is to:

A. Shield parts of the film for background readings
B. Determine the amount of radiation
C. Help determine the type and energy of radiation
D. Determine the identity of the isotope

17. If you have a source of radiation that emits both high energy betas and gammas, the most appropriate shielding materiel(s) is (are):

A. A container of lead
B. A container of plastic
C. A container of plastic inside a container of lead
D. A container of lead inside a container of plastic

QUIZ 4

Name: ____________________

Company: ________________

Date: ____________________

1. What are the four primary safety considerations with which users of fixed devices should be concerned? (Manual Section 7)

   a.

   b.

   c.

   d.

2. Several documented actions are required each time a device is installed or relocated. Circle all that apply.

   a. Notify the regulatory agency

   b. Survey

   c. Evaluate the area for posting

   d. Leak test

   e. Update inventory

3. Survey meters designed to monitor the intensity of X or gamma radiation are rate meters and read in _______________.

4. Match the following:

Roentgen	Unit of absorbed dose (100 ergs/gm; 0.01 J/kg.)
Rem	Unit for dose equivalent (Rad X QF)
Rad	Unit of exposure (2.58×10^{-4} C/kg. air)

5. Rem dose is usually derived by multiplying ______________ X _______________.

QUIZ 4

6. The time required to receive a 100 mR exposure from a radiation field intensity of 500 mR/h is:

   A. .2 second
   B. 20 seconds
   C. 1.2 minutes
   D. 12 minutes

7. The term Roentgen applies only to ______________ or ______________ radiation.

8. What level of contamination dictates that a sealed source be removed from service and reported? ________________________ (31.5)(c)(5))

9. Regulations define certain specified areas and assign radiation intensity limits for those areas. Two of particular interest are:

   Unrestricted Area: (20.1301)

   Any area which is not controlled by a licensee to protect individuals from exposure. Assuming continuous occupancy, each licensee shall conduct operations so that the dose does not exceed ________________ in any one hour or TEDE does not exceed ___________________ in one year.

   Radiation Area (20.1003)

   An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of ___________________ in one hour at ____________________ from the radiation source or from any surface that the radiation penetrates.

10. No posting of a caution sign is required due to the presence of a sealed source, if radiation levels do not exceed _______________ at a distance of _______________. (21.1903(c))

QUIZ 4

11. Certain notices to workers are required to be posted. Describe these. (19.11(a)(b)&(c))

12. (A) Define the term "ALARA" in your own words.

(B) How often must the ALARA program be audited.

13. The annual total effective dose equivalent limit for occupationally exposed individuals is __________________. (20.1201)

14. The annual limit for "members of the public" is ____________________. Of this limit, each licensee can contribute ______________________. (20.1301)

15. One must provide monitoring devices to individuals who receive __________% of the annual occupational limit. (20.1502)

16. Certain records or documents are required to be maintained to support the radiation protection program. List at least five of these.

1.
2.
3.
4.
5.

QUIZ 4

17. List four reportable incidents or occurrences: (20.2201 - 20.2204)

1.

2.

3.

4.

18. (A). The total effective dose equivalent for a "declared pregnant female" is _________________ for the gestation period.

(B). The dose limit for an embryo/fetus is the same as the mother and a separate record must be made. (20.2106(e))

True False

19. A survey is made to assess radiation fields. Leak tests are performed to determine the presence or absence of contamination.

True False

20. List at least five procedures one should have to support the radiation safety program.

1.

2.

3.

4.

5.

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LEVEL II

AGENDA

ONE-DAY TECHNICIAN TRAINING

Basic Concepts of Radiation
- Radioactive materials
- Common uses of radiation
- Isotopes
- Half-life

Working With Radiation
- Units
- Quality factors,
- Time, Distance, Shielding

Gauge Construction
- Basic design
- Beam geometry
- Source construction/testing
- Inspection procedures

Working Safety With Industrial Gauges
- Risks
- Accidents
- Radiation Protection Guides
- Dose limits
- Personnel monitoring

Biological Effects
- Radiosensitivity
- Radiation exposure
  - High dose effects
  - Low dose effects

Survey Meters
- Types and purpose
- Calibration check
- Confirmation of scale
- Survey techniques

"Hands-on" Exercises
- Inspection
- Lock-out and confirm shutter position
- Radiation survey
- Leak test

Regulatory Implications
- Requirements
- Posting
- Operating procedures
- Emergency procedures

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APPENDIX C

OPERATING AND EMERGENCY PROCEDURES

APPENDIX C INDEX

TITLE	PROCEDURE NUMBER
Nuclear Device Lockout Procedure	RS-001
Installation and Commissioning Procedure	RS-002
Radiation Survey Procedure	RS-003
Take-Down of Devices For Storage	RS-004
Reinstallation of Gauges From Storage	RS-005
Procedure For Silica Analyzer (NOLA) Servicing	RS-006
Damage to Device Containing Radioactive Material	RS-007
Radiation Exposure - Declared Pregnant Female	RS-008
Procurement of Radioactive Material	RS-009
Receipt of Radioactive Material	RS-010
Nuclear Device Inventory and Inspection	RS-011

NUCLEAR DEVICE LOCKOUT PROCEDURE Procedure No. RS-001

Approved By: Revision: Date: 6/30/95

Purpose:

There are many measurement systems used throughout our operations which contain small sources of radioactive material, and which have associated low intensity radiation fields. These components are well marked, clearly identified with radiation symbols and information about the materials they contain. This procedure is to be followed whenever work requires that radiation intensities need to be reduced for personnel protection.

1. This section addresses repair, removal or relocation of the source containing portion of a measurement system. The work must be done by or under the direct supervision of the Radiation Protection Officer (RPO) or his designee.

   a. Prior to any movement of the source containing portion of a device, an authorized individual will use a survey meter to ensure that the "On/Off" mechanism is secured in the off position.

   b. The device will be locked out with a gang styled lockout mechanism. The authorized individual's lock will be the first one installed with a red tag identifying the work to be performed.

   c. The survey readings taken to ensure the "On/Off" mechanism is in the off position should be recorded.

      i. If moved for repair, the device will be transported to an appropriate location where the repair work can proceed. The device shall be constantly attended by the authorized individual.

      ii. If the device is removed for placement in storage, it shall be constantly attended by the authorized individual until placed in the secured, properly posted storage area.

      iii. If the device is removed for relocation, the source containing portion shall be constantly attended by the authorized individual or secured from unauthorized access until the relocation is complete.

d. When the device is reinstalled either in its present location or a new location, the locks are to remain in place until the installation is complete; including the electronics portion of the system. Upon completion of the installation, the locks are to be removed, the "On/Off" mechanism placed in the on position, and the commissioning survey and leak test performed.

e. Each employee involved in the work is responsible for removing his/her lock after completing the work.

2. Other work performed on a pipe or vessel where a nuclear device is mounted will proceed as follows:

a. Notify the RPO or his designee of the work to be performed.

b. The RPO or his designee will make a decision as to whether the device must be removed or locked out in place.

c. If the decision is to leave the device mounted with the "On/Off" mechanism off and locked out, then a survey reading will be taken and recorded to ensure closure.

d. The device must be locked out with a gang styled lockout mechanism. The RPO or his designee's lock will be the first lock installed with a red tag stating the work to be performed.

e. If the work to be performed allows an individual to have a major portion of the body in the region the radiation beam traversed prior to securing the "On/Off" mechanism in the off position, the work area itself must be surveyed.

f. If the work to be performed is on the electronics portion of the system only, a decision to lock out will be made dependent upon the need to produce a radiation signal in the detector during the work. Any qualified technician can perform work on the detector with the "On/Off" mechanism in either the on or off position. If the "On/Off" mechanism is on, he/she must be instructed as to what the radiation fields are at his/her location.

g. If repair requires removal of the detector, the source containing portion of the device must be locked out following the procedure described above.

h. If the decision is to lock out the device, each employee must put on his personal lock and sign and date the red tag.

i. Each employee involved in the work is responsible for his/her lock after completing work.

j. The RPO or designee will remove his lock last.

k. Resurvey after all lock-outs to ensure proper operation of device. If no movement of the components has occurred, then no resurvey is required.

