

**DECOMMISSIONING PLAN**  
**FOR**  
**THE UNIVERSITY OF KANSAS**  
**TRAINING REACTOR**

**Prepared For:**  
**THE UNIVERSITY OF KANSAS**

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# CHAPTER 1

## 1. SUMMARY OF PLAN

### 1.1 Introduction

The University of Kansas intends to dismantle its lightwater-moderated and light water-cooled pool-type nuclear training reactor (KUTR) and to terminate its possession-only license No. 17-02. All radioactive materials above unrestricted release limits will be removed from the site to a licensed disposal facility and the site and remaining facility will be released by the U.S. Nuclear Regulatory Commission (NRC) for unrestricted use by the University.

### 1.2 Background

#### 1.2.1 Reactor Facility Description

The KUTR is located in a building on the western edge of the main campus of the University of Kansas at Lawrence. Lawrence is situated on the banks of the Kansas River in the northeast corner of the State of Kansas, approximately midway between Kansas City and Topeka. Figure 1-1 shows the location of the reactor site on the Kansas University campus. Figures 1-2 and 1-3 show the ground level and upper level layout of the KUTR building.

The KUTR and the reactor building share no facilities or equipment with other buildings on the campus except for utilities including electricity, gas, water, compressed air and sewer system.

#### 1.2.2 Reactor Description

The KUTR is an open-pool-type heterogeneous assembly. The core was moderated and cooled by light water and was reflected by graphite on three faces and by water on the top, bottom and one face. The fuel elements were of uranium-aluminum alloy clad with aluminum. The fuel was enriched to approximately 93% U-235.

The reactor core was located to one side near the bottom of a 6,600 gallon tank. The tank is cylindrical at the top and formed with a rectangular pocket on one side near the bottom of the tank to accommodate the core.

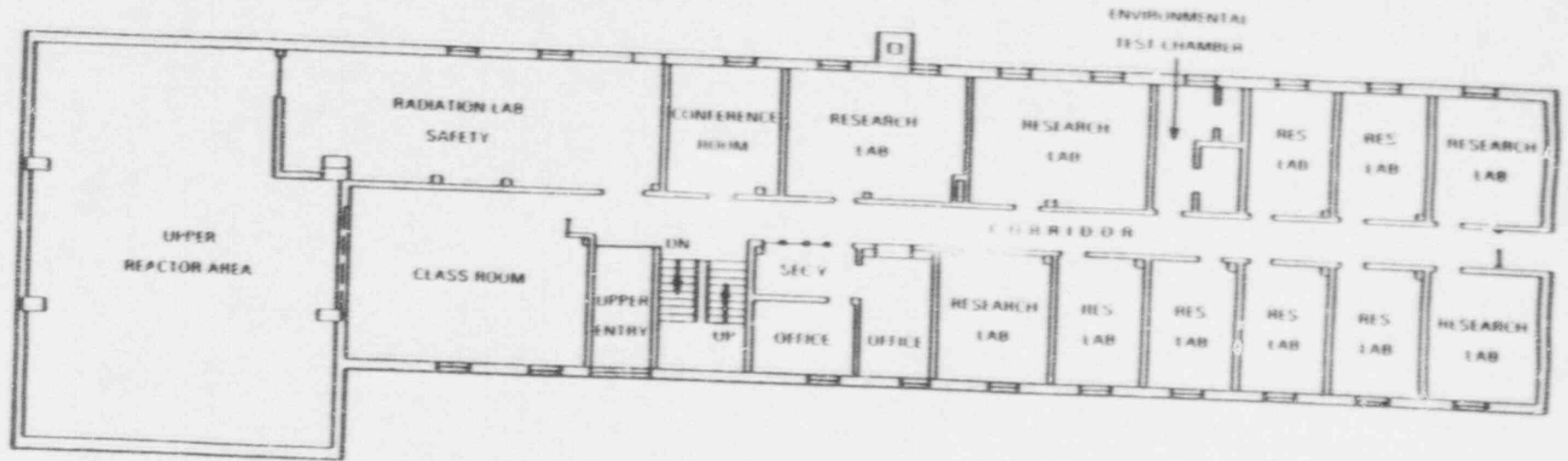
The core was composed of thirteen standard fuel elements and three control rod fuel elements, containing a total of 2.5 kg fully enriched uranium.

The structure around the reactor core includes four 6 in. diameter beam ports, a thermal column measuring 4 ft X 5 ft X 6 ft, a shield tank measuring 7.5 ft in diameter and 20 ft high, and a pneumatic conveyor.





# NUCLEAR REACTOR BUILDING



1-4



GROSS AREA - 6181 ⬆  
NET AREA 5497 ⬆



Figure 1-3 Nuclear reactor building, upper-level floor plan  
Source: University of Kansas SAR

Currently, the reactor configuration includes the aluminum tank (dry), graphite thermal column, beam tubes and beam port plugs and concrete biological shield in-place. The activated control rods and sheaths, grid plate assembly (the core support structure), aluminum angles and stainless steel bolts are stored in the shielded vault in the hot lab (see Figure 1-2). The nonactivated neutron detection chambers, control rod drive motors, magnets, armatures, rod drive extension rods and guide tubes have also been removed from the reactor and are stored in the reactor facility.

All nuclear fuel elements and source material have been shipped off-site or transferred to a state license. All unirradiated nuclear fuel element assemblies were shipped to the Oak Ridge National Laboratory at Oak Ridge, Tennessee on January 6, 1986. All irradiated nuclear fuel element assemblies were shipped to the Savannah River Plant at Barnwell, South Carolina in two shipments on January 28, 1986 and on February 2, 1986. The only residual radioactivity at the facility is in certain of the activated components of the reactor including portions of the core support structure, aluminum tank wall and biological shield concrete in the region near the core location.

### 1.2.3 Operating License History

The KUTR was initially authorized to operate at power levels up to 10kw. In 1971, after approximately 8600 kw-hours of operation, the reactor was authorized to operate at 250kw for short periods. The total thermal energy generated from startup in June 1961 through June 1983 was about 24,000kw-hours. Of that amount, 15,300 kw-hours was after the higher power (peak) authorization. From 1961 through 1977, the reactor was operated primarily as a training reactor. From 1978 to cessation of operations in June, 1984, the reactor was primarily used for experimentation and demonstration. Since June, 1984, the reactor has been effectively shut down.

## 1.3 Decommissioning Program Elements

### 1.3.1 Selected Method

The University intends to remove all residual radioactive materials from the site, verify the absence of residual radioactivity, terminate the Possession-Only License and release the site for unrestricted use.

### 1.3.2 Estimated Cost

The estimated cost of this program, including disposal of all wastes, is \$490,000 in 1990 dollars.

### 1.3.3 Availability of Funds

The State of Kansas is committed to providing the funding for this dismantlement program.

### 1.3.4 Major Tasks and Schedules

The major tasks of this program include:

1. Initial radiation survey of equipment, structures and areas
2. Removal of reactor aluminum tank
3. Removal of activated concrete of biological shield
4. Removal of beam ports and pneumatic tube
5. Packaging, shipping and disposal of irradiated and contaminated material, equipment and rubble at a low level radioactive waste repository

6. Final radiation survey of facility
7. Final report preparation

Approval of the decommissioning plan via issuance of a Decommissioning Order by the U.S. Nuclear Regulatory Commission is anticipated by November, 1991. The University of Kansas personnel will prepare a technical bid specification and request proposals from experienced contractors. After the bids have been reviewed by KU management staff, a Decommissioning Contractor (DC) will be selected so that work can proceed on or about July 1, 1992. It is expected that the final radiation survey and application for license termination will occur by (January 15, 1993).

### 1.3.5 Program Quality Assurance

The decommissioning contractor (DC) will be chartered with the responsibility of performing the preparatory engineering, decommissioning work, waste packaging and disposal and final radiation survey. The DC will be required to implement his own radiological control program and quality assurance program. However, the University of Kansas will conduct its own overcheck of the DC's programs to ensure that the work is performed in a safe and controlled manner.

The University's overcheck program will be defined in a Quality Assurance Program Plan which will include:

1. Review of contractor's operating personnel health and safety training program
2. Review of DC's radiological control program including ventilation, instrument usage and calibration, personnel monitoring and area monitoring procedures
3. Review of DC's work procedures with regard to public health and safety and the principles of ALARA
4. Audit of contractor records including training, radiation surveys, instrument calibration and shipping data
5. Independent check of area radiation levels and surface contamination levels
6. Approval chain of documentation to be submitted to the NRC.

### 1.3.6 Executive Engineer

The University intends to utilize the services of an Executive Engineer (to be selected) who will:

1. Coordinate University review of decommissioning contractor (DC) documents
2. Approve DC documents, as required, on behalf of the University
3. Monitor the work performance of the DC
4. Prepare periodic progress and schedule reports, field change reports, radiation survey overcheck reports, and waste shipment summaries
5. Exercise control of the work via his authority to cease operations if the work is not being performed in accordance with approved procedures
6. Assist the DC where possible to ensure safe and efficient performance of the program.

### 1.3.7 Final Radiation Survey Plan

After completion of the program tasks as listed in Section 1.3.4, the DC will perform a thorough radiation survey of the physical area and structures within the licensed facility boundary. The survey will be in accordance with NUREG/CR-2082, "Monitoring for Compliance with Termination Survey Criteria."

The limits of acceptance for unrestricted release of the facility and for termination of the Possession-Only License are as follows:

1. Surface contamination shall be below the limits specified in Table 1, "Acceptable Surface Contamination Levels," of U.S. NRC Regulatory Guide 1.86, "Termination of Operating License for Nuclear Reactors."
2. Residual radioactivity shall not cause area dose levels to exceed  $5 \mu$  Rem/hr above background at 1 m above the surface of the radioactive materials.

## CHAPTER 2

### 2. CHOICE OF DECOMMISSIONING ALTERNATIVE AND DESCRIPTION OF ACTIVITIES INVOLVED

#### 2.1 Decommissioning Alternative

The University of Kansas has selected the DECON method of decommissioning for the research reactor at Lawrence, Kansas. The definition of this alternative is as follows:

DECON is the removal from the facility site of all fuel assemblies, source material, radioactive fission and corrosion products, and all other radioactive and contaminated materials having activities above unrestricted release levels.

In the case of the KUTR, the facility housing the reactor is the nuclear reactor building (see Figures 1-2 and 1-3). The reactor is contained in the room at the south end of the building. The material to be removed to achieve termination of the Possession-Only License is located in the reactor room, the adjacent hot lab on the lower level and in the upper level radiation lab storage area.

The facility also contains active laboratories, offices and classrooms in addition to the reactor. Therefore, during the dismantlement program, precaution will be taken to preclude unauthorized access to controlled areas, to prevent the spread of airborne contamination and to prevent any direct radiation hazards to personnel.

#### 2.2 Decommissioning Activities, Tasks and Schedules

##### 2.2.1 Activities and Tasks

Since the fresh fuel and spent fuel have already been disposed of and since the coolant in the reactor system has been discharged, the program work will commence with the removal of residual radioactive material. The major activities comprising the program are as follows:

<u>Activity Number</u>	<u>Description</u>
Contractor Pre-Deployment Phase:	
1	Initial Radiation Survey of Equipment, Structures and Areas
2	Preparation of Program Work Procedures and Program Control Documents
3	Design of Containment Barriers and Controlled Ventilation System
Contractor Post-Deployment Phase:	
4	Contractor Mobilization
5	Installation of Containment Barriers and Controlled Ventilation System
6	Removal of Pool Liner and Remaining Pool Internals
7	Removal of Activated and Contaminated Concrete

<u>Activity Number</u>	<u>Description</u>
8	Removal of Beam Tubes, Pneumatic Tubing and Miscellaneous Piping and Materials
9	Packaging and Shipping of Radioactive Waste
10	Facility and Equipment Cleanup
11	Perform Final Radiation Survey
12	Final Report Preparation

The activities involving personnel radiation exposure are listed in Table 2-1 together with the estimated occupational exposures.

Table 2-1

<u>Activity</u>	<u>Estimated Occupational Exposure, mRem</u>
• Decontaminate Equipment Prior to Removal	48
• Remove Thermal Column Door & Remaining Graphite Blocks from within Thermal Column	22
• Remove Aluminum Reactor Tank	284
• Remove Divider Plate & Chamber Pockets	160
• Remove Reactor Box Walls	160
• Reactor Tank Aluminum Floor	120
• Set-up and Breakdown Scaffolding, as required to Support Reactor Tank Removal	46
• Core Bore Beam Tubes, Remove, Segment and Package	27
• Remove Pneumatic Tube Assembly of Activated/Contaminated Materials & Concrete	1
• Remove Thermal Column Lining	38
• Set-up Lower Reactor Tank Region Transport Cart for LSA Material Egress through Thermal Column Door Opening	21
• Breakup, Remove and Package Activated Concrete from Inside of Reactor Walls and Floor	882
• Cut and Package Activated Control Rod Blades, Grid Plates, Bolts and Angles	81
JOB TOTAL:	1890 mRem

As noted in Section 3.1.2, the residual radioactive inventory at KUTR is not large. Therefore, the expected radiation dose during the dismantling program will be relatively small. The residual inventory is concentrated in the pool liner activated concrete and beam ports in the vicinity of the core location. Removal of the beam ports by concrete boring is a remote activity which will minimize exposure. Liner removal and activated concrete removal will require the presence of equipment operators within the biological shield in proximity to the material being removed.

