UNI-3001

ARCL Calculations For Decommissioning the 117-H Filter Building (132-H-2)

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Title

ARCL CALCULATIONS FOR DECOMMISSIONING
THE 117-H FILTER BUILDING

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FORWARD

This document describes how the Allowable Residual Contamination Levels (ARCL) method was used in conjunction with in-situ decommissioning to permanently disposition the 117-H building. Using these strategies, the decommissioned 117-H building will not cause a dose to a maximally exposed individual greater than 25 mrem/year to the whole body or to any organ.

Since this is one of the first efforts in decommissioning a Hanford facility using the ARCL method, a very conservative application of the ARCL method has been used. The conservatisms include: (1) The highest activity sample for each isotope was used to calculate the ARCL value for each section of the 117-H building. (2) All alpha activity remaining in the 117-H building was attributed to Pu-239. (3) The depth of clean fill over the rubble is greater than 5 meters in most cases. However, a contamination condition of 1-4 meters deep was used for all sections of the 117-H building except for the seal pits, where a contamination condition of greater than 5 meters was used.

The calculations in the document have been prepared in accordance with UNI-2522, "Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site," and as authorized by DOE in a letter to Hanford contractors, July 3, 1984, from the Manager, DOE-RL.

Reference 4 was used as an unrestricted release criteria where non-contaminated surfaces were involved. This allowed a reduction in the amount of building rubble that had to be considered contaminated.

ARCL CALCULATIONS FOR DECOMMISSIONING THE 117-H FILTER BUILDING

1.0 DETERMINATION OF RESIDUAL CONTAMINATION LEVELS AND ALLOWAB RESIDUAL CONTAMINATION LEVELS (ARCL) FOR THE 117-H FILTER BUILDING