INSTALLATION AND COMMISSIONING PROCEDURE Procedure No. RS-002

Approved By: Revision: Date: 6/30/95

Purpose:

The purpose of this procedure is to provide guidance for the safe installation and commissioning of devices containing radioactive material, in compliance with Tilden Mine specific license conditions.

1. The authorized individual who intends to move or supervise the movement and mounting of the device will obtain a copy of the manufacturer's mounting procedures. The current regulatory position requires that for this authorization, Tilden Mine will agree to follow these mounting procedures and ensure that the instructions are maintained in a file for future inspection by regulatory agency personnel.

2. Following the manufacturer's procedures, the device will be moved to its appropriate location and securely mounted. No disassembly of the source containing portion, if separate, is allowed. If this is a two component system, the detector can be wired and powered following mounting.

3. Upon completion of the physical installation, the authorized individual shall remove the shipping bolt from the device shutter; perform a leak test; and complete a radiation survey of the device.

4. Documentation of the leak test results and radiation survey shall be reviewed and maintained by the Radiation Protection Officer.

RADIATION SURVEY PROCEDURE Procedure No. RS-003

Approved By: Revision: Date: 6/30/95

Purpose:

Radiation fields are measured as a part of gauge relocation procedures; to help in assessing occupancy factors for personnel who work in or near areas where gauges are located; to determine the transport index prior to shipping packages containing radioactive materials; and in emergency response situations. This procedure is designed to facilitate the efficient and timely completion of surveys when they are required.

1. Prior to performing radiation measurements, personnel will review the techniques for proper use of survey instrumentation listed in "Survey Techniques and Pointers," which is a part of this procedure. A field verification test will also be performed, if appropriate.

2. Appropriate survey meters are always available through the RPO. There are Geiger-Mueller, thin end window probes (1-2 mg/cm^2) and side window models. The meters will be calibrated as required in the Tilden Mine license, by authorized individuals; and calibration documentation will be maintained by the RPO.

3. These meters will be used to survey energetic gamma emitters, including devices containing Cs-137. Any correction factors used will be those supplied by the instrument calibration facility.

4. The radiation survey will be made by the authorized installer using the appropriate survey pattern sheet.

5. Assess radiation levels around the installed device. Check the installation for additional shielding or any signage which may be necessary.

6. The original survey sheet will be forwarded to the RPO to be placed in the proper file.

7. Return the survey meter to its storage location.

RADIATION SURVEY PROCEDURE Procedure No. RS-003

Approved By: Revision: Date: 6/30/95

SURVEY TECHNIQUES AND POINTERS

1. Response Check

Prior to making any measurement with a survey meter, a brief inspection and test will be performed to verify its functionality. The following steps will ensure a correctly operating unit. Once again, there is no substitute for familiarity with the meter for quickly recognizing irregularities.

- Visually inspect the meter for damage. Look for loose cable terminations, broken switches and other gross physical damage.
- Check the calibration date for currency. This is more important from a statutory than physical standpoint, as a meter past its due date may be perfectly well calibrated.
- Turn on the meter and allow the circuit to stabilize.
- Test the battery using the built-in battery check scale.
- Verify the response of the instrument using the manufacturer supplied check source (if available).

2. Survey Techniques

The following tips and techniques will increase the quality of your radiation measurements, while increasing your confidence in the meter.

- Allow sufficient time for the meter to stabilize, and select a time constant appropriate to the measurement.
- Start surveying on a high range and work down to the lowest range practicable.
- When surveying for loose contamination, move slowly enough to accommodate the instrument's response time.
- Most meters have audio or earphone capabilities; they can be useful in low light or awkward conditions.
- Surveying radiation types or energies different from those for which a meter was calibrated can give false readings - make certain you know the energies with which you are working.
- Be aware that changing source - detector geometries can change readings dramatically - work for reproducible geometries.

TILDEN MINING COMPANY, L. C.

TAKE-DOWN OF DEVICES FOR STORAGE	Procedure No. RS-004	
Approved By:	Revision:	Date: 12/01/94

Purpose:

The purpose of this procedure is to provide guidance for the safe handling of devices containing radioactive material, as they are removed from installed locations and placed in storage.

1. A properly trained, authorized Tilden Mine employee shall supervise the removal of the device from its installed location; and its transport to the storage area. No device shall be moved unless it is within current leak test.

2. Personnel involved with the physical removal of the device shall be knowledgeable of procedures to be followed, hazards and potential exposure, prior to beginning work with the device.

3. The authorized individual will close and secure the shutter mechanism in its closed position, performing an abbreviated radiation survey to confirm that the shutter is closed.

4. The device shall be removed from its installed location and transported to the properly posted, secured storage area.

5. A survey will be performed to document radiation levels around the storage area.

6. A copy of the storage area survey results will be reviewed and maintained by the RPO, along with documentation of the removal and storage of the device. The site inventory will be updated to reflect the storage location of the device.

REINSTALLATION OF GAUGES FROM STORAGE Procedure No. RS-005

Approved By: Revision: Date: 12/01/94

Purpose:

There are occasions when Tilden Mine personnel must remove the source containing portion of installed devices, generally because of extended work in the immediate area.

1. Removal and storage of devices will be done according to Procedure RS-004 "Take-Down of Devices for Storage."

2. Once a device has been removed from its installed location and moved to storage, it must be leak tested prior to transfer or reinstallation, if the device has been in storage more than six months. The device will be inspected to ensure that the shutter is still closed and secured in the closed position.

3. Removal from storage and reinstallation of the device will be authorized by the Radiation Protection Officer or his designee before the device can be transported and remounted in its original configuration.

4. After mounting, the shutter will be opened and the device will be resurveyed and leak tested. The survey results will be compared with earlier survey readings to ensure that radiation levels have not changed significantly.

5. Documentation of the reinstallation, including completed leak test and survey forms will be maintained in the device file. Any previous occupancy studies will be updated accordingly.

PROCEDURES FOR SILICA ANALYZER SERVICING Procedure No. RS-006

Approved By: Revision: 1 Date: 6/30/95

The purpose of these procedures is to address radiological health and safety issues, and provide step-by-step operating instructions so any properly trained individual can safely work with the silica analyzer.

SECTION I: Repair of Density Gauge Assembly

This section is to be followed when one must work inside the density gauge enclosure. The density gauge assembly consists of the density gauge detector, the preamp, secondary and primary collimators mounted on a base plate. This assembly is mounted inside a NEMA enclosure; with a density gauge source head containing Cs-137 mounted on the outside of the same enclosure.

1. Place the NOLA system in a stand-by or off-line mode.

2. Open the main valve and flush valve to remove material from the analysis loop.

3. Switch the pump, agitator and all valves Off.

4. Switch the high voltage (H.V.) power supply Off.

5. Switch the element and density stabilizers to Calibrate, if applicable.

6. CAUTION: No work will be done on the density gauge assembly unless the source shutter on the density gauge head is closed and locked in the Closed position. A survey meter calibrated to measure high energy gamma radiation will be used to confirm that the shutter has closed. Readings will be taken near the entry port where the radiation beam would enter the NEMA enclosure; and generally will be <10 mR/h. CAUTION: Electrical power to the system must be removed because the line voltage is exposed within the NEMA enclosure.

Removal of the Density Gauge Detector Assembly

1. With the H.V. off, disconnect all coax connectors at the preamp assembly.

2. Remove the screws holding the preamp and detector clamps.

3. With the density gauge head shutter closed, there is no significant radiation field inside the detector assembly during this operation.

4. Gently remove the detector and preamp assembly for any repair.

SECTION II: Replacement of Analysis Loop Tubing in Density Gauge

Work on the analysis loop tubing can proceed after Steps 1 through 6 of Section I have been completed.

1. Disconnect the analysis loop tubing at the bulkhead connectors located on the inside of the NEMA enclosure.

2. Remove the allen head bolts and the top half of the lead collimator. Remove the old section of tubing and clean any spill.

