FORM NRC-313 I (1 79) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

1. APPLICATION FOR (Check and/or complete as appropriate)

30-17788

X a. NEW LICENSE

b. AMENDMENT TO LICENSE NUMBER 03120

c. RENEWAL OF LICENSE NUMBER L-4-L 19495

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

2. APPLICANT'S NAME (Institution, firm, person, etc.)

Indian Health Service
Phoenix Area

TELEPHONE NUMBER AREA CODE NUMBER EXTENSION
241-2041 (602)

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION

Michael Verschelden

TELEPHONE NUMBER AREA CODE NUMBER EXTENSION
425-3173 (602)

4. APPLICANT'S MAILING ADDRESS (Include Zip Code)

801 E. Indian School Road
Phoenix, Arizona 85501

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED (Include Zip Code)

Primary storage at 16th St. & Indian School Road, Phoenix, Arizona Location A and Whiteriver IHS Storage Yard, Ft. Apache Reservation, Arizona Statewide job sites

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

FULL NAME	TITLE
a. Lloyd Spangler, P.E.	Staff Engineer
b. Pete Johnson, P.E.	District Engineer
c. Michael Verschelden, P.E.	District Engineer

7. RADIATION PROTECTION OFFICER

Lloyd Spangler, P.E.

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.

8. LICENSED MATERIAL

LINE NO	A. ELEMENT AND MASS NUMBER	B. CHEMICAL AND/OR PHYSICAL FORM	C. NAME OF MANUFACTURER AND MODEL NUMBER (If Sealed Source)	D. MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME
(1)	Cesium 137	Sealed Source	Troxler #3411B	Two * 8 mCi (ea)
(2)	Americium 241	Sealed Source	Troxler #3411B	Two * 40mCi (ea)
(3)				
(4)				

DESCRIBE USE OF LICENSED MATERIAL
E

(1) *Sealed in two Troxler Electronics Laboratories, Inc. Model 3411B surface gauges,

(2) which will be used to measure the moisture and density of engineering materials.

(3)

(4)

04763

FORM NRC 313 I (1 79)

9. STORAGE OF SEALED SOURCES

LINE NO.	A. CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED	B. NAME OF MANUFACTURER	C. MODEL NUMBER
(1)	Portable Moisture - Density Gauge	Troxler Electronics Lab	3411
(2)			
(3)			
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	A. TYPE OF INSTRUMENT	B. MANUFACTURER'S NAME	C. MODEL NUMBER	D. NUMBER AVAILABLE	E. RADIATION DETECTED (alpha, beta, gamma, neutron)	F. SENSITIVITY RANGE (milliroentgens/hour or counts/minute)
(1)	N/A					
(2)						
(3)						
(4)						

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☐ a. CALIBRATED BY SERVICE COMPANY
NAME, ADDRESS, AND FREQUENCY

NA

☐ b. CALIBRATED BY APPLICANT
Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

NA

12. PERSONNEL MONITORING DEVICES

A. TYPE (Check and/or complete as appropriate.)	B. SUPPLIER (Service Company)	C. EXCHANGE FREQUENCY
☐ (1) FILM BADGE ☒ (2) THERMOLUMINESCENCE DOSIMETER (TLD) ☐ (3) OTHER (Specify) _____	Radiation Detection Company 162 Wolfe Road Sunnyvale, California 94086	☐ MONTHLY ☒ QUARTERLY ☐ OTHER (Specify) _____

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s).

☐ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS (Include filtration, if any), ETC.
☒ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING (fixed and/or temporary), ETC.
☐ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC.
☐ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC. (See sketches)

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED
Source will be returned to the manufacturer

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

DEPARTMENT OF HEALTH, AND HUMAN SERVICES ~~EDUCATION, AND WELFARE~~

HEALTH SERVICES ADMINISTRATION

TROXLER SURFACE MOISTURE DENSITY GAUGE

A. HANDLING PROCEDURES

The Troxler instruments were designed with operator safety as a prime consideration; however, as with any piece of potentially hazardous equipment, some general precautions should be observed.

1. Do not operate or attempt to operate the instrument unless you have been authorized to do so.
2. Keep the source position in the "SAFE" or stored position when not in use.
3. Wear a film badge or other dose measurement device when using or transporting the instrument.
4. While exposure dose levels are well within limits for radiation workers, never expose yourself to the bare source without sufficient reason for justification of the additional dose.
5. Keep all unauthorized persons out of operating area. A suggested distance is 5 meters or 15 feet. The general public must not be unnecessarily exposed to radiation.
6. Maintain security of the instrument at all times. The source lock should be in place when not in use and the instrument should be kept in a locked vehicle when transported. When stored, the area should be locked. Not only is it an expensive piece of equipment, but if stolen, could be abandoned under conditions which could be hazardous to the general public.
7. Every user organization has standard operating procedures; the operator should follow these procedures and report any that he feels are unsafe.
8. Insure that the gauge has had leak test measurements at the proper intervals as required by your Radioactive Materials License.
9. If you have any doubts about use of the instrument, ASK. Your Radiological Safety Officer either has the answer, or can obtain one.
10. Do not attempt to repair, modify or open the sealed source under any circumstances.

B. SECURITY

Regulations require that locks be maintained on radiographic equipment to prevent accidental exposure of a sealed source when not under the direct supervision of approved personnel. In addition, storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.

C. TRANSPORTATION BY MOTOR VEHICLE

This instrument, in its container, may be transported by motor vehicle under the "YELLOW II" label without placarding the vehicle as required by 49 CFR 177.823.

The source rod lock should be in place and the container placed in a portion of the vehicle which can be locked. When not in transit, the instrument should be stored in a secured area.

Since the container has a Transport Index of 0.1 or greater, it may not be stored in less than 30 centimeters from passengers per 49 CFR 174.586. It also should not be stored for more than 8 hours at less than 1 meter from undeveloped film.

D. EMERGENCY PROCEDURES

1. Acidents

a. In the event of the possibility of damage to the source or source control mechanism, the operator will keep unauthorized persons at least ten feet from the gauge and prevent removal of the gauge from the site until authorization by the RSO or appropriate authority.

b. If there is any possibility that the source capsule might be ruptured then the source capsule location must be covered by a sheet of material (e.g. plastic, tarp, etc.) and held down by weights (e.g. rocks, bags of material, etc.) to prevent scattering of the radioactive material by the elements.

c. The operator must then immediately notify his Radiation Safety Officer of the incident and give an appraisal of the probable condition of the source.

d. The Radiation Safety Officer will then immediately notify the following authority who will provide instructions and assistance in accordance with the circumstances of the incident:

Region V, USNRC
Office of Inspection and Enforcement
1990 N. California Blvd.
Suite 202
Walnut Creek, CA 94596
(415) 486-3141 - Daytime, nights and holidays.

2. Source stolen or lost

a. The operator must immediately notify the local police or other law enforcement agency within whose jurisdiction the incident occurred.

b. The operator must also notify his Radiation Safety Officer who will in turn notify the authority listed in item D-1-d above.

