DL-111496_02

The Applied Radiant Energy Corporation

Manufacturers of **Gammapar** Acrylic Wood Flooring

Venture Drive • Forest Commercial Center
P.O. Box 289 • Forest, Virginia 24551

Toll Free 1 800 283 5667 • 804 525 5252 • Fax 804 525 7437

November 14, 1996

Mr. Earl G. Wright
Senior License Reviewer
Division Nuclear Materials Safety
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N.W., Suite 2900
Atlanta, GA 30323-0199

Dear Mr. Wright:

Attached please find a copy of NRC Form 313 submitted as application to renew our Materials License (45-11496-01). Also attached is additional information for items 5 through 11 of the form. As you requested in your letter of August 28, 1996, (Mail Control #292009), outdated information submitted in a previous application of January 21, 1988 has been deleted and information as required by 10CFR Part 36 has been added.

As no further action has been taken on the original application, I have been advised by the Region II office that no further fee is necessary.

If you have any questions regarding this application, please phone me at (804) 385-5300.

Yours truly,

THE APPLIED RADIANT ENERGY CORPORATION

James J. Myron Ph.D.

James J. Myron, Ph.D.
V.P. - Safety & Regulatory Affairs

JJM/dek (F445)

Attachments: NRC Form 313
Additional information for NRC Form 313

APPENDIX A

NRC FORM 313 — U.S. NUCLEAR REGULATORY COMMISSION

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.

1 THIS IS AN APPLICATION FOR (Check one)

- [ ] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER
- [X] C. RENEWAL OF LICENSE NUMBER 45-11496-01

2 NAME AND MAILING ADDRESS OF APPLICANT (Include zip code)

The Applied Radiant Energy Corp.
P.O. Box 289
Venture Dr./Forest Commercial Center
Forest, VA 24551

3 ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

2432 Lakeside Drive
Lynchburg, VA 24501

4 NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

James J. Myron, Ph.D.

TELEPHONE NUMBER

804/385-5300

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	INDIVIDUALS 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	LICENSE FEES (See 10 CFR 170 and Section 170.31) FEE CATEGORY 3E AMOUNT $ -0-

13 CERTIFICATION (Must be completed by applicant)

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 2 CERTIFY THAT THE APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 31, 32, 33, 34, 35, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: IT IS A CRIME TO KNOWINGLY MAKE OR CAUSE TO BE MADE A FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER - PRINT/TYPED NAME AND TITLE	SIGNATURE	DATE
James J. Myron - V.P. Safety & Regulatory Affairs	James J. Myron	11/14/96

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		

APPROVED BY | DATE

NRC FORM 313 (6-89)

PRINTED ON RECYCLED PAPER

INFORMATION FOR NRC LICENSE RENEWAL APPLICATION
Submitted: November 14, 1996

Page

Item #5: Radioactive Material:

Isotope	Form	Maximum Amount
A. Cobalt-60	-A. Sealed Sources (BNL standard source strips) and Neutron Products, Inc. Source encapsulated as described in letters dated July 3, 1968, February 5, 1981 and February 6, 1981) and Nordion International, Inc. Model C-188 Sources. See attached specification drawing for Nordion Sources (Attachment 1)	A. 400,000 curies
B. Cobalt-60	-B. Nuclear Chicago Model RR-61	B. 100 millicuries

ARECO still possesses Brookhaven National Laboratory (BNL) standard source strips.

Item #6: Purposes for which licensed material will be used:

A: i) For use in custom designed irradiator facilities for the irradiation of materials, other than explosives or undiluted highly flammable products. Materials would include that of condition 17 for the present Materials License (dealing with food irradiation).

a) ARECO irradiates the following flammable material:

Methyl Methacrylate - a colorless organic liquid with a flash point of 49°F. This chemical may have small amounts (1%-3%) of other chemicals (dyes, other monomers, reaction facilitators, etc.) only one of which has a flash point of less than 140°F. This added compound has a flash point of 114°F and may be present in the methyl methacrylate at a level of about 1% or less.

However, the Methyl Methacrylate and dilute solutions of Methyl Methacrylate will not be irradiated as neat liquids. When irradiated it will be present as absorbed material in wood (as an impregnate). This dilution by the wood plus the fact that irradiation takes place in an underwater irradiator will ameliorate any potential danger arising from this type of operation.

b) The quantity of Methacrylate or Methacrylate plus additives that is being irradiated at any one time will vary greatly, depending

largely on the type of wood that absorbs the impregnate and the number of batches being processed. Currently, the range would be between 300 to 3,000 pounds.

c) The maximum quantity of flammable (flash point <140°F) material in our facilities at any one time is 80,000 pounds.

The maximum quantity of flammable organic liquid irradiated at any one time is 3,000 pounds (absorbed in wood).

ii) For research and development in the design and use of underwater irradiators. This use precludes restrictions on the rearrangement of sources, irradiator plaque design and mode of operations.

B: For use in the calibration of instruments.

Item #7: Individuals Responsible for Radiation Safety Program and their Training and Experience:

Amendment No. 17 to our Material License 45-11496-01 amends condition 12 to read: "12. The Radiation Protection Officer for the activities authorized by this license is Lawrence G. Barrett, Sr., James J. Myron, or Rodney W. Bell." Their experience and educational background and their formal training in radiation safety has been submitted in a previous, January 21, 1988, license renewal application.

These three people, plus Gregory J. Middaugh, are the ARPCO personnel directly responsible for irradiator safety.

L.G. Barrett, Sr. is the Company Founder and former President and although he is presently working out of the Company's facility in Forest, Virginia (five and one-half miles from the irradiator) in the capacity of C.E.O., he maintains close ties with the irradiator and is familiar with its operation and safety. He designed the irradiator over thirty (30+) years ago. Presently, he is a Radiation Protection Officer (RPO).

James J. Myron is Vice President of Safety and Regulatory Affairs and his office is in the present irradiator building. He reports only to Barrett. He has been with the Company for the past sixteen years during which time he has been responsible for keeping current and administering the Company's Radiation Safety Program and ensuring safe irradiator operations. Currently he is a RPO.

Rodney W. Bell is the Conversion Specialist with an office in the irradiator building. He reports to J.J. Myron. He has been with the Company for the past sixteen years. Bell is responsible for implementing all facets of the Radiation Safety Plan and maintaining all equipment necessary for safe irradiation operations. He is currently a RPO.

Greg J. Middaugh is the Conversion and Irradiation (C&I) Department Manager with an office in the irradiator building. He reports to the Company President and has been with the Company for the past ten years. He has been a trained operator of the irradiator for the past nine years and confers with Myron and Bell whenever operational changes that affect radiation safety are made.

All four individuals (Barrett, Myron, Bell and Middaugh) have the authority and can act alone to stop unsafe operations.

An update of Myron's experience and educational background is enclosed. (Attachment 2)

Item #8: Training for Individuals Working in or Frequenting Restricted Areas.