However, local shielding can be utilized to reduce the dose contribution. The work area within the biological shield will be enclosed in a contamination control envelope serviced by a HEPA unit such that the work area will be maintained under a negative pressure relative to the surrounding environment. The HEPA section will be located so as to draw air across the work piece away from the operators. These steps will result in the occupational exposure being As Low As Reasonably Achievable.

### 2.2.2 Schedule

The major activities and tasks are shown in Figure 2-1. The total program duration, from receipt of the Decommissioning Order until completion of the Final Radiation Survey is forty-six (46) weeks. It is expected that the Decommissioning Order will be received on or about November 1991.

### 2.3 Decommissioning Organization And Responsibilities

The organization for the management of the reactor facility during the decommissioning program is shown in Figure 2-2. The organization is consistent with that defined in Amendment No. 15 to Facility Operating License No. R-78 which authorized possession, but not operation, of the University of Kansas reactor.

Two levels of authority are provided, as follows:

Level 1: The individual responsible for site administration, including licensing

Level 2: The individual responsible for safe accomplishment of the reactor decommissioning program.

Responsibility for the decommissioning program shall be within the chain of command shown in Figure 2-2.

THE UNIVERSITY OF KANSAS

PRIMAVERA PROJECT PLANNER

REPORT DATE 5/20/90 RUN NO. 19  
20:00

DECOMMISSIONING OF KU RESEARCH REACTOR

KANSAS REACTOR DECOMMISSIONING - SCENARIO 1

ACTIVITY DESCRIPTION		06	13	20	27	03	10	17	24	31	07	14	21	28	05	12	19	26				
ACTIVITY ID	DD	RD	PCT	CORRES	FLOAT	SCHEDULE	JUL	JUL	JUL	JUL	AUG	AUG	AUG	AUG	SEP	SEP	SEP	SEP	OCT	OCT	OCT	OCT
							92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
Prepare Decommissioning Procedures	4000	15					*															
DGC Mobilize Site	81000	1					*															
Conduct General Employee Training and Orientation	81300	3					*															
Perform Confirmatory Radiation Survey	82000	2					*															
Construct CCE over Tank	8300G	3					*															
Perform Confirmatory Survey of Drain Line	89000	1					*															
Remove Thermal Column Door and Construct CCE	85300	1					*															
Decontaminate Equipment Prior to Removal	84000	1					*															
Set Up Cutting Station and Test Equipment	85100	3					*															
Remove Tank, Divider Plate & Box and Chan. Pocket	85620	8					*															
Remove Pneumatic Tube Assembly	85720	1					*															
Remove Thermal Column Lining	85730	1					*															
Set Up Transport Cart and Area	86100	1					*															
Remove Activated Concrete from Inside Tank	87100	10					*															
Core Bore Beam Tubes	85710	5					*															
Clean Up and Decontaminate Tank Region	87200	1					*															
Conduct Final Radiation Survey	89000	8					*															
Prepare Final Decommissioning Report	89200	5					*															
Ship and Dispose of Contaminated Materials	89100	2					*															
Final Site Cleanup	89400	2					*															
Site Demobilization	89300	5					*															

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Figure 2-1

Program Schedule - Major Activities and Tasks

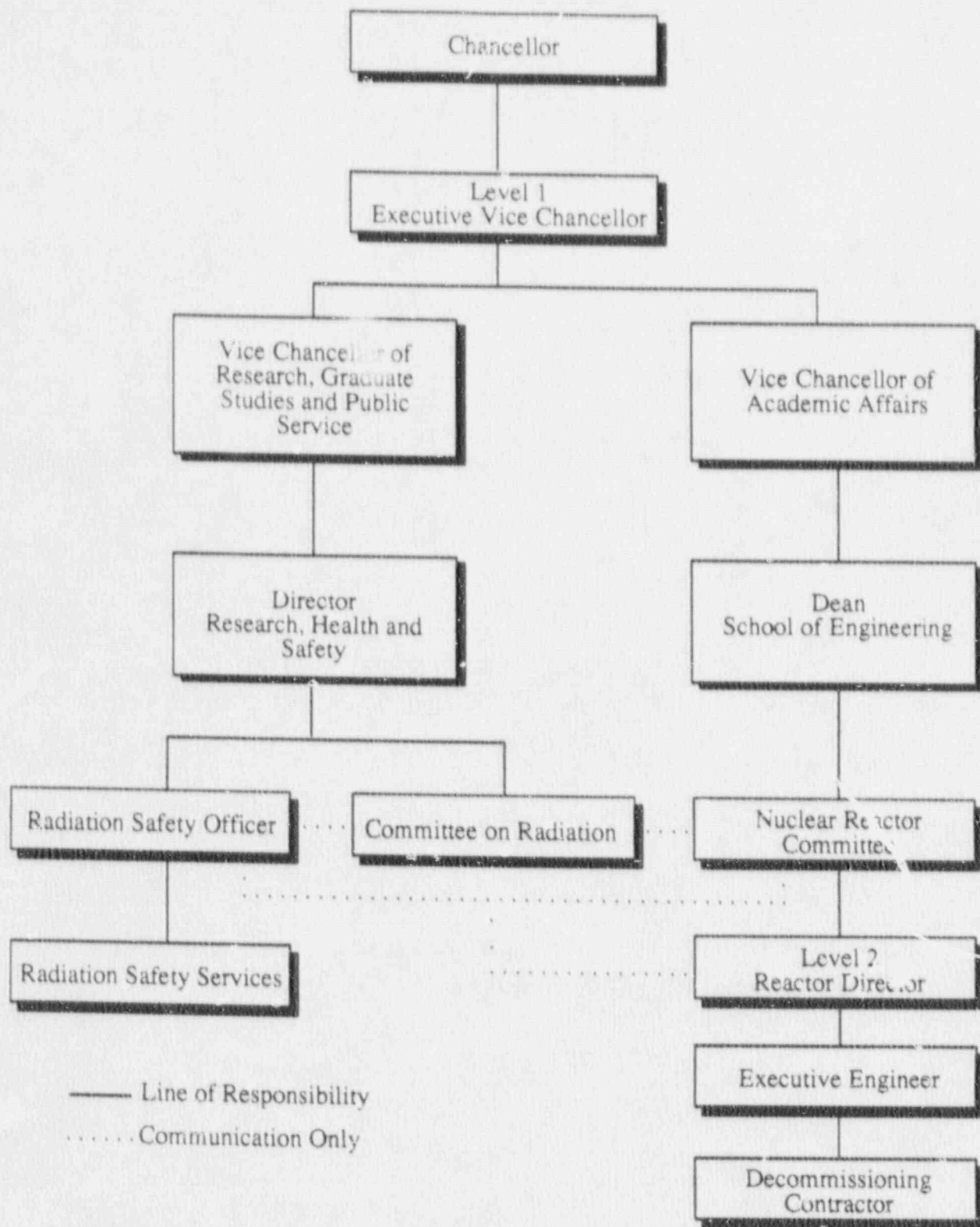


Figure 2-2  
 KU Organization Structure During Decommissioning Program

### Radiation Safety Officer

The Radiation Safety Officer (RSO) heads the Radiation Safety Service and supervises a professional staff. This person is a qualified health physicist who shall maintain proficiency in radiation safety with the Decommissioning Contractor (DC) during decommissioning activities. The RSO will advise the Reactor Director about all matters regarding radiation monitoring and radiation safety during decommissioning activities.

The RSO will direct his health physics staff to perform independent radiation monitoring audits over the DC health physics staff during decommissioning activities and final release survey.

### Nuclear Reactor Committee

The Nuclear Reactor Committee, as constituted by Amendment No. 15 to the KUTR license, shall monitor facility decommissioning activities. This may be accomplished via an independent review and audit of the decommissioning operations by a qualified individual designated by the Nuclear Reactor Committee. The audit shall include radiation safety controls, implementation of approved procedures, instrument calibrations, personnel certification, and all associated records.

### Executive Engineer

The Executive Engineer will assist the Reactor Director in providing overall contractual direction to the Decommissioning Contractor. The Executive Engineer will be from a nuclear engineering firm who will prepare demolition bidding documents, review bids, and schedule the work in accordance with the on-going needs of the University. The Executive Engineer will supervise the worker safety training and will provide the following services:

1. Review and approve contractor work procedures and program documents to ensure conformance to the bid specification
2. Continuously monitor contractor's performance to ensure satisfactory execution of the work
3. Review and approve all radiation work permits
4. Approve and administer all changes and additions to the contractor's contract
5. Routinely report on program progress to the Reactor Director

### Decommissioning Contractor

The Decommissioning Contractor shall be an experienced nuclear D&D firm who will be responsible for actual field performance of the dismantling program. The contractor shall be responsible for preparation of detailed work procedures; radiological monitoring and control of his own work; safe removal of all radioactive materials, including demolition, packaging and shipping; performance of the final radiation survey; preparation of the final report in support of the license termination application to the U. S. Nuclear Regulatory Commission.

### 2.4 Training Program

The training program for all personnel directly involved with accomplishment of the decommissioning program will include:

1. General Employee Training in compliance with 10 CFR 19.12 for all personnel involved with radioactive materials or in the vicinity of radioactive materials. The radiation safety program will include personnel monitoring, radiation surveillance and monitoring, controlled areas and ventilation, access controls and Health Physics administrative controls.
2. Respiratory Protection Training in accordance with the requirements of ANSI 2-88.2, NRC Reg Guide 8.15, NRC NUREG-0041 "Manual of Respiratory Protection," and 29 CFR 1910.134.
3. Hearing Conservation Training to meet the requirements of 29 CFR 1910.25.
4. Hazard Communication Training to meet the requirements of 29 CFR 1910.1200. Radiological and demolition-induced hazards will be reviewed together with precautionary measures.
5. Technical Training including mockup simulation or pre-performance briefings to ensure proper equipment usage and achievement of ALARA. Topics will include decontamination, material segmentation and demolition, and packaging and shipping.

The training will be conducted by personnel qualified in the program contents. The instructors will include the Radiation Safety Officer, the Executive Engineer and others as determined by the Reactor Director.

#### 2.5 Contractor Assistance

As noted in Section 2.3 the University intends to hire two outside organizations, i.e., the Executive Engineer and the Decommissioning Contractor. The prece- of the program by which the University will ensure that health and safety will be maintained throughout the decommissioning program include:

1. Pre-planning of all work activities via written and approved procedures
2. Executive Engineer overcheck to ensure that all work is accomplished in accordance with approved procedures
3. Executive Engineer's authority to stop work at any time and without question should he believe work is not being performed in accordance with approved procedures or if he sees a condition that could compromise worker or public health and safety
4. Assurance of satisfactory experience on the part of the Decommissioning Contractor
5. Training of the Decommissioning Contractor's staff
6. Periodic audits of program performance by the Radiation Safety Officer and the Nuclear Reactor Committee

#### 2.6 Radioactive Materials Unrestricted Release Criteria

##### Decontamination and Decommissioning Documents

The Radioactive Materials Unrestricted Release Criteria limits for surface contamination shall be below the limits specified in Table 1, "Acceptable Surface Contamination Levels," of USNRC Regulatory Guide 1.86, "Termination of Operating License for Nuclear Reactors."

The residual radioactivity shall not cause area dose levels to exceed 5 microRem/hr above background at 1 m above the surface of the activated materials.

The final survey will be in accordance with NUREG/CR-2082, "Monitoring for Compliance with Termination Survey Criteria."

## 2.7 Decontamination and Decommissioning Documents

The Decommissioning Contractor will be responsible for preparing and implementing the following Decontamination and Decommissioning Documents during the performance of this project.