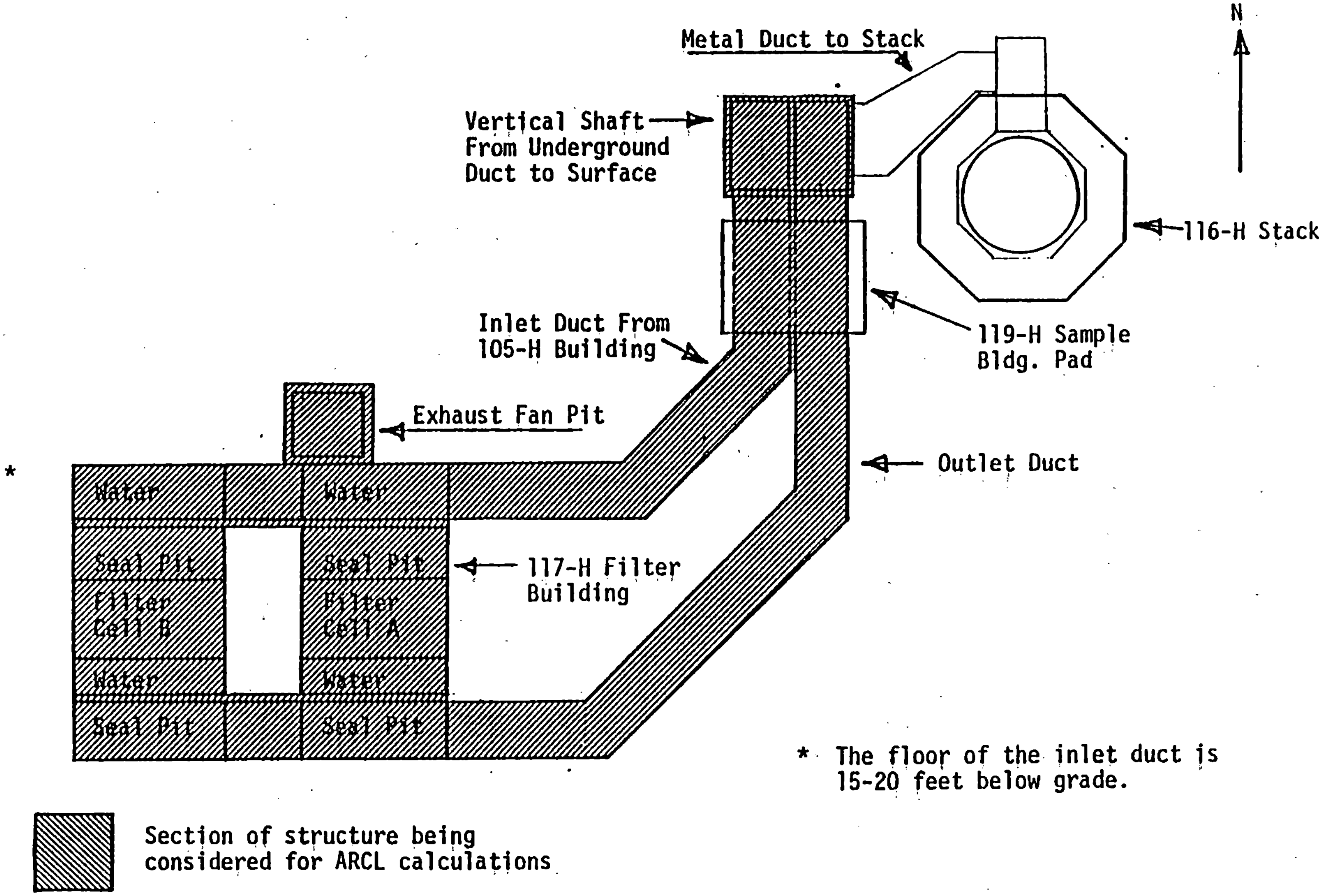
1.1 Introduction

The purpose of this document is to demonstrate the Allowable Residual Contamination Level (ARCL) methodo and to show that the remaining or residual contaminat in the 117-H Filter Building is less than the allowab levels specified by the ARCL. The ARCL establishes t amount of radioactive contamination that may remain i the structure when it is demolished and buried in-sit Fundamentally, the ARCL methodology can be applied to an entire structure or various parts of a structure. In the case of the 117-H Building the methodology was applied to the individually contaminated sections listed below (see Figure 1, 117-H Filter Building):

- Inlet Duct (including exhaust fan pit)
- "A" Inlet Seal Pit
- "B" Inlet Seal Pit
- Filter Cell A
- Filter Cell B
- "A" Outlet Seal Pit
- "B" Outlet Seal Pit
- Outlet Duct

The Operating Gallery, Equipment Gallery and Filter Access Room were surveyed with portable GM and alpha scintillation instruments and these surveys were less than the limits specified in the letter to R. A. Paas from J. J. Dorian, "Radiological Criteria for Deconta ination and Decommissioning of the Retired 100 Area 117 Filter Buildings", dated May 18, 1983. (Referenc 4, Section 1.2) The results of technical smears in these rooms were less than 200 dpm $\beta\gamma$ and 20 dpm α.

ARCL calculations for the 117-H Building were based upon an unrestricted use mode of 25 mrem per year. A burial depth of 1-4 meters was selected for all secti of the structure except the four seal pits, where bur depth of greater than 5 meters was used. The resulti ARCL value, for each section of the 117-H building,



* The floor of the inlet duct is 15-20 feet below grade.

Section of structure being considered for ARCL calculations

FIGURE 1 - 117-H FILTER BUILDING

provides level of contamination in the buried rubble that must not be exceeded if a dose to a maximum exposed individual is to remain below 25mrem/year, to the whole body or, to any organ.