Personnel Training: This will encompass operator and non-operator instruction.

A) Operator training will be both classroom (Myron - Instructor) and "hands on" (Bell - Instructor) training.

1) Classroom training topics will include:

a) Principles and fundamentals of radiation safety and good safety practices applied to irradiators. This will involve differences between external radiation and radioactive contamination, units of radiation dose, NRC dose limits, why large radiation doses must be avoided, how shielding and controls prevent large doses, how irradiator design prevents contamination, proper use of survey meters and personnel dosimeters, other safety features of an irradiator and the basic function of an irradiator.

b) The requirements of parts 19, 20 and 36 of NRC regulations that are relevant to irradiator operations.

c) The operation of the irradiator.

d) Emergency procedures.

e) Case histories of accidents or problems involving irradiators.

2) "Hands On" training will be given on the subjects listed in A)1.a) that lend themselves to practical instruction.

3) Safety reviews will be given annually to all operators. The material covered in this review will include:

a) Changes in operating and emergency procedures since the last review.

b) Changes in regulations and license conditions since the last review.

c) Reports on recent irradiator events.

d) Relevant results of operator safety performance.

e) Relevant results of facility inspection and maintenance checks.

f) Emergency drills.

Operators will be instructed so that any deficiencies will be corrected.

A copy of the April 11, 1986 correspondence in which the training program is outlined has been submitted with the January 21, 1988 license renewal application. Some conditions are to be updated or changed as follows:

i) The first and second paragraphs of the letter refer to Condition #13 of the Materials License. This is now Condition #11 of our amended license (July 10, 1986) and this condition has been amended as per the amendment of April 9, 1987 to reflect some name changes.

ii) The last line of the first paragraph of page 2 cites Condition 13 as referring to Radiation Protection Officer. After amendment 15, July 10, 1986, this becomes Condition 12.

iii) The conditions of the training program are current except for the statement on page 2, section 2, last sentence. The waiting period to undergo training has been changed to 30 days. This change and the reasons for it were communicated by phone to Mr. Earl Wright, Senior License Reviewer at the NRC Region II Office in Atlanta, Georgia on October 8, 1987.

iv) The last sentence of page 2 is to be deleted i.e., "During office hours, only the front door shall be unlocked." This door is now locked at all times, with only selected personnel having a key. The door is self locking when closed.

v) The last line of the letter gives an outdated phone number for J. Myron. The current one is 804-385-5300.

4) Before being permitted to perform the duties of an operator, workers will be given a written test that will cover both the classroom and "hands on" instruction. Test results will be recorded and maintained.

A sample examination with answers has been supplied with the April 11, 1986 communication.

5) Personnel who provide training must be high school graduates with good command of the English language and have at least three year experience as irradiator operators.

B) Individuals who will be permitted unescorted access to the irradiator pool room, such as company maintenance personnel, will be given instruction in radiation and irradiator safety and emergency procedures in response to radiation alarms. An oral quiz will be given to trainees to assure understanding of the material. Such training shall be documented by an attendance record.

C) Individuals (workers), other than operators, who must be prepared to respond to radiation alarms shall receive training in radiation and irradiator safety and emergency procedures. This training will be given to all company workers who have regular duties in the building that houses the irradiator pool, e.g. material handlers who are not irradiator operators. They will be tested for their comprehension of the material by an oral test. Such training shall be documented by an attendance record.

Item #9: Facilities and Equipment

Information for this item is contained in previous written communications to the NRC; especially letters of information to the NRC of April 18, 1986, January 31, 1983, and June 29, 1982.

The ARECO irradiator is a pool-type irradiator where the Cobalt-60 sources are always kept fully submerged under water to a depth where full biological radiation protection is provided to operating personnel and the public at all times.

Site: A sketch (Attachment 3) is enclosed. It presents both a site plan and a floor plan of the facility.

Four property areas (A, B, C and D) are noted on the site plan. The use of these four properties is as follows:

1) Property A is zoned industrial and contains a building that is presently used by ARECO for storage purposes.

2) Property B contains a private residence.

3) Property C is zoned commercial and contains a small service business.

4) "Property D" is a section of Virginia State Highway 221.

The only "restricted area", as defined in 10CFR, 20.1003, in the facility is the irradiator room itself, which is identified on both the floor and site plans of Lakeside Drive drawing A-1.

The function of each area of the floor plan is given on the drawing and, except for minor modifications, is current. However, the floor plan of our irradiator building is subject to change as material irradiation requirements may develop.

- Irradiator Building: The irradiator is housed in a building of cinder block walls and steel roof decking construction.

- Seismic Considerations: According to 10 CFR 36.2 a seismic area is on one which the probability of a horizontal acceleration in rock of more than 0.3 times the acceleration of gravity in 250 years is greater than 10% as designated by the U.S. Geological Survey.

  It was learned in communications with the U.S. Geological Survey that current seismic maps chart peak ground acceleration in %g with a 2% probability of exceedance in 50 years. This corresponds approximately to 10% in 250 years. The map that includes Lynchburg shows it to be in an area where the peak ground acceleration is between .12g and .14g, which is well below the .30g of the definition of a seismic area given in 10CFR 36.2.

- Shielding: The irradiator pool is below grade. Shielding is therefore provided by the depth of water over the radioactive sources, the concrete pool walls and the surrounding earth exterior to the pool walls. The pool consists of purified demineralized clear water of a depth that radiation levels at the pool surface are such that worker exposure will not exceed limits imposed by 10CFR, Part 20.

- Access Control: The regulations of 10 CFR 36.23 all refer to panoramic irradiators. Their intent is to prevent people from entering the irradiator area when there are higher levels of radiation than would be extant if the radioactive sources were fully shielded.

  At our irradiator, the following conditions prevail: There are two accesses to the pool irradiator room and these are shown in both the facility floor plan and the irradiator pool room floor plan. During the irradiator's operation, qualified personnel are always present at the facility either in the irradiation area or areas adjacent to it. All personnel are made aware of the necessity of preventing unauthorized individuals from entering areas other than the front office area. The door in the irradiator room to the west of the pool leads to a storage area and serves as an alternate exit in case of emergency. It is normally locked from the pool room side.

- Fire Protection: There are six smoke detectors distributed throughout the building. They are the domestic type normally found in homes and are located in the office area, in two bathrooms, in the workers' breakroom, in the hallway of the lab area and in the canister loading area. There is also a household smoke/heat detector in the pool room over the oven area. See plan sketch titled "ARECO Irradiator Pool Room". (Attachment 4)

- Automatic Fire Extinguishing System: Due to the design of the irradiators and their mode of operations, such a system is not deemed to be necessary.

- Control Devices, Alarms and Signals: Due to the pool containment design of the irradiators, conventional "control" devices are not necessary. Visual and audible alarms that would be activated by higher than normal radiation levels are located as follows.

