RADIATION STERILIZERS INCORPORATED

August 8, 1988

Nuclear Regulatory Commission, Region III
Attn: Bruce S. Mallett, Ph.D.
Chief, Nuclear Materials Safety and Safeguards Branch
799 Roosevelt Road
Glen Ellyn, Illinios 60137

Gentlemen:

Response to your August 5, 1988, request for information on the use of cobalt for irradiation operations during the period of time that cesium WESF capsules are stored at our Westerville, Ohio facility is enclosed. Radiation Sterilizers is anxious to initiate operations at the Westerville irradiator as soon as possible; however, we share with the Nuclear Regulatory Commission, their concern that operations proceed in a safe manner.

We feel the information that is embodied in our answer to your request satisfies all requirements for safe operation of the Westerville irradiator. If you have any questions, please call me at your earliest convenience.

Sincerely,

Allan Chin /jm

Allan Chin
President

Barry Fairand

Barry Fairand
Vice President, Operations

jm
cc: Patty Whiston
Mike LaMastra

Enclosure

1. <u>Visual Inspection</u>

a. As each capsule is removed from the source racks it will be visually inspected using binoculars for evidence of corrosive attack that is similar to the morphological effects observed in Decatur. A video display of the Decatur capsules is available for evaluation by the Westerville staff. This information will serve as a comparative baseline in the evaluation of the Westerville capsules. Results of the visual inspection will be recorded and made available for inspection by Nuclear Regulatory personnel. To date, all testing of the WESF capsules at the Decatur facility has been performed by the Department of Energy (DOE). For this reason a program that is developed and instituted by RSI personnel to test the capsules at Westerville does not seem appropriate. DOE has requested that the capsules be placed in safe storage. RSI feels that this should be accomplished with minimal disturbance to the capsules and with as little handling as possible.

It is expected that before removal of the cesium capsules from the Westerville facility DOE will want to conduct a more detailed inspection of the capsules. It must be remembered that sensitive monitoring techniques have uncovered no evidence of cesium chloride in the water. Since the capsules will remain in a quiescent state, i.e., no thermal cycling, there is no reason to believe a capsule will be spontaneously compromised.

b. Other than periodic, e.g., once per month, visual inspection of the capsules and holders, it would seem that the capsules should be left in a dormant state and not removed from their holders for closer examination.

2. <u>Unloading of Cesium-137 WESF Capsules</u>

a. The cesium racks exceed 11 feet in height as well as width and weight 703 pounds apiece. Lack of physical space precludes storage of these racks in our pool while simultaneously operating our system with cobalt racks.

b. Five holders, each capable of storing 36 WESF capsules, will be placed on the bottom of the Westerville pool. Four of these holders will contain 36 capsules and the fifth holder will store the remaining 35 capsules. All capsules will be stored in an upright position.

c. The holders will be centered between the two source racks with four of the holders being two abreast and the fifth residing by itself (see Figures 1 and 2). All of the holders will be positioned so that they are not on contact with each other. As described in an earlier letter to Region III (see attachment) the holders have a width of 14 inches and an overall length of 33 1/4 inches including the end tab.

The two source racks and their guide cables are centered 12 inches from the pool liner. The racks have an overall width of 5 inches, therefore, the inner dimension between the two source racks is 43 inches. Two holders positioned side by side and centered between the racks have an overall width of 28 inches. After allowance for a standoff distance of approximately 1 inch between the holders, the nearest distance between the racks and holders exceeds 6 inches. The nearest distance between the holders and the sides of the pool is 22 inches. One weld at the bottom of the pool runs along the centerline in the longitudinal direction; however, the holders can be positioned to avoid this weld.

d. The holders that will be used for temporary storage of the cesium capsules are constructed from aluminum. It is a known fact that galvanic action can occur when dissimiler metals are placed in an electrolyte; however, corrosive effects to the stainless steel due to this mechanism are not of concern. The electrochemical potential of aluminum is significantly greater than stainless steel. Therefore, migation of ions from the metal which would result in erosion of the surface will occur from the aluminum holders, not the stainless steel. In additfon, galvanic action is dependent on the presence of an electrolyte, i.e., a solution that is capable of conducting an electric current. Water in the Westerville pool will be maintained at a conductivity level of 10 microsiemens per centimeter or less. Because of the very high resistivity of the water, i.e. greater than 100,000 ohm-cm, it is a very poor electrolyte. For this reason galvanic action will be greatly retarded. As testimony to this conclusion, WESF capsules were stored for two months in the same aluminum holders at the Decatur facility without adverse effects.