3. NOTE: Do not loosen or remove the bottom half of the lead collimator or change the location of the secondary collimator.

4. Install a new section of tubing, of comparable length, in the bottom lead collimator and install the top half loosely.

5. Adjust the loops in the tubing section until they are just below the level of the top of the NEMA enclosure lid when closed.

6. Replace and secure the top half of the lead collim. :or.

7. Install the tubing and test for leaks.

SECTION III: Count Cell and Detector Assembly

Any irradiated slurry in the sampling lines may contain some low-level radioactive material. The lines are to be disconnected when the count cell or detector assembly is to be removed. As the lines are disconnected from the bulk head connections, flush them and catch any irradiated slurry. The slurry should then be deposited in a process wastewater drain and the pan washed out. Removal or repair of any electronics is not the purpose of this procedure.

SECTION IV: Holding Tank Assembly & Associated Lines

Radiation exposure associated with the holding tank assembly and lines is minimal and there should be no buildup of radioactive material in the holding tank.

1. Place the NOLA system in a stand-by or off-line mode.
2. Open the main valve and flush valve to remove material from the analysis loop.
3. Switch the pump, agitator and all valves Off.
4. Disconnect the lines from the holding tank and dispose of any process slurry in a process wastewater drain.

SECTION V: Primary Neutron Source Shield

The neutron source shield is typically filled with water containing a corrosion inhibitor. The proper water level in the shield should be indicated by a conductive level probe, float switch or other appropriate device, and should be maintained at that indicated level. There will be no radioactive build-up in the water or outer source shield. Both neutron and gamma radiation levels are well known around the shield; with gamma radiation fields typically the higher.

The inner source shield is a right circular cylinder containing the encapsulation cell, and is filled with oil. No particular oil is specified, other than it should be relatively clear for visual inspection. If a leak develops between the inner shield and the outer water shield, oil will be displaced and may float out onto the surface of the tank water.

There is no need to run neutron surveys around the outer source shield. These radiation levels are well known and are <1 mrem/h everywhere on the surface of the tank. Typical readings at the top of the column of oil would be in the range of 0.02 - 0.03 mrem/h. Readings on the side of the tank at the pump, for example, are typically around 0.4 - 0.7 mrem/h. Gamma radiation fields at the same points typically exceed these levels by a factor of two to as much as a factor of ten. Total dose levels are still very low, but the gamma fields contribute a much greater proportion than the neutron dose.

PROCEDURES FOR SILICA ANALYZER SERVICING Procedure No. RS-006

Approved By: Revision: 1 Date: 6/30/95

SECTION VI: Activation Analysis Irradiate Cell Check and Removal Procedure

The process flow system includes pumps, lines, the cell, its encapsulation, and the oil shield. The following will be utilized to verify the integrity of all parts of the system except the irradiate cell and its encapsulation.

1. Place the NOLA system in a stand-by or off-line mode.

2. Open the main valve and empty water from the analysis loop.

3. Switch the pump, agitator and all valves to Off.
4. Visually inspect the system to determine what has failed, e.g., the pump, tubing, or the cell.

5. Proceed with the visual inspection by loosening the cable lock and ring and visibly inspecting the oil bath and tubing. The cell top cover is retained with six hex head screws. Removing these screws and gently lifting up on the top cover allows for the inspection of the bulkhead fitting on the under side of the top cover plate. If the break has occurred outside the encapsulation cell, where it is visible, one can often simply reconnect the tubing section. If the separation occurs inside the cell encapsulation, cell removal is the only way to effect repair. In either case, reinstall the cell top cover. It must be in place before one can exert upward pressure on the cell itself.

Encapsulation and Cell Removal

1. Cover a work area on top of the tank with an oil absorbent material.

2. Position a plastic pan nearby so the encapsulation cell can be lifted up through the oil and placed in the pan with little spillage. Handle the cell with rubber gloves which can be easily washed.

3. Attach an appropriate lifting device to the eye-bolt on the encapsulation cell cover. Remove the cable lock and bolts from the inner source shield cover.

4. The encapsulation cell will act like a hydraulic piston in the oil column. Therefore, it must be removed slowly so the oil can drain past the encapsulation cell column as the cell is moved upward. Monitoring the oil level at the top will indicate how fast the cell may be raised. If one must gently shake or rotate the cell to get it to move upward freely, always remove the cell in a counter-clockwise direction as one would view a clock looking down on the oil bath from the top of the tank. The encapsulation cell will also be full of oil. This oil should be allowed to drain either into the column or a container, before the cell is placed in the pan.

   If one has access to an appropriate neutron survey meter, then the source position can be verified during cell removal. However since the cell contains radioactive material, a gamma survey meter will see significant increases in the radiation field as the encapsulation cell moves upward. This does not mean the source is moving. When the encapsulation cell clears the tank, visually inspect the bottom to ensure that the source has remained in the oil column. If there is any reason to believe the source itself has moved, stop the operation and notify the RSO. Don't proceed with any disassembly until any problem is resolved.

5. The cell and plastic pan will be moved off the tank and temporarily stored nearby to allow for decay of the radioactive buildup. Decay of most radioactive buildup will be very rapid. Measure the radiation exposure rates close to the surface of the encapsulation cell. One can safely proceed with disassembly of the encapsulation cell when radiation levels are <10 mR/h. If time is not of the essence, then radioactive decay can be allowed to continue as long as is desirable. If the encapsulation cell assembly is to be stored for any extended period of time, one must flush the cell with water to clear any accumulated slurry and deposit the residue in a process drain.

6. Disassembly of the encapsulation cell and its cleaning will be done in accordance with instructions in the manual provided by the manufacturer. This basically involves pulling screws, lifting the glass cell out and flushing with water. However, the actuate cell is glass and <u>very fragile</u>, particularly at points of contact with the cell cover fittings.

7. The cell and tubing can be replaced or repaired with extremely low radiation exposure, but its construction demands extreme care in assembly and disassembly.

8. Residual waste slurry and cleaning water should be washed to a process drain. Do not flush down a sanitary sewer drain. Residual oil will be disposed in accordance with plant procedures for hydrocarbon disposal.

9. If it is necessary for the oil column to be cleaned of slurry before the cell and its encapsulation assembly are reinserted, it can be done with water. As the slurry and oil mix is being pumped from the oil column, add water to maintain a shield level. If the water combination is maintained within one foot of the top of the column, it will provide a shield factor of at least 120. Neutron doses should not exceed 0.1 mrem/h, and gamma exposure should not exceed 1 mrem/h; for a total dose (conservatively) of approximately 1.1 mrem/h. After the column is cleaned, the oil can be added back as the water is pumped out.

SECTION VII: Cleaning of the Inner Source Shield and Encapsulation Assembly

The encapsulation assembly can be disassembled and flushed with water. The assembly is made of glass and is very fragile, so this procedure must be done very carefully. Slurry from the assembly will be disposed down a process wastewater drain. Residual slurry in the inner column can be pumped out. This is best done by pumping out oil while inserting water. The oil can be reclaimed, i.e., it can be easily filtered and reused, but should not be disposed in a process drain. Once the inner column is clean, it must be refilled with oil, again to about one foot from the top; before the encapsulation cell assembly is lowered into place.

1. When the encapsulation assembly is properly installed, the distance from the top of the encapsulation cell cover to the top of the inner source shield cover should be approximately 15/16 inch.

2. After the cell is seated over the neutron source holder, top-off the oil bath level to within 1-2 inches from the top of the cell.

3. Reconnect the loop tubing; pump water through the lines; and check for leaks.

4. Secure the inner source shield cover with the lock ring screws and locking cable.

SUMMARY OF RADIATION SAFETY INFORMATION

A. NOLA Density System

1. Cs-137; 500 mCi in a lead-filled source head.

2. Results of the radiation survey completed at the time of installation must be maintained on file for inspection. Radiation surveys need not be repeated unless the device is removed from its installed position.

3. Leak test once every three years using an approved procedure.

4. Ensure that the source shutter is closed during any maintenance on the enclosed electronics. One or two survey readings inside the electronics box are appropriate since the shutter is enclosed.