- Radiation Monitors: A radiation area monitor (Victoreen Gammaguard Area Monitor Model 828 or equivalent) is mounted on the wall of the pool room such that its visible alarm can be seen from outside the pool room. Its audible alarm can be heard throughout the entire building. The alarm set point for this instrument is 2 mr/hr which is the lowest setting at which false alarms are avoided.

  There is also a monitor (Eberline SRM-100 "Smart Alarm" or equivalent) mounted in the same location whose probe measures increases in radiation levels of the cation bed of the pool demineralizer. Its visible and audio alarms have the same scope as the area monitor. The alarm set point for this instrument is 0.4 mr.hr.

- Areas adjacent to the Irradiation Room: These areas are diverse in nature and include outdoor, storage, laboratory, and operations areas. The pool room has background radiation levels and no restriction of movement is normally necessary in these areas by workers or visitors accompanied by authorized company personnel.

- Safety Systems: Essentially, the main safety system for the source material (Cobalt-60) is the maintenance of a sufficient depth of water over it to provide adequate shielding so that personnel working at floor level above the pool would not be subject to radiation levels exceeding background levels.

It should be noted that during over 28 years operation no "over-exposure" incidents have occurred at the facility. This is the result of implementing the ALARA concept so that radiation levels to which personnel are exposed are normally background levels.

The continuous radiation monitoring instruments with alarms mentioned above provide warning if radiation levels in the pool room are above normal. Speedy exit from the irradiation room is always possible.

- Water Storage (and Operating) Pool: The irradiator pool does not have a stainless steel liner. However, it has a low likelihood of substantial leakage as it is constructed of steam cured reinforced concrete pipe and is made up of four pipe sections with sealed joints. The entire pool is below grade in dry soil. More details are contained in an April 11, 1986 report of Masters Engineers and Designers which accompanied the January 21, 1988 license renewal application.

  In the event of a leaking Cobalt-60 source, decontamination could be safely effected by transferring the Cobalt-60 sources from the source holder frame (plaque) to four stainless steel tubes that extend thirteen (13) feet below the pool floor. Waterstops are welded to these pipes and they are embedded in the concrete base of the pool which renders them water tight.

  There is a pipe that is part of the water circulation system near the bottom of the pool. Loss of pool water via this outlet is prevented by a siphon breaker in the line.

  The pool measures nine (9) feet inside diameter and is approximately 22 feet deep.

  Water conductivity, pH, temperature, and flow rate through the ion exchange beds are recorded on a daily basis.

- Pool Water Replenishment: During normal operation in our irradiator pool, it is not desirable to automatically replenish water that is lost from the pool. This arises from the fact that the number of irradiation canisters being processed in the pool at any given time varies from zero to four. Each of these displaces approximately 35 cubic feet of water. Thus, the insertion and removal of these canisters can have an effect on pool water level of approximately 2.2 feet. When the water level is at its lowest level, with no cans in the pool, adequate shielding is fully provided by the remaining water. Under these conditions, the radiation readings over the pool are still the same as background as measured by an Eberline GM survey meter E-200 with an HP-270 probe (or equivalent).

  Manual make-up is made whenever losses due to evaporation requires it.

  With an automatic water replenishment system one could have a fairly large leak in the pool and the automatic system would continue to keep the water level up. No knowledge of the leak would be had unless a recorder were kept in operation showing consumption of water through the automatic make-up system.

Normal make-up water is supplied as needed through a demineralizer at a rate of approximately three (3) gallons per minute. Water can be supplied under emergency conditions at a rate exceeding 100 gallons per minute from a nearby fire hydrant.

Additions of make-up water are recorded and retained for reference.

- Pool Water Level Indicators: This indicating system consists of two floats to measure high and low water levels, a status board containing various indicator lights, and a power supply for the lights, relays and floats. The status board which gives visible warning of abnormal water levels is mounted on the wall directly opposite the pool room entrance for convenient viewing. In addition, two other floats that also measure high and low water are connected to an audible alarm having a separate power supply.

- Pool Water Purification System: The pool water is circulated by one inlet and one outlet line. It is pumped through a diatomaceous earth filter then through cation, anion, and mixed ion exchange beds. A conductance meter measures the conductivity of the water just before it enters the demineralizer system. Observation of the pool water clarity is used to determine the effectiveness of the diatomaceous earth filter.

  10 CFR part 36.63 requires that the conductivity of the pool water be maintained below 20 microsiemens per centimeter. Records of water conductivity gathered over the past several years, during which time the present demineralizers and filter were operative, show that the system is capable of maintaining <20 microsiemens per centimeter between bed regenerations.

- Pool Leakage: A leakage test was performed during March, 1986, where the pool was filled to a level within the normal operating range and the level noted. The identification numbers of each canister located within the pool at the time of start of test was also noted. No make-up water was added over a period of four (4) days. A record was made of the number of canisters removed form the pool during this period of time and an estimate made of amount of water removed with each canister. (A small amount clings to surface and fills recesses of canister.)

  Allowance was made for water lost on canister removals and also losses due to evaporation from the pool surface. The pool geometry with the starting canisters was then duplicated at the end of the test period. The water loss was determined to be less than five (5) gallons a day which is within the experimental error imposed by the method employed.

  Principals of Master Engineers and Designers PC (registered in the State of Virginia) were responsible for the design and installation of the irradiator pool. One of the engineers, Mr. C. M. Parker, has made a thorough inspection of the pool and has provided a report on the pool structure. A copy of the report was attached to the January 21, 1988, submission for license renewal. This report of April 11, 1986, was required to comply with a request for information from the NRC in a letter dated March 11, 1986. It concludes that the pool was water-tight at the time of inspection. In the interim a 1.21 megacurie Cesium-137 irradiator was added to the pool. For a time the temperature rise, associated with the added radioactive material, caused considerable evaporate loss. Consequently, a water cooling

system was installed in August, 1987. (This was reported by phone to Mr. Earl Wright, Senior License Reviewer, NRC, Region II on August 31, 1987.) After its installation, the make-up water addition rate was the same as before the Master Engineers and Designers' survey. It is, therefore, concluded that the integrity of the pool did not change from the time of the investigation.

The Cesium-137 sources have since been returned to DOE.

- Pool Components: The pool is constructed of steam cured reinforced concrete pipe and is made up of four pipe sections with sealed joints. The entire pool is below grade in dry soil. More details are contained in the April 11, 1986 report of Master Engineers and Designers.

  Other materials in the pool are aluminum and stainless steel.

- Personnel Barrier Around Pool: Workers are afforded protection from falling into the pool by two horizontal courses of 1-1/2" steel pipe that surrounds about 80% of the pool perimeter. This piping is 1-1/2' and 3' from the floor. Three lengths of sturdy metal chain (located 1-1/2', 3' and 4-1/2' from the floor) provide fall protection at the remainder of the pool perimeter.