1. Quality Assurance Program
2. Radiological Control Procedures
  - Radiation Work Permit Procedure
  - Surface Contamination Control Survey Procedure
  - Airborne Radioactivity Control Procedure
  - Calibration & Maintenance of Survey Instruments Procedure
  - Radioactive Check Source Accountability Procedure
3. Radioactive Waste Procedures
  - Radioactive Waste Packaging Procedure
  - Handling, Storage and Shipping of Radioactive Materials Procedure
  - Solidification of Radioactive Liquids Procedure
4. Health, Safety and Emergency Procedures
  - General Industrial Safety Procedure
  - Health and Safety Procedure
  - Housekeeping Procedure
  - Emergency Action Procedure
  - Waste Transportation Emergency Procedure
5. Work Procedures
  - Construction of Contamination Control Envelope (CCE) Procedure
  - Aluminum Tank Removal Procedure

- Surface Decontamination Procedure
- Activated and Contaminated Concrete Removal Procedure
- Removal of Beam Tubes and Pneumatic Tube Procedure
- Final Site Radiation Survey Procedure
- Final Site Clean-up Procedure

## CHAPTER 3

### 3. PROTECTION OF OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

#### 3.1 Facility Radiological Status

##### 3.1.1 Facility Operating History

The reactor was operated from 1961 through June, 1984. A review of the annual operating reports and interviews with the reactor management staff indicate there were no unusual events including no radioactive spills within the facility nor radioactive releases from the facility. The only remaining system beyond the biological shield is a drain line running beneath the reactor room floor to the equipment room hold-up tank. The entire piping run is accessible via an open pipe chase beneath the floor. The KU staff personnel surveyed the drain line and the sample results from the hot lab drain and drain pipe to hold-up tank ascertained no contamination to be present.

##### 3.1.2 Current Radiological Status of Facility

Figure 3-1 shows a plan view of the reactor core configuration and its relationship to the beam tubes and the pneumatic tube. Figure 3-2 shows an enlarged top view of the reactor core configuration and its relationship to the beam tubes and pneumatic tube assembly. The entire core support structure and the ion, source and fission chambers have been removed.

##### Area Dose Rates -

The area dose levels within the dry reactor tank at floor level are shown in Figure 3-3. Figure 3-4 shows the contact dose rates within the region of the thermal column external to the reactor tank and the contact dose levels on the outer surface of the beam ports. Measurements were made with an Eberline Ionization Chamber, Model RO2.

##### Surface Contamination -

There was low level surface contamination on the graphite blocks located within the thermal column region, therefore, low level surface contamination is present in the thermal column area. There is no surface contamination on the inner surface of the reactor tank.

##### Activation -

Material samples in the form of aluminum coupons and concrete borings were taken from the reactor tank wall and floor in the vicinity of the core. Approximately 30% (1.6 ft<sup>3</sup>) of the aluminum liner is activated with a total estimated activity of 1.96  $\mu$ Ci's. The  $\mu$ Ci's were calculated based on a linear correlation between the net cpm/g of sample #5 (calculated by KU personnel) and the laboratory measured isotopic concentration analysis results of aluminum sample #5 in  $\mu$ Ci/g (predominant isotope was Co60). The assumption was made to set up a linear correlation between the KU determined net cpm/g results of samples 1,2,3,4 & 6 to the known sample #5 net cpm/g and  $\mu$ Ci/g to calculate the remaining samples  $\mu$ Ci/g results based on a linear relationship.

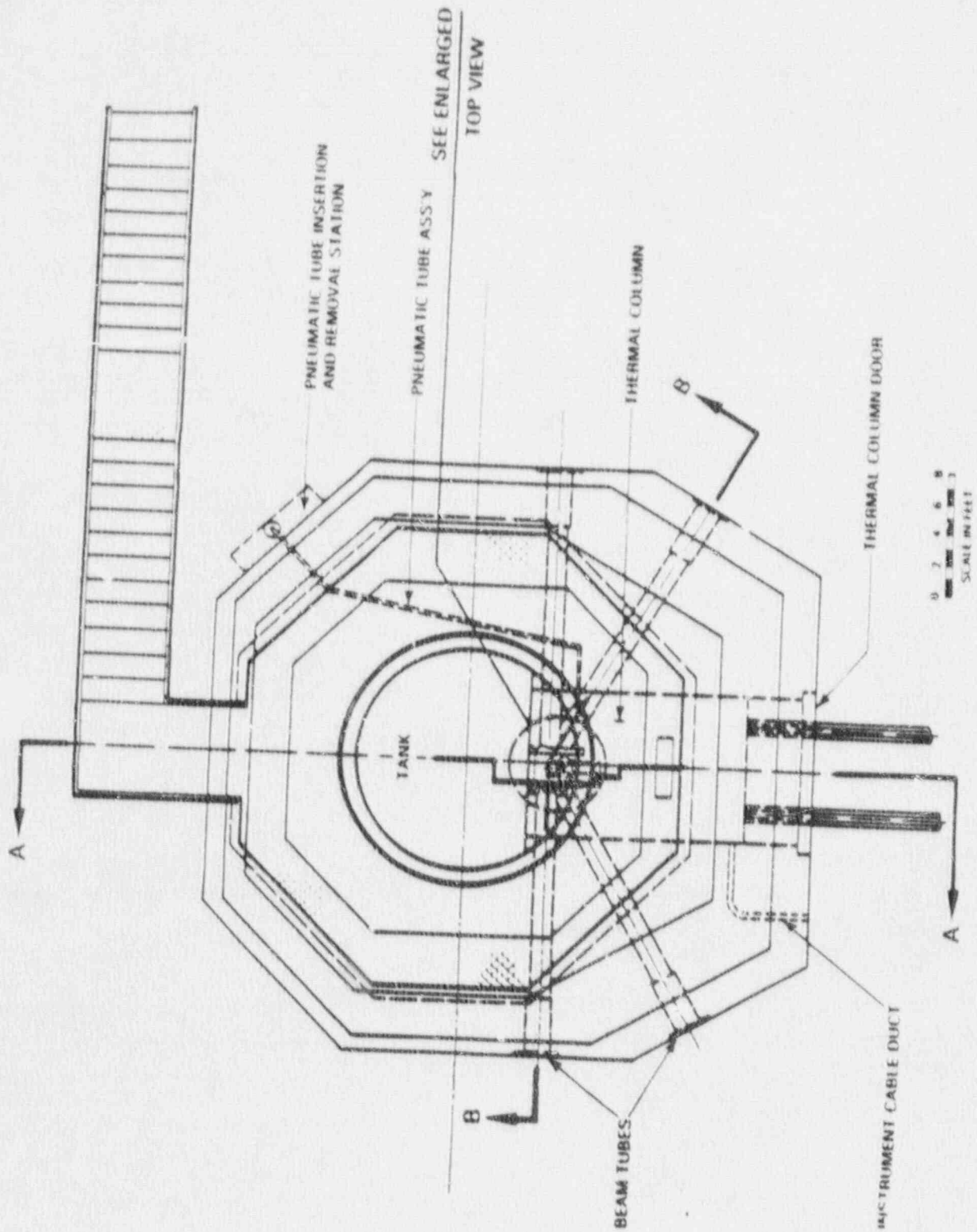


Figure 3-1 Top view of the reactor  
 Source: University of Kansas SAP

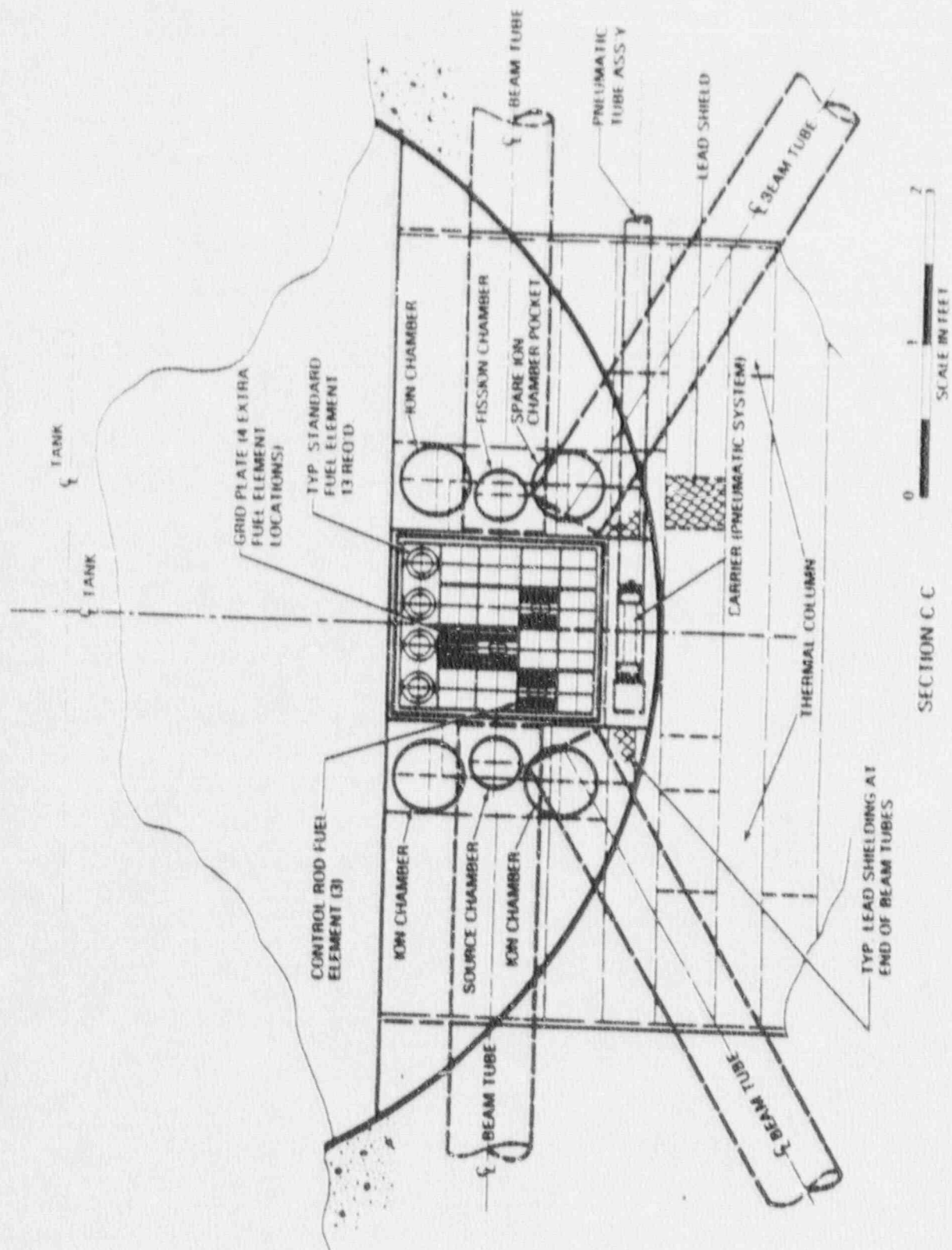
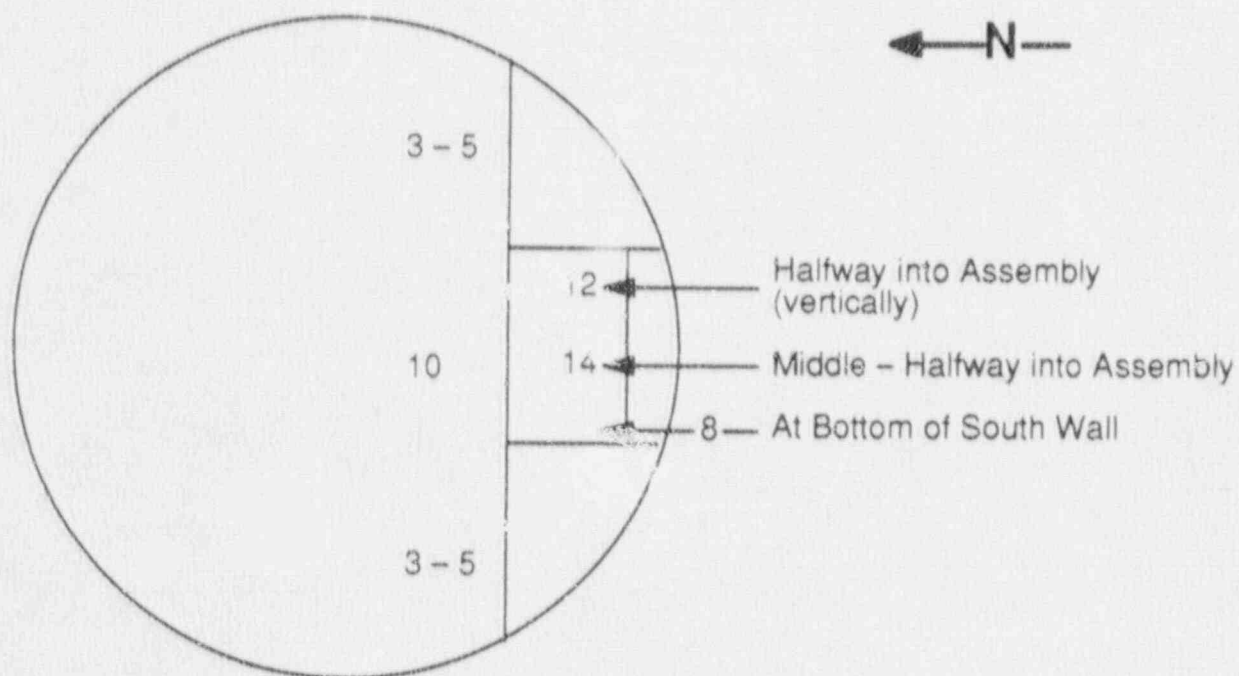