e. The bottom of the Westerville pool is presently in a clean state. Once the holders are in place, the 1 inch wide aluminum bars that span the bottom of the holder will rest directly on the stainless steel liner. Gradual deposition of sedimentary deposits will not affect thermal contact between the holder and pool liner. Contact between the capsule and holder will not be affected for the same reason. Based on historical observations, accumulation of debris is sufficiently slow that circulation of water around the capsules will not be impeded unless the capsules are stored for extremely long periods of time, i.e., for more than a year.

3. Storage of Cesium-137 WESF Capsules

a. All water quality and temperature measurements of the storage pool are conducted with portable equipment. The conductivity meter is capable of measuring down to 0.2 microseimens per centimeter. Color comparison tests are used to check pH and free chloride content. Fluoride tests would be in order if we stored strontium fluoride capsules in addition to cesium chloride. Since this will not occur, this test is not necessary. All remaining tests as stipulated in Section 3. a. will be made.

The typical operational temperature of the pool will be less than 110 degrees Fahrenheit; however, maintenance requirements and power outages may result in temporary excursions i.e., 48 hours or less, to temperatures of approximately 125 degrees Fahrenheit.

b. The pool water temperature is measured by insertion of a thermometer near the surface of the pool. Exclusive of local hot spots, this temperature is representative of the bulk pool temperature.

DOE studies and surface temperature measurements made on a capsule mockup that was located in the Westerville source racks have demonstrated that the equilibrium surface temperature of the cesium capsules is approximately equal to the temperature of the surrounding water. This will be true as long as the capsule's contact with the surrounding reservoir of water is not significantly impeded. The capsules are loosely held by the aluminum cylinders. They will not restrict circulation of water around the surface of the capsules. Also aluminum is an excellent thermal conductor and will efficiently dissipate heat to the water. Finally, no localized boiling of water was observed when the capsules were stored at the Decatur facility under identical conditions.

c. Four banks of anion/cation DI tanks have been added in parallel to the recirculation system. This configuration will allow the chiller and DI tanks to be operated in combination.

d. The total recoverable energy per decay of cesium-137 that is deposited as heat in the capsule, water, walls, etc., is 0.79 Mev per decay. Of this energy, part is lost from the system, e.g., gamma rays that penetrate into the surrounding terrain. This fraction is estimated to be less than 20 percent of the total. When this loss factor is taken into account, the total power per curie that needs to be dissipated is 3.7×10^{-3} watts per curie. The total curies of cesium-137 presently being stored in the Westerville pool is 8.16×10^{6} curies. Therefore, the heat load from the cesium capsules is 30 kilowatts. Part of this heat load must be removed by the chiller while the remaining fraction is conducted away through the stainless steel pool walls into the surrounding environment.

A maximum of 1.2×10^{6} curies of cobalt-60 is scheduled for use at the Westerville facility. If this source were left in the pool 100 percent of the time, approximately 15 kilowatts of heat would have to be dissipated. In actuality the cobalt sources will be out of the pool and irradiating product on an average of 80 percent of the time. The effective heat load that needs to be dissipated is 20 percent of 15 kilowatts or 3 kilowatts.

Based on the above numbers, the combined heat load from cesium and cobalt that needs to be dissipated is approximately 33 kilowatts. The ten ton chiller (approximagely 35 kw) presently in operation at Westerville is capable of handling this heat load. It must be remembered that conductive cooling through the pool walls assists in dissipation of the heat. With cesium alone the chiller has a net positive output and present pool temperatures are less than 100 degrees Fahrenheit.