- Pool Tools: During normal production operations, as well as maintenance and repair procedures, a variety of long handled tools may have one of their ends close to the radioactive sources. These tools are generally hollow poles with a work piece on one end. This provides a potential for radiation streaming if the top end of the pole is closed off. Therefore, it is a departmental radiation safety rule that all such tools must have both ends open so that the tool will fill as it penetrates the pool water. In addition, instruction on the prevention of streaming is given in the radiation safety lecture provided to all new radiation workers as well as during operator training.

- Canister-Source Interference: Target material-source interference is prevented by the irradiator design and mode of operation. Articles to be irradiated are placed in various sized and shaped containers which are then lowered by an electric hoist to a position adjacent to the Cobalt-60 radioactive sources near the bottom of the pool. These sources are held in an aluminum frame that is termed the "plaque." Contact between product canisters and plaque is prevented by encasing the sources in an aluminum shroud that fits snugly around the source plaque. Sudden jarring hits by the product canisters are largely prevented by the damping effect of the water.

- Canisters are properly positioned over the pool surface away from the irradiator plaque. They are lowered slowly and vertically until they reach the level of the radioactive source plaque.

  Safety chains are used during the transition from support by the overhead hoist chain to the canister support cables which are attached to an overhead trolley system.

  The source plaque is then moved to an "irradiation" position and the canister is moved horizontally in the pool adjacent to the plaque. Over

50,000 canister transfers have been made safely over more than 28 years. Removal of canisters involves essentially the reverse operations.

All such canister manipulations are performed by trained technicians. These technicians have been taught to observe precautions that minimize canister contact with the pool walls and the irradiator plaque.

Item #10: Radiation Safety Program

(1) A. Access Control

Access control has been addressed under "Facilities and Equipment".

B. Personnel Dosimeters

Company employees who enter the pool room wear radiation monitoring devices. All individuals who normally work in the C&I (irradiator) building, company maintenance men and some company management people wear film badges. Other company employees who enter the pool room infrequently and outside visitors are issued direct reading "pencil" dosimeters for each visit. These pencil dosimeters are also issued to radiation workers who work in the pool room during activities that could generate higher than normal radiation levels, such as receipt or return of radioactive source material.

The film badges are supplied by R.S. Landauer, Jr. and Company of Glenwood, Illinois. They are changed and analyzed monthly. Landauer's designation for this type of badge is GI, and the minimum measurable dose quantity is 10 millirems.

The pencil dosimeters read to 200 millirems. They are Model 862 as supplied by Dosimeter Corporation of America (or equivalent).

Radiation Detection Instruments: ARECO has on hand at its irradiation facility a G-M survey meter capable of measuring up to 1 roentgen per hour.

The survey meter is calibrated so that the readings are + - 20% of the actual values over the range of the instrument.

Certificates showing the results and date of the last calibration are kept on hand.

Calibration is carried out regularly as part of a calibration audit conducted by Health Physics Consultation at periods not exceeding 12 months. This company also calibrates after servicing if the accredited service company does not. Health Physics Consultation's NRC license number is 45-19958-01.

All calibration records are kept for a minimum of 2 years after each calibration is performed by Health Physics Consultation (or the original equipment supplier).

system was installed in August, 1985. It was reported by phone to Mr. Earl Wright, Senior License Reviewer, NRC, Region IV, in August 21, 1985. After its installation, the makeup water addition rate was the same as before the Master Engineers and Designers services. It was, therefore, concluded that the integrity of the pool did not change from the time of the investigation.

The Cesium-137 sources have since been returned to DOE.

- Pool Components: The pool is constructed of steam cured reinforced concrete pipe and is made up of four pipe sections with sealed joints. The entire pool is below grade in dry soil. More details are contained in the April 11, 1986 report of Master Engineers and Designers.

  Other materials in the pool are aluminum and stainless steel.

- Personnel Barrier Around Pool: Workers are afforded protection from falling into the pool by two horizontal courses of 1-1/2" steel pipe that surrounds about 80% of the pool perimeter. This piping is 1-1/2" and 3' from the floor. Three lengths of sturdy metal barn (located 1-1/2", 3' and 4-1/2' from the floor) provide fall protection at the remainder of the pool perimeter.

- Pool Tools: During normal production operations, as well as maintenance and repair procedures, a variety of long handled tools may have one of their ends close to the radioactive sources. These tools are generally hollow pipes with a work piece on one end. This provides a potential for radiation streaming if the top end of the pole is left off. Therefore, it is a departmental radiation safety rule that all such tools must have both ends open so that the tool will fill as it penetrates the pool water. In addition, instruction on the prevention of streaming is given in the radiation safety lecture provided to all new radiation workers as well as during operator training.

- Canister-Source Interference: Target material source interference is prevented by the irradiator design and mode of operation. Articles to be irradiated are placed in various sized and shaped canisters which are then lowered by an electric hoist to a position adjacent to the Cobalt-60 radioactive sources near the bottom of the pool. These sources are held in an aluminum frame that is termed the plaque. Contact between product canisters and plaque is prevented by [illegible] aluminum shroud that fits snugly around the source plaque. [illegible] the product canisters are largely prevented by the [illegible] water.

- Canister [illegible] are properly [illegible] irradiator plaque. They are [illegible] the level of the [illegible]

  Safety [illegible] are used [illegible] hoist chain to the canister [illegible] for the [illegible] system.

  The [illegible] plaque is then [illegible] is not to be moved [illegible]

background level of <0.05 mr hr. Resins to be discarded will be checked for levels above this with the Eberline E-520 survey meter fitted with a thin windowed HP-270 cylindrical probe (or equivalent system) which is capable of detecting radiation levels of 0.05 millirems per hour.

Continuous Radiation Leak Detectors: Two systems are utilized. Their functioning is based upon the accumulation of radioactive material in a demineralizer bed with water flowing through it at a known rate. Radioactive ions dispersed in the pool at relatively low concentrations will be concentrated in the demineralizer bed.

An Eberline HP-270 probe connected to an Eberline Smart Radiation Monitor is placed in continuous contact with the outside surface of the cation ion exchange bed at a level where the ionized water first contacts the exchange resin. The alarm is set at a level slightly above that which would register an alarm from high background level bursts of radiation. As the water flows through the exchange bed at three (3) gallons per minute, very low levels of dissolved Cobalt-60 or its compounds in the pool water would set off this continuous monitor alarm.

The second system uses the continuous area radiation monitor as required under our present license. The detector of this device also monitors (in addition to the working area) the level of radioactivity present in the demineralizer although it would be less sensitive than the Smart Alarm. This too has audio and visual alarms.

Particulate Cobalt-60 would be trapped in the diatomaceous earth filter and would be detected by the weekly radiation survey of the pool room. All ion exchange and filter beds are specifically checked during this survey.

E. Leak Testing of Sources

The continuous monitoring of the cation bed for above background levels described above constitutes a type of source leak test. Any new cobalt-60 sources that would be added to the irradiator will have to be accompanied by a certificate from the supplier of leak testing that was performed within six months of the time of receipt of the sources.