Figure 3-2 Enlarged top view of the reactor  
 Source: License Application (Docket 50-148)

MAP OF REACTOR TANK FLOOR LEVEL



PLAN VIEW

All Dose Rate Readings in mR/hr  
(Readings taken on March 9, 1989)

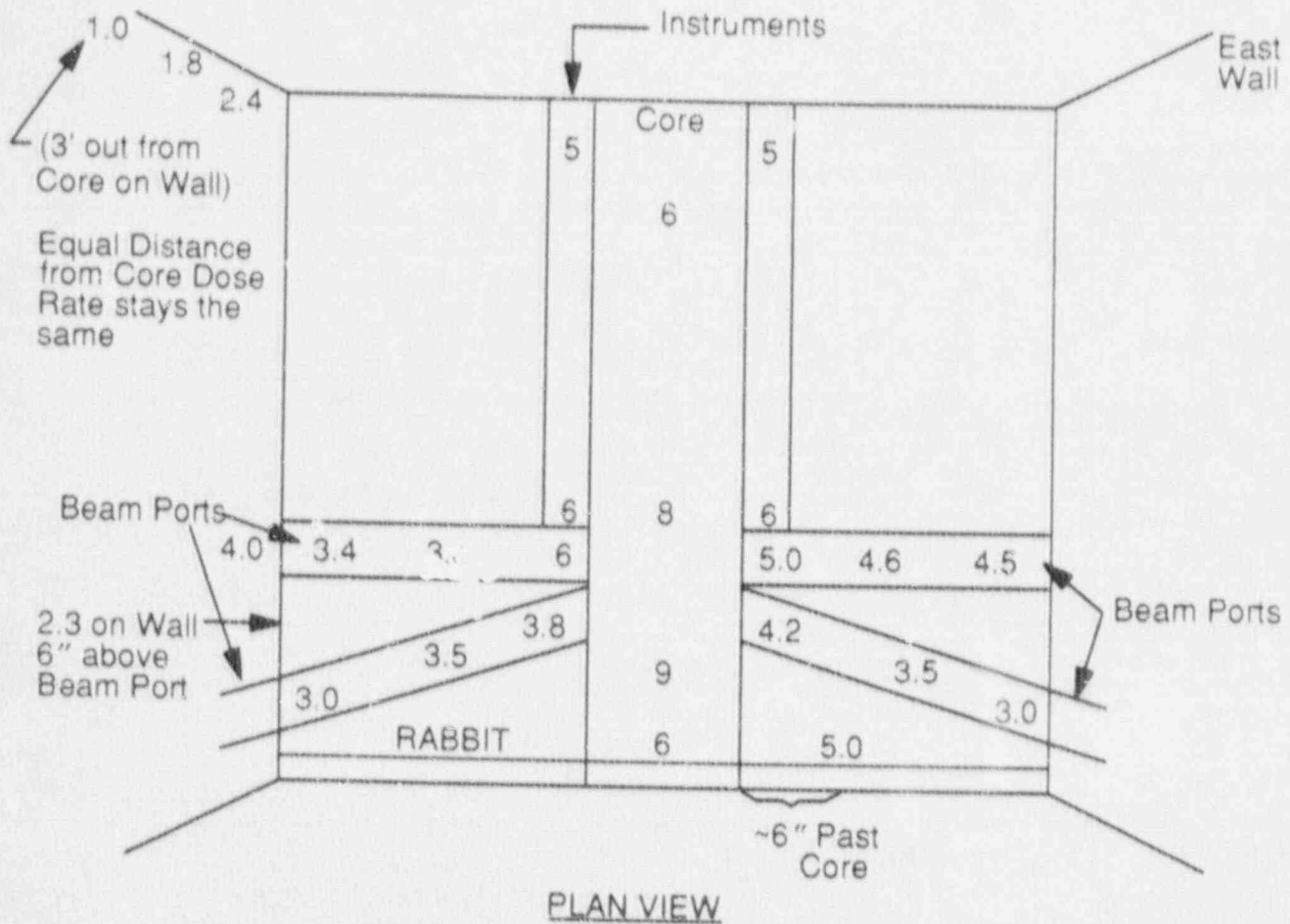
Survey Instrument -

Measurements taken with an Eberline Ionization  
Chamber, Model R02.

Figure 3-3

Area Dose Rates Within the Dry Reactor Tank at Floor Level

## MAP OF THERMAL COLUMN



All Dose Readings in mR/hr  
(Readings taken on May 12, 1989)

Survey Instrument-

Measurements taken with an Eberline Ionization Chamber, Model R02.

Figure 2-4

Contact Dose Rates Within the Region of the Thermal Column External to the Reactor Tank and the Contact Dose Rates on the Outer Surface of the Beam Ports

Example: (Concentration of Co60 in Aluminum sample #3, Linear Correlation)

$$\begin{array}{l}
 \text{(KU results} \\
 \text{samp. \#3 \& \#5)} \\
 \\
 (50 \text{ cpm/g avg.}) \times \\
 \\
 \text{(KU results samp. \#5)}
 \end{array}
 \times
 \begin{array}{l}
 \text{(Laboratory results} \\
 \text{samp. \#5)} \\
 \\
 \frac{(3.09 \text{ E-}^5 \mu\text{Ci/g})}{(21 \text{ cpm/g})} \\
 \\
 \text{(sample \#3 results)}
 \end{array}
 = 7.3\text{E-}^5 \mu\text{Ci/g}$$

Of the core support structures removed from the reactor tank, only the grid plates, bolts and aluminum angles show indication of radioactivity. This is predominantly Cobalt 60. Their estimated activity is as follows:

<u>Item</u>	<u>Weight, lbs</u>	<u>Activity (mCi)</u>
Grid Plates (2)	18	0.03
Bolts (20) and Aluminum Angles (2)	5	0.5

The samples obtained from the lead shielding and graphite stringers that were located in the thermal column region are somewhat activated. The estimated activity of the lead shielding is 1.40  $\mu\text{Ci}$  in approximately ten (10)  $\text{ft}^3$  of lead. The estimated activity of the graphite is 2.28  $\mu\text{Ci}$  in approximately one hundred and twenty (120)  $\text{ft}^3$  of graphite. There was no indication of alpha activation.

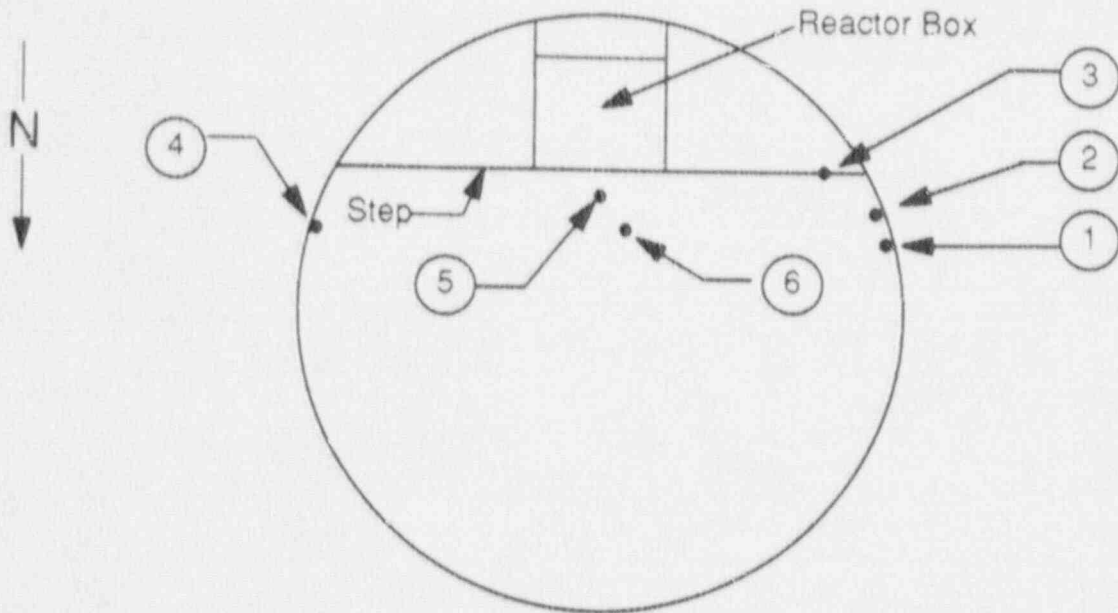
Core samples were taken of the activated concrete as shown on Figure 3-5. An analysis of the samples indicates low levels of activation as determined by laboratory analyses of the concrete core samples. The same type of assumption was made for the concrete core sample #3 with respect to sample #2 with known net cpm/g &  $\mu\text{Ci}$  activity by correlating the net cpm/g and  $\mu\text{Ci/g}$  to determine total activity as calculated for the activated aluminum. Based on the laboratory results an estimated .008% (15  $\text{ft}^3$ ) of the total volume of the concrete shield is activated with a total estimated activity of 4,865  $\mu\text{Ci}$ 's.

### 3.2 Radiation Protection

#### 3.2.1 Ensuring that Occupational Radiation Exposure Are As Low As Reasonably Achievable (ALARA)

The University of Kansas administration, through its Radiation Safety Office, has established a policy for the campus of minimizing all radiation exposures to ALARA. This requirement will be transmitted to the Decommissioning Contractor who will be required to prepare an ALARA Plan specific to the decommissioning of the KUTR. The plan shall demonstrate knowledge of the source of radiation during dismantling, pre-planned mitigation of the source impact, pre-planned minimization of the duration of personnel exposure to the source and the protection of personnel during their exposure. The ALARA Plan shall include, as a minimum, the information listed below.

### MAP OF REACTOR TANK



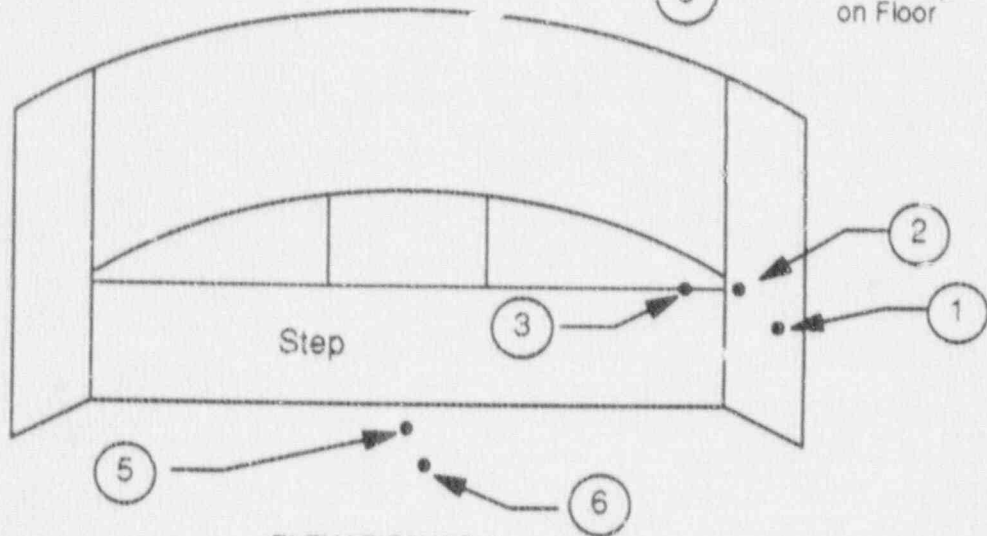
### PLAN VIEW

#### Sample

- ① 14.5" from Step  
27.5" from Floor
- ② 2.5" from Step  
31.5" from Floor
- ③ 6" from Step  
26.5" from Floor

#### Sample

- ④ 14.5" from Step  
27" from Floor
- ⑤ 3" from Step  
dead center on Floor
- ⑥ 15" from Step  
on Floor



### ELEVATION VIEW

Figure 3-5

Map Of Concrete Core Bore Samples

Description of Worker Training – All personnel working on this project and in the vicinity of the reactor room will be given instructions in radiation safety prior to the commencement of their work activities. There shall be three types of training:

1. Non-radiation workers
2. Radiation workers directly involved in handling activated or contaminated materials and entering radiation areas
3. Persons directing the activities of radiation workers

The training program will follow the guidelines of the Institute for Nuclear Power Operations General Employee Training Program. OSHA hazardous environment protection training shall also be provided with emphasis on dust ingestion prevention, noise mitigation and handling of heavy loads.