B. Activation Analysis System

1. Pu-238-Be emitting 1.1×10^8 n/sec.

2. The initial radiation survey and the manufacturer supplied drawing showing both neutron and gamma levels should be maintained on file together.

3. The license issued for possession of the unit will require leak testing for the Pu-238-Be source at least once every 6 months.

4. Radiation fields under normal conditions of use are very low.

5. The source is threaded with counter-clockwise threads on a plate at the bottom of the oil bath.

6. Loss of the entire water shield would not preclude repair to a leaking tank with the source cell and oil column in place. The maximum radiation levels without water in the tank would be 15-20 millirem per hour at the tank surface on the closest side.

7. The slurry loop will be flushed, if possible, with water prior to any shutdown of the pump or external sampling systems to preclude slurry from settling around the source for a long period of time.

8. Failure of the tubing or the glass irradiate cell can require removal of the cell and cell container for repair. The cell, any slurry, and the cell encapsulation will all have some level of radioactivity in or on them from being near the neutron source. Any loose slurry may be slightly radioactive and therefore the cell should be treated as having surface contamination. All loose slurry should be flushed into a process wastewater drain.

   The activation products buildup will not create radiation fields that are high in terms of significant dose. However, one should monitor these radiation fields with a standard GM tube when handling the irradiate cell. Gloves must be worn during handling, and the gloves and hands washed upon completion. All components will be cleaned and stored until reassembly. Any residual slurry should simply be washed off and down a process wastewater drain.

9. The silica analyzer has recently been resurveyed for neutron dose. Most of the numbers are lower than those originally reported by the manufacturer. Even though the doses are very low, all individuals directly assigned to this kind of work are to be considered occupationally exposed because the classification depends on work assignment, not dose levels. Neutron doses are typically 1/10 - 1/100 of the gamma doses at any point, even at the surface.

10. The principle radioisotope made in the steel construction of all components is Fe-55 formed from Fe-54$(n,\gamma)\rightarrow$Fe-55. The total energy available from Fe-55 disintegration is approximately 5.9 keV. It is extremely low and offers little possibility of dose to live tissue. The primary source of gamma radiation is the irradiated slurry containing the short lived isotope of aluminum and gammas formed both from production of neutrons at the source and their capture in hydrogen. The radioactive material content of the irradiate cell encapsulation assembly should decay very rapidly in time.

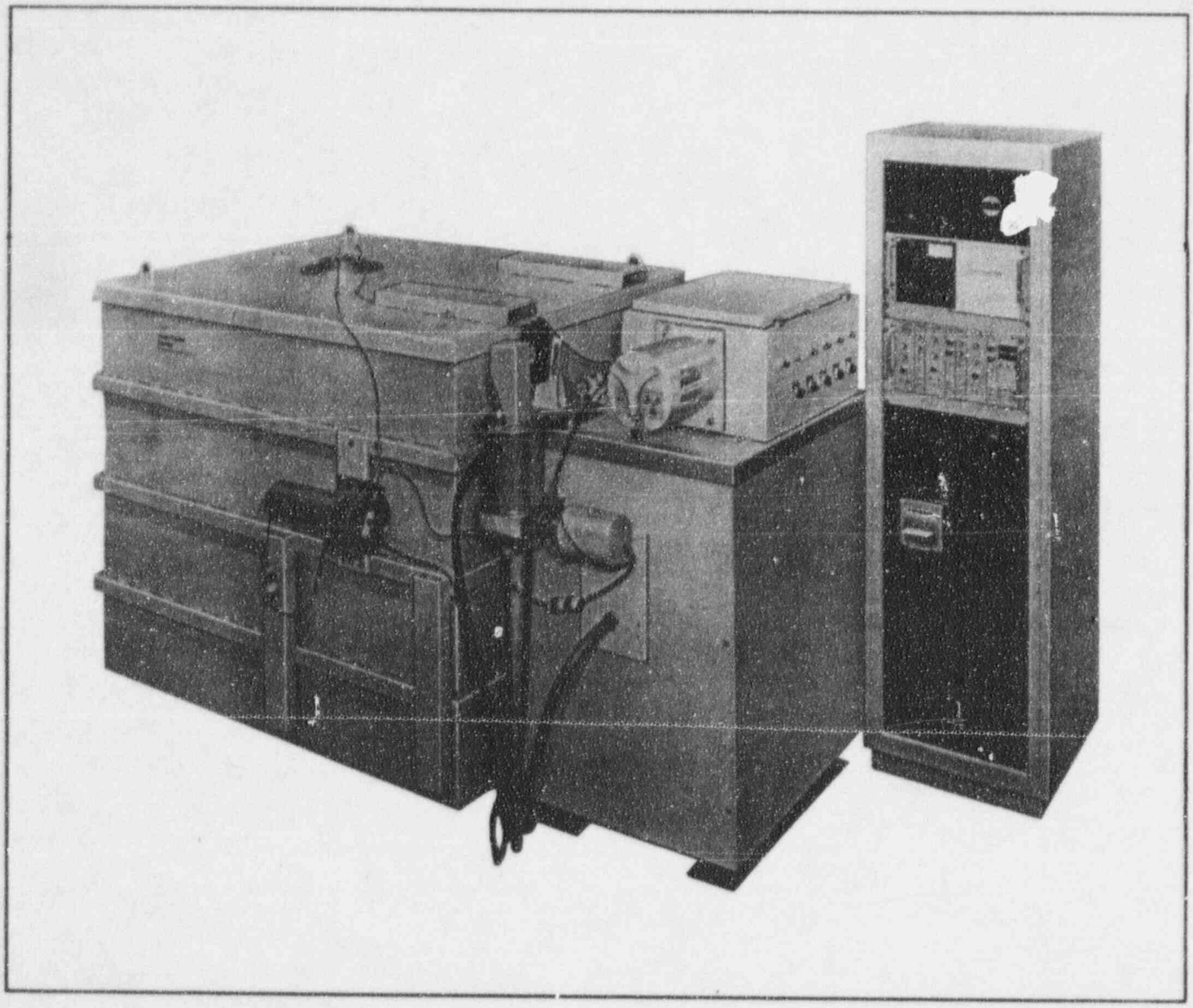
TEXAS NUCLEAR
A Baker Hughes company

Model NA79

NOLA

Neutron Activation Analysis for Industrial Process Control

Technical Specifications



AUTOMATIC, SENSITIVE, FAST ANALYSIS OF SILICA IN IRON ORE

- Analysis time typically 3 to 6 minutes
- Accuracy of ±4.0% relative at the 95% confidence level.
- Low-maintenance, continuous operation.
- Completely automated sample handling.
- Variable sample volume accepted.
- Low cost per analysis.
- Simple to operate.
- Local and remote printout of % SiO_2.
- Computer interface capability.
- Drift compensated circuits.
- Modular, solid-state circuitry.
- Neutron source maintenance-free

INTRODUCTION

Quantitative elemental analysis plays a most important role today in the control of product quality and operating plant efficiency. In many plant operations, rapid analysis and information feedback are essential for adequate control. Conventional laboratory analytical techniques are often too slow and not easily integrated into the computer controlled plant.

One practical approach to closed loop control is real time elemental analysis. Process trends can be instantaneously observed and the necessary control applied. Neutron Activation Analysis, in many cases, provides such a method of analysis. The relatively high penetration of the neutrons and the ensuing gamma radiation enable measurements to be made with the minimum of sample preparation, and many of the problems which beset x-ray techniques such as heterogeneity, particle size, and matrix effects are not encountered. Special thin window sample presentation cells are not necessary, and measurements can be made on bulk material transported by ordinary conveyor belts or on flowing streams in pipes. The deep penetration of the radiation also minimizes errors due to sampling, since the weight of material being measured can often be made large enough to be representative of the process stream. Finally, and not least, changes in the chemical composition of the matrix produce a negligible effect on the analytical accuracy, since activation analysis is specific to the element of interest.