Twenty-four hour service is available for service and repair of the chiller. A list of critical components will be placed in stock so that repair will not be delayed beyond 48 hours.

e. The in-line monitor shown in Figure 3 is designed to monitor the pool water whenever the water recirculation system is active. A fraction of the recirculated water is directed through a specially designed stainless steel canister that is contained within a 4 - pi lead shield (3 inches thick). The water is directed into the bottom of the canister where it mixes and through swirling action eventually exits through a port located at the top of the canister. The sensitive element of the system consists of a 2-inch diameter by 2-inch high sodium iodide scintillation crystal coupled to a 2-inch diameter photomultiplier tube. The output of the photomultiplier tube is fed into a rate meter / scaler / single channel analyzer. The detector high voltage and analyzer window are set for optimum detection of the photon energy of interest, i.e., cesium-137. The combination of shielding and energy discrimination permits detection of radioisotopic concentrations down to about 2 x 10^{-7} μci per cubic centimeter of water. At this sensitivity, less than 20μci of radioisotope uniformly dispersed in 20,000 gallons of water could be detected. The system has the following specifications:

Detector:

Bicron Model G2 NaI (Tl) scintillation probe with 2" x 2" crystal coupled to a 2" diameter photomultiplier tube.

Electronic Equipment:

Bicron Model LABTECH ratemeter/scaler/analyzer with preamplifier.

Saturation Level: 4 x 10^{-2} μ ci/ml *

Canister Volume: 1 gallon of water

Flow Rate Through Canister: 0.5 - 2 gallons per minute

A one nanocurie cesium-137 source was used to calibrate the in-line monitor. The canister volume was first divided into several geometric regions and then source counts were taken as a function of radial distance from the crystal for each one of these regions. The geometric regions used in the analysis and radial traces where counts were taken are shown in Figure 4. Because the canister exhibits azmuthal symmetry upon rotation about Trace A, it was not necessary to generate radial traces in the unhatched regions. The volume of each geometric region was determined and then divided into several radial slices.

The counts observed along each radial trace were weighted according to the fractional volume in each slice. In this manner it was possible to obtain a volume weighted average count along each trace. These counts were subsequently weighted by the fractional volume in each geometric region thereby giving one average count that was representative of the count that would be observed if one nanocurie of cesium were uniformly dispersed in the canister. This count is duplicated when the cesium source is located along Trace A at a distance of 1.8 inches from the crystal. Counts taken at this location gave a value of 8377 counts per 100 minutes with a statistical scatter of +/- 120; at 2.0 σ. Background counts also were taken over several days. These numbers are shown in Figure 5. From a comparison of these numbers, it is obvious that one nanocurie of cesium activity is easily discernable above background. Since the canister holds one gallon of water or 3785 milliliters, the detector system is capable of detecting down to 2.6×10^{-7} μci per milliliter of water.

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* This radioisotopic concentration is detectable with a GM probe.

Alarm (3×10^{-6})

The detector system will be set to alarm if the count rate exceeds 1000 counts per minute (equivalent to a specific activity of approximately 3×10^{-6} μci per ml). If the alarm persists for one minute or more, the system will be shut down and the RSO or Assistant RSO notified of the event. Additional 100 minute counts will be taken and if the above level of activity is confirmed, the plant will be secured and NRC will be notified. Daily tests, that involve placement of a cesium-137 check source in the vicinity of the detector system, will be made to check system operability.

f. Once the DOE has confirmed that they can receive the capsules, it will take approximately 5 weeks to remove all of the 179 capsules now present in the Westerville pool. RSI has 9 casks that are available for shipment of cesium. Each cask can accommodate 4 capsules. If the capsules are destined for Hanford, it will require a minimum of one week to remove 36 capsules and have the empty casks returned to Westerville for removal of 36 more capsules. The time frame for total removal of the cesium capsules will be shortened if they are shipped to a DOE facility that is closer to the RSI irradiator than Hanford.

4. Cobalt-60 Loading

a. A total of 1.2×10^6 curies of Cobalt-60 is scheduled to be loaded into the Westerville facility. These Type C188 capsules, which are manufactured by the Atomic Energy of Canada Limited, Radiochemical Company Kanata, Ontario, have a maximum activity per capsule of 15,000 curies. A total of 116 capsules are scheduled for shipment to the RSI facility in Ohio.

b. Casks containing the cobalt capsules will be lowered onto a 4 foot by 4 foot load pad that is located on the bottom of the pool at its north end. (see Figure 2). All off loading of cobalt capsules from the casks will occur at this location.

After the cask is at the bottom of the pool and the plug has been removed, the source cage containing the cobalt capsules is removed from the cask and placed on the load shelf, which is also located at the north end of the pool.

