DECOMMISSIONING PLAN
FOR THE
L-77 RESEARCH REACTOR

UNIVERSITY OF CALIFORNIA
SANTA BARBARA

Prepared for UCSB

by

Rocketdyne Division
Rockwell International Corporation
Canoga Park, California

August 5, 1985

8508200650 850812
PDR ADOCK 05000433
P PDR

1.0 PLAN BACKGROUND AND MANANEMENT

1.1 SUMMARY DESCRIPTION

The UCSB L-77 Research Reactor is a small, solution-type nuclear reactor designed for laboratory use. It was manufactured by the Atomics International Division of North American Aviation, a predecessor of the Rocketdyne Division of Rockwell International. It consists of a reactor core tank, containing the fuel solution, within an inner shield tank, which is mounted inside a water-filled outer shield tank. The reactor is installed in Room 1251 in the eastern end of Building 572 (Physics Unit 1) on the UCSB campus near Goleta, California. Room 1251 was created by walling off the southern portion of Room 1356, shortly after refueling and startup of the reactor.

This reactor was licensed by NRC under the room identified in the license application as the reactor facility, Facility Operating License R-124, issued December 3, 1974. The reactor had initially been installed and operated at the University of Nevada at Reno, and was moved to UCSB in 1974, with startup in January of 1975. At both sites, the reactor was licensed for operation at power not to exceed 10 W (thermal).

The currently utilized laboratory space is needed for other purposes, and the academic needs for the reactor no longer justify its continued operation, so UCSB has decided to decommission the reactor, prepare the facility for release for unrestricted use, and seek termination of the facility operating license. To accomplish this, the reactor fuel solution (containing enriched uranium) and the neutron startup source (Pu-Be) will have been removed prior to beginning any dismantling operations and sent to authorized DOE facilities. (The Pu-Be source may be kept at UCSB under a license from the State of California.)

After defueling of the reactor, under procedures of the current operating license, the external equipment (control rod drives, thimble shield plugs, off-gas and fuel valves) will be removed and the outer shield tank drained of

water and disassembled. The inner shield tank, containing the reactor core tank, recombiner, and thimbles, will be disposed of, intact, as low-level radioactive waste.

Because of the effective shielding surrounding the reactor, and the hermetically sealed system, no radioactivity, due either to activation or contamination, exists outside the reactor assembly itself. After disposal of the reactor and removal of associated equipment, a final radiological survey will be performed to demonstrate compliance with the criteria for release for unrestricted use.

The results of this survey will be reported to NRC, with the request for termination of the license.

The cost for decommissioning the reactor facility is estimated to be approximately $90,000, including planning and operations conducted in preparation for dismantling. This cost is currently budgeted by the University of California.

All dismantling operations will be performed by personnel from the decommissioning contractor, the Rocketdyne Division of Rockwell International, successor to the manufacture of the L-77 Research Reactors. This contractor was selected as a result of a competitive bidding review, including consideration of technical competence and experience. These operations will be subject to the review and concurrence of the facility manager and the UCSB Radiation Safety Officer, thus retaining full responsibility for health and safety with the licensee.

Dismantling the reactor is scheduled to begin in early January 1986, be complete in approximately 3 weeks, and a final report summarizing the decommissioning operations and the results of the final survey will be completed by January 31, 1986.

An existing approved quality assurance plan will be implemented for all transport packages containing radioactive materials. All instruments used for

radiation protection purposes are serviced and appropriately calibrated by a group within the decommissioning contractor's Quality Assurance Department. Final survey measurements will be performed by members of the decommissioning contractor's Radiation Safety Department, with a formal procedure for qualifying instruments, performing survey measurements, and analyzing and interpreting the survey data.

The final survey will be performed by use of a sampling inspection plan designed to implement the acceptance criteria as directly as possible. The detectors to be used will include thin-window pancake GM detectors for total beta surface activity, large-area alpha scintillation detectors for total alpha surface activity, gas-flow proportional counters for both removable beta and removable alpha surface activity, and sodium iodide scintillation detectors for ambient exposure rate. The data will be statistically analyzed by a method routinely used by the decommissioning contractor in justifying release of decontaminated facilities for unrestricted use. (Several survey reports using this method have been reviewed and accepted by NRC Region V Office of Inspection and Enforcement, Nuclear Materials Safety and Safeguards Branch.)