The NOLA I (Neutron On-Line Analyzer) is a radioisotope neutron-source activation analysis system for the measurement of silicon in iron ore slurries. The use of this instrument permits measurement of the silicon content of a sample in six minutes versus the several hours required by wet chemistry techniques. Since the system is automated, consistent analysis from one sample to the next is assured and cost per sample is minimized. The NOLA I output expresses the measured silicon content as percent by weight silica, since this is the chemical form of interest. Three output options are provided:

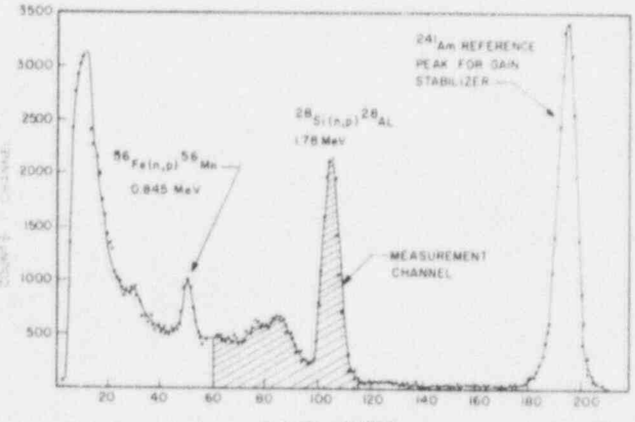
(1) A digital record of the percent by weight silica, time and date can be printed locally and/or at a remote station.
(2) A digital signal that can be interfaced into a computer.
(3) An Analog signal, 0-10V and/or 0-4-20 mA, that can be used for process control.

The percent silica contained in a 50% solids content iron ore slurry can be measured in a six minute analysis time, with a guaranteed accuracy of ±4.0% relative at the 95% confidence level for silica concentrations greater than 4% by weight. Slurries containing less solids and/or shorter analysis times can be accommodated but with some sacrifice in relative accuracy.

PRINCIPLE OF OPERATION

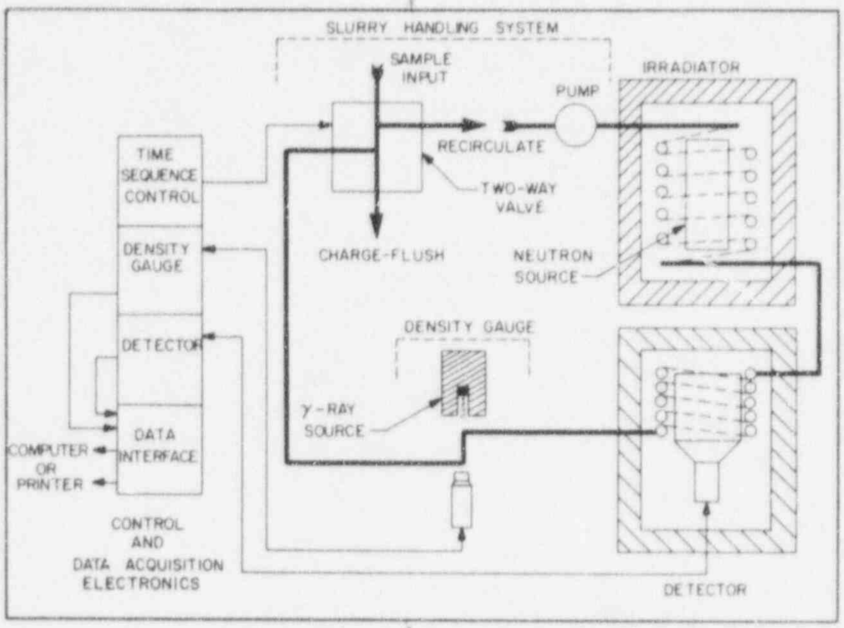
NOLA I uses the techniques of fast neutron activation analysis to measure the silica content of a flowing stream of iron ore slurry. When exposed to fast neutrons, the slurry becomes slightly radioactive (i.e., is activated) through certain nuclear reactions between sample nuclei and bombarding neutrons. The activated sample returns to a stable form by emitting characteristic radiation with a known rate of decay. This radiation is quantitatively measured and used to determine the mass of the activated element in the bombarded sample.

Specifically, for determination of silica in taconite, the neutrons interact with the silicon nuclei to produce an unstable isotope of aluminum which decays by emission of 1.78-MeV γ-rays. The half-life of the decay process is 2.3 minutes. The complete γ-ray spectrum from an iron ore sample after bombardment with fast neutrons



is shown in Figure 1. The portion of the spectrum designated as "Measurement Channel" includes the 1.78-MeV γ-ray and part of the "Compton tail" due to this radiation. The digital output received from the "Measurement Channel" is used to determine the amount of silica in the sample.

The overall analysis procedure used in NOLA I is illustrated in the schematic shown in Figure 2. The analysis loop is completely filled via a solenoid-operated, two-way valve with approximately 500 milliliters of taconite slurry containing a maximum of 50% solids. During analysis the slurry sample is continuously recirculated through the IRRADIATOR, DETECTOR, and DENSITY GAUGE, which comprise the analysis loop. This technique, termed Recirculation Activation Analysis, has several advantages in this application:



(1) maximum sensitivity for a 6-minute analysis time;
(2) least dependence on changes in slurry flowrate; and,
(3) permits a high rate of flow without loss in sensitivity to minimize the problems of slurry sedimentation.

In the IRRADIATOR, the slurry is exposed to neutrons from a doubly-encapsulated, ^{238}Pu-Be source. This maintenance-free isotopic source emits approximately 1×10^8 neutrons per second with a characteristic half life of 87.4 years. The residual radiation in the slurry, induced by interaction with the neutrons from the ^{238}Pu-Be source in the IRRADIATOR, is measured in the DETECTOR.

The DETECTOR consists of a large NaI (Tl) γ-ray spectrometer, count cell, and radiation background shield. The activated slurry is pumped through the count cell where the residual radiation is measured. This assembly is enclosed in a low-background shield.

The DENSITY GAUGE consists of a NaI (Tl) γ-ray spectrometer and a **Texas Nuclear** Model 5176 density gauge head which provides a collimated beam of 0.662-MeV γ-rays from ^{137}Cs. The intensity of the γ-ray beam transmitted through a segment of slurry path is measured with the γ-ray detector and used to normalize the silicon signal to slurry solids content. One side of this enclosure contains the control panel for manual operation of the system.

The CONTROL AND DATA ACQUISITION UNIT houses the ancillary electronics for the two detectors, a time-sequence controller, a data interface unit which provides either a direct print-out of the percent silica, transmission of digital data to a computer, and/or an analog signal.

Texas Nuclear
A Baker Hughes company

Box 9267
Austin, Texas 78766 USA
Telephone (512) 835-0801
Telex 77-6413

For additional information, contact:

or Factory

SYSTEM PERFORMANCE

NOLA I has been extensively tested both in the laboratory and in the field. The instrument is operating satisfactorily on a 24-hour-per-day basis in both U. S. and Canadian iron ore processing plants. Figure 3 shows a typical calibration curve. The background-corrected silicon counts, normalized to 50% solids slurry via the gamma-ray transmission gauge measurement, are represented on the ordinate versus the percent by weight silica determined by wet chemistry techniques on the abscissa of the curve. A least squares analysis applied to these data indicates a standard deviation about the curve of ±0.1% silica. The system precision for repeated measurements on identical samples has been determined to be ±0.06% silica for a sample with nominal 6% silica concentration. These results are typical of the many samples measured from widely separated iron ore deposites in both the United States and Canada.