E. TROXLER WIPE TEST

1. General Precautions

a. Keep exposure time to a minimum.
b. Maintain distance between source and body.
c. Use shielding where available.
d. Never touch the source with bare hands.
e. Never touch the filter paper after wiping.

2. Procedure

The wipe test procedure manual states that a whole body dosimeter should be used while performing the wipe test. However, for the purposes of the Troxler unit in the Phoenix Area, the following should be accomplished:

a. Transport the Troxler unit to the nearest IHS installation which would have x-ray equipment available.

b. Use film badge clipped to collar shirt.

c. Utilize protective devices such as lead apron and gloves while performing the wipe test.

d. Preparation: Before opening the instrument or exposing the sealed source in any way, obtain the materials (tongs, dowel, etc.) from the kit and wet the filter paper with a few drops of the solution. It is not necessary to saturate the complete disc, but visible wetness should exist over at least half of the paper.

e. Exposing the Source and Wiping: Regulations require that either the actual source capsule be wiped (weld area) or the most accessible point of a containment system. Most licensees of radioactive material are not permitted to disassemble or service a source containment system. PLEASE NOTE - YOU ARE NOT PERMITTED TO DISASSEMBLE THE UNIT.

If a source holder is involved, then it may be exposed to allow wiping the most accessible point. Remember to keep the source as far as possible from the body.

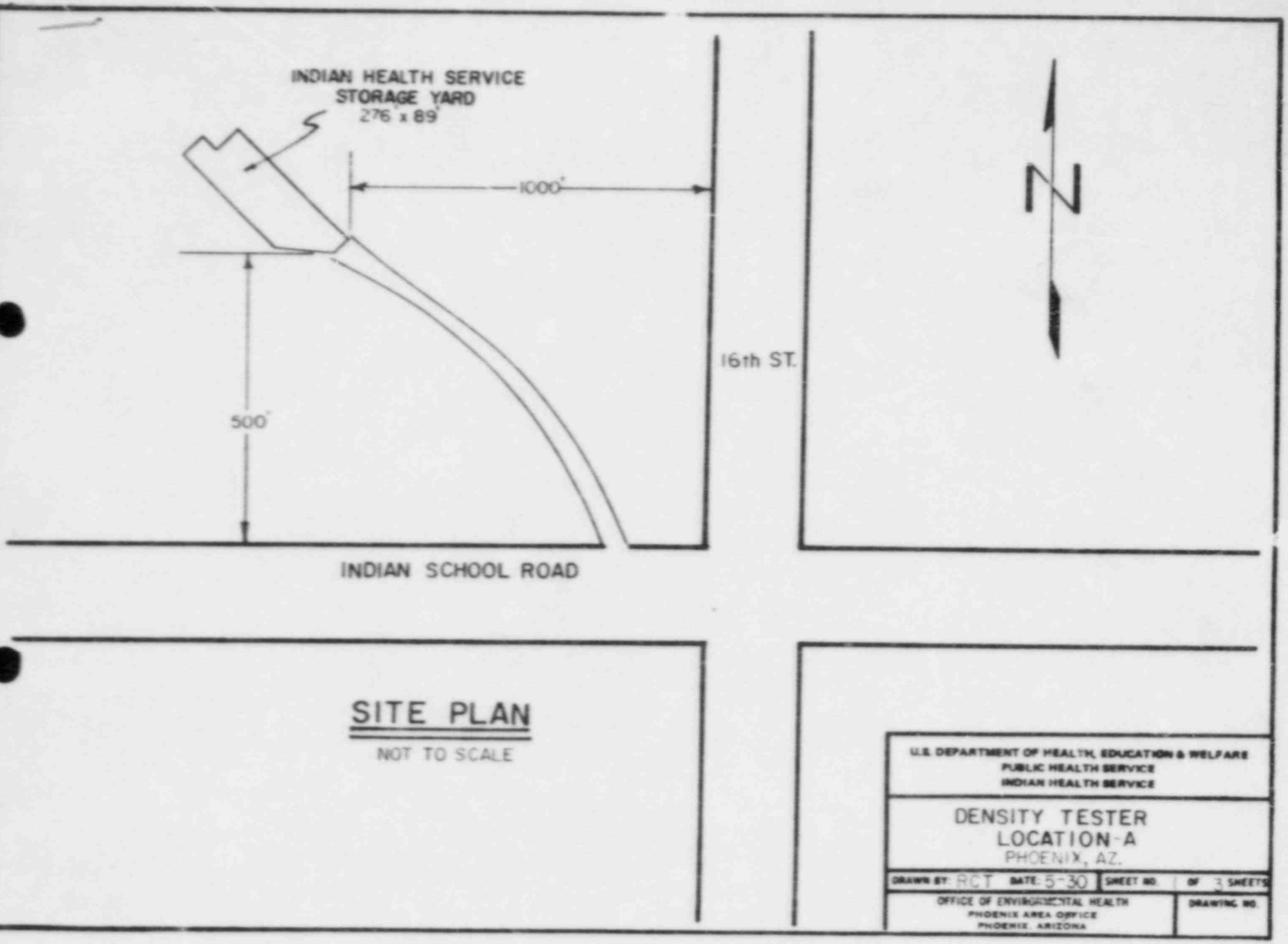
Grasp the filter paper with the tongs and using the wood dowel, gently rub the wetted filter paper over the area selected to be wiped. Lay the filter paper on a clean paper towel with the unused side of the filter paper in contact with the towel.

Close the instrument or re-shield the source as applicable.

Where possible, leave the wet filter paper exposed to air for several hours in order to dry the solution. If a warm surface is available, the drying can be accomplished in five to ten minutes. Holding the paper over a hot light bulb is recommended.

The papers for the test are completed. Place the filter paper in the plastic bag, label it with the gummed label. Use the original of the statement to be sent to the company with the sample. Send the copy of the test to the Area Office of Environmental Health, along with the test kit.

ANYTHING ABOVE ZERO READOUT WILL BE REPORTED TO YOU IMMEDIATELY.