Additional briefings and practical training will be performed as required to review work procedures, equipment usage, radiation control requirements and specific hazards associated with certain procedural steps. Records of each individual training will be maintained by the DC on the job site.

Administrative Controls – Three areas of radiological control are pertinent to this dismantling program including:

1. Personnel radiation exposure limits
2. Radiation work permits
3. Surface contamination area isolation.

The personnel radiation exposure limits are established in 10 CFR 20, Standards for Protection Against Radiation. They are summarized in Table 3-1.

Table 3-1  
10 CFR 20 Radiation Exposure Limits for a Radiation Worker  
During a Calendar Quarter

<u>Body Element</u>	<u>Maximum Allowable Radiation Exposure, mRem</u>
Whole body, gonads, blood forming organs, lens of eye	1,250
Hands and forearms, feet and ankles	18,750
Skin of the whole body	7,500

Under no circumstances shall the limits of Table 3-1 be exceeded.

Because of the nature of the work and the relatively low radiation fields anticipated during this decommissioning program, the work can be accomplished with much lower radiation dose to the workers. Therefore, the administrative limits shown in Table 3-2 will be adhered to throughout this program.

Table 3-2  
Administrative Limits For Whole Body Dose

<u>Period</u>	<u>Maximum Dose, mRem</u>	
	<u>Non-radiation workers and Visitors</u>	<u>Radiation Workers</u>
Daily	20	100
Weekly	50	250
Calendar Quarter	100	500

Visitors and non-radiation workers must be escorted by a radiation worker whenever they enter a controlled areas.

Although there is no public exposure expected due to the decommissioning program for the KUTR, the decommissioning contractor shall ensure that the limits for public exposure specified in 10 CFR 20.105, Permissible Levels of Radiation in Unrestricted Areas, are not exceeded.

Radiation Work Permits will be prepared to assure that the radiological or other hazardous work conditions associated with a specific activity or group of activities are well-defined; that all necessary preparations and plant conditions have been established; and that all required personnel protective measures are clearly specified. All Radiation Work Permits shall be approved by the Executive Engineer and by the Reactor Safety Officer. Work within a radiation or controlled area cannot commence without an approved Radiation Work Permit. Should radiological or hazardous conditions change significantly during the performance of an activity under a Radiation Work Permit, then it is incumbent on the decommissioning contractor's field supervisor to stop the work and initiate a revision to the permit which reflects the changed condition.

As a minimum, all RWPs shall contain the following information:

1. Radiation and contamination mapping based upon current radiological surveys, analytical results, and calculations
2. Explicit description and survey of the available work area (e.g., contaminated areas, "clean" working areas, examination area, low dose waiting areas, hot spots, etc.)
3. Access requirements to control the spread of contamination from contaminated to "clean" working areas and methods employed to minimize exposure to all personnel
4. Description of the methods to identify and mark all removed items, and note their place or origin, their contamination and radiation levels, and any other pertinent radiological information
5. Description of packaging contaminated wastes in appropriate containers (as prescribed by NRC and DOT regulations and radwaste disposal site criteria)
6. Explicit description of the protective clothing and respiratory equipment required
7. Listing of work area monitoring requirements necessary to detect changes in the radiological conditions
8. Listing of required personnel dosimetry and protective devices
9. Requirements for Radiation Control Technician (RCT) coverage (continual, intermittent, on-call, or not required)
10. Description of the work to be performed including estimates of time required
11. Requirements for additional information (pre-job briefings, additional training, ALARA briefings, etc.)
12. As addendum to the RWP, personnel entry logs shall be maintained to document entry and egress from areas governed by the RWP and to track accumulated exposure for ongoing work

All work involving the demolition of contaminated materials or potentially contaminated material shall be performed within a contamination controlled envelope (CCE). The CCE shall be maintained at a negative pressure relative to the environment outside the CCE during the time that physical demolition or handling of the material is occurring. The exhaust from the CCE will be through a HEPA unit to ensure retention of potential contamination. All personnel entries into and exits from a CCE shall be made at a contamination control point which shall include a step-off pad, replaceable floor covering (paper or plastic) for contamination control, personnel radiation

monitoring equipment, and repository for used anti-contamination clothing. All equipment or materials to be removed from a CCE and intended for unrestricted use shall be surveyed and verified that the limits of Table 1 in NRC Regulatory Guide 1.86 are met before being released from the control point. If the limits are exceeded then the material or equipment shall be decontaminated before being released.

Planning - In planning the details of the decommissioning program, the general sequence to be followed will be the removal of the most activated material first. This serves two important ALARA purposes:

1. Retains the inherent shielding of the biological shield during removal of the activated material, and
2. Minimizes the period of exposure of the work force to the largest segment of the radioactive inventory.

Special Techniques and Practices - The decommissioning contractor will be encouraged to utilize local shielding where appropriate to reduce exposure fields. A separate HEPA exhaust system shall be maintained at the point of demolition to further minimize the potential spread of contamination.

All demolition activities involving the potential for airborne contamination shall be accomplished with workers using appropriate respiratory protection equipment.

The decommissioning contractor has the responsibility for reflecting ALARA concepts in the detailed planning of the program and for the day-to-day implementation of ALARA principles in the accomplishment of the work. The Executive Engineer and the Reactor Safety Officer will reflect the University's responsibility for ensuring the achievement of ALARA via their approval of program documents including Radiation Work Permits. The Executive Engineer will also monitor the decommissioning contractor's performance to ensure that program requirements are adhered to.

### 3.2.2 Health Physics Program

The implementation of the health physics program during the decommissioning campaign will be the responsibility of the decommissioning contractor. Approval and monitoring of the contractor's program will be performed by the University of Kansas' Radiation Safety Officer. The contractor will be responsible for:

1. Preparation of a health and safety plan
2. Provision of a full time health physics staff to perform all survey, monitoring and radiological control functions
3. Selection of appropriate instrumentation for radiation and contamination surveys and for personnel monitoring
4. Calibration, testing and maintenance of the instrumentation
5. Monitoring of effluent discharges from contamination control envelopes.

Health and Safety Plan - This document shall include a description of the controls to be exercised to minimize personnel exposure including stipulation of radiation exposure limits to workers and non-radiation worker personnel; personnel dosimetry including film badges, self-reading pocket dosimeters, extremity TLDs and tracking of radiation exposures; internal

radiological monitoring including bio-assay and excretion analysis; identification and monitoring of controlled areas including radiation areas, controlled surface contamination areas, airborne radioactivity areas, and radioactive materials areas; radiological survey techniques and frequencies; respiratory protection including engineering controls and respirator use; air monitoring and dust control; contamination control; and satisfaction of OSHA requirements.

For the measurement of area dose levels near background, a ratemeter with a 2 inch by 2 inch NaI detector shall be used. Air ionization chambers will be used to measure exposure rates above 0.1 mR/per hour. An ionization chamber with a remote telescoping extension will be available for high radiation area measurements should the need occur. Fixed contamination shall be measured with a GM probe for beta-gamma contamination and a scintillation probe for alpha contamination. Swipe surveys for loose contamination shall be measured with laboratory equipment or with appropriate GM and scintillation probes.

A written procedure for the calibration and maintenance of survey instruments shall be prepared by the decommissioning contractor. It shall identify the staff responsibilities for instrument control and records. The procedure shall also define pre-use instrument check requirements, protection and storage of instruments, and calibration requirements. All instruments used for surveys shall be calibrated at no greater an interval than six months and after every instrument repair.

The contractor shall prepare an airborne radioactivity control procedure which shall define how compliance will be attained with the provisions of 10 CFR 20, Appendix B, Table II, Respiratory Protection Requirements and Use. The procedure shall define air sampling techniques and frequencies; the calculation of beta-gamma and alpha concentration in the air samples; the use of portable and continuous air monitors; air sampling of the environment outside the contamination control envelopes; and maintenance of air sampling records. The procedure shall also define the limits and conditions under which full-faced respirators or hoods shall be worn; airborne limits for alpha and beta-gamma beyond which personnel will not be allowed entry into the area; respirator maintenance and decontamination; and the operation of HEPA-protected contamination control envelopes. All demolition activities which have the potential of creating airborne radioactivity shall be performed within a contamination control envelope (CCE). Whenever work activities are occurring inside a CCE, a HEPA exhaust system, sized for at least three CCE volume air changes per hour, shall be in continuous operation exhausting from the CCE. In addition, HEPAs shall also be utilized to control known airborne generating activities such as burning or scabbling on contaminated materials so that a separate exhaust can be taken at the point of generation within a CCE.

### 3.3 Radioactive Waste Management

#### 3.3.1 Fuel Disposal

All nuclear fuel has been shipped from the site. The irradiated fuel was transported in two shipments to the Savannah River Plant in the Model 700 cask, USA/5942/B( )F on January 28, 1986 and February 2, 1986. The unirradiated fuel was shipped to Oak Ridge on January 8, 1986.

#### 3.3.2 Radioactive Waste Processing

Since all systems at KUTR are dry, the only source of radioactivity during decommissioning will be the solid waste associated with the concrete and metallic structure of the reactor facility. This radioactivity will evidence itself in three radwaste forms:

1. Airborne particulates
2. Solids
3. Some contaminated liquids from cutting operations

The airborne particulates will be generated during the mechanical demolition of the concrete biological shield and the mechanical cutting of the aluminum tank and the beam tubes. This contamination will be controlled within a CCE by local HEPAs.

The solid radioactive waste will be comprised of the reactor tank material concrete biological shield and the integral metals of the beam ports, pneumatic assembly, thermal column liner and reinforcing bar. This material will be cut into segments which will be packaged in LSA boxes for shipment to a low level radioactive waste repository. The expected volume of solid radioactive wastes is shown in Table 3-3.

Table 3-3  
Expected Volume of Solid Radioactive Waste\*  
Generated During KUTR Decommissioning Activities

<u>Radioactive Waste Description</u>	<u>Volume, Ft<sup>3</sup> (Including Packaging)</u>
1) Poly Sheeting from inside of Thermal Column Door & Graphite Blocks	96
2) Activated Aluminum Liner (50 Ft <sup>3</sup> w/packaging efficiency) Beam Tubes (4 - 6' long X 6" diameter segmented in half) Pneumatic Tube Assembly (Segmented)	96
3) Thermal Column Lining & Reinforcing Bar	96
4) Activated Concrete from Reactor Shield	96
5) Angles, Bolts, Control Rod Blades, and Grid Plate Assembly	192
	-----
	576 Ft <sup>3</sup>

\*NOTE: All radwaste generated during decommissioning activities (i.e., dress out materials - anti-C's, booties, gloves, respirator cartridges, etc., and all contaminated materials generated from disassembly of all CCE's and final clean-up of site) will not generate additional radwaste containers, but will be packaged in the void spaces of the listed radwaste containers.

Liquid contamination may be generated during certain evolutions where cooling water must be supplied to a cutting tool. The volume will be small and will be processed manually. That is, the liquid will be mopped up and manually solidified in a LLW drum for disposal at a burial facility.

No existing plant system will be required or utilized in the processing of the radioactive waste. The temporary systems are limited to the airborne controlled ventilation HEPA exhaust systems and the manual solidification of contaminated liquids.

### 3.3.3 Radioactive Waste Disposal

The DC shall prepare a procedure for Handling, Storage and Shipping of Radioactive Materials with a section specifically on Radioactive Waste Disposal. This section shall contain the provisions of 10 CFR 20.311, Transfer for Disposal and Manifests and 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste, and applicable disposal site license conditions for processing and disposal of low-level radioactive wastes shall be met.

#### 1. Radioactive Material Shipments Manifest

(Provisions of 10 CFR 20.311)

The Radioactive Material shipment manifest shall include the following:

- 1.1 A completed radioactive material shipment record with each shipment of Low Specific Activity (LSA) Radioactive Material.
- 1.2 Utilize the U.S. Ecology, Inc. Radioactive Material Shipment Manifest for radwaste shipments to the Richland, Washington disposal site.
- 1.3 Radioactive Material Shipment Record should contain the following information:
  - 1) Shipment Number – From the Radioactive Material Shipment Log.
  - 2) Shipment Date – The date the shipment leaves the KUTR facility.
  - 3) Carrier – The name of the carrier transporting the shipment.
  - 4) Driver signature – The signature of the driver picking up the shipment.
  - 5) Number of Packages – The total number of packages in the shipment.
  - 6) Total Activity – The total activity (in curies or millicuries) of all packages in the shipment.
  - 7) Total Weight – The total gross weight (in pounds) of all packages in the shipment.
  - 8) Total Volume – The total volume (in cubic feet) of all packages in the shipment. The volume is based on the external physical dimensions of each package.
  - 9) Proper Shipping Name/Identification Number– Check the space next to Radioactive Material, LSA, NOS, UN 2912.