The holders containing cesium capsules will be at least 4 feet away from the load pad and load shelf. Transfer of the cobalt capsules from the source cage to the rack modules is performed on the load shelf. The rack modules are then dispersed in the cesium racks. These racks have six vertical locations for storage of isotope. All of the modules will be dispersed in a single horizontal row of baskets that are the fourth ones from the bottom of the racks. These baskets are over 6 feet from the bottom of the pool or over 4 feet above the top of the cesium capsules.

c. Prior to insertion of the cobalt casks into the pool, both the interior and exterior regions of the casks are checked for contamination. Water is flushed through the interior region of the cask and subsequently collected for analysis. In addition, smears are taken on the exterior surfaces of the casks. If a cask exhibits any indication of contamination it will not be inserted into the pool.

5. **Emergency Procedures**

a. In the unlikely event cesium-137 contamination is observed in the Westerville pool, operations will cease immediately. Analogous to procedures already in place at our Decatur facility, the Department of Energy (DOE) will take responsibility for analysis and decontamination of the facility. They will work closely and in cooperation with the Nuclear Regulatory Commission and Radiation Sterilizers, Inc.

b. The manager/RSO of the Westerville facility has extensive past experience in dealing with contaminated environments. Upon notification of the contamination problem at the Decatur facility, all staff at the Westerville facility were advised of the situation. Although all production staff have received formal training in the safe use of radioactive materials, the additional risks associated with radioactive contamination were reviewed. An interim operating procedure, that was subsequently formalized by NRC's confirmatory action letter of July 10, 1988, was immediately put in place. These procedures were posted in the control room area and reviewed with cognizant staff.

The dangers of radioactive contamination and methods of control will be reviewed with all staff at our monthly safety meetings. These training sessions will continue until the cesium capsules are removed from the Westerville pool.

c. The confirmatory action letter issued by the Nuclear Regulatory Agency, Region III, on July 29, 1988, delineates procedures for early detection and control of potential contamination from the cesium-137 capsules stored in the Westerville pool.

The following additional procedures also will be placed in effect:

(1) Whenever entrance to the cell is required, the lead individual on the shift will monitor the surface of the pool for possible signs of radiation.

(2) Upon exit from the cell, staff will use a Xetex GM probe to monitor their shoes and peripheral clothing for

any signs of elevated radiation levels.

(3) If there are any indications of levels of radiation above background, the irradiator will be immediately shut down and the RSO or assistant RSO notifi

(4) Staff on site at the time of the incident will not be permitted to leave the premises until they have been monitored by the RSO or assistant RSO. All contaminated articles of clothing will be retained onsite.

d. The ventilation system at the Westerville facility is equipped with HEPA filters. If contamination is noted in the pool or surrounding cell area, the ventilation system will be immediately shut down, thereby confining all airborne contamination to the cell area.

6. <u>Records</u>

The following records will be maintained.

a. The location and orientation of the WESF capsules in the source rack prior to removal for storage.

b. The location and orientation of the WESF capsules in the storage holders.

c. The results of the visual inspections performed on the WESF capsules.

d. The results of pool temperature, radioactivity, and water quality tests.