SITE PLAN

NOT TO SCALE

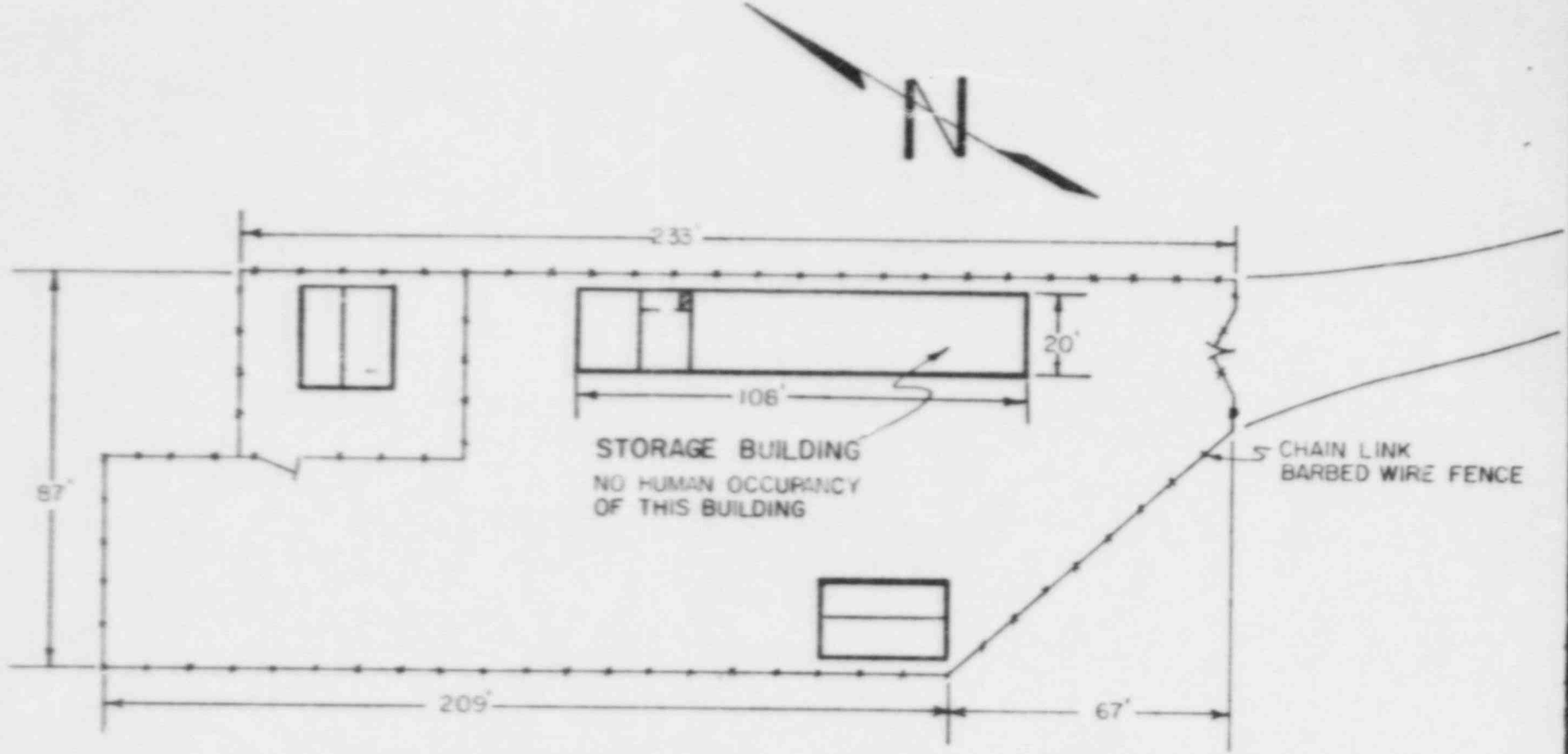
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE

DENSITY TESTER
LOCATION-A
PHOENIX, AZ.

DRAWN BY: RCT DATE: 5-30 SHEET NO. OF 3 SHEETS

OFFICE OF ENVIRONMENTAL HEALTH
PHOENIX AREA OFFICE
PHOENIX, ARIZONA

DRAWING NO.



LOCATION PLAN

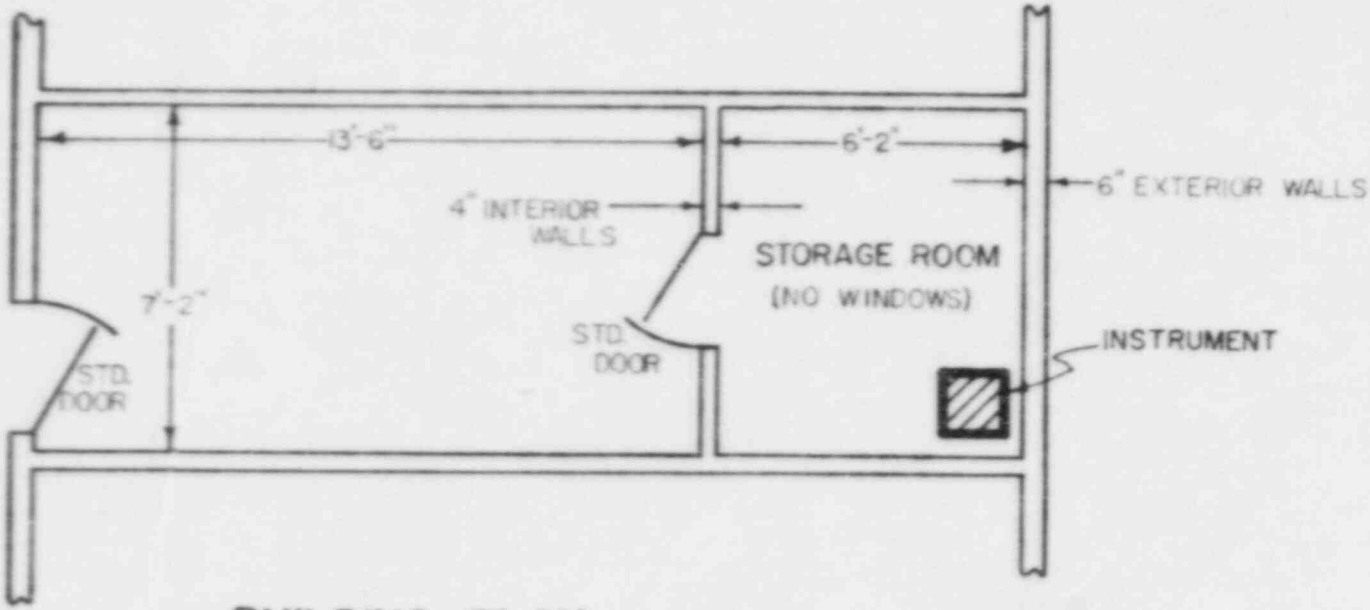
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE

DENSITY TESTER
PHX. LOCATION-A

DRAWN BY: RCT DATE: 5-02 | SHEET NO. 2 OF 3 SHEETS

OFFICE OF ENVIRONMENTAL HEALTH
PHOENIX AREA OFFICE
PHOENIX, ARIZONA

DRAWING NO.