1.2 References

The data and information that were collected and utilized in preparing the ARCL work sheets are based on the following sources:

1. Field radiological sampling and analysis.
2. UNI-946, "Radiological Characterization of the Retired 100 Areas," dated 1977.
3. UNI-2522, "Allowable Residual Contamination Level for Decommissioning Facilities in the 100 Areas of the Hanford Site."
4. Letter to R. A. Paasch from J. J. Dorian, "Radiological Criteria for Decontamination and Decommissioning of the Retired 100 Area 117 Filter Buildings", dated May 18, 1983. (Attached as Appendix B)

1.3 Sample Selection For The 117-H Filter Building

Decontamination activities consisted mainly of wiping down with Masslin cloth the vinyl base coating coverin all surfaces exposed to the air flow through the facility. The vinyl coating was of uniform thickness (1mm) and provided a very hard and smooth barrier that covered the concrete. For the ARCL calculations isotopic concentrations were determined from analyses of paint samples. Concrete samples were collected from beneath the paint in the inlet and outlet ducts to establish the depth of penetration of contamination. Based on the results of these analyses, the contamination in the concrete did not exceed the limits specified in the referenced letter in Section 1.2 of this report. Dispersed activity was less than 20 pCi/gm $\beta\gamma$ and 1 pCi/gm α. Technical smears were less than 200 dpm $\beta\gamma$ and 20 dpm α. The concrete samples from the inlet duct were used to represent the concrete beneath the paint in all areas of the structure upstream of the filters. The concrete samp from the outlet duct were used to represent the concrete from beneath the paint in all areas of the structure down stream of the filters.

Radiation surveys were performed on 100% of the internal accessible surface areas of the facility. Since contamination was not found to be uniform over any given grid area, the entire grid surface was considered contaminated.

Paint samples were analyzed on a multi-channel analyzer (MCA) with a germanium detector for gamma energy identification. The isotopes of Co-60, Cs-137, Eu-152 and Eu-154 were identified by this method. Selected paint samples were sent to US Testing Co., in Richland, Washington, for gross alpha, Tritium (H-3), C-14 and Sr-90 analyses.

1.3.1 Tritium and Carbon-14

Tritium and C-14 activities for the 117-H building were based on one paint sample collected from the A Cell inlet seal pit. The concentrations for H-3 and C-14 were 17 pCi/gm and 3 pCi/gm respectively, and were used in all ARCL calculations for the facility. The basis for this approach is the fact that H-3 and C-14 concentrations can vary considerably and not significantly influence the final yearly dose from the buried rubble.

The reason for this is that the concentrations of Sr-90 and Pu-239 are more limiting than H-3 and C-14, and will be the factors controlling the ARCL values. This has been illustrated in the section of the appendix dealing with the inlet duct.

1.3.2 Strontium

Sr-90 analysis was performed by US Testing on at least one paint sample from each section of the contaminated facility. The ratios of Sr-90 to Cs-137 in each sample varied considerably. For added conservatism a ratio of 1:2 (Sr-90 to Cs-137) was used for all ARCL calculations (except in the "A" outlet seal pit where a ratio of 1:1 was used). The Sr-90 concentration was obtained by ratio from the highest activity sample for Cs-137 in each section of the facility.

1.3.3 Alpha Concentrations

Gross alpha analysis of the paint samples showed results in excess of 1 pCi/gm dispersed activity. To account for the alpha activity in the ARCL calculations it was assumed that all alpha activity was due to Pu-239. The sample containing the highest concentration of gross alpha was selected to be representative for the particular section of the facility and entered in the ARCL work sheet as Pu-239.

1.4 Basic Assumptions for ARCL Calculation

For ARCL work sheet preparation, the following assumptic were made in addition to these already present within t! ARCL methodology:

1. The highest activity for each isotope was used to establish radionuclide concentrations for each ARCL calculation.

2. Alpha activity was attributed to Pu-239, which is the most limiting alpha emitting nuclide.

3. Sr-90 concentrations were calculated using a ratio of 1:2 to Cs-137, even though sample analyses did not establish this relationship in all cases. A ratio of 1:1 was used in the case of the "A" outlet seal pit because a Sr-90 to Cs-137 ratio of 6:7 was established by analysis.