(2) Emergency Procedures

Operating and Emergency Procedures: Copies of operating and emergency procedures are provided to all personnel engaged in the use of the irradiator(s). These procedures include instructions concerning: immediate evacuation when a radiation alarm sounds, notification of a Radiation Protection officer (if one is not present), briefing of RPO on conditions just prior to alarm activation, and the use of survey meters during approach to the irradiator area to take corrective action. Such corrective actions are described for various situations that would be expected to be possible causes for alarm activation.

A. Personnel Dosimetry: All personnel engaged in irradiator operations are ordered to wear their personal film badges while working around the

irradiator. Radiation Protection Officers and senior technicians check on a non-scheduled basis to see that badges are being worn.

B) Irradiator Start-up: Irradiator start-up and shut-down in the case of our irradiator essentially means sinking or raising leak-tight containers of target material into or out of the pool.

C) Radiation Survey: In addition to constant monitoring of the area, a weekly radiation survey is carried out. This survey, using an Eberline G.M. survey meter E-520 with HP-270 probe (or equivalent), surveys a number of designated areas in the pool room with emphasis on all ion-exchange beds and the diatomaceous earth filter.

D) Loss of Shielding: The most likely emergencies (excluding a leaking source) that can occur with a category III irradiator differ from the more common cell design. The great majority involve an insufficient depth of water between the radioactive isotopes and the working area around the pool. Actions or conditions that could cause such situation to exist have been listed in the emergency procedures along with actions to be taken. Instructions include the provision that at least one Radiation Protection Officer be notified of the emergency.

E) Associated Irradiator Operations: Major associated irradiator operations; e.g., instrument calibrations, leak testing, etc., are carried our under the supervision of Radiation Protection Officers or Health Physics Consultation. Transfer of radioactive material from a supplier to the bottom of the irradiator pool is carried our by R.P.O.s assisted by senior radiation workers, all of whom follow a detailed set of instructions drawn up especially for each such transfer. Other ancillary operations such as regeneration of ion-exchange beds, and cleaning and changing of diatomaceous earth filters are carried out as per written S.O.P.s by qualified trained operators. These S.O.P.s contain the performance standards for these operations.

F) Sources stuck in the unshielded position: The irradiator is an ANSI Category III underwater irradiator. Therefore, the condition of sources stuck in the unshielded position does not apply.

G) Personnel Overexposures: In the event of a radiation alarm, emergency procedures, posted throughout the facility, direct workers to immediately cease activities in the pool room, quickly proceed to an office area that is well removed from the pool area and contact an RPO. Under normal conditions the radiation levels in the pool room are background and in the 30+ years that the irradiator has been operating no worker has received an annual dose of greater than 30 millirems.

H) Sounding of a Radiation Alarm: Workers will follow the emergency procedures outlines in item (7) above. An RPO will determine the cause of the alarm and proceed with appropriate corrective procedures.

I) Detection of Pool water Contamination from a "leaker": Upon indication of the existence of a leaking source, a telephone report shall be given to NRC Operations Center and the office of NRC Region II.

(i) Shut off the pool circulating system.

(ii) Monitor all personnel for contamination.

(iii) Promptly initiate decontamination procedures on all contaminated personnel.

(iv) Monitor all equipment and surfaces in the pool room for decontamination.

(v) Monitor the remaining areas of the facility for contamination.

(vi) Initiate decontamination procedures on contaminated equipment and surfaces.

(vii) Remove product canisters from the pool.

(viii) Initiate decontamination procedures on the canisters.

Note: As the material being irradiated does not come into contact with the pool water it is not necessary to check irradiated product for contamination.

(ix) Initiate actions to identify and isolate the "leaker" as follows:

Take the aluminum protective shroud off of the Cobalt-60 plaque. Unhook the plaque containing the elements from its suspension plate and lean it at a slight angle against the pool wall. Beginning at the top, remove an element from the top bin and perform underwater swabbing of the element paying particular attention to the welded ends. Determine if the swab has picked up any contamination. Repeat with all elements in a bin (2-5 elements). If none of the elements show traces of contamination, replace them in the bin from which they were taken. Proceed in this manner until the presence of contamination on a swab indicates a leaker. Swab all (2-5) elements in the bin containing the suspected leaker to be sure it was not "carry-over" contamination detected initially. When the wipe, or swab, test is performed, contamination will be measured using an Eberline G.M. survey meter (Model E-520 or equivalent using an Eberline HP-260 detector.)

Activity levels will be measured either by a Radiation Protection Officer of AREVO or by Health Physics Consultation.

Once the leaker has been identified, transfer it to a "leaker containment vessel" at the bottom of the pool. Seal the lid of the vessel with a "long-handled wrench" tool and then pump the water from the vessel.

While the identification and removal procedure is being followed, concurrently make arrangements for a shipping cask

to send the leaker back to its supplier in the containment vessel.

(x) Circulate the pool water through a clean-up demineralizer which has been placed into the pool water in order to provide shielding from any radioa tivity that is concentrated on its resin bed.

(xi) Resume operation after each canister has been checked for contamination and decontamination procedures have been performed, if necessary.

J. Low Water Alarm: Insufficient depth of water in the pool will cause the radiation alaarm to sound.

Low water level can be caused by:

i) Evaporation and other routine loss, such as water loss through can removal over an extended period of time.

ii) Broken plumbing in the water recirculating line that would cause water to go elsewhere other than back to the pool.

iii) A leak developing in the pool walls or bottom.

Action to be Taken:

Cause i: Add water to the pool through the demineralizer.

Cause ii: The interlock between the radiation alarms and the circulating pumps would shut them off and prevent further decreases in water level. After repairs to the plumbing, use demineralized water to bring the water level back to its normal point.

Cause iii: Add water to the pool through a garden hose at the rate of approximately 10 gallons per minute. In the case of gross rupture of the pool walls or bottom contact the fire station on U.S. Rt. 221 (phone 911) and have the firemen supply water to the pool from the fire hydrant near the building on Lakeside Drive at a rate of up to 100 gallons per minute. If water loss continues to be severe notify NRC Region II.

K. Loss of Electrical Power: In the event of electrical power loss, emergency lighting is provided in the irradiator pool room and surrounding areas. Thus, a person can proceed from the pool room to a phone in the "loading" area with adequate illumination as these lights come on automatically when power fails. The loading area phone has emergency power.

Besides emergency lighting, a portible gasoline-driven generator will be activated for back up power to selected equipment. As a minimum, power to all water circulating pumps will be maintained. Manual hoists will be substituted for electrical hoists if needed as the latter are

three phase. The Eberline Smart Radiation Monitor has battery back up. The emergency generator is located adjacent to the pool room.

L. Fire or Explosion: As the irradiator is an underwater one, the chance of damage to the sealed sources by fire and explosion is much less than with a cell type irradiator. As per the "Emergency Plan for the Conversion & Irradiation (C&I) Building," if either of these events occurs, workers in the building will immediately evacuate to a safe location. Then professional fire fighters from the Lynchburg Fire Department will be summoned. Personnel from this station have visited the facility during the past year to familiarize themselves with the hazards (including the irradiator) present in it.