BUILDING PLAN

1" = 4'-0"

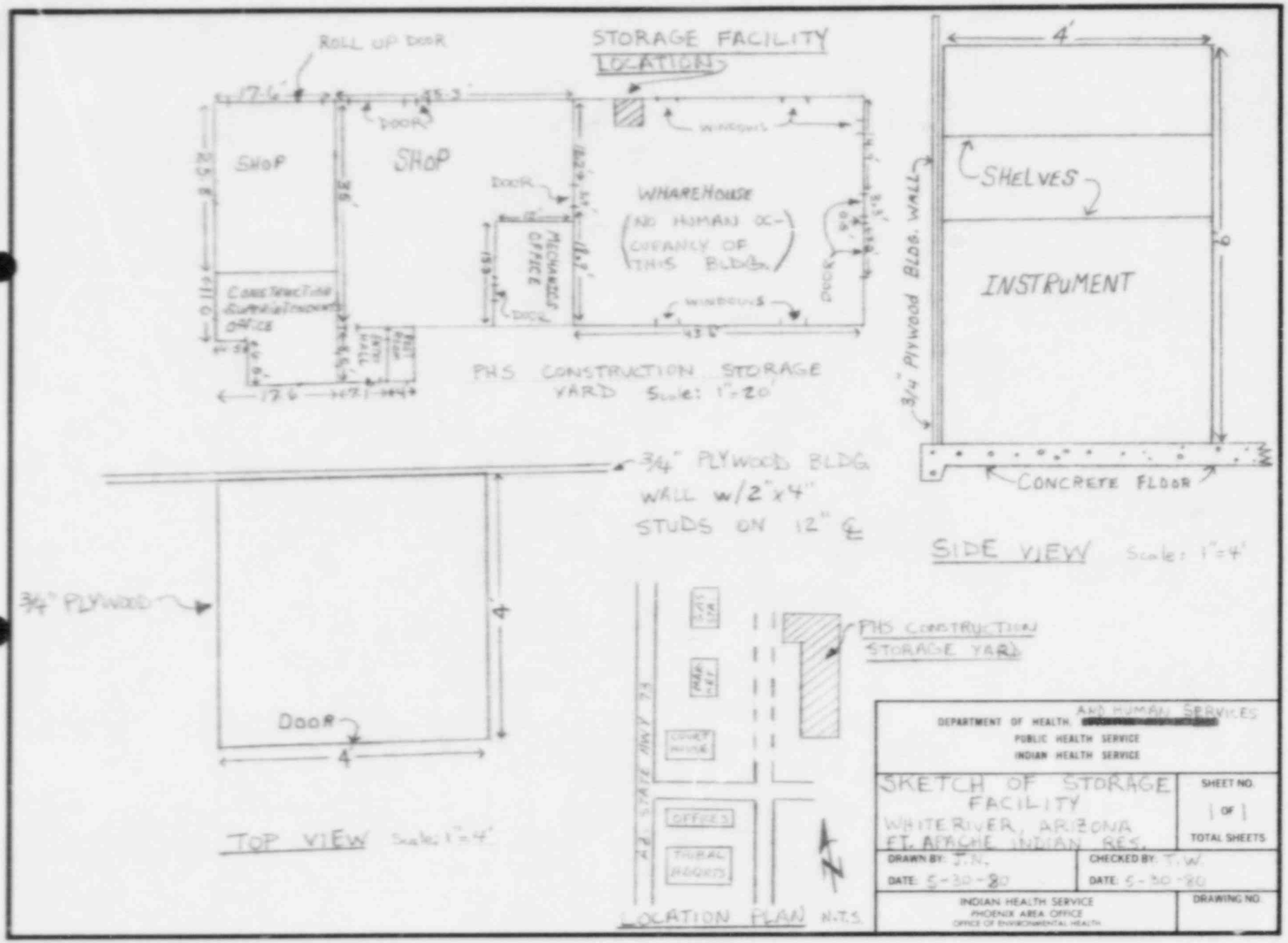
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE

DENSITY TESTER
PHX LOCATION - A

DRAWN BY: RCT DATE: 5-02 | SHEET NO. 3 OF 3 SHEETS

OFFICE OF ENVIRONMENTAL HEALTH
PHOENIX AREA OFFICE
PHOENIX, ARIZONA

DRAWING NO.



☆ U.S. GOVERNMENT PRINTING OFFICE: 1977-795-166

RADIATION SAFETY TRAINING
(Relates to Item No. 8 in License Application)

Formal training in items 8 was given during a two day training session given by the Troxler Electronics Laboratories, Inc. on June 10 and 11, 1980 at the Caravan Inn, 3333 East Van Buren Street, Phoenix, Arizona 85008, for the operators listed below.

Operators

Michael Verschelden is a registered Professional Engineer who has been employed with the Indian Health Service since September of 1974. Mr. Verschelden has a baccalaureate degree in Mechanical Engineering and a Masters degree of Public Health. Mr. Verschelden received training in the safety and use of the Troxler Density Gauge in October of 1978 and June of 1980 by the Troxler Electronics Laborato ies, Inc. and has operated a Troxler Density Gauge in field use on numerous occasions.

Pete Johnson is a registered Professional Engineer who has been employed with the Indian Health Service since October of 1978. Mr. Johnson previously worked for five years with the Environmental Protection Agency in the Kansas City Regional Office. Mr. Johnson has a Baccalaureate and Masters degree in Civil Engineering. Mr. Johnson received a two day safety course in Phoenix on June 11 and 12, 1980, which was conducted by Troxler Electronics Laboratoreis, Inc.

Lloyd Spangler is a registered Professional Engineer who has been employed with the Indian Health Service since October 1977. Mr. Spangler has spent 17 years with the U.S. Army prior to joining the Indian Health Service. Ten of the 17 years were with the U.S. Army Corps of Engineers and 7 years with the Medical Corps. Mr. Spangler has a baccalaureate in Geological Engineering and a Masters in Civil Engineering. Mr. Spangler received a two day safety course in Phoenix on June 11 and 12, 1980, which was conducted by Troxler Electronics Laboratories, Inc.

TROXLER ELECTRONIC LABORATORIES, INC.

HEREBY CERTIFIES THAT

MICHAEL VERSCHELDEN

of

U.S. PUBLIC HEALTH SERVICE

HAS SUCCESSFULLY COMPLETED THE TROXLER ELECTRONIC LABORATORIES, INC. TRAINING COURSE FOR THE USE OF NUCLEAR TESTING EQUIPMENT.

SUBJECTS INCLUDED IN THIS COURSE WERE AS FOLLOWS:

Radiological Safety

1. *Principles and practices of radiation protection.*
2. *Leak testing procedures.*
3. *Mathematics and calculations basic to the use and measurement of radioactivity.*
4. *Biological effects of radiation.*
5. *Radioactivity measurement standardization and monitoring techniques and instruments.*
6. *Accident and incident procedures.*
7. *Procedures for nuclear gauge storage and transportation.*
8. *General safety precautions.*

Gauge Operation

1. *Instrument theory*
2. *Operating procedures*
3. *Maintenance*
4. *Field application*
5. *Gauge calibration*

	9/14/78	WILLIAM F. TROXLER
INSTRUCTOR	DATE	PRESIDENT

TROXLER ELECTRONIC LABORATORIES, INC.