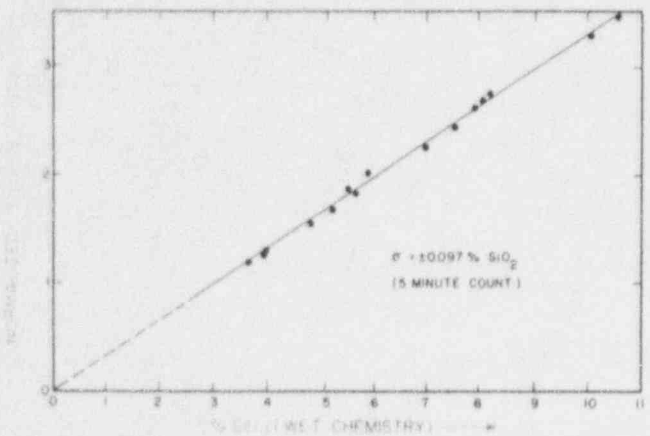


Fig. 3

SUMMARY

This brochure describes an instrument system that represents a major breakthrough in on-line elemental analysis for the taconite benefaction industry. An environmentally hardened system based on Neutron Activation Analysis is described. This instrument offers the advantage of speed, convenience and automation of earlier X-Ray systems, but performs the analysis independent of heterogeneity, particle size or chemical matrix effects. In addition, due to the higher penetration of the radiation, rugged cells may be used, alleviating the problem of window rupture or cell blockage.

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DAMAGE TO DEVICE CONTAINING RADIOACTIVE MATERIAL Procedure No. RS-007

Approved By: Revision: Date: 12/01/94

Purpose:

To record safety precautions and procedures to be used in the event a device is damaged. The possibility of a fire, explosion or accident causing significant damage to the secure housing of a device containing a sealed source is extremely unlikely. An intense, sustained fire could result in some melting of the lead shield around the radioactive material thereby increasing external radiation levels. However, failure of the source capsule inside the gauge resulting in a release of radioactive material (contamination) is very unlikely. Even so, all incidents will be handled from a very conservative approach. The Radiation Protection Officer and authorized users are familiar with storage locations of radiation monitoring devices. A radiological survey of the area must be conducted prior to entering that area.

SAFETY PROCEDURES

A. Reporting Responsibilities

1. Employee

If an employee recognizes a situation in which a device containing radioactive material has been involved in a fire, explosion or otherwise damaged, it is their responsibility to evacuate the area, notify fellow employees in the immediate area and report the situation immediately to Security, their supervisor and the Radiation Protection Officer. In the process of notification the employee will state a brief description of the situation, location of the incident and give his/her name and department.

2. Security Personnel

Sound the alarm for the fire brigade and notify them of the situation, then contact the Radiation Protection Officer for radiological guidance.

B. Leadership "On the Scene"

1. The supervisor initially informed, or a responsible "on-site" person contacted by security personnel, is the "on-the-scene" supervisor until relieved by the Fire Brigade Leader.

2. The Radiation Protection Officer will act as a technical advisor to the Fire Brigade Leader.

C. Safety Objectives and Precautions

1. Evacuate the area and then secure against unauthorized entry until a Radiation Protection Officer makes a radiological survey and gives approval for re-entry.

2. Injured personnel should be immediately removed from the area taking all necessary precautions warranted by the extent of the injury. All life saving measures should be performed. The Radiation Protection Officer will examine the injured for possible radioactive contamination.

3. If the incident involves a fire, attempts to extinguish should be made from as great a distance as possible, avoiding smoke, fumes or dust to every extent possible. The fire should be treated as one involving toxic chemicals. Clothing and tools used at the fire must be segregated until checked by a radiological survey.

4. Any persons suspected of potential contact with loose radioactive material shall be detained until examined and released by the Radiation Protection Officer.

5. No attempt to clean up debris or material involved in the incident is to be made prior to approval by a Radiation Protection Officer.

RADIATION EXPOSURE - DECLARED PREGNANT FEMALE Procedure No. RS-008

Approved By: ______ Revision: ______ Date: 12/01/94

Purpose:

Regulations require that a licensee ensure radiation exposure to an occupationally exposed declared pregnant female, and to the embryo/fetus, does not exceed 500 mrem for the remainder of the gestation period once the pregnancy has been declared in writing. The following procedure shall be followed when an occupationally exposed female employee makes a written declaration of her pregnancy.

A. Upon declaration, Tilden Mining Company, L. C. shall begin individual monitoring for the pregnant female and the unborn embryo/fetus. This monitoring shall be conducted by the RPO or his designee.

C. Exposure shall be monitored with the use of film badges; one for the female and one for the embryo/fetus.

C. Monitoring shall be conducted on a monthly basis from the time of declaration until the female goes on maternity leave.

D. Exposure records for the female and the embryo/fetus shall be kept separately in files maintained by the Radiation Protection Officer.

PROCUREMENT OF RADIOACTIVE MATERIAL Procrdure No. RS-009

Approved By: Revision: Date: 12/01/94

Purpose:

Tilden Mine routinely uses devices containing sealed radioactive sources in various applications throughout the plant site. It is important that the Radiation Protection Officer be aware of any devices or any activity involving the use of radioactive material, prior to that material being brought on site; and that the RPO or his designee handles the receipt of such materials.

A. Personnel who expect to order any product containing radioactive material shall contact the Tilden Mine RPO in advance.

B. The potential purchaser should send information to the RPO prior to placing an order for radioactive material. As a minimum, this information shall include:

* Vendor and Contact Person
* Product Model Number
* Isotope
* Activity
* Intended Use
* Date Required

C. The RPO will review the request to determine if possession of the radioactive material is currently authorized under Tilden Mine's specific license, or if a license amendment must be secured.

The request will be reviewed for completeness of information, enabling the RPO to resolve early on, incomplete facts regarding the intended use, design or integrity of the device. In addition, the RPO will determine or obtain:

a. The ANSI classification for the source (NBS Handbook #126)
b. The form of the radioactive material (49 CFR 173.403)
c. The chemical composition of the radioactive material
d. The leak test frequency
e. Mounting requirements/arrangement

D. Once satisfied all information is complete, the RPO will sign and forward the request to the Purchasing Department. The purchase order will be submitted to the appropriate vendor. No device containing radioactive material will be ordered, received or released to any user on Tilden Mine property, without this procedure having been followed.

E. Any purchase requisition for devices containing radioactive material received in Purchasing without the RPO's approval will be returned to the RPO for approval prior to being processed.

RECEIPT OF RADIOACTIVE MATERIAL Procedure No. RS-010

Approved By: Revision: Date: 12/01/94

Purpose:

To provide information regarding the safe receipt of devices containing radioactive material as sealed sources.

1. RECEIPT OF DEVICES CONTAINING TYPE A QUANTITIES OF RADIOACTIVE MATERIAL

A. Immediately upon receiving a radiation source, receiving personnel are to contact the Radiation Protection Officer to insure the safe receipt of the gauge.

B. The shipping box or crate must be visually inspected by receiving personnel and the RPO to determine if any damage has occurred during transport. The RPO will conduct a radiological survey to determine the radiation field in the area of the shipping container.

C. The outer covering of the box or crate is to be removed but the gauge is to remain attached to the skid base. Again, visual inspection will be conducted checking for possible transport damage, status of the shutter locking mechanism and correctness of labeling.

D. Conduct another brief radiation survey to insure the security of the source and the shutter.

E. If damage is evident, the source unit is to be isolated and leak tested for contamination using an approved mailable kit. Damage or any degree of contamination precludes installation and the supplier of the unit will be notified immediately. Following an inspection which does not indicate any problems the device may be transported to the mounting location. The RPO or his designee should accompany the device to insure safe transport. The RPO will assemble receiving documentation for company records, along with the transport papers and leak test certificate which should accompany the device.

2. RECEIPT OF RADIOACTIVE MATERIAL IN EXCESS OF TYPE A QUANTITIES (NOLA SYSTEMS)

A. Upon receipt of devices containing radioactive material in excess of Type A quantities (at Tilden this would only be NOLA Systems), a radiation survey of the external surface of the package, and receipt documentation must be accomplished:

1. within three (3) hours after the package is received if it is received within normal work hours, or

2. not later than three (3) hours from the beginning of the next working day if received after normal working hours.

B. Follow steps outlined in Section 1, ensuring that a RPO is notified within the three (3) hour limit.

NUCLEAR DEVICE INVENTORY AND INSPECTION Procedure No. RS-011

Approved By: Revised: Date: 12/01/94

Purpose:

This procedure is designed to facilitate completion of the Tilden Mine semi-annual inventory and inspection of devices containing radioactive material.