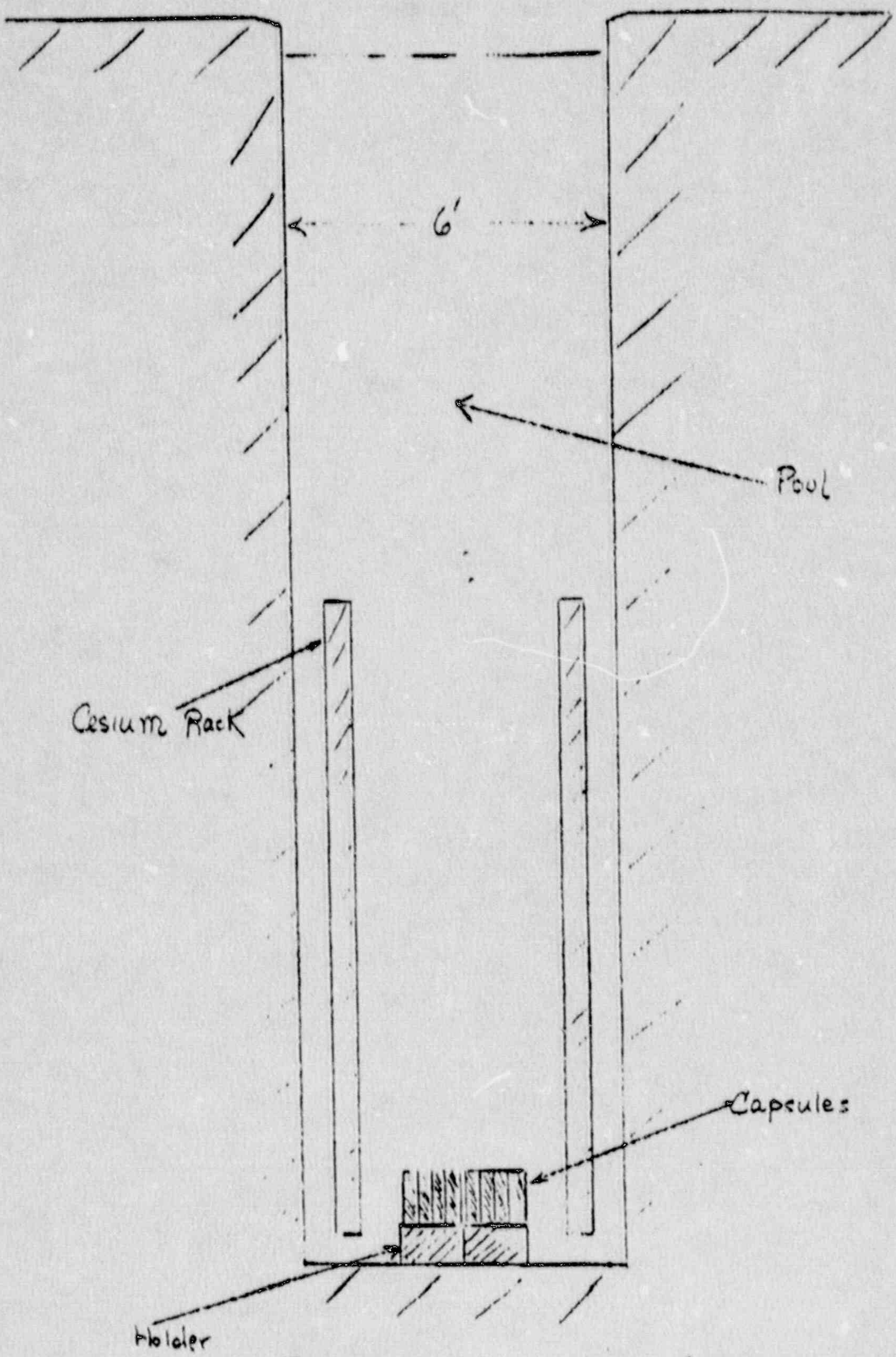

FIGURE 1. Cross Section of Pool

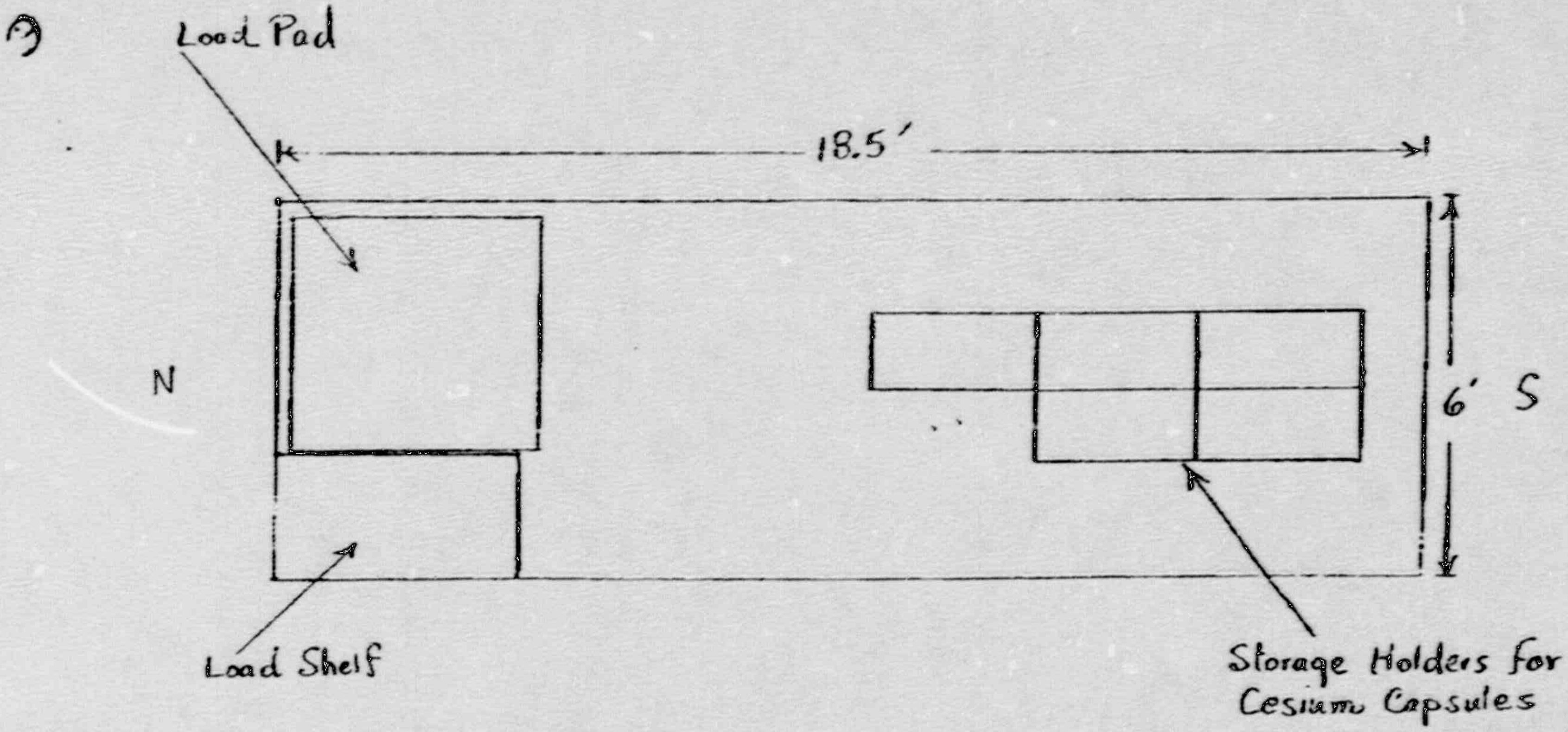