HEREBY CERTIFIES THAT

Michael Verschelden

of

Indian Health Service

HAS SUCCESSFULLY COMPLETED THE TROXLER ELECTRONIC LABORATORIES, INC. TRAINING COURSE FOR THE USE OF NUCLEAR TESTING EQUIPMENT.

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Gauge Operation

1. *Instrument theory*
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5. *Gauge calibration*

Daniel R. Howe
INSTRUCTOR

June 10 & 11, 1980
DATE

William F. Troxler
PRESIDENT

TROXLER ELECTRONIC LABORATORIES, INC.

HEREBY CERTIFIES THAT

Pete Johnson

of

Indian Health Service

HAS SUCCESSFULLY COMPLETED THE TROXLER ELECTRONIC LABORATORIES, INC. TRAINING COURSE FOR THE USE OF NUCLEAR TESTING EQUIPMENT.

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Gauge Operation

1. *Instrument theory*
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5. *Gauge calibration*

Samuel R. Howe
INSTRUCTOR

June 10 & 11, 1980
DATE

William F. Troxler
PRESIDENT

TROXLER ELECTRONIC LABORATORIES, INC.

HEREBY CERTIFIES THAT

Lloyd Spangler

of

Indian Health Services

HAS SUCCESSFULLY COMPLETED THE TROXLER ELECTRONIC LABORATORIES, INC. TRAINING COURSE FOR THE USE OF NUCLEAR TESTING EQUIPMENT.

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Daniel R. Howe
INSTRUCTOR

June 10 & 11, 1980
DATE

William F. Troxler
PRESIDENT

THE ROAD/READERS

THE 3400B SERIES SURFACE MOISTURE-DENSITY GAUGES

The 3400B Series is specifically designed to measure the moisture content and density of soils, soil-stone aggregates, cement and asphalt treated bases, and asphalt paving. With suitable calibration, it can also be used to measure these parameters of other materials having approximately the same range of density and/or moisture content.

The 3400B Series incorporates the latest state-of-the-art in solid-state semiconductor design to provide a high degree of accuracy and reliability. The nuclear geometry and radioactive source design are the culmination of some twenty years of Troxler research and experience in developing instruments of this type. In addition to laboratory work, user experience of approximately 5000 instruments aided in the selection of the required design criteria and desirable end specifications.

The 3400B Series features simultaneous moisture and density measurements in both the Backscatter and Direct Transmission test modes; greatly extended operation between battery recharges and increased battery life; liquid crystal display which allows increased readability in high ambient light conditions; greatly improved Backscatter performance; and simplified operation to reduce operator error.

The Model 3411B contains a micro computer which holds all calibration constants and algorithms necessary to compute and display directly, wet density, moisture, dry density, percent moisture, and percent compaction in either kilograms per cubic meter or pounds per cubic foot, as chosen by the operator. The Model 3411B eliminates the error in wet density due to the presence of hydrogen in the measured sample. The error is created by the high mass attenuation coefficient of hydrogen. This correction has not been possible in earlier gauge models. The Model 3411B also provides a means of compensating the moisture measurement for hydrogen that is present in the measured material, and is not in the form of free water.

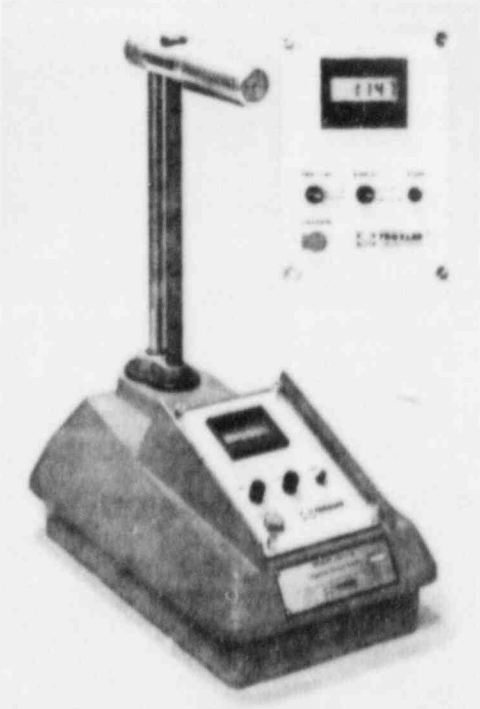
The Model 3401B offers the customer a quality instrument at a lower cost. A simple calculation must be made by the gauge operator and measurement results determined by the use of computer derived calibration tables. The Model 3401B can easily be converted into a Model 3411B by changing scaler modules.

FROM TROXLER®

P.O. Box 12057, Cornwallis Road
Research Triangle Park, N. C. 27709, U.S.A.
Phone: 919 549-8
Telex: 579474

TROXLER ELECTRONIC LABORATORIES, INC.
DANIEL R. HOWE
Western Branch Manager

5041-H COLLEGE OAK DRIVE
SACRAMENTO, CA 95841
BUS. 916/332-773
RES. 916/482-245

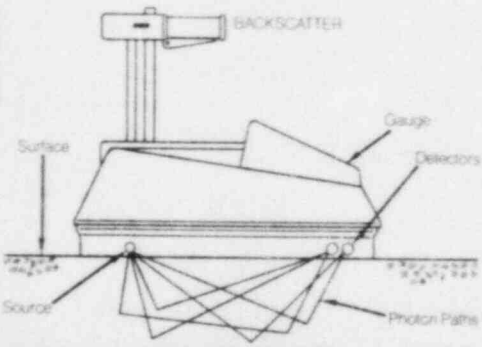


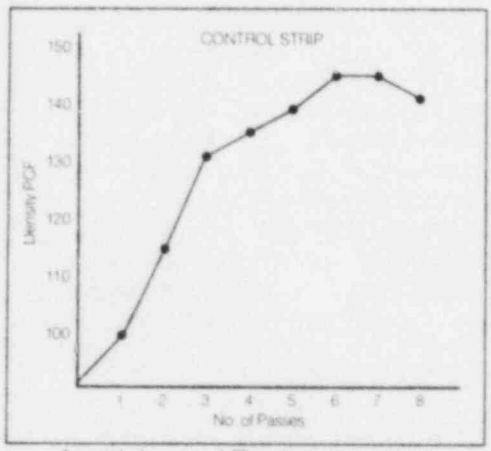
DENSITY TEST MODES

The 3400B Series offers two test modes for measuring the density of construction materials. The operator may choose either Backscatter or Direct Transmission, depending upon the material and the thickness of the lift to be tested.

BACKSCATTER

The Backscatter method is non-destructive and may be performed rapidly. Both the gamma source and detectors remain on the surface. Gamma rays enter the material and those scattered back into the detectors are counted. Backscatter is generally insensitive to changes in density below 3.5 inches, which limits its use to thin lifts of material. Backscatter is recommended primarily for use on asphaltic concrete. The 3400B Series has greatly improved Backscatter performance in sensitivity and reduced surface roughness error. With a .05", 100% void underneath the gauge, the surface roughness error is 4.0 PCF, which is one-half that of previous models.