- 10) Enter the total number of pages.
- 11) Consignee - The organization receiving the shipment.
- 12) Contact - The individual within the receiving organization responsible for receipt of the shipment.
- 13) Address - The delivery address for the shipment.
- 14) Telephone Number - The telephone number of the receiving organization.
- 15) License Number - The radioactive materials license number of the receiving organization.
- 16) Exclusive Use Vehicle - Check: Yes
- 17) Item Number - The serial number of each individual package.
- 18) Material Description - A brief description of the material.
- 19) Radionuclide - List each radionuclide present in the material.
- 20) Activity mCi - The activity, in millicuries, of each listed radionuclide. If activity is less than the lowest level detectable (LLD), that shall be noted and the LLD identified.
- 21) Physical Form - Enter: Solid
- 22) Chemical Form - The most prevalent chemical form of the material: metallic oxides, toluene, specific acids or bases, etc.
- 23) Type Package - Enter: Strong-Tight
- 24) Package Weight - The total gross weight in pounds of the package.
- 25) Package Volume - The volume in cubic feet of the package based on the exterior dimensions.
- 26) mR/hr Item Surface - The maximum dose rate on contact with the surface of the package.
- 27) mR/hr Package Surface - The maximum dose rate on contact with the surface of the package.
- 28) mR/hr Package 1 meter - The maximum dose rate at any point 1 meter from the package surface.
- 29) dpm/100 cm<sup>2</sup> Alpha - The maximum loose surface Alpha contamination on the surface of the package. If less than 22 dpm/100 cm<sup>2</sup>, may be entered as < 22.
- 30) dpm/100 cm<sup>2</sup> Beta-Gamma - The maximum loose surface Beta-Gamma contamination on the surface of the package. If less than 220 dpm/100 cm<sup>2</sup>, may be entered as < 220.

- 31) Label - Enter: Radioactive LSA - No Label Required
- 32) The signature of the KU representative.
- 33) Date - The date the certification is made.

2. Waste Classification (Provisions of 10 CFR 61)

The criteria for waste classification for low-level waste disposal is contained in 10 CFR 61. The significant radionuclides generated as a result of neutron activation are shown in Table 3-4. In addition the KUTR contains a very small quantity of stainless steel, present in components such as grid support plate bolts. It is concluded that the radioactive wastes from the KUTR can be classified as Class A. Class A wastes do not need to be segregated for disposal, providing they meet the stability criteria described in paragraph 61.56 of the regulation (i.e., wastes do not structurally degrade and affect the overall stability of the disposal site through lumping, collapse, etc). The type of waste container to be used to package the LSA materials is a 4' x 4' x 6', B-25 (96 ft<sup>3</sup>) and the estimated volume of LSA materials to be generated including packaging is listed in Table 3-3 in Section 3.3.2.

The radioactive waste from the KUTR decommissioning will meet these criteria because they will be in solid form (aluminum liner, concrete and other metal components). To further comply with the regulations, the containers will be filled so that voids will be kept to a minimum for ensuring structural stability when overburdened or when other packages are placed over them. The estimated waste volumes include packaging (4' x 4' x 6', B-25 container, 96 ft<sup>3</sup>) are listed in Section 3.3.2.

The activity concentrations of the aluminum liner, concrete and other metal components waste that are activated can be found in Section 3.1.2.

Table 3-4  
Isotopes Potentially Present at the KUTR and Their Principal  
 Decay Characteristics

<u>Isotope</u>	<u>Half-Life</u>	<u>Decay Mode</u>
C-14	5730 y	$\beta^-$
Mn-54	303 d	EC <sup>(a)</sup> , $\gamma$
Fe-59	45d	$\beta^-$ , $\gamma$
Co-57	270 d	EC, $\gamma$
Co-58	71.3 d	$\beta^+$ , EC, $\gamma$
Ni-59	7.5x10 <sup>4</sup> y	EC, $\gamma$
Co-60	5.26 y	$\beta^-$ , $\gamma$
Ni-63	92 y	$\beta^-$ , $\gamma$
Cs-134	2.05 y	$\beta^-$ , $\gamma$
Cs-137	30.0y	$\beta^-$ , EC, $\gamma$
Ce-144	284 d	$\beta^-$ , EC, $\gamma$
Eu-152	12 y	$\beta^-$ , $\beta^+$ , EC, $\gamma$

<sup>(a)</sup>Electron Capture.

### 3.3.4 General Industrial Safety Program

The General Industrial Safety Program (GISP) for the decommissioning project shall pertain to and fulfill the requirements of the federal Occupational Safety and Health Administration (OSHA) as presented in 29CFR1910 (as revised) and the requirements imposed by the Decommissioning Contractor.

#### 3.3.4.1 General Provisions

All personnel shall comply with the requirements of this program for all DC work activities. Supervisory personnel shall be responsible for taking corrective actions concerning occupational health, safety, and environmental deficiencies resulting from their operations.

Deficiencies or violations which endanger "life" or "limb", as determined by the DC, shall be immediately corrected and work shall not proceed until such corrective measures are in place.

On a weekly basis, the Executive Engineer along with the DC shall perform safety inspections of the DC's operations and equipment to assure compliance with the requirements of this program and all applicable state, federal, local, and KU regulations. Documentation shall be maintained in a daily log book by the Executive Engineer and the DC for all safety and health inspections performed. Any safety violations will be identified, recorded in the log book and the corrective actions taken immediately. The following items will be specifically addressed during these weekly inspections as a minimum:

1. Integrity of CCE's
2. Proper Maintenance of Step-Off-Pads
3. HEPA Performance
4. Radwaste Packaging
5. Air Monitor Performance
6. Radiation Work Permits
7. Hearing Protection
8. Barricades
9. Safety Signs
10. Scaffolds
11. Tripping Hazards
12. Storage of Combustible Materials
13. Lifting Devices

#### 3.3.4.2 Industrial Hygiene Requirements

All work performed under the DC supervision shall ensure that personnel exposures to toxic or harmful physical agents do not exceed the limits specified by (1) subpart Z of 29CFR 1910,

or (2) the current threshold limiting values of the American Conference of Governmental Industrial Hygienists (ACGIH).

Personnel may be required to wear personal monitoring devices in order to assure compliance with the above. All such devices shall be supplied and maintained by the DC.

#### 3.3.4.3 Medical Surveillance Program

The Medical Surveillance Program is established for all workers who may be occupationally exposed to radiological or hazardous chemical agents and is implemented by the DC. A baseline health assessment shall be completed for each individual worker by a licensed Medical Doctor. The baseline health assessment shall include the following:

1. Pre-deployment medical examination, including pulmonary adequacy and audiometric response
2. Up-to-date Form 4 occupational radiation exposure history
3. Pre-deployment Bioassay

After completion of the project, post-performance bioassay and post-performance audiometric response tests will be required.

Personnel health assessment records shall be maintained on file with the DC site Radiation Protection Department and shall be maintained in accordance with federal requirements for inclusion of exposure data, including appropriate update frequency and access privileges. These records are available for inspection by KU and the Executive Engineer at any time and become the property of KU upon completion and termination of the project.

Non-routine medical treatment or emergency medical treatment shall be performed at the nearest and most convenient location including on-site facilities if available. Off-site medical treatment of personnel shall be performed at a facility licensed to handle such cases, for example a hospital or emergency clinic. In cases of personnel injury transportation shall be of the most expeditious available, for example, private automobile or ambulance service.

The worksite shall be monitored for health hazards associated with the work environment, including chemicals that may be present in liquid, dust, fume, mist, vapor, or gaseous forms. Physical hazards such as noise, pressure, vibration, and illumination shall also be monitored and controlled.

#### 3.3.4.4 Hearing Conservation Program

The hearing conservation program shall apply to all workers who are exposed to noise levels of 85 dB(A) or greater (as an 8-hour, time-weighted average exposure). This program will include:

1. Noise monitoring in areas where the levels exceed 80 dB(A)
2. Audiometric testing for all workers (as part of the medical surveillance program) to determine baseline hearing performance before exposure and test results after exposure
3. Personnel training and education
4. Recordkeeping
5. Hearing protection devices

Personnel assigned tasks in known noise-hazardous areas  $\geq 90$  dB(A) shall be enrolled in the hearing conservation program prior to beginning of work. Other personnel may be required to participate after monitoring reveals that their 8-hour, time weighted average exposure exceeds 85 dB(A).

Noise control measures, including the requirement to wear hearing protection equipment, shall be determined by the DC after appropriate noise monitoring is completed throughout Burt Hall and the immediate area surrounding the facility.

Records shall be maintained that document the following:

1. All noise monitoring conducted
2. Employee training
3. Control measures implemented
4. Protective equipment issued.

#### 3.3.4.5 Respiratory Protection Program

The Respiratory Protection Program shall be written in compliance with ANSI 2-88.2, NRC Regulatory Guide 8.15, IOCFR20.103 and OSHA requirements.

The guidelines governing the Respiratory Protection Program shall include the following:

1. Written standard operating procedures governing and use of respirators
2. Assignment of responsibilities
3. Types of records
4. Training of employees and supervisors
5. Qualitative testing
6. Work area surveillance
7. Medical surveillance
8. Special respirator use problems and limitations
9. Maintenance and repair of respirators

All respirator protection equipment utilized shall meet the requirements of Mine Safety and Health Administration (MSHA) and or National Institute for Occupational Safety and Health (NIOSH) approved respiratory protection equipment.

All respiratory protection equipment shall be stored and maintained such that it is protected from outside contamination and damage, and routinely inspected.

#### 3.3.5 Basic Safe Practices

Basic safe practice is the responsibility of each individual worker. The DC shall provide the tools and equipment necessary to provide the workers with a safe work environment to perform the different decommissioning tasks.

#### 3.3.5.1 Fire Protection

Fire protection devices such as portable Type A and B/C fire extinguishers shall be made available by the DC in key locations of the Reactor Room to serve the various cutting stations and decommissioning activities.

Flammable and combustible liquids in quantities greater than one gallon shall be kept in approved metal safety cans. An approved safety can is one which is approved by Factory Mutual or Underwriters Laboratory.

Combustible material quantities shall be kept at a practical minimum and combustible products shall not be allowed to accumulate to the extent of creating a fire hazard as determined by the DC. All flammable materials shall be stored a minimum of ten feet from all buildings in a neat and orderly manner in an area designated by KU.

#### 3.3.5.2 Tools and Equipment

All tools and equipment shall be in good condition for use during decommissioning activities. Wheels, belts, cutters, etc., shall be properly guarded and abrasive wheels and rotating blades shall not be operated in excess of manufacturer's rated or recommended speeds. Scaffolding, rigging and staging shall be inspected and conform to the applicable sections of 29CFR1910 and 29CFR1926.

#### 3.3.5.3 Hoisting Devices

The Hoisting Devices used by the DC for decommissioning activities (including KU's fuel handling monorail hoist) shall comply with the applicable manufacturer's specifications and limitations applicable to equipment operation. Hoisting loads, operating speeds, and special hazard warnings shall be adhered to along with applicable OSHA requirements.

#### 3.3.5.4 Personal Protection

All safety equipment and apparel shall be furnished by the Decommissioning Contractor. Personnel are required to wear head protection equipment (hardhats, helmets) when there is a possible danger of head injury from impact, flying or falling objects, or electrical shock and burns. Hardhats/helmets (i.e., MSA or equivalent for Rad Con work) shall be worn in any area where personnel are working off ground level on a ladder, platform, lift or any such device. This requirement shall apply to all personnel within an area identified and posted as a hardhat area by the Decommissioning Contractor.

Hardhats/helmets for protection against the impact of falling objects shall meet the requirements of ANSI Z89.1, Safety Requirements for Industrial Head Protection, latest edition.

Approved eye and face protection meeting the requirements of ANSI Standard 487.1 shall be worn whenever machines or operations present potential eye or face injury from physical or chemical agents.

### 3.4 Accident Analyses

Since all nuclear fuel has previously been shipped off site and since the residual radioactive inventory is very small, there is negligible probability for an accident to occur that could significantly affect occupational or public health and safety during decommissioning activities.

## CHAPTER 4

### 4. PROPOSED FINAL RADIATION SURVEY PLAN

#### 4.1 Introduction

A final radiation survey of the facility under NRC jurisdiction will be conducted in order to ensure that the DECON area satisfies the unrestricted release criteria for radioactive material.

The final radiation survey will be conducted after all other decommissioning activities have been completed.