4. The density of concrete was assumed to be 150 lbs/ft3, based on standard industrial mixes for concrete.

5. The density of paint was assumed to be 1.15 gm/cm3 based on standard density determination procedures.

6. The thickness of paint was assumed to be uniform at 1mm based on measurements of paint samples collected.

1.5 Overview of ARCL Method

1.5.1 Determination of ARCL Values

The ARCL values were calculated by establishing the post-decon activities of each isotope contributing to the total residual contamination levels in each section of the 117-H Building. The ratio of each isotope to the total activity is then calculated. This is important because the ARCL values for each isotope will reflect this same ratio to the total ARCL value. The scenario-specific dose factors are then selected for each isotope. The selection of these factors are determined by the depth at which the structure is to be buried in-situ. (Reference Table 5.2.2, UNI-2522). For the 117-H Building a contamination condition of 1-4 meters was used for all sections of the building except the 4 seal pits where a burial depth of greater than 5 meters was used. The contamination condition of >5 meters deep for the seal pits was selected because the top of the walls of the seal pits were 6 meters below grade.

The product of radionuclide concentration ratios and scenario-specific dose factors for each isotope is then obtained and summed. This total is divided into the unrestricted use mode of 0.025 rem/year to obtain the ARCL value for the particular building or section of building. The ARCL value is a controlling value of contamination that relates directly to the residual contamination left in the facility or section of facility. In other words, the residual contamination in the rubblized structure, buried in-situ at a specified depth, must be less than the ARCL value or the dose to a maximum exposed individual would exceed .025 rem/year, to the whole body, or to any organ. ARCL work sheets were prepared for each contaminated section of the 117-H Building and are attached to the appendix. In each case the residual contamination in the rubblized 117-H Building is significantly less than the ARCL value.

1.5.2 Determination of Residual Contamination Levels of Rubble

Decommissioning of the 117-H Building involves demolition and burial in-situ. Once demolished, the total curie inventory can be integrated into clean mass of concrete immediately below the contaminated surface. For contaminated surfaces, even though the contamination on inner surface area of the facility was not uniform (there were small clean areas within some grids), the entire surface area was considered contaminated and the entire mass of concrete of each section of the facility was used in the calculations for residual contamination levels.

Based on radiological surveys, the extent of contamination in the 117-H Building was determined and the dimensions of the contaminated areas were established. Paint samples were collected and analyzed to determine the radionuclide identity and concentrations. Total curie inventory was calculated by first determining the volume of paint covering the concrete surfaces. An evaluation of sample gamma analyses of the concrete beneath the paint showed that the contamination did not penetrate the paint and absorb into the concrete. From the volume, the mass of paint and total curie inventory were calculated. The concentration of residual contamination for each section of the building was then determined by dividing the total mass of that section of the building into the total curie inventory.

STEP 1 - Calculate total volume of concrete for each section of facility.

STEP 2 - From volume of concrete calculate mass of concrete.

STEP 3 - Calculate the volume of contaminated paint based on a thickness of 1mm.

STEP 4 - From volume of paint calculate mass of paint.

STEP 5 - From activity concentrations and mass of paint, calculate total curie inventory (pCi/gm x Step 4).

STEP 6 - Determine the activity of concrete rubble (Step 5 x Step 2).

1.5.2 Determination of Residual Contamination Levels of Rubble (Cont'd)

Turning vanes from the inlet and outlet ducts were wiped down with Masslin cloth to remove smearable contamination. The amount of fixed contamination on these components was insignificant and would not influence the ARCL calculations. The turning vanes and grating in the seal pits were significant and the activity associated with these components were integrated into the appropriate calculations for the affected section of building. (See Inlet and Outlet Seal Pit Section in Appexdix A.