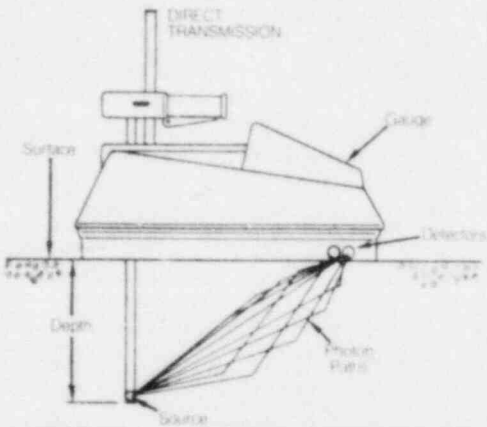
A widely used Backscatter technique for stone base and asphaltic concrete lifts is the "control strip" method. The procedure involves the construction of a 400 sq. yd. test section of representative material. Compaction is accomplished with selected rollers and nuclear Backscatter tests are performed after each roller pass until no further increase in density is observed. Maximum density is determined by taking the average of 10 randomly selected tests. Nuclear tests are normally run on 2800 sq. yd. sections and must average 98% of the target density, with no single test falling below 95%. A new test section must be established when a change of material occurs or after 10 sections have been approved. *The obvious advantage of the nuclear gauge on hot asphalt is a quick, on-the-spot test which pinpoints areas needing compactive effort while the asphalt can still be worked.*

The Model 3411B allows the entry of Marshall values (maximum obtainable density of asphalt) and will compute and display percent compaction of wet density.

If proctor densities are not used for compaction control, the specific gravity of the solids may be entered instead of the proctor value. This will enable the operator to determine the percent solids. A simple subtraction will then allow the operator to determine percent voids.

DIRECT TRANSMISSION

Direct Transmission is a pseudo non-destructive test which places the gamma source into the material by means of a punched access hole. Standard gauges have eight inch depth capabilities in two inch increments. One inch increments are available by special order. A special twelve inch depth capability with one or two inch increments may also be ordered. Gamma rays are transmitted from the source through the material to be measured to the detectors located on the surface. The average density of the lift of material is determined. *Direct Transmission allows the operator to choose the depth of measurement and greatly reduces error resulting from surface roughness and chemical composition of the test material.* Gauge precision is also improved. Direct Transmission is used primarily for testing medium to thick lifts of soil, stone base, and asphalt.



The 3411B also allows the entry of Proctor values for soil and soil aggregate. The micro computer will process the data and display percent moisture and percent compaction of dry density.

Current approved standards for nuclear density testing include ASTM D-2922-78, "Standard Test Method For Density Of Soil And Soil-Aggregate In Place By Nuclear Methods" (Shallow Depth); and ASTM D-2950-74, "Standard Test Method For Density Of Bituminous Concrete In Place By Nuclear Method."

MOISTURE

The moisture measurement is non-destructive with the neutron source and detector both located on the surface of the test material. A field of fast neutrons enters the material and thermalization occurs after a series of collisions between the neutrons and hydrogen atoms present in the test material. The helium-3 detector, located in the gauge, detects the thermal neutrons.

It is suggested that factory moisture calibration data be compared to oven dry methods and adjustments be made, if necessary. *The Model 3411B has a "built-in" provision to allow the insertion of a correction factor for hydrogen which is not contained in the free water removed during standard oven drying procedures. This correction factor automatically adjusts for changes in the dry density of the soil which contains the moderator or neutron absorber.*

The ASTM Standard D-3017-78 "Standard Test Method For Moisture Content Of Soil And Soil-Aggregate In Place By Nuclear Methods" (Shallow Depth) is the current approved standard. The 3400B Series instruction manual details the procedure for obtaining moisture correction factors.

MECHANICAL STRUCTURE

The 3400B Series instruments are housed in a permanent-mold aluminum casting which is heat treated and annealed to provide a rugged structure which is immune to physical damage except for major accidents. There are no openings from the bottom surface to the interior which would allow ground water or soil to enter the instrument. All topside openings are gasketed to maintain a clean environment. The instrument can sustain repeated drops from twelve inches (30 cm.) on a one-inch (2½ cm.) steel ball placed on the unyielding surface without damage or alteration of calibration. The exterior of the housing is either anodized or coated with epoxy paint.

The source rod is manufactured from stainless steel, hardened to 45-55 Rockwell C to reduce wear and insure proper indexing of the measurement geometry. The source rod is positioned in stainless steel linear bearings. The indexing mechanism is made from 4130 steel, hardened to 45 Rockwell C so that any wear is produced on parts which are easily replaced.

All interior parts are either anodized aluminum or stainless steel to prevent corrosion.

RADIOLOGICAL

The instrument contains two sealed sources – an eight millicurie glass-bead source of cesium-137 to provide gamma radiation for the density measurement and a forty millicurie americium-241: beryllium source yielding seventy thousand neutrons per second for the moisture determination. Both sources are doubly encapsulated in stainless steel, and fusion welded.

All biological shielding is constructed of tungsten having a specific gravity of eighteen, a high gamma attenuation coefficient and a melting point of over 3,000°C. While more expensive than lead, tungsten insures permanent protection since it does not cold flow nor melt under conditions likely to be imposed on the instrument by fire.

Radiation levels on any surface of the instrument are less than fifteen millirem-per-hour, including both gamma and neutron. The dose rate at four inches (10 cm.) from any surface of the gauge are less than five millirem per hour. Packed in its transport or shipping case, the instrument meets all applicable requirements of the Department of Transportation under 7A designation.

BATTERIES

The 3400B Series operates on two nickel-cadmium battery packs with a capacity of 40 watt hours. *A 3400B Series gauge can operate for approximately eight weeks on a full charge. Under normal conditions and using recommended charging procedures, the battery packs should never need replacing.* Recharge may be made overnight by use of a 110/220 volt 50-60 Hz charger or by means of a DC charger plugged into a cigarette lighter using 12 volt vehicle power.

DETECTORS

Two high temperature platinum lined Geiger-Mueller detectors are used for density determinations. Platinum greatly increases the efficiency and life of these detectors which are manufactured to rigid Troxler specifications. Years of research and nuclear gauging experience have contributed to the design of these highly efficient detectors.

One helium-3 detector is used for the moisture measurement. This detector is specifically designed for use in the Troxler 3400B Series. This helium-3 detector is totally insensitive to gamma radiation below one Mev. This insures no interaction from the cesium-137 gamma source.

ELECTRONIC ASSEMBLIES

All 3400B electronic assemblies are packaged in modules which allow 100% field replacement by unskilled personnel. No adjustments or plateau procedures are required to obtain stable operation of the detectors. High voltage and counting thresholds are stable to within ±.01%/°C. All components are selected to insure operation over an ambient temperature range of -10°C. to 70°C. *All electronic circuits utilize CMOS large-scale integrated circuits for increased reliability, reduced complexity, and longer battery life.*

Three timing periods have been included which allow measurements to be made in either fifteen seconds, one minute, or four minutes. Timing periods are separated by statistical factors of two. The four digit liquid crystal display indicates readings which are one minute rates regardless of the timing period selected. *Bright sunlight enhances the readability of the liquid crystal display and shading is never required.* Notations are included to indicate a low battery condition and that the instrument is in the process of accumulating data.