FIGURE 2. Top View of Pool

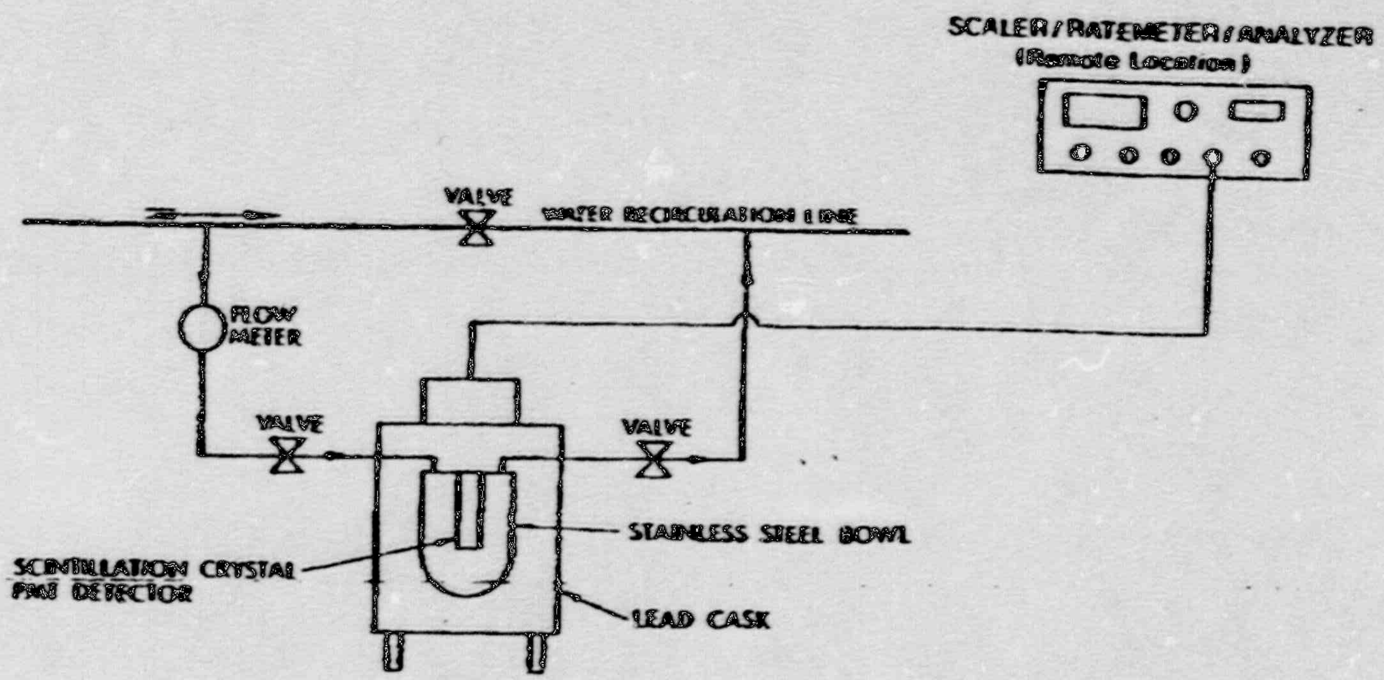

Figure 3. In Line Monitor