The level of activity in the rubble is then compared to the ARCL value. If the residual activity in the rubble is less than the ARCL value, the facility can be demolished and buried in-situ. If the residual activity of the rubble is greater than the ARCL value additional decontamination efforts must be initiated. It is important to emphasize at this point that the determination of the ARCL value and the residual contamination levels are calculated concentrations and are performed prior to demolition to insure that appropriate decontamination steps have been taken. Calculation work sheets, ARCL work sheets and radiological survey data for each section of the 117-H Building are attached in the Appendix.

1.6 Method of Sample Collection and Radiation Surveys

Except for the seal pits, each section of the 117-H Building was marked off into 2m by 2m grids. Each grid was surveyed with portable alpha and beta-gamma instruments and the highest reading was assigned to the grid. Due to the difficulty in entering the seal pits and the hazard of surveying over the open turning vanes, the seal pits were not divided into grids. The turning vanes were constructed to fit in the seal pits with very close tolerances at the east and west walls. Approximately 75% of the surface area of these walls could not be surveyed. Based on the survey data collected at the perimeter of the turning vanes, the unsurveyed wall sections were assumed to be equally contaminated.

At least one technical smear was collected from each grid area throughout the building and selected areas in the seal pits. The background for the micro-R-meter was established outside the facility and readings were collected approximately one foot from the surface near the center of each grid. Only readings above backgroun were entered on the survey data sheets.

Paint samples were collected by removing approximately 150 cm^2 of paint from the concrete surfaces. The amount of concrete adhering to the paint was minimal. The paint was placed into 250ml plastic jars to maintain constant geometry for gamma spectrum analysis. Selected paint samples were sent to US Testing Corp. in Richland, Washington, for tritium, C-14 gross alpha and beta, and Sr-90 analyses. Concrete samples from the inlet and outlet ducts were analyzed for gamma isotopic, gross alpha and gross beta by UNC.

1.7 Radiological Instruments

1.7.1 Isotopic Analysis

1.7.1.1 Laboratory measurements for Co-60, CS-137, Eu-152 and Eu-154 were made using the Nuclear Data, Model No. 60 Multi-Channel Analyzer (MCA) located in Room 50, at the 100-N Reactor Facility. The MCA was equipped with a 3" x 3" high purity germanium scintillation detector. The MCA is operated and maintained by the Radiation and Water Quality Control Section, 100-N Area. Calibration and Quality Control Procedures were conducted in accordance with UNI-M-76 REV1, "Effluent Radioanalytical Program".

1.7.1.2 Tritium, carbon-14 gross alpha and strontium-90 paint analyses were performed by:

United States Testing Company, Inc.
2800 George Washington Way
Richland, Washington 99352

1.7.2 Counting Instruments

Technical smears were counted for gross beta-gamma and alpha on the following instruments:

Automatic System:	Gamma Products Inc. Model G4000, Gas Flow Proportional Counter
Manual System:	Nuclear Measurements Corp. Model DS-33P, Gas Flow Proportional Counter
Portable Beta-Gamma Detector:	Eberline Instrument Corp. Model BNW-1 With P-11 "Pancake" probe
Portable Alpha Detector:	Eberline Instrument Corp. Model E-140B with alpha scintillator detector and MS-2 scaler with 6 in. dia. alpha scintillator probe.

1.7.3 Micro-R-Meter

Ludlum Instrument, Inc.
Model 12S

Portable survey instruments were maintained and calibrated by the Instrument Calibration and Evaluation Section, Pacific Northwest Laboratories, located in the Hanford 300 Area.