1.2 FACILITY OPERATING HISTORY

After operating without incident at the University of Nevada at Reno, the reactor was defueled and removed to its current location at UCSB. There the fuel solution was returned to the core tank and the reactor operated for instructional purposes. No spills of fuel solution occurred during the refueling operation.

The reactor was also used for activation analyses, but no significant amounts of long-lived radioisotopes were produced, and so, no contamination of the facility resulted from these operations.

The reactor was operated intermittently at power levels less than 10 W (thermal) throughout its history. The integrated power during operation within the last 10 years amounts to approximately 360 W·h.

All radioactivity remaining after defueling the reactor and removing the startup source is associated with the reactor core tank and inner shield and the control rods. These rods will be mechanically crimped in their thimbles and disposed of with the inner shield assembly. There are no areas with hot spots of radioactivity in the reactor facility, outside of the inner shield assembly. Some areas of low-level tritium contamination exist as a result of operations with an accelerator neutron source. These will be decontaminated separately.

1.3 CURRENT RADIOLOGICAL STATUS OF FACILITY

There are no areas in the facility, outside the reactor shield, where radiation or radioactivity exceeds normal background levels (other than the tritium areas). After draining the shielding water and removing the outer shield tank, radiation levels up to about 0.2 mR/h may be found. No radioactive contamination is expected. The shielding water is expected to be free of radioactivity and will be analyzed for radioactivity concentration to confirm this prior to disposal. Provided that the activity in the water is less than 3×10^{-8} µCi/ml, the water will be disposed of by discharge to the local sanitary sewage system.

Activation of the cobalt impurity in stainless steel components of the core vessel is estimated to be less than 20 µCi at the present time. No other significant activities are expected to exist.

Because of the sealed and contained nature of the L-77 reactor, no release of radioactive material to the environment is expected. The exposure rate to the public during dismantling and transport of the reactor assembly to a disposal site is negligible. There are no significant exposure pathways to the public.

1.4 DECOMMISSIONING ALTERNATIVE

Because of the need for the currently occupied laboratory space for other purposes, no alternative to dismantling and decommissioning is acceptable to the licensee.

1.5 DECOMMISSIONING ORGANIZATION AND RESPONSIBILITIES

The decommissioning operations will be performed by the Rocketdyne Division of Rockwell International Corporation, acting as a contractor to the University of California, Santa Barbara. These operations will be conducted under the cognizance of Professor A. Edward Profio, Department of Chemical and Nuclear Engineering, as Reactor Director. All health, safety, and environmental protection concerns will be subject to review and concurrence by Frank E. Gallagher, III, UCSB Radiation Protection Officer. Ultimate responsibility and authority for proper compliance with all requirements is vested in these two individuals.

Dr. Profio reports to the Chairman of the Department of Chemical and Nuclear Engineering, who ultimately reports through the College of Engineering to the Vice-Chancellor for Administration, UCSB. Dr. Profio is a licensed Senior Reactor Operator. Mr. Gallagher reports to the Manager of Environmental Health and Safety who, in turn, reports to the Vice-Chancellor for Administration, UCSB. Mr. Gallagher is a Certified Health Physicist (ABHP).

The onsite contractor staff consists of a project engineer, one or two decommissioning mechanics, and a health physicist. These personnel are supported by the resources of the Engineering & Test Department and the Radiation & Nuclear Safety Group at Rocketdyne, in Canoga Park, California.

The project engineer reports to the manager of the System and Component Test Group within Engineering & Test, who ultimately reports to the Rocketdyne President through the Vice-President, Atomics International. The mechanics report directly to the project engineer. The health physicist reports to the Manager, Radiation & Nuclear Safety, who ultimately reports to the Rocketdyne President through the Division Director, Human Resources and Communications. These independent reporting paths assure objective resolution of any differences at the working level.

The project engineer is responsible for the proper technical performance of the dismantling work. The health physicist is responsible for all matters related to health, safety, and environmental protection.

The contractor staff consists of trained and qualified radiation workers, experienced in decontamination operations performed under NRC Special Nuclear Materials License 21 and State of California Radioactive Materials License 0015-70. Training includes both lecture instruction in radiation properties, hazards, and safety procedures, and practical training in decontamination, packaging, and radiation monitoring.

The University of California, Santa Barbara, is committed to a policy of maintaining radiation exposures as low as reasonably achievable. This policy is fully implemented in this dismantling project by the contractor's established ALARA policy and organization. In view of the protective nature of the reactor assembly and the very low exposure rates, no additional precautions beyond nomal good work practices are required.