A. A physical inventory and inspection of each device containing radioactive material will be performed by authorized Tilden Mine personnel once every six months.

B. Inventory records will include:
The manufacturer, model and serial number of each device containing radioactive material;
The radionuclide and its estimated activity;
The location of each device;
The date of the inventory;
The signature of the radiation protection officer or designee completing the inventory.

C. Check all tags and labels on the gauging device to make sure they are legible.

D. If the tag or label is illegible, it must be replaced. New replacement tags must be ordered from the manufacturer.

E. Check the operation of the device shutter. If it does not operate freely, clean, lubricate, and try to free it up. If the shutter will not move, notify the RPO.

F. If the housing shows signs of significant rust or corrosion, it can be repainted making certain labels and the tag are taped prior to doing so. Additionally, one should use care around the shutter to ensure that paint does not inhibit shutter movement.

G. Maintenance items identified during routine inspections will be logged by the RPO or his designee on the Maintenance Request Form attached or equivalent computerized form and forwarded to the proper department for action. Completed forms will be returned to the RPO, after maintenance requests have been fulfilled.

H. Completed inventory/inspection forms will be provided to the RPO for his review prior to filing.

I. Records will be maintained for a minimum of two years or as specified in the Tilden Mine specific license.

MAINTENANCE REQUEST FORM

SECTION I

The following maintenance items are required for the identified gauging device:

To:	Department:
Device Identification:	Device Location:
Maintenance to be performed:	
Requested By:	Date:

SECTION II

MAINTENANCE COMPLETION CERTIFICATION

Requested maintenance was completed, per the following:

Signature:	Date:
Comments:	

1. Complete Section I and forward to appropriate department for required maintenance.
2. Upon completion of requested maintenance, complete Section II and return to Radiation Protection Officer.
3. Radiation Protection Officer will file completed form with appropriate inspection file.

APPENDIX D

APPENDIX C OF DRAFT REGULATORY GUIDE DG-0008

APPENDIX I OF DRAFT REGULATORY GUIDE DG-0008

(NOTE: Where these Draft Guides refer to Radiation Safety Officer and RSO, please note that our procedures and text refer to Radiation Protection Officer and RPO.)

APPENDIX C

DUTIES AND RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER

The Radiation Safety Officer (RSO) is responsible for implementing the radiation safety program and ensuring that radiation safety activities are performed in accordance with approved procedures and regulatory requirements.

The RSO's duties and responsibilities include:

1. Ensure that licensed material possessed by the licensee is limited to the kinds (e.g., cesium-137 as a sealed source) and quantities of byproduct material listed on the license.

2. Ensure that individuals using gauges are properly trained; are designated by the RSO; receive refresher training at least annually, including participation in a "dry run" of emergency procedures and review of operating and emergency procedures and Department of Transportation (DOT) requirements; and are informed of all changes in regulatory requirements and deficiencies identified during annual audits.

3. Ensure that personnel monitoring devices are used as required and reports of personnel exposure are reviewed in a timely manner.

4. Ensure that gauges are properly secured against unauthorized removal at all times when gauges are not in use.

5. Ensure that proper authorities are notified in case of accident, damage to gauges, fire, or theft.

6. Ensure that audits are performed at least annually to ensure that (a) the licensee is abiding by NRC and DOT regulations and the terms and conditions of the license (e.g., periodic leak tests, inventories, use limited to trained, approved users), (b) the licensee's radiation protection program content and implementation achieve occupational doses and doses to members of the public that are ALARA (see 10 CFR 20.1101), and (c) the licensee maintains required records with all required information (e.g., records of

personnel exposure; receipt, transfer, and disposal of licensed material; gauge user training) sufficient to comply with NRC requirements.

7. Ensure that results of audits, identification of deficiencies, and recommendations for change are documented (and maintained for at least 3 years) and provided to management for review; ensure that prompt action is taken to correct deficiencies.

8. Ensure that audit results and corrective actions are communicated to all personnel who use licensed material (regardless of their location or the license under which they normally work).

9. Ensure that all incidents, accidents, and personnel exposure to radiation in excess of ALARA or Part 20 limits are investigated and reported to NRC and other authorities, as appropriate, within the required time limits.

10. Ensure that licensed material is transported in accordance with all applicable DOT requirements.

11. Ensure that licensed material is disposed of properly.

12. Ensure that he or she has up-t -date copies of NRC's regulations, reviews new or amended NRC regulations, and revises licensee procedures, as needed, to comply with NRC regulations.

13. Ensure that the license is amended whenever there are changes in licensed activities, responsible individuals, or information or commitments provided to NRC in the licensing process.

APPENDIX I

SAMPLE AUDIT PROGRAM

An audit is conducted, in part, to fulfill the requirements of 10 CFR 20.1101 for an annual review of the content and implementation of the licensee's radiation protection program. It should also identify program weaknesses and allow licensees to take early corrective actions (before an NRC inspection). During an audit, the auditor needs to keep in mind not only the requirements of NRC's regulations, but also the licensee's commitments in its applications and other correspondence with NRC. The auditor should also evaluate whether the licensee is maintaining exposures to workers and the general public as low as is reasonably achievable (ALARA), and if not, make suggestions for improvement.

The form in this appendix can be used to document the annual audit of the radiation protection program. Guidance is provided here on completing each section of the form. In the remarks portions of the form, note any deficiencies that were identified and the corrective actions taken (or to be taken).

1. Audit History. Enter the date of the last audit, whether any deficiencies were identified, and whether actions were taken to correct the deficiencies.

2. Organization and Scope of Program. Briefly describe the organizational structure, noting any changes in personnel. Describe the scope of licensed activities at the audited location. Check whether the Radiation Safety Officer (RSO) is the person identified in the license and fulfills the duties specified in the license.

3. Training, Retraining, and Instructions to Workers. Ensure that workers have received the training required by 10 CFR 19.12. Be sure that, before being permitted to use a gauge, the user has received training (from the manufacturer or in an alternative course approved by NRC) and has a copy of, and training in, the licensee's operating and emergency procedures; records should be maintained. Note whether refresher training is conducted in accordance with licensee commitments. By interview and observation of selected workers, ensure that each

has a copy of the licensee's operating and emergency procedures and can implement them properly.

4. Internal Audits. Verify that audits fulfill the requirements of 10 CFR 20.1101, are conducted in accordance with licensee commitments, and are properly documented.

5. Facilities. Verify that the licensee's facilities are as described in its license documents.

6. Materials. Verify that the license authorizes the sealed source/device combinations that the licensee possesses. Verify that the licensee uses the source/device combinations in accordance with license provisions. Ensure that gauges are maintained in accordance with licensee commitments.

7. Leak Tests. Verify that all sealed sources are tested for leakage at the prescribed frequency and in accordance with licensee commitments. Records of results should be maintained.

8. Inventories. Verify that inventories are conducted at least once every 6 months to account for all sealed sources; inventory records should be maintained.

9. Radiation Surveys. Verify that the licensee has at least one operable, calibrated survey instrument at each jobsite and that the instruments are calibrated in accordance with licensee commitments; in accordance with 10 CFR 20.2103, calibration records must be retained for three years after the record is made. Alternatively, evaluate the licensee's arrangements for timely access to survey instruments in case of an incident. Check that radiation levels in the vicinity of use of the gauge and immediately outside areas used for gauge storage are within regulatory limits; in accordance with 10 CFR 20.2103, records of surveys must be retained for three years after the record is made. Verify compliance with 10 CFR 20.1301; records should be maintained.

10. Receipt and Transfer of Radioactive Material (Includes Waste Disposal). Verify that gauges received from others (e.g., new gauges) are received, opened,

and surveyed in accordance with 10 CFR 20.1906. Ensure that gauge transfers are performed in accordance with 10 CFR 30.41. Records of surveys, receipt, and transfer must be maintained in accordance with 10 CFR 20.2103 and 30.51.