1.8 Noncontaminated Spaces

1.8.1 Filter Access Room

Filter change-out was accomplished by removing the steel plate roof sections of the 117-H Filter Building to gain access to the filter access plugs. Each of the two berths, which comprised a filter bank, had its own concrete plug. Each berth of 24 filters could be removed, exchanged and replaced as required. The initial pre-decommissioning surveys indicated that there was no radioactive contamination in the filter access room. Final radiological surveys verified all surfaces in the filter access, including the access plugs were less than the limits specified in the referenced letter in section 1.2 of this report. Technical smears were less than 200 dpm $\beta\gamma$ and 20 dpm α. The concrete access plugs were demolished in place and the rubble was added to that of the rest of the building. The mass of the access plugs were not included in the ARCL calculations

Prior to conducting decontamination and radiological surveys, the filters in each filter cell were removed for disposal.

1.8.2 Operating Gallery

The Operating Gallery was a space between the tv filter cells which could be entered to service radiation monitoring equipment or other in-line instrumentation while the 117-H Filter Building was in service. Access into the spaces between filter banks could also be accomplished from this room when a filter cell was out of service The floor of the Operating Gallery was comprise solely of grating, which separated the room from the Equipment Gallery. The east-west walls of the Operating Gallery were shared by those on the filter cells and the north-south walls were shared by the inlet and outlet ducts Since these walls were incorporated into the ARCL calculations for filter cells and ducts the only remaining surface to be released was the ceiling. The ceiling was surveyed and released based on the limits set forth in the referenced letter in section 1.2 of this repor Technical smears were less than 200 dpm βγ and 20 dpm α.

1.8.3 Equipment Gallery

The Equipment Gallery was located below the Ac Gallery. The Operating Gallery contained most piping and valving for sample lines and exhaus system. All piping in the Equipment Gallery v and surveyed with portable instruments, and fc completely free of radioactive contamination. Operating Gallery the Equipment Gallery sharec walls with the filter cells and inlet and out: and were incorporated into the ARCL calculati for the cells and ducts. The floor of the Equ ment Gallery was surveyed and released based limits set forth in the referenced letter in section 1.2 of this report. Technical smears were less than 200 dpm $\beta\gamma$ and 20 dpm α.

1.8.4 Turning Vanes

Both the inlet and outlet ducts contained vertical turning vanes to direct the airflow around corners. These turning vanes were removed and wiped down with Masslinn cloth and placed in the west end of the outlet duct. These turning vanes were not decontaminated to release limits. However, the contribution of activity on the turning vanes to the total activity of the 117-H Building is not significant and would not impact any of the ARCL calculations.

1.8.5 Metal Duct From Outlet Duct To 116-H Stack

Air flow from the outlet duct was directed through a sheet metal duct into the 116-H stack. This metal duct was removed and surveyed with portable alpha and beta instruments. After decontaminating the inner surface of the duct with Masslinn cloth there were several small areas on the flanges that contained low levels of fixed contamination. The metal duct was lowered to the bottom of the vertical section of the outlet duct to be buried with the rest of the structure.