Good work practices will be directed by both the project engineer and the health physicist. These will include the use of survey instruments with audible output; frequent surveys as work progresses; monitoring for removable radioactive contamination; personnel surveys before leaving the work area; prohibition of eating, drinking, and smoking in the work area if any removable contamination is found or if other findings support this restriction. Both the project engineer and the health physicist have the responsibility and the authority to halt work for health and safety purposes.

UCSB management has final authority relative to health, safety, and environmental protection.

1.6 REGULATIONS, REGULATORY GUIDES, AND STANDARDS

The following regulations, regulatory guides, and standards are applicable to this decommissioning project:

Code of Federal Regulations

Title 10, Part 19; "Notices, Instructions and Reports to Workers; Inspections"

Title 10, Part 20; "Standards for Protection Against Radiation"

Title 10, Part 71; "Packaging of Radioactive Materials for Transportation and Transportation of Radioactive Material Under Certain Conditions"

Title 29, Part 1910; "General Industry Safety Orders"

Title 49, "Transportation"

U.S. NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors"

U.S. NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material"

ANSI N13.12-1985, "Surface Radioactivity Guides for Materials, Equipment, and Facilities to be Released for Uncontrolled Use"

ANSI/ANS-15.10-1981, "Decommissioning of Research Reactors."

1.7 TRAINING AND QUALIFICATIONS

The Reactor Director is a licensed Senior Reactor Operator for the UCSB L-77 reactor. The UCSB Radiation Protection Officer is a Certified Health Physicist. Both have been trained in the subject matter required by 10 CFR 19.12. No further training is proposed.

The contractor project engineer has been previously licensed as a Senior Reactor Operator for an L-77 reactor. The decommissioning mechanics are experienced decontamination workers. The health physicist is experienced in radiation protection with a wide variety of radioactive material in diverse operations. All are trained in the subject matter required by 10 CFR 19.12.

Prior to beginning work on site, the contractor's crew will be provided with a facility familiarization conducted by the Reactor Director, or his designee. No further training is proposed.

In addition to training in radiation safety, the contractor's staff has been trained in industrial safety and hygiene, use of respiratory protection devices, and radiation monitoring.

Training records for UCSB personnel are maintained at UCSB. Training records for the contractor's staff are maintained at the Rocketdyne Training Department offices, 8900 De Soto Avenue, Canoga Park, California.

5029Y/sjv

2.0 OCCUPATIONAL AND RADIATION PROTECTION PROGRAMS

2.1 RADIATION PROTECTION PROGRAM

The radiation protection program to be used for this decommissioning project is an extension of the program used by the contractor under NRC Special Nuclear Material License SNM-21, the State of California Radioactive Materials License 0015-70, and under a Department of Energy prime contract.

Two types of survey instruments will be used: one type for working surveys and personnel monitoring, the other for the termination survey. The working surveys and personnel monitoring will be performed using portable count rate survey meters such as the following, or equivalent:

Ludlum Model 12 count rate meter with Ludlum 44-9 thin-window pancake GM for beta surface activity

Ludlum Model 12 count rate meter with Ludlum 43-5 alpha scintillator for alpha surface activity

Ludlum Model 12S Micro-R Meter for ambient (gamma) radiation

Eberline Model RO-2 ion chamber for ambient and surface dose rate.

In addition, smears for removable surface activity will be counted by use of a Nuclear Measurements Corporation ACS-77 thin-window gas-flow proportional counter automatic alpha-beta counting system.

The termination survey instrumentation is described in Section 8.0.

In addition to radiation monitoring, personnel dosimetry is performed by use of direct-reading pocket dosimeters for exposure control guidance and by use of a dosimetry film badge service provided by R. S. Landauer, Jr. and Company. All radiation workers have an NRC Form-4 on file, and all occupational radiation exposure is included in their monitoring record. Radiation workers are provided with a medical examination biennially or annually if qualified for respirator use.

Work involving radiation exposure or potential for release of radioactive material requires the presence or availability of a health physicist. It is his responsibility to measure and assess conditions and make recommendations to the project engineer to assure that radiation exposures are kept ALARA and do not exceed regulatory limits.

Both the project engineer and the health physicist have the authority to halt unsafe operations. It is the responsibility of the project engineer to avoid and prevent any unsafe operations. It is the responsibility of the health physicist to assure that adequate information is provided to the project engineer.