The detailed plan for the final radiation survey will depend on:

1. The details of the dismantling/decontamination process
2. The results of radiation surveys during that process
3. The radiological history and other specific characteristics of the KUTR facility
4. The results of the preliminary survey

#### 4.2 Preliminary Survey

As stated in NUREG/CR-2082 a brief preliminary radiation survey will be made in order to formulate plans for an efficient, comprehensive survey. Before designing the preliminary survey, decisions will be made concerning logical divisions of the KUTR room. A minimum number of 30 measurements will be made in each survey unit, and each survey unit should cover an area of at most 30 m<sup>2</sup>. Dimensions of the survey units will be obtained so that a scaled drawing of each unit can be prepared prior to the termination radiation survey. The KUTR site has been under a periodic survey program and indoor radiation and contamination surveys during operation. Because of this data base, current survey data may be incorporated into the preliminary survey data if it meets the criteria of NUREG/CR-2082. The preliminary survey ensures the presence of grid markers for locating and recording preliminary measurements. The preliminary survey will aid in deciding how to sample the site; that is, whether by random sampling, stratified random sampling, systematic sampling, or other methods.

#### 4.3 Final Survey Procedures

##### 4.3.1 Building Survey

As stated in NUREG/CR-2082 for the final radiation survey, each survey unit is divided into two subunits: (1) lower surfaces comprised of floor surfaces, wall surfaces up to a height of 2 m, and any other surface easily accessible to a surveyor standing on the floor; and (2) overhead surfaces comprised of ceiling surfaces, wall surfaces more than 2 m above the floor, and all other surfaces not described in (1). A HEPA unit will be installed in the existing reactor room ventilation system to maintain a negative pressure in the room. This system will serve as a secondary CCE to eliminate the possibility of release of airborne radioactive materials to the atmosphere (in case of a failure of the CCE over the reactor tank during decommissioning activities). The internal surface of the existing reactor room ventilation system will be surveyed for internal contamination up to and including the ventilation exhaust to the atmosphere.

The floors and lower walls will be divided by a rectangular grid system such as that shown in Figure 4-1. The smaller blocks formed in this manner are referred to as "survey blocks," and the corners of the survey blocks are called "grid points." The choice of the particular grid system is guided by the following rules:

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The floors and lower walls will be divided by a rectangular grid system such as that shown in Figure 4-1. The smaller blocks formed in this manner are referred to as "survey blocks," and the corners of the survey blocks are called "grid points." The choice of the particular grid system is guided by the following rules:

1. No survey block should measure less than 1 m on a side. Survey blocks of less than 1 m on a side would require an impractically large number of measurements in the buildings.
2. No survey block should measure more than 3 m on a side. Survey blocks larger than 3 m on a side could lead to large uncertainties as to the precise location of the contamination.
3. There should be at least 30 blocks in the population according to the equation 3.1 in NUREG/CR-2082.

The radiological conditions to be characterized on the lower surfaces include alpha contamination levels (by direct reading), beta-gamma dose rates at 1 cm above the surface, external gamma radiation levels at 1 m above the floor, and removable alpha and beta contamination levels.

At 1 m above the center of each survey block, the external gamma radiation level is measured. At the surface in each survey block, five direct measurements each of alpha contamination levels, beta-gamma dose rates, and gamma radiation levels will be made at uniformly spaced points in a 1 m<sup>2</sup> area in the center of the survey blocks as shown in Figure 4-2. (If the entire survey block has an area of approximately 1 m<sup>2</sup>, then the "corner" measurements shown in the 1 m<sup>2</sup> area in Figure 4-2 are moved 30 cm toward the center of the block.) For each type of measurement, the average value and the local variability in this 1 m<sup>2</sup> area can be estimated. For an area of only 1 m<sup>2</sup>, five alpha or beta-gamma measurements will be used to yield an estimate of the average in that area. The survey block is next scanned with a G-M meter (open window), the point showing where the maximum reading (if any) is located; and each type of measurement (including smear samples of measurements of transferable alpha and beta contamination levels) is made at this "beta-gamma maximum point."

The manner of data recording for a building survey is illustrated by the headings in Table 4-1. The following minimum data are needed:

1. Survey block numbers, identifiable on a scale drawing, and
  - a) the building name or number;
  - b) the building floor number;
  - c) the surfaces surveyed;
  - d) types of measurements and the units (dpm/100 cm<sup>2</sup>, millirad/h, and/or R/h; mGy/h and microGy/h).
2. Name of surveyor taking measurements, date of survey, location data relative to the grid coordinates, and log book pages for original data
3. Surface smears, plaster chips, etc., taken, and the indoor block number from where they were taken, the container number, and whether matched to any air readings
4. Type, model number, calibration data, sensitivity limit, and any other information needed about the portable survey instruments to interpret the data obtained with these instruments and to ensure quality control on the data so obtained
5. When the block surveyed is below the sensitivity of the instrument, the fact that such a measurement was made will be included as a significant datum

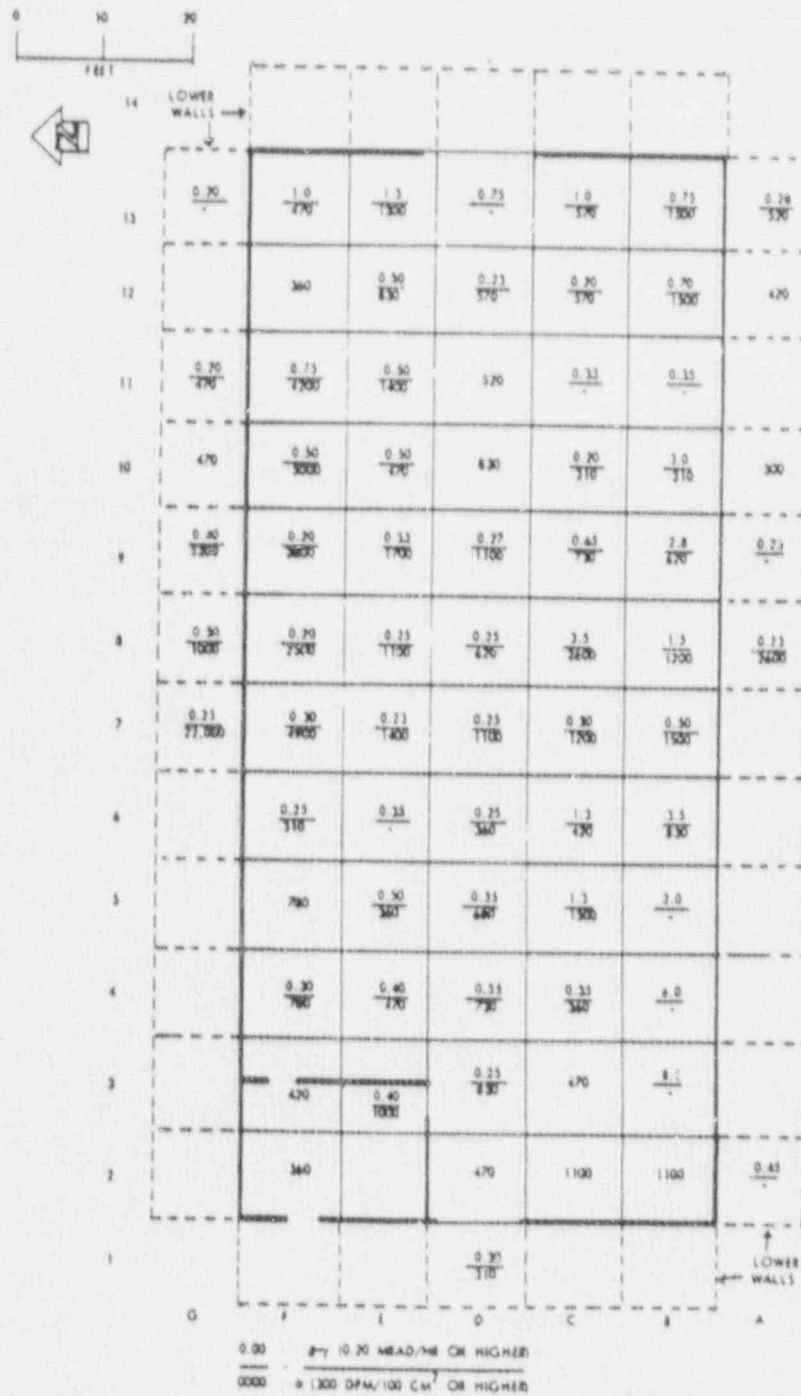


Figure 4-1  
(See NUREG/CR-2082)  
Measurement Made in a Typical Survey Block

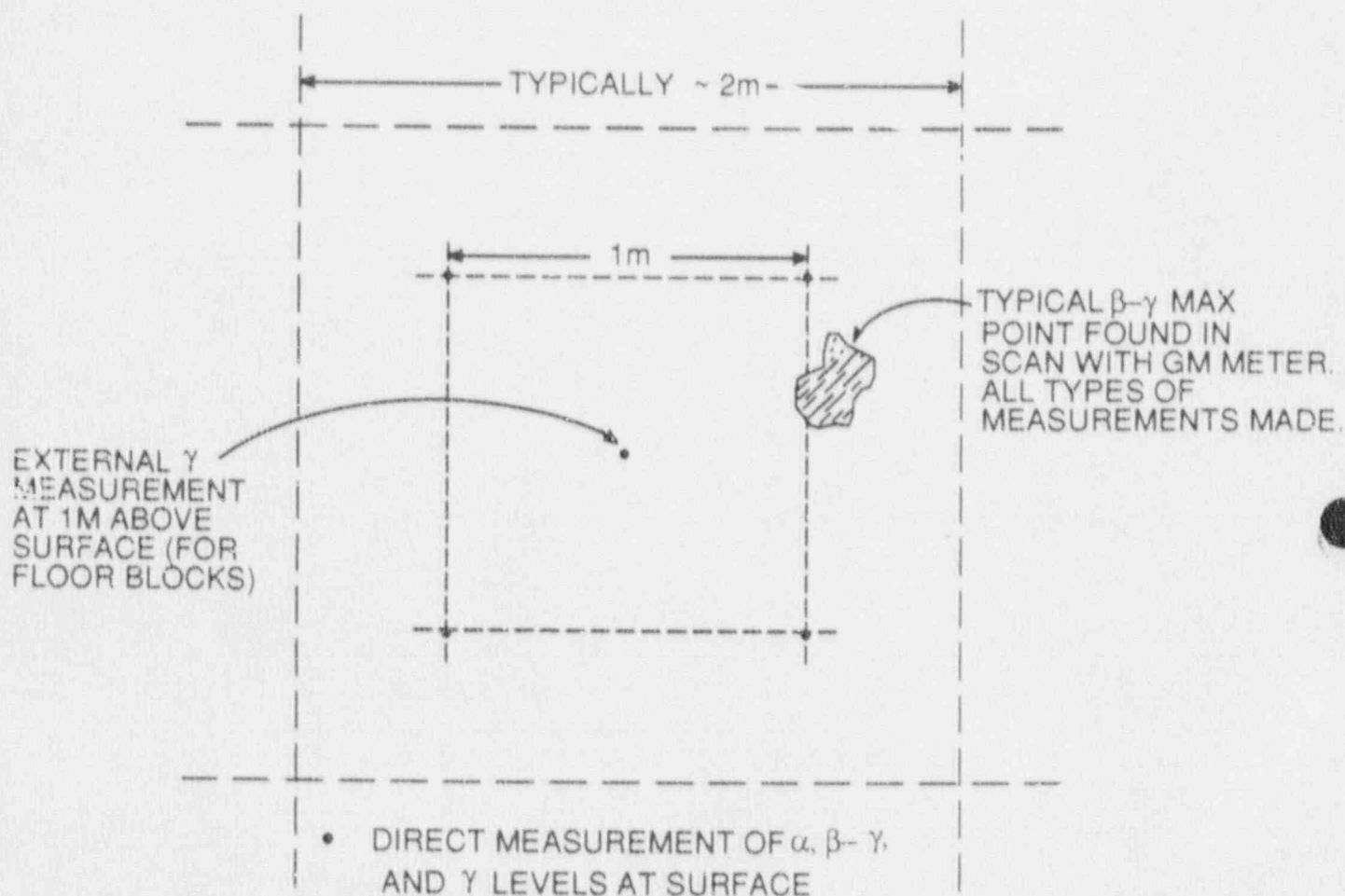


Figure 4-2  
(See NUREG/CR-2082)  
Example of Maximum Observed Beta-Gamma Dose  
Rate and Direct Measurement of  $\alpha$ ,  $\beta$ - $\gamma$  and  $\gamma$  Levels In a Survey Block

Table 4-1 (See NUREG/CR-2082)

Alpha, Beta-Gamma, and External Radiation Levels  
in KUTR Room, Burt Hall, Including Floor and Lower  
Wall Surfaces