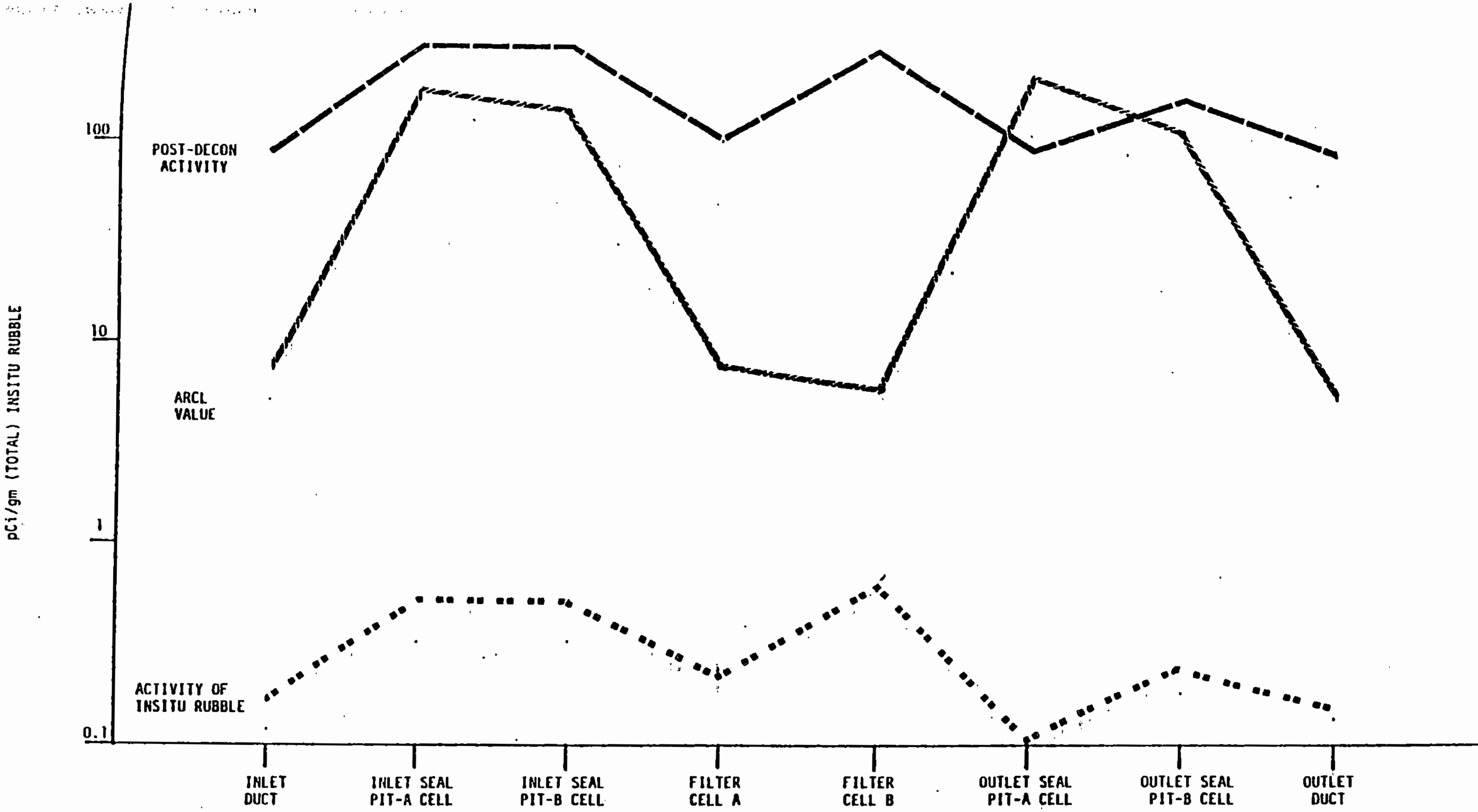
2.0 CONCLUSION

ARCL calculations indicate that the 117-H filter building can be decommissioned in-situ with a potential dose to a maximally exposed individual of less than 1mrem/yr, well below the 25 mrem/yr guideline. Figure 2 compares the residual activity of the rubble in each section of the building with the ARCL value and post-decon activity. In each case the residual activity of the rubble is significantly less than the ARCL value.

Total radionuclide inventory in the 117-H Building is estimated to be .41 millicuries. The radionuclides comprising this figure are H-3, C-14, Co-60, Sr-90, Cs-137, Eu-152, Eu-154, and Pu-239/241. Of these radionuclides, Sr-90 is the most restrictive in the ARCL calculations.

Direct radiation readings taken in the various rooms of the 117-H Building using a Micro-R-Meter showed no increase over the general background readings. Very minor amounts of alpha contamination were detected, but at concentrations that did not impact the ARCL calculations.

Approval of this document along with approval of the associated Decommissioning Work Procedures (DWP) and Radiation Work Procedures (RWP) constitutes permission to demolish in-situ the 117-H Filter Building.



ACTIVITY OF INSITU RUBBLE VS STRUCTURAL COMPONENT OF 117-H FILTER BUILDING

FIGURE 2