Model 3411B reference standard counts for both moisture and density are stored in accumulators and can be addressed and read at any time. The accumulator contains both the moisture and density measurement counts in addition to the standard counts and any one of the four may be addressed and displayed as desired.

The 3411B micro computer has 3 user activated test routines which will verify proper operation of panel switches,

MEASUREMENT SPECIFICATIONS

BACKSCATTER DENSITY	.25 MIN	1 MIN	4 MIN	
Precision at 120 PCF	1.04	.52	.26	±PCF
Composition Error at 120 PCF	2.5	2.5	2.5	±PCF
Surface Error (.05" 100% void)	4.0	4.0	4.0	–PCF
Expected Total Error	3.9	3.4	3.3	±PCF
Depth of Measurement (98%)	4.0	4.0	4.0	inches
DIRECT TRANSMISSION DENSITY				
Precision at 120 PCF 6" Depth	.48	.24	.12	±PCF
Composition Error at 120 PCF	1.4	1.4	1.4	±PCF
Surface Error (.05" 100% void)	0.9	0.9	0.9	–PCF
Expected Total Error	1.8	1.6	1.5	±PCF
Depth of Measurement	2-8	2-8	2-8	inches
MOISTURE CONTENT				
Precision at 15 PCF	.64	.32	.16	±PCF
Surface Error (.05" 100% void)	1.1	1.1	1.1	–PCF
Expected Total Error	1.5	.90	.70	±PCF
Depth of Measurement at 15 PCF	7.0	7.0	7.0	inches

RADIOLOGICAL SPECIFICATIONS

Gamma Source	8 mCi cesium-137 (Troxler Drawing #A-102112)
Neutron Source	40 mCi americium 241:be, 70,000 neutrons/second (Troxler Drawing #A-102451)
Source Encapsulation	Stainless steel doubly encapsulated
Shielding	Tungsten and lead
Surface Dose Rates	15 mrem/hr maximum, neutron and gamma
Shipping Case	DOT 7A, Yellow II Label, 0.1 Transport Index

MECHANICAL SPECIFICATIONS

Case	Epoxy finish aluminum casting
Vibration Test	0.1 inches at 12.5 Hz
Drop Test on 1" Steel Ball	12 inch height
Operating Temp:	
Ambient	-10°C to 70°C
Surface	175°C
Size (excluding handles)	14.5 x 9 x 7.2 inches (36.3 x 22.5 x 18 cm)
Total Height	19.5 inches (49 cm)
Weight	36 pounds (16.4 Kgm)
Shipping Weight with ABS case	85 pounds (38.6 Kgm)

ELECTRICAL SPECIFICATIONS

Timer Accuracy and Stability	± .005% ± .0002%/°C
Readout (direct sunlight viewing LCD)	4 digits
Number of Count Registers	2-Model 3401B/ 4-Model 3411B
Stored Power	40 watt-hours
Power Consumption	0.12 watts
Recharge Time	16 hours
Charger Input	110/220 VAC, 50-60 Hz or 12-14 VDC

ACCESSORIES

ACCESSORIES SUPPLIED WITH GAUGE

Scraper plate/drill rod guide
Drill rod
110/220V, 50-60 Hz charger
12-14 VDC charger
Heavy-duty cardboard shipping container with insert
Reference Standard
Manual
Calibration table

OPTIONAL ACCESSORIES

Metric calibration
12 inch (30 cm) depth
1 inch (2.5 cm) increments
High impact plastic ABS transport case
3400 Series tool kit
X Model 3880 leak test kit $53.00
X Molykote lubricant, spray & paste
2 amp buss type GMW fuse
Radiological survey meter
Model 3940 Scaler Test Station
Model 3954 PROM Programmer
Model 3960 Microprocessor Test Station
X RADIATION SIDE KIT

5 free wipes

$32 for 5 wipes

TROXLER®

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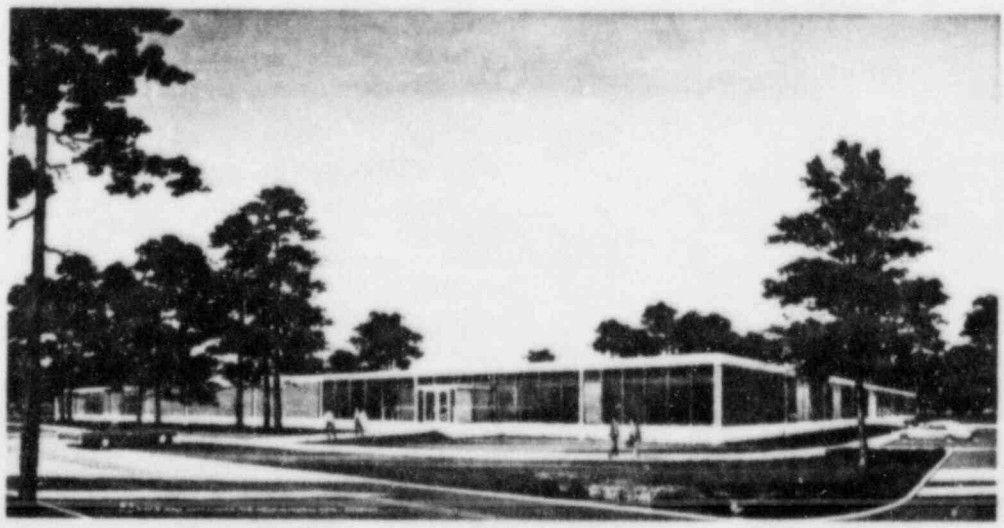
Branch office opening soon in the Northwestern United States.

International sales handled through our subsidiary, Troxler International, Ltd.



key board, and display. It is factory programmed with calibration constants to compute wet density, dry density, moisture, percent moisture, and percent compaction. Results may be displayed in either U.S. Customary or metric units.

The micro computer automatically corrects wet density readings for errors caused by the high mass attenuation coefficient of hydrogen found in the measured material. The true hydrogen density is evaluated, prior to any corrections for moisture content, and is used to correct the wet density which significantly improves the density accuracy. *The Model 3411B also allows the insertion of a K factor to correct for hydrogen in the measured material which is not contained as free water.* This moisture correction factor is applied, after comparison of conventional and nuclear moisture test data, by means of moisture correction switches located at the bottom of the scaler module. Plus or minus corrections may be entered by the operator. The K factor automatically adjusts for changes in dry density. This is necessary since the material causing the error by moderation of fast neutrons or absorption of thermal neutrons is contained in the dry soil and is not a part of the moisture content.