The ultimate responsibility for compliance with applicable regulations resides with UCSB management.

Rocketdyne selects the best standard-grade commercial instruments available for radiation protection purposes and therefore has not established selection criteria.

Use of radiation survey instruments for radiation protection purposes (including transportation and termination surveys) by the contractor is limited to members of the Radiation & Nuclear Safety Group. These instruments are stored in a manner to minimize the risk of damage to them. Instruments are calibrated by a group within the Quality Assurance Department on a 13-week or sooner recall period. Each instrunent is electronically tested as appropriate and calibrated by use of a suitable source of radiation. A documented calibration record is maintained and a dated label is affixed to the instrument.

Instruments used for general surveillance are qualitatively tested prior to use by the health physicist by checking the battery test and background indications. Faulty or out-of-date instruments are withdrawn from service and sent for repair and calibration.

Prior to leaving an area subject to radioactive contamination or easily transported sources of radiation, each person, piece of equipment, lot of material, and container of waste is subject to an appropriate survey. The work site is surveyed for removable surface contamination by smearing 100 cm^2 with a small filter paper disk, counted for radioactivity in a gas-flow proportional counter. Large areas may be surveyed by use of a mop or towel measured by use of a portable survey instrument. During dismantling, these surveys are performed as the work proceeds.

Readings on pocket dosimeters are recorded daily, or more often as the conditions dictate.

Protective clothing (such as lab coats or coveralls), rubber or canvas gloves, and shoe covers are provided as needed.

2.2 INDUSTRIAL SAFETY AND HYGIENE PROGRAM

No significant amounts of any nonradiological hazardous materials are anticipated in this project. No blasting will be performed and no solvents are needed. All members of the contractor's crew have been trained in routine industrial hygiene and safety practices as applied to dismantling and decontamination operations. Emphasis is placed on portable electrical tools, eye protection, and mobile equipment. The contractor maintains an industrial hygiene and safety staff for review and consultation, as required.

Both the project engineer and the health physicist have the authority to halt unsafe operations. It is the responbility of the project engineer to avoid and prevent any unsafe operations. It is the responsibility of the health physicist to assure that adequate information is provided to the project engineer by seeking home office guidance, if necessary.

Rocketdyne selects the best standard-grade commercial equipment available for industrial hygiene and safety purposes and therefore no selection criteria have been established.

Accident prevention is practiced by reviewing operations and equipment prior to starting, by providing both management and health physics supervision, and by emphasizing the need for safe work practices. Accident response during the dismantling project will be provided by onsite (UCSB) and municipal fire-protection and emergency medical services.

2.3 CONTRACTOR ASSISTANCE

All dismantling work, packaging for disposal, and radiation surveys will be performed by the Rocketdyne Division of Rockwell International Corporation, under contract to UCSB. Rocketdyne is the successor organization to the Energy Systems Group of Rockwell International, which has, for many years, performed decontamination, dismantling, and decommissioning projects in its own operations and under contract to others. In addition to this general experience, this organization has decommissioned its own L-77 reactor (NRC License R-40).

Transportation of radioactive waste resulting from the dismantling operations will be performed by an authorized common carrier.

To ensure that UCSB is able to effectively exercise its responsibility for compliance with all NRC requirements, frequent reviews of work will be performed by UCSB project management, including the Reactor Director and the Radiation Protection Officer. The decommissioning will also be reviewed by the UCSB Reactor Operations Committee and the Radiation Safety Committee.

Since the contracted work is essentially the complete project, its relation to the schedule is shown in Section 3.0.

2.4 COST ESTIMATE AND FUNDING

The cost of the entire project, including dismantling, waste packaging, transportation, and disposal, and the termination radiation survey is estimated at approximately $90,000. This amount has been budgeted by the University of California.

3.0 DISMANTLING AND DECONTAMINATION TASKS AND SCHEDULES

3.1 TASKS

The initial, preparatory task of defueling the reactor will have been completed, using currently licensed procedures, before beginning the dismantling.

The major dismantling tasks consist of disposal of the shield tank water; drying the core vessel; disconnection of the control rod drives, thimbles, throughtubes, and fuel and vent lines; removal of the shield tank; and packaging and disposal of the reactor assembly. This will be followed, after a general housecleaning, by the termination radiation survey.

3.2 SCHEDULE

The entire dismantling project is scheduled to be completed in 3 weeks, with submission of the final report on approximately January 31, 1986.