M. Unauthorized Entry: During shift hours, unauthorized entry is very unlikely as there are shift personnel in areas leading to the pool room and entrances to the facility are kept locked. When the irradiator is not operating, there is an intruder alarm in the pool room which is connected to an automatic dialer. This will call the home phone numbers of two people (presently two alternate RPOs) and a pager that is carried by one of the RPOs. They respond not knowing the nature of the given alarm. If the presence of an intruder is indicated, the responder will notify local law enforcement officers to investigate further.

N. Natural Phenomena: Earthquakes and flooding are very unlikely events due to the location of the facility. If severe damage to the building by any natural phenomenon occurs, the NRC Operations Office and Region II will be notified. A protective covering will be placed over the pool and a guard will be posted until the irradiator can be secured again or until other actions are called for by the NRC.

O. Water Migration to Municipal Water: The location of the facility is such that any discharge of pool water has no chance of joining with any existing water supply system.

P. In Air Irradiations: None are performed.

Q. Hospital Arrangements: Such arrangements have been made with Lynchburg General Hospital, which is located approximately five (5) miles from the irradiator facility. A copy of a letter of agreement to treat employees in the event of an accident or injury due to irradiator operation is enclosed. (Attachment 5)

(3) Inspection and Maintenance

A) Access Control System: For ARECO's underwater irradiator, the inspection and maintenance of the access control system only involves testing of ordinary door closures and locks to assure operability.

B) Water Contamination Monitor: The operability of this monitor is checked daily with a (1 millicurie) check source. This source is stored in the pool water at the end of a cable. Results are recorded.

C) Over Pool Radiation Monitor: The operability of this instrument is also checked daily with the same check source as for 2. above. Results are recorded.

D) Water Circulation Leak Tightness: The integrity of the plumbing in the pool water circulating system is best checked by visually searching for water on the floor under and near the equipment. This check will also be performed daily and the results recorded.

E) Smoke and Heat Detector: The smoke and heat detector located in the pool room is checked for operability by deliberate activation at the same time as other smoke detectors in the building on a monthly basis. The results of the check are recorded.

F) Pool Water Replenishment: There is no automatic water replenishment system. Water is normally added from the municipal system through the demineralizer at a rate of about three gallons per minute by manually turning a valve.

G) High and Low Water Level Indicators: These floats can be closed manually with the aid of a stick to sound the appropriate alarm. These will be tested monthly and the results recorded.

H) Intrusion Alarm: This alarm (and dialer), located in the pool room, is checked for proper functioning monthly. The alarm is set then the person performing the check moves to activate one of the alarm's sensors. The checker will be carrying a beeper which should sound after the movement. The results of the test are logged.

I) Source Cables: As the irradiator is of the underwater type there is no system to raise or lower the sources in the pool. However, there is a source movement system by which the sources move horizontally near the bottom of the pool. The cables for this system will be checked visually, where access is available, semi-annually. The results of the inspection will be recorded.

J) Source Barrier: The source rack protection called for in 10CFR 36.35 has to do with irradiators that have product conveyor systems. Underwater irradiators do not have such systems.

K) Added Pool Water Records: As mentioned in 6. above, there is no automatic water addition system, only a manual one. Whenever water is added to the pool the amount is recorded for future reference.

L) Radiation Damage to Electrical Wiring: Radiation levels around all electrical wiring is background and so there should be no radiation damage to it.

M) Conductivity Measurements: Pool water conductivity is measured via a probe positioned directly in the water recycling system and is recorded daily. Conductivity meter calibration will be performed annually.

(4) Detection of Leaking Sources:

The method for checking the pool water for contamination is having a cylindrical Geiger Mueller probe permanently affixed to the cation bed of the demineralizer. This Eberline HP-270 probe is connected to an Eberline SRM-100 "Smart Alarm." The alarm set point is 0.4 mr/hr. In addition, a weekly radiation survey is performed with special attention being to the demineralizer beds. All radiation readings are recorded and a build up of radioactive material in the cation bed would be detected by increased radiation levels in succeeding surveys.

During this weekly survey, a one liter sample of pool water is collected and tested for radioactive contamination. This is done by evaporating the sample to less than a milliliter and using a "pancake" Eberline HP-260 probe to detect radiation in the remaining small volume. This analysis is performed by an RSO.

(5) Radiation Detection Instrument Calibrations: All such calibrations are done by a certified Health Physicist, Mr. John Cure of Health Physics Consultation, Inc., every six months.

(6) Pool Water Purity: The water purification system consists of a filtration system and a demineralizer system in the water circulation loop.

The filter system contains a pleated paper diatomaceous earth filter having an effective area of 150 square feet. Water passes through this unit at a rate of 100 gallons per minute.

The deionizing system has three resin bed columns, cation, anion and mixed bed, through which the water flows. Each bed contains about 1-1/2 cubic feet of resin beds. The resins used are: Dow HCR-SH cation bed resin, Dow SAR anion bed resin, and Dow MR3-NG mixed bed resin. Equivalent resins may be substituted. The system is supplied by Hungerford & Terry, Inc. (Model #TBD-9.5). Water passes through this unit at a rate of 3 gallons per minute.

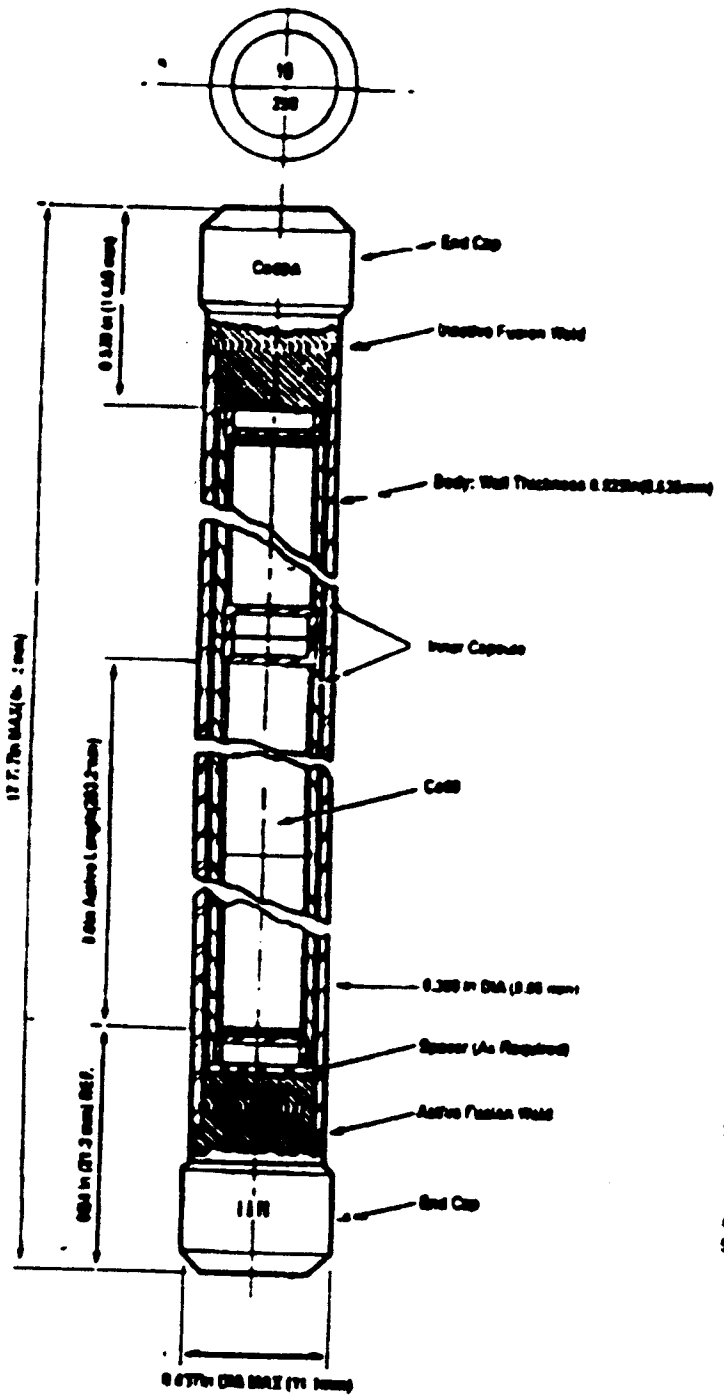
This water purification system is in continuous operation, even when no production operations are in progress. The criterion for acceptable purity will be a conductivity of 20 microsiemens per centimeter or less.