CALIBRATION

The Troxler moisture and density calibration technique is the unique product of years of research and development. Only Troxler customers have the advantage of this sophisticated and accurate calibration method.

DENSITY CALIBRATION

Count rate data is accumulated on five standard density blocks for the determination of density versus count rate computations and one standard density block to verify calibration accuracy. Specific gravities of the three metallic standard blocks are known to an accuracy of 0.1%, and of the natural material standards to 0.2%. A standard deviation of less than ± .15 PCF is assured for all data points.

Gauge response to density is by computer evaluation of the arithmetic function: Count Ratio = $A \cdot EXP(-B \cdot d) - C$, where d = density and A, B & C are constants determined on magnesium and aluminum standard blocks, and a combination magnesium and aluminum standard block. These constants obtained on the metallic standards determine the general shape of the calibration curve. Data is then taken on the limestone and granite standards and the values for the constant B are computed for these natural materials. The average of these two B values will produce a density calibration suitable for normal soils. A calibration validity check is then performed on a low density standard. In order to eliminate long-term effects of source decay and electronic drift, all data is normalized to a reference standard and expressed as a ratio. The calibration constants are stored in non-volatile memory in the Model 3411B.

Gauge parameters of precision, composition error, surface roughness error, and the root-mean-square sum of errors are determined for each gauge to predict probable field error. Computer calibration printouts are furnished for each density test mode and depth from 70 PCF to 170 PCF in ½ PCF increments. Metric calibrations are available upon request.

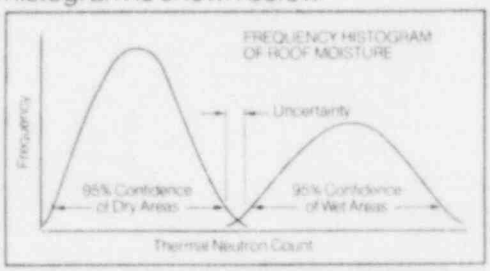
MOISTURE CALIBRATION

Two moisture calibration standards, magnesium, which represents zero moisture, and a permanent moisture standard which is 36 PCF moisture, are used for the 3400B moisture calibration. Count rate data is normalized to a moisture standard count to eliminate the effect of long-term electronic drift in the instrument. These count ratios are then used to solve the equation: Count Ratio = E + F x M, where E = gauge response at zero moisture content, F = slope of the moisture curve, and M = moisture content. In the Model 3411B, the moisture calibration constants are stored in a non-volatile memory.

The moisture performance parameters of precision, surface roughness, and the expected field error are determined for each gauge. Computer moisture calibration printouts are provided for a range of 0 PCF to 40 PCF in ¼ PCF increments.

SPECIAL ROOF MOISTURE APPLICATION

The 3400B Series can be used to evaluate the degree of water migration within layers of a built-up flat roof. A ten by ten foot grid is laid out on the roof and non-destructive nuclear moisture counts are taken at grid intersections. A frequency histogram is next plotted of all the data points and used to identify wet and dry areas. A typical bimodal histogram is shown below.



With this type of distribution, the 95% confidence limits can be established for a normal distribution. Core samples are taken in areas which indicate definite wet conditions to determine the amount of moisture present. Once the wet threshold has been determined, a gridded roof drawing can be prepared and used to map the roof for repairs.

LICENSING INFORMATION

The radioactive sources are by-product materials and do require a special license which is issued by an "agreement state" or by the Nuclear Regulatory Commission. Troxler will assist the customer in obtaining and completing the proper license application. Required radiological safety training courses are held periodically in the home office and in Troxler branch offices. A nominal fee is charged. Field training may also be arranged for a fee covering the instructor's time and applicable expenses.

NRC Form 374
(5-84)

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Amendment No. 03

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, 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.

Licensee	
1. Kerr-McGee Coal Corporation Clovis Point Mine	In accordance with application dated November 30, 1984
2. Caller Box 3014 Gillette, Wyoming 82716	3. License number 49-19207-01 is amended in its entirety to read as follows:
	4. Expiration date August 31, 1990
	5. Docket or Reference No. 030-17135

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.

9. Authorized use

A. For possession and use in Texas Nuclear 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.

CONDITIONS

10. Licensed material shall be used only at Kerr-McGee Coal Corporation's Clovis Point Mine, Gillette, Wyoming.

11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 19, "Notices, Instructions and Reports to Workers; Inspections" and Part 20, "Standards for Protection Against Radiation."

12. Licensed material shall be use by, or under the supervision of, David B. Richardson or Bruce W. Stunkard.

13. Sealed sources containing licensed material shall not be opened or removed from their respective source holders by the licensee.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number
49-19207-01

Docket or Reference number
030-17135

Amendment No. 03

14. A. (1) Each sealed source containing licensed material, other than hydrogen-3, with a half-life greater than 30 days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed 6 months; except those sealed sources as specified by the manufacturer and specifically authorized by the Commission or an Agreement State may be leak tested at intervals not to exceed 3 years. In the absence of a certificate from a transferor indicating that a test has been made within 6 months prior to the transfer, a sealed source received from another person shall not be put into use until tested.

(2) Notwithstanding the periodic leak test required by this condition, any licensed sealed source is exempt from such leak tests when the source contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.

(3) The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within 6 months prior to the date of use or transfer.

B. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

C. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Commission regulations. A report shall be filed within 5 days of the test with U. S. Nuclear Regulatory Commission, Region IV, 611 Ryan Plaza Dr., Suite 1000, Arlington, Texas 76011, describing the equipment involved, the test results, and the corrective action taken.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number
49-19207-01

Docket or Reference number
030-17135

Amendment No. 03

14. (continued)

D. The licensee is authorized to collect leak test samples in accordance with the procedures described in the licensee's application dated November 30, 1984, for analysis by Texas Nuclear. Alternatively, leak test samples may be collected and/or analyzed by other persons specifically authorized by the Commission or an Agreement State to perform such services.

15. Installation, relocation, removal from service, maintenance, repair, and initial radiation survey of devices containing licensed material and installation, replacement, and disposal of sealed sources containing licensed material used in devices shall be performed only by Texas Nuclear or by other persons specifically authorized by the Commission or an Agreement State to perform such services.

16. The licensee shall conduct a physical inventory every 6 months to account for all sealed sources received and possessed under the license. The records of the inventories shall be maintained for 2 years from the date of the inventory for inspection by the Commission, and shall include the quantities and kinds of byproduct material, manufacturer's name and model numbers, location of sealed sources and the date of the inventory.

17. Except as specifically provided otherwise by this license, the licensee shall possess and use licensed material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated November 30, 1984. The Nuclear Regulatory Commission's regulations shall govern the licensee's statements in applications or letters, unless the statements are more restrictive than the regulations.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date AUG 26 1985

By Original Signed By
Jack E. Whitten
Nuclear Materials Safety Section
Region IV
Arlington, Texas 76011

Official Record Copy

IN 1140