3.3 TASK ANALYSES

The following specific tasks have been identified:

1) Analyze and dispose of shield tank water
2) Remove rod drives and cut and crimp rod and source thimbles
3) Dry core vessel of any residual water from defueling operation
4) Disassemble reactor shield tank, cut and crimp throughtubes and fuel and vent lines
5) Remove and package reactor assembly (intact within inner shield tank) for transportation to disposal site
6) Remove all other equipment
7) Perform termination radiation survey.

3.4 SAFE STORAGE

The packaged reactor assembly will be stored in the reactor facility until it is shipped for disposal.

If the reactor facility is required for other uses before the reactor assembly can be shipped, then another safe storage area will be utilized.

5029Y/sjv

4.0 SAFEGUARDS AND PHYSICAL SECURITY

The current NRC-approved physical security plan will continue in effect until the fuel is shipped offsite. The security plan will be terminated at that time.

No material control plan was required since no transfers of Special Nuclear Material were involved in operation of the facility.

5029Y/sjv

5.0 RADIOLOGICAL ACCIDENT ANALYSES

The reactor will have been defueled prior to the start of dismantling, and so no specific analysis is required.

5029Y/sjv

6.0 RADIOACTIVE MATERIALS AND WASTE MANAGEMENT

6.1 FUEL DISPOSAL

The reactor will have been defueled and the fuel packaged in approved transportation containers before dismantling begins.

6.2 RADIOACTIVE WASTE PROCESSING

The only radioactive waste to be produced during this dismantling project will be the reactor assembly. This will be packaged intact for disposal at an authorized site. The inner shield tank is approximately 48 in. high by 48 in. in diameter, with a volume of 50 ft^3. The disposal package will be approximately 125 ft^3.

No special radwaste systems need to be implemented to meet safety and ALARA requirements.

5029Y/sjv

7.0 TECHNICAL AND ENVIRONMENTAL SPECIFICATIONS

Because of the contained, sealed, and shielded structure of the reactor assembly, exposure rates are insignificant (less than 0.2 mR/h), and there are no releases of radioactive material expected throughout the decommissioning project. Therefore, exposures to the decommissioning personnel and the public are ALARA and are small fractions of the appropriate limits (3000 mrem per quarter whole body occupational exposure and 500 mrem per year whole body public exposure).

The criteria for acceptable residual radioactivity for release for unrestricted use, derived from 10 CFR 20, Regulatory Guide 1.86, and recent NRC guidance, are presented below:

		Surface Contamination	
	Total Average[a]	Total Maximum[b]	Removable
Alpha	5000 dpm/100 cm^2	15,000 dpm/100 cm^2	1000 dpm/100 cm^2
Beta	5000 dpm/100 cm^2	15,000 dpm/100 cm^2	1000 dpm/100 cm^2
Liquid contamination	3×10^{-8} μCi/ml		
Ambient radiation	<5 μR/h above background		

[a]Averaged over 1 m^2
[b]Averaged over 100 cm^2

There criteria apply to equipment and materials released for other uses at UCSB or otherwise or disposed of as ordinary scrap or waste, as well as to the remaining facility, as demonstrated by the termination radiation survey.

Survey results will be documented for all equipment and material disposed of as nonradioactive.

5029Y/sjv

8.0 PROPOSED TERMINATION RADIATION SURVEY PLAN

After dismantling has been completed, and all other equipment has been removed from the facility, termination radiation survey locations will be selected and identified. This will be done, in general, by establishing a virtual 3-m-square grid on the floor, walls, and ceiling. From each 3-m square (approximately 100 ft^2), a single 1-m square will be selected that, as judged by the health physicist, is most likely to represent the highest amount of residual radioactivity within the 3-m square. The termination survey measurements are made in this square. This method results in 11% of the surface area within the facility being uniformly sampled. This sampling will be increased on the floor, as necessary, to assure that at least 30 locations on the floor are tested.

In addition, each drain and any other floor penetrations will be tested.

The survey measurements to be performed consist of determination of the average alpha surface radioactivity, average beta surface radioactivity, removable alpha surface radioactivity, removable beta surface radioactivity, and the ambient radiation exposure rate at 1 m from the surface. If measurements of the average alpha and/or beta surface radioactivity indicate the presence of residual "hot-spots," a measurement of the radioactivity in a 100-cm^2 area at the hot-spot location will be made.