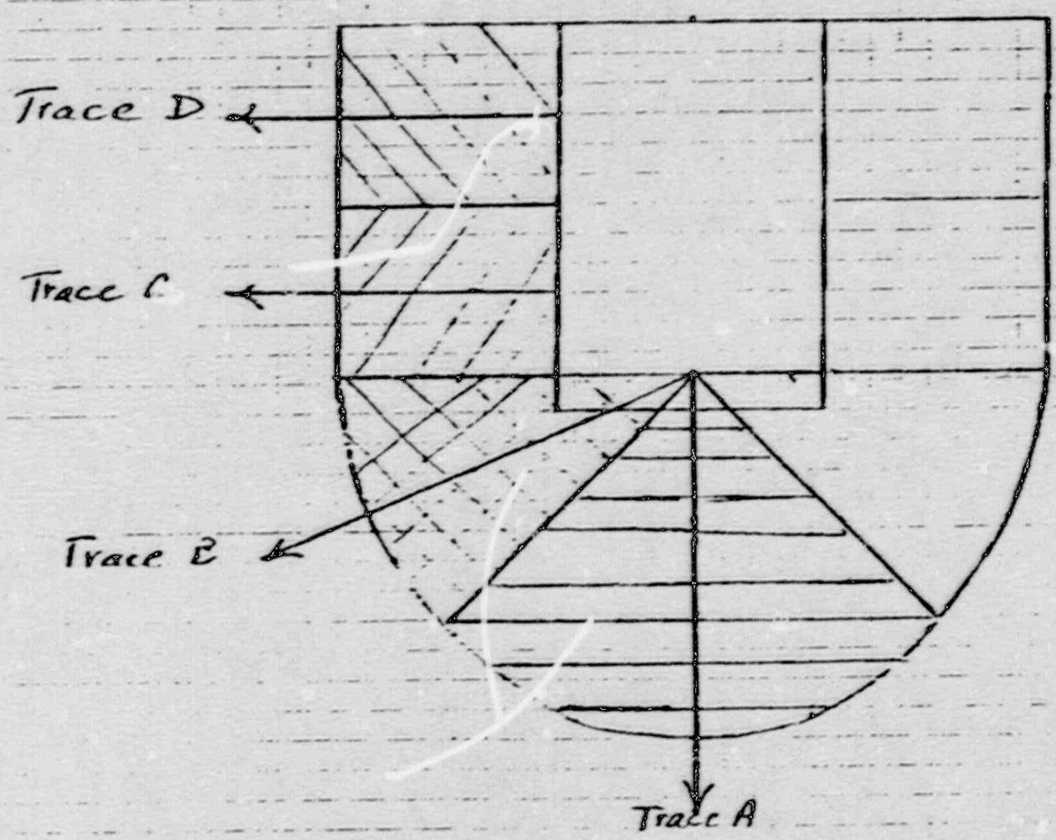

Figure 4. Calibration Geometry

BACKGROUND COUNTS

$V_T = 0.25V$; $\Delta V = 0.25V$