The method of calibration of the conductivity meter to be employed will be adopted after discussions with the manufacturer.

Item #11: Waste Management

Sealed sources will be shipped only to authorized recipients, transfer will be done as soon as practical after there is no further use for the source, and transport will be done in accordance with 10CFR Part 71.

ATTACHMENT 1



Drawing Type Number	Capsule Number of Inners
1	C-177/C-177
2	AC-191/AC-191
3	AC-195/AC-195
4	C-348
5	AC-339/AC-339
6	AC-348/C-348
7	C-177/AC-191
8	C-177/AC-195
9	C-177/AC-339
10	AC-191/AC-195
11	AC-191/AC-339
12	AC-195/AC-339

NOTES:

1. All dimensions in inches & millimeters
2. Outer capsule material Type 316L stainless steel
3. Engraved as follows:
   (A) Upper End Cap (Base): serial number
   (Alternate): Co60A
   (B) Lower End Cap (Alternate): NR
4. Dimensions shown are at 68°F (20°C)
5. Conforms to IAEA Special Form requirements
   AECB Certificate No. CDSS0183

NORDION INTERNATIONAL INC.

447 March Road, P.O. Box 13500
Kanata, Ontario, Canada K2K 1X3
Tel: (613) 592-2790 • Fax: (613) 592-6937 • Telex: 053-4102

TITLE: Co-60 Sealed Source			
DATE: FEB 3,1997			No. C-188
DRAWN: D.L.S BLANC	CHECKED	APPROVED	REV. K
			SHEET 1 of 1

ATTACHMENT 2

EXPERIENCE AND EDUCATIONAL BACKGROUND FOR JAMES J. MYRON

James J. Myron - B. Sc. (Chemistry)
- Engineering Diploma, Ph.D. (Radiation Chemistry)

Myron received his Ph.D. in radiation chemistry from the University of Alberta, Edmonton, Alberta, Canada (1964). For 4-1/2 years he engaged in research on the radiolysis of organic compounds using a medical Cobalt-60 gamma ray source (maze configuration production) and an Atomic Energy of Canada Ltd. Gammacell unit. This work and associated courses involved radiation effects on chemical systems, principles and practice of radiation protection and mathematics and calculations pertaining to the use and measurement of radioactivity.

He then spent two years at Florida State University, Tallahassee, Florida (Post Doctoral position) continuing studies in the radiation effects on chemicals using the x-rays generated by a 1.5 Mev Van de Graff accelerator (1964-1966).

Two more years were spent at the Oak Ridge National Laboratory at Oak Ridge, Tennessee, where he employed a Cobalt-60 Gamma source for radiation synthesis studies (1966-1968).

From 1968 - 1980 he was employed at Goodyear Tire and Rubber Company, Akron, Ohio, performing radiation research and was listed as a user on their AEC-NRC license #34-00508-04 for their 10,000 curie Cobalt-60 source. From 1975-1980 he also used a 0.5 Mev electron accelerator for material processing.

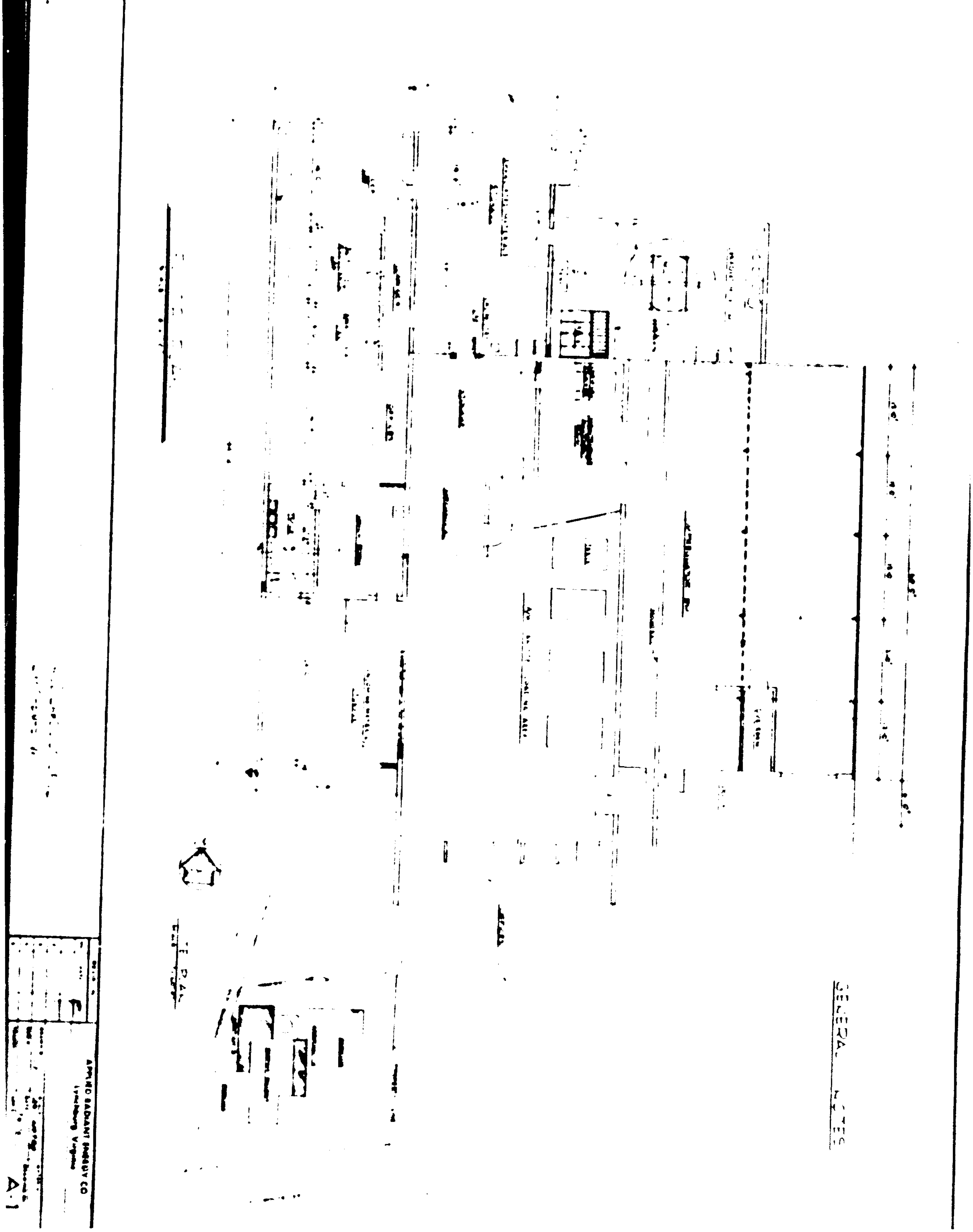
From August 1980 to the present, he has been employed at the Applied Radiant Energy Corporation. Presently he is Vice President - Safety and Regulatory Affairs and is responsible for the safe use and regulatory compliance of all radioactive sources possessed by the company.