Measurements of the average alpha and beta surface radioactivity in a 1-m square are made by using portable scalers (Ludlum Model 2220-ESG) with audible output, connected to a Ludlum Model 43-1 alpha scintillator for alpha activity and a Ludlum Model 44-9 thin-window GM for beta activity. These probes are uniformly scanned over the surface (in close proximity) and the counts recorded for 5 min. Correction for detector efficiency, as measured by use of a Th-230 source for alpha and a Tc-99 source for beta, local background, detector area, and count time results in a measure of the residual radioactivity averaged over 1 m^2. Measurement of the maximum surface radioactivity averaged over 100 cm^2 within that 1 m^2 is done, if warranted, by similarly scanning an area of 100 cm^2, and doing the same numerical computation.

Removable surface radioactivity is determined for each 1-m square by smearing a 100-cm^2 area, using Whatman 540 filter paper, and counting the resulting deposit in a Nuclear Measurements Corporation ACS-77 automatic sample counter with a thin-window gas-flow proportional counter. This provides automatic and simultaneous measurement of alpha and beta radioactivity. This counting system is calibrated by use of a Th-230 alpha source and a Tc-99 beta source.

The ambient radiation exposure rate is measured by means of a Ludlum Model 2220-ESG portable scaler with audible output connected to a Ludlum Model 44-2 sodium iodide scintillator. (This is the same scintillator that is used in the Model 12S Micro-R Meter, 1 in. x 1 in.) This is calibrated in terms of counts per minute per micro-R per hour by use of a Cs-137 gamma source.

Floor drains and similar features (utility boxes or trays, etc.) that do not permit such a methodical approach will be inspected by use of portable survey instruments for alpha, beta, and gamma activity, and by smears for removable alpha and beta activity.

All sources used for calibration of survey instruments are traceable to the National Bureau of Standards.

The nominal characteristics of these instruments are presented below. (The lower limit of detection is calculated as the activity corresponding to three times the standard deviation of background, above background.)

Alpha surface radioactivity

Ludlum Model 2220-ESG with alpha scintillator

Detector area = 75 cm^2

Background = 1 cpm

Efficieny factor = 7 dpm/cpm

Lower limit of detection (for 5-min scan) = 13 dpm/100 cm^2

Beta surface radioactivity

Ludlum Model 2220-ESG with thin-window pancake GM

Detector area = 20 cm^2

Background = 30 cpm

Efficiency factor = 7 dpm/cpm

Lower limit of detection (for 5-min scan) = 257 dpm/100 cm^2

Removable alpha surface radioactivity

Nuclear Measurements Corporation ACS-77 with thin-window gas-flow proportional counter

Background = 1 cpm

Efficiency factor = 3 dpm/cpm

Lower limit of detection (for 5-min count) = 4 dpm/100 cm^2

Removable beta surface radioactivity

Nuclear Measurements Corporation ACS-77 with thin-window gas-flow proportional counter

Background = 30 cpm

Efficiency factor = 3 dpm/cpm

Lower limit of detection (for 5-min count) = 22 dpm/100 cm^2

Ambient (gamma) radiation exposure rate

Ludlum Model 2220-ESG with sodium iodide scintillator

Background = variable from about 4 μR/h to 20 μR/h

Efficiency factor = 0.0038 μR/h/cpm

Lower limit of detection (for 5-min count) = 0.3 μR/h above background

In all cases, the actual values for background and efficiency factor are determined for each instrument.

The data obtained are analyzed by use of a computer program that takes the fundamental instrumnent reading and performs the necessary calculations to produce the derived result, either dpm/100 cm^2 or μR/h, thus minimizing transcription and arithmetic errors. The results are then interpreted in a cumulative probability distribution that permits comparison with the acceptance limit in a manner analogous to sampling inspection by variables as described in MIL-STD-414. The inspection test is calculated for a consumer risk of 10% at a

lot-tolerance-percent-defective of 10%. The graphical display provided by the computer program clearly shows any results indicating contaminated locations, well below the acceptance level. This display also shows calculated uncertainties in the results, based on counting statistics and provides a means for checking the consistency and freedom from error of the input data.

Instrument qualification sheets are prepared for each instrument, generally daily. These, and the fundamental data sheets are reviewed and compared with the analytical results to confirm the survey quality.

A summary report of the survey results is prepared for submission to NRC to support a request for termination of the license.

All survey documents are retained until after concurrence by NRC that the facility is acceptable for release for unrestricted use.

5029Y/sjv