11. Transportation. Determine compliance with Department of Transportation (DOT) requirements. Verify that hazardous materials training is conducted as required by 49 CFR 172.700-704. Verify that radioactive packages are prepared, marked, and labeled in accordance with 49 CFR Parts 172 and 173 requirements. Be sure that the licensee has records of performance testing of its special form sources and DOT-7A packages. Verify that shipping papers are prepared, contain all needed information, and are readily accessible during transport (49 CFR 172.200-204 and 177.718). Check that packages are blocked and braced (49 CFR 177.842). Check for any needed placarding (49 CFR 172.504); if overpacks are used, verify that they are properly marked and labeled (49 CFR 173.25).

12. Personnel Radiation Protection. Evaluate the licensee's determination that unmonitored personnel are not likely to receive more than 10 percent of the allowable limits. Alternatively, if personnel dosimetry is provided and required, verify that it complies with 10 CFR 20.1501(c) and licensee commitments. Review personnel monitoring records; compare exposures of individuals doing similar work; determine reasons for significant differences in exposures. If any worker declared her pregnancy in writing, evaluate the licensee's compliance with 10 CFR 20.1208. Check whether records are maintained as required by 10 CFR 20.2101-2104 and 20.2106.

13. Auditor's Independent Measurements (If Made). If the licensee performs extended maintenance, the auditor should make independent measurements and compare the results with those made or used by the licensee. If the licensee does not perform extended maintenance, the auditor may, if desired, make independent measurements.

14. Notification and Reports. Check on the licensee's compliance with the notification and reporting requirements in 10 CFR Parts 19, 20, and 30. Ensure that the licensee is aware of the telephone number for NRC's Emergency Operations Center.

15. <u>Posting and Labeling</u>. Check for compliance with the posting and labeling requirements of 10 CFR 19.11, 20.1902, 20.1904, and 21.6.

16. <u>Recordkeeping for Decommissioning</u>. Check to determine compliance with 10 CFR 30.35(g).

17. <u>Bulletins and Information Notices</u>. Check to determine whether the licensee is receiving bulletins, information notices, NMSS Newsletters, etc., from NRC. Check whether the licensee took appropriate action in response to NRC mailings.

18. <u>Special License Conditions or Issues</u>. Verify compliance with any special conditions on the licensee's license. If the licensee has any unusual aspect of its work with portable gauges, review and evaluate compliance with regulatory requirements. If the licensee conducts licensed activities at locations other than the one being audited, consider the deficiencies identified at the other locations and ensure that the corrective actions implemented in response to those deficiencies have in fact been implemented at the audited locations.

19. <u>Continuation of Report Items</u>. This section is self-explanatory.

20. <u>Problems or Deficiencies Noted, Recommendations</u>. This section is self-explanatory.

21. <u>Evaluation of Other Factors</u>. Evaluate management's involvement with the radiation safety program, whether the RSO has sufficient time to perform his/her duties, and whether the licensee has sufficient staff to handle the workload and maintain compliance with regulatory requirements.

NOV 15 1996

Robert G. Clark
Corporate Radiation Protection Officer
Tilden Mining Company L.C.
Tilden Mine
P. O. Box 2000
Ishpeming, MI 49849

Dear Mr. Clark:

Enclosed is your NRC Material License Number 21-26748-01 in accordance with your request.

Please review the enclosed document carefully and be sure that you understand all conditions. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region III office at (630) 829-9887 so that we can provide appropriate corrections and answers.

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Unless your license has been terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.

2. Not possess and use materials authorized in Items 6, 7, and 8, on the license until:

   a. You have constructed the facilities and obtained the equipment described in the license application and supporting documentation; and

   b. You have notified the U. S. Nuclear Regulatory Commission, Region III, ATTN: Chief, Nuclear Materials Licensing Branch, in writing, that activities authorized by the license will be initiated.

3. Notify NRC, in writing, within 30 days:

   a. When the Radiation Safety Officer permanently discontinues performance of duties under the license or has a name change; or

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b. When the licensee's mailing address changes (no fee is required if the location of byproduct material remains the same).

4. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license:

   a. When you decide to terminate all activities involving materials authorized under the license; or

   b. If you decide not to complete the facility, acquire equipment, or possess and use authorized material.

5. Request and obtain a license amendment before you:

   a. Change Radiation Safety Officers;

   b. Order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;

   c. Add or change the areas of use or address or addresses of use identified in the license application or on the license; or

   d. Change ownership of your organization.

6. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or certifying official rather than a consultant.

You will be periodically inspected by NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the General Policy and Procedures for NRC Enforcement Actions. Since serious consequences to employees and the public can result from failure to comply with NRC requirements,

prompt and vigorous enforcement actic., will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Sincerely,

Original Signed By
W. P. Reichhold
Nuclear Materials Licensing Branch

License No.: 21-26748-01
Docket No.: 030-34221

Enclosure: New License Package

DOCUMENT NAME: M:\03034221.CL6

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	DNMS/RIII				
NAME	WREICHHOLD:jaw				
DATE	11/ /96				

OFFICIAL RECORD COPY

Cliffs Mining Services Company
Subsidiary of Cleveland-Cliffs Inc
Ishpeming, Michigan

October 16, 1996

Mr. William Reichhold
U. S. Nuclear Regulatory Commission
Region III
801 Warrenville Road
Lisle, IL 60532-4351

Reference: License Review for Tilden Mining Company, L.C.

Dear Mr. Reichhold:

This letter is in response to the questions contained in your fax dated September 30, 1996. The questions are answered in the same order as presented.

1. It was our intent for Level II individuals to perform some licensed activities (i.e., mount or remove gauges) under the supervision of and in the presence of a Level II individual who has completed forty (40) hours of industrial radiation safety training. These individuals are experienced and have been performing such activities under supervision for a number of years under License No. 21-03076-01 issued to The Cleveland-Cliffs Iron Company. The wording of Condition 16 of License No. 21-03076-01 would work well for our intended purposes.

2. Enclosed is an agenda for the annual refresher training referenced in our application.

3. For the Pu-238-Be sources in NOLA systems, you are correct in that the Monsanto Corporation drawing is No. DOMISC-2001 as listed on License 21-03076-01. HMC-A-1047 is an identical drawing renumbered by Texas Nuclear; however, for consistency it would be better to use the Monsanto number.

Relative to the Cs-137 sources in the density channel of the NOLA system, License No. 21-03076-01 is not correct as currently written. The source capsule model number is 570-57157C and is used in a Texas Nuclear Model 5176 source head. Therefore, License 21-03076-01, Item 7.M., should also be corrected.

Regarding the Am-241 50 nanocurie stabilizer sources, the same comments apply as for the Pu-238-Be sources. The Harshaw Chemical Company drawing number is AMK312G312K. Drawing AMC-312 is an identical drawing renumbered by Texas Nuclear. However, as above, for consistency it would be better to use the Monsanto number.

We apologize for this confusion and hope this clarifies the matter.

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PM: 10-16-96

504 Spruce Street • P.O. Box 1000 • Ishpeming, MI 49849-0900

OCT 21 1996

4. Thank you for your reminder in Item 4. We will ensure this is accomplished in compliance with 10 CFR 20.1906(3).

We appreciate your cooperation and assistance in this matter. Feel free to give me a call if any further clarification is needed.

Sincerely,

CLIFFS MINING SERVICES COMPANY

Robert G. Clark
Radiation Safety Officer
906-475-3812
906-475-3904 (fax)

RGC:lmk
Enclosure: Agenda
cc: TDW
PTG
WCH
RGC
File

AGENDA

FOUR-HOUR TECHNICIAN TRAINING

Basic Concepts of Radiation
- Radioactive materials
- Common uses of radiation

Working With Radiation
- Units
- Time, Distance, Shielding

Gauge Construction
- Basic design
- Beam geometry
- Source construction/testing
- Inspection procedures

Working Safety With Industrial Gauges
- Risks
- Accidents
- Radiation Protection Guides
- Dose limits
- Personnel monitoring

Survey Meters
- Types and purpose
- Calibration check
- Confirmation of scale
- Survey techniques

Regulatory Implications (Brief)
- Operating procedures
- Emergency procedures