He had the prime responsibility for the safe installation of approximately 1.2 million curies of Cesium-137 at the company's irradiation facility I November of 1986.

He is presently a member of the American National Standard Institute subcommittee for the Safe Design and Use of Gamma Irradiators.

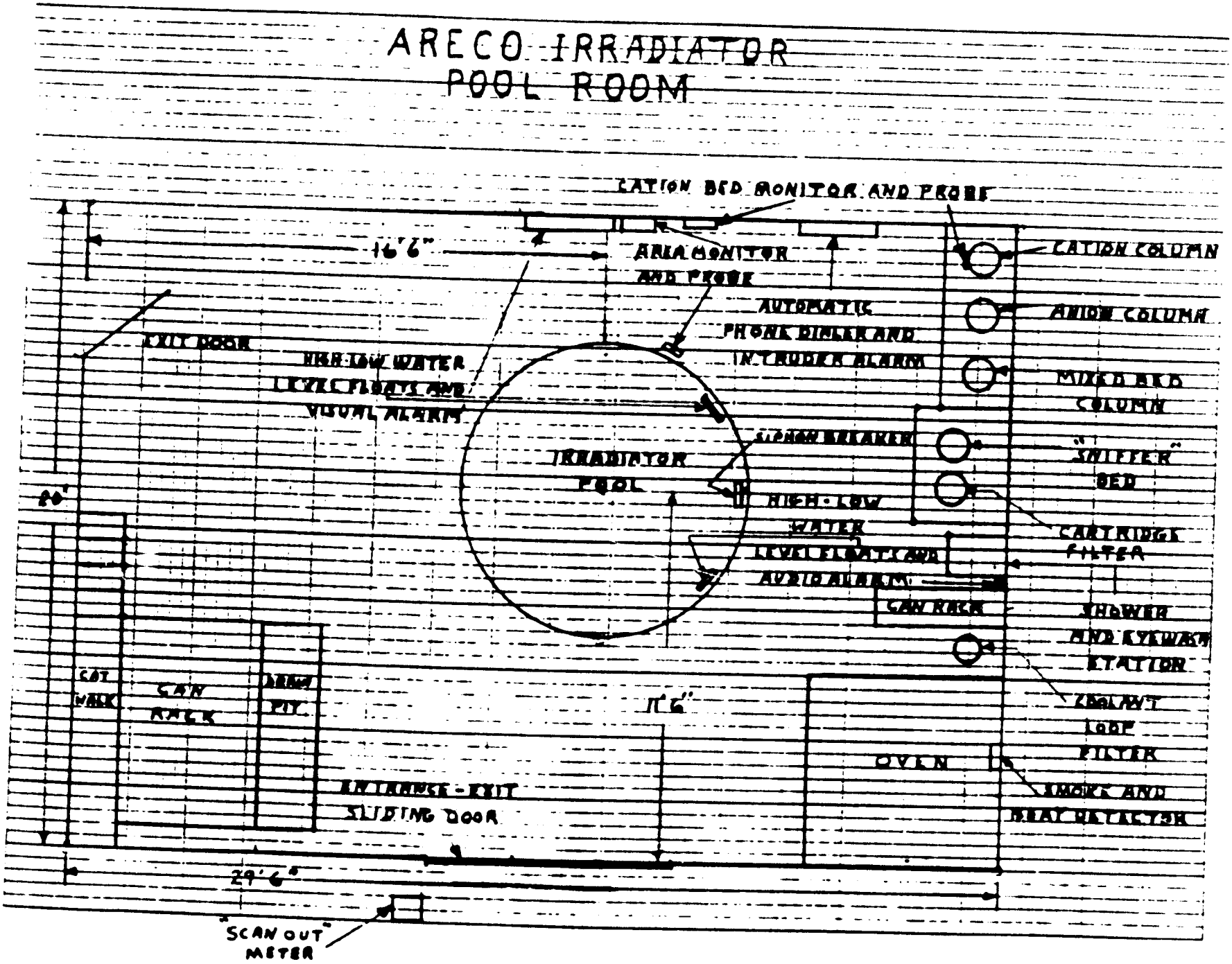
Ref: License #45-11496-01

ATTACHMENT 3



ATTACHMENT 4

ARECO IRRADIATOR
POOL ROOM



ATTACHMENT 5

Centra Health
1901 Tate Springs Road
Lynchburg VA 24501-1104
(804) 947-3000

April 2, 1996

James J. Myron, PH.D.
Dir. of Radiation & Technical Services
The Applied Radiant Energy Corp.
2432 Lakeside Drive
Lynchburg, VA 24501

Dear Dr. Myron:

This communication is to affirm the agreement of Lynchburg General Hospital to treat your company's employees in the event of an accident or injury resulting from irradiation operation. This treatment would be carried out in accordance with the hospital's Emergency Preparedness Plan. If you have an accident victim who may pose a radiation threat to others, please:

a. Phone the Nursing Office at 947-3055, (or if no answer, call the Emergency Department at 947-3027) and inform us of the situation.

b. Bring the contaminated victim to the side entrance of the Emergency Department to the door marked with a yellow triangle.

Please let me know if additional preparation is needed.

Sincerely,

Curt L. Whitlock
Director
Safety, Security, Risk Management

CLW:hrw

pc: Disaster File