Survey block	Directly measured contamination at center of block		Directly measured contamination surface at maximum beta-gamma point		External gamma radiation level 1 m above floor (R/hr)
	Alpha (dpm/100 cm <sup>2</sup> )	Beta-gamma dose rate at 1 cm (millirad/hr)	Alpha (dpm/100 cm <sup>2</sup> )	Beta-gamma dose rate at 1 cm (millirad/hr)	
A 2	100	0.05	100	0.45	NA <sup>a</sup>
3	100	0.08	NR <sup>b</sup>	0.08	NA
4	200	0.13	NR	0.13	NA
5	210	0.13	NR	0.13	NA
6	50	0.13	NR	0.13	NA
7	160	0.05	NR	0.10	NA
8	220	0.15	270	0.23	NA
9	100	0.15	210	0.23	NA
10	210	0.15	NR	0.15	NA
11	100	0.15	NR	0.15	NA
12	120	0.15	NR	0.15	NA
13	120	0.28	120	0.28	NA
B 1	210	0.05	NR	0.05	NA
2	150	0.10	270	0.10	40
3	160	0.10	160	8.5	35
4	220	0.18	260	6.0	45
5	260	1.8	160	2.0	40
6	210	0.10	280	3.5	50
7	150	0.35	90	0.50	75
8	280	0.25	210	1.5	70
9	160	0.30	160	2.8	100
10	290	0.25	240	3.0	130
11	260	0.25	210	0.35	120
12	150	0.20	110	0.70	130
13	100	0.60	150	0.75	220
14	160	0.15	NR	0.15	NA
C 1	50	0.05	NR	0.05	NA
2	110	0.09	NR	0.09	35
3	170	0.08	NR	0.15	40
4	110	0.13	140	0.35	60
5	120	0.15	130	1.3	80
6	120	0.13	290	1.3	75
7	140	0.13	80	0.30	70
8	220	0.30	280	3.5	50
9	260	0.08	200	0.65	55
10	110	0.11	270	0.20	55
11	210	0.15	260	0.33	90
12	170	0.15	100	0.20	85
13	170	0.40	210	1.0	170

<sup>a</sup>NA = not applicable    <sup>b</sup>NR = no reading taken

#### 4.3.2 Instrumentation and Methods for Contaminated Surface Surveys

As stated in NUREG/CR-2082, determining instrumentation to be used in the decommissioning activities, isotopes of concern must be identified. Those isotopes that may be present as contamination are listed in Table 3-4 in Section 3.3.3. The instruments to be used in the radiation surveys will be selected on the basis of the type and level of radiation anticipated as a result of reviewing KUTR historical data, the decontamination process, and the results of the preliminary survey.

Both the direct and indirect (wipe) monitoring methods will be used to obtain a complete assessment of the surfaces being examined during the termination survey. For direct methods of surface monitoring, the scanning speed will be slow enough to ensure a source detection probability of at least 50%. When surface activity is detected, the probe will be held stationary for a quantitative measurement and the instrument reading will be averaged over 100 cm<sup>2</sup> and compared to Table 1 of NRC Regulatory Guide 1.86 for final disposition of the area being surveyed.

The amount of removable radioactive material will be determined by wiping representative portions of the surface being surveyed with soft absorbent material and applying uniform moderate pressure. Efforts should be made to standardize, as much as practical, the procedure for taking the wipe.

Instrument Selection - The instruments used for direct and indirect monitoring of surface contamination will be capable of measuring surface activity at the guide levels specified in Table 1 of NRC Regulatory Guide 1.86. Instruments will be tested and calibrated in accordance with the specifications contained in the American National Standard, "Radiation Protection Instrumentation Test and Calibration," ANSI N323-1977, or the most recent revision.

Table 4-2 lists the detection capabilities of the various types of survey instruments that could be used to support decommissioning activities.

#### 4.3.3 Documentation

As stated in NUREG/CR-2082, proper documentation of every aspect of the program is necessary for future reference to the decommissioning survey. The DC shall maintain an accurate mapping of the reactor room and surrounding area within this decommissioning project for future review and verification by a regulatory inspector.

Instrument measurements and analytical results will include the following data:

1. Location of the measurement or sample
2. Date or dates of measurements or sample collection
3. Measured concentration of the specific nuclides in pCi/m<sup>3</sup> or mBq/m<sup>3</sup> for air samples; pCi/g or mBq/g for soil samples
4. Analytical error at 95% confidence level should be reported for all analyses

Table 4-2  
 Typical Minimum Detection Capabilities for Various Survey Instruments

Surface Types	Nuclide	Instrument or Method	Detection Levels
Soil	Gross Alpha	ZnS scintillator	$\geq 10^2$ pCi/cm <sup>2</sup> , source dependent
	Gross Beta-gamma	Thin-walled, shielded Pancake G-M	500 – 5,000 pCi/cm <sup>2</sup> , E <sub>max</sub> $\geq$ 0.15 MeV
		NaI detector	500 – 5 x 10 <sup>5</sup> pCi/cm <sup>2</sup>
		Ion chamber/micro Rem meter	$\geq 10^3$ pCi/cm <sup>2</sup>
Facility walls, floors, equipment	Gross Alpha	ZnS scintillator	$\geq 100$ pCi/cm <sup>2</sup>
		Thin NaI or CaF <sub>2</sub>	$\geq 30$ pCi/cm <sup>2</sup> , for alpha delay x-rays
		Proportional chamber	$\geq 50$ pCi/cm <sup>2</sup> very slow scan on surface
	Gross Beta-gamma	Thin-walled, shielded G-M	$\geq 30$ pCi/cm <sup>2</sup> $\geq 1$ mg/cm <sup>2</sup>
		NaI	$\geq 500$ pCi/cm <sup>2</sup>
		Pressurized ion chamber	50 – 50,000 pCi/cm <sup>2</sup>
		Air ionization chamber	500 – 5,000 pCi/cm <sup>2</sup>
		Intrinsic germanium	30 – 3,000 pCi/cm <sup>2</sup>

5. Name of surveyor, sampler, or analyst
6. Analysis date
7. Instrument specifications and calibration data
8. Confidence level, standard error, etc. attached to analytical results
9. Name of person verifying results

The actual net measured values (including negative values) and their associated errors will be reported. For values lower than the lower limit of detection (LLD), the LLD will be provided. Whenever possible, values lower than the LLD will be reported in the following manner:

Example (See NUREG/CR-2082):

$11.1 \pm 18.5$  pCi/L or mBq/L or  $7.4 \pm 18.5$  pCi/g or mBq/g.

The following supplemental information will be included with the radiation measurements and analytical results report for inclusion in the final report:

1. Description of survey and sampling equipment
2. Survey and sampling procedures, including sampling times, rates, and volumes
3. Analytical procedures
4. Calculation methods
5. Calculation of the lower limit of detection
6. Calibration procedures
7. Discussion of the program for ensuring the quality of results

The data will be presented so that the radiological condition of the site is completely and accurately depicted and the radiological condition of the site can be ascertained without further analysis and manipulation of the data.

A report will be written and submitted to the NRC on the Final Radiation Survey as required by NRC Regulatory Guide 1.86. The report will include a description of the survey methods, instruments, analyses, and an evaluation of the results.

## CHAPTER 5

### 5. UPDATED COST ESTIMATE AND PLAN FOR ASSURING AVAILABILITY OF FUNDS

#### 5.1 Cost Estimate Summary Including Assumptions

The estimated cost for performing the decommissioning of the KUTR is approximately \$490,000 as shown in Table 5-1. In general, the work consists of removing the aluminum reactor tank, floor, reactor box, divider plate, chamber pockets and all activated & contaminated concrete from shield structure, and shipping the debris to a nuclear waste disposal facility. The estimate is broken down into the specific tasks, described in detail in Section 2.2. The basis of the estimate is as follows:

1. Labor and Burden – Union labor rates (1990) for Topeka, Kansas were used.
2. Equipment Usage – Equipment usage includes rental and operating cost of construction equipment. It also includes power tools, scaffolding, and consumables such as drill bits, concrete saw blades, etc.
3. Material – Consumable materials prices are based on available data and vendor quotes.
4. Subcontract – Subcontract costs were estimated for:
  - Medical Examinations
  - Laboratory Isotopic Analyses
  - Laboratory Bioassays
  - Transportation of Radioactive Materials to
  - U.S. Ecology's Handford, WA Burial
  - Facility
5. Labor, Equipment, and Consumables Costs – Decommissioning Contractor's Overhead and Profit included the following markups:
  - 15% On Craft Labor and Burden
  - 15% On Purchased Equipment
  - 15% On Rental Equipment
  - 15% On Purchased Consumables

Table 5-1  
UNIVERSITY OF KANSAS  
RESEARCH REACTOR DECOMMISSIONING COST ESTIMATE

<u>ACTIVITY</u>	<u>COST</u>
<u>Contractor Pre-Deployment Phase I:</u>	
1.0 Material Analysis	KU
2.0 Decommissioning Plan Preparation	KU
3.0 Achieve Decommissioning Order	KU
4.0 Preparation of Documents	\$36,000
<u>Contractor Post-Deployment Phase II:</u>	
1.0 Site Mobilization	
1.1 Travel In	\$1,700
1.2 Mobilize Equipment	\$7,200
1.3 General Employee Training (GET)	\$6,200
2.0 Confirmatory Radiation Survey	Included in DC Staff Costs
3.0 Set Up Work Areas	
3.1 Staff Office	Included in DC Staff Costs
3.2 Storage Area	\$400
3.3 Anti-C Change Room Facility	\$3,300
3.4 install Temporary Power Service	\$1,300
3.5 Construct CCE Over Reactor Tank	\$4,500
3.6 Modify Reactor Room Existing HVAC	\$7,800
4.0 Decontaminate Equipment Prior to Removal	\$400
5.0 Removal of Activated Material and Components	
5.1 Setup and Test Cutting Equipment	\$8,900
5.2 Setup cutting Station	\$6,700
5.3 Remove Thermal Column Door and Remaining Blocks	\$8,900
5.4 Construct CCE Door at Thermal Column Opening	\$1,700
5.5 Install HEPA at Thermal Column Door	\$2,600
5.6 Segment, Remove and Package Aluminum Tank, Floor, Reactor Box, Divider Plant and Chamber Pockets	\$20,000

Table 5-1 (Cont.)

<u>ACTIVITY</u>	<u>COST</u>
5.7 Remove, Segment and Package	
5.7.1 Core Bore Beam Tubes	\$3,000
5.7.2 Pneumatic Tube Assembly	\$600
5.7.3 Thermal Column Lining	\$13,000
6.0 Setup Lower Tank Region Transport Cart for Waste Material Egress Through Thermal Column Opening	\$2,400
7.0 Remove Activated Concrete	
7.1 Breakup, Remove and Package Activated/Contaminated Concrete from Walls and Floor	\$37,500
7.2 Cleanup and Decontaminate Tank Region	\$400
8.0 Perform Confirmatory Survey of Drain to Holding Tank	\$300
9.0 Perform final Radiation Survey	Included in DC Staff Costs
10.0 Cut, Package, Ship and dispose of Activated/ Contaminated Materials and Components	\$23,100
11.0 Prepare Final Decommissioning Report	Included in DC Staff Costs
12.0 Final Site Cleanup	\$800
13.0 Site Demobilization	\$4,000
Undistributed Cost - Phase I and II =	<u>\$242,800</u>
Sub--Total Cost =	\$445,500
+ Contingency (10%) =	\$44,500
Total Cost Phase I and II =	<u>\$490,000</u>

6. Undistributed Costs – Includes the following:
  - Executive Engineer's Labor, Per Diem, Rental Car and Airfare
  - Decommissioning Contractor's Staff Plus Per Diem and Rental Car
  - 15% On Purchased Health Physics Supplies and Equipment
  - 15% On Small Tools Purchased
7. Contingency – A 10% contingency is recommended and is included in this estimate.

## 5.2 Assumptions

Assumptions used in this estimate are listed below:

1. The University of Kansas will contract an Executive Engineer to represent KU and assist the Reactor Director with the functions described in Section 2.3.
2. The DC will have access to the use of the fuel handling hoist.
3. All spent fuel is already disposed of by others.
4. Free power and utilities will be made available to the DC.
5. The nuclear waste disposal fee used in this estimate is \$72.11/ft<sup>3</sup> in 1990 dollars for U.S. Ecology's Hanford, WA Burial Facility.
6. Sufficient trailer, storage and parking space will be provided by KU near Burt Hall.
7. The decommissioning will be carried out continuously from start to completion.
8. The DC will have unrestricted and unencumbered access to Burt Hall & the Reactor Room.

## 5.3 Availability of Funds

The State of Kansas is committed to providing the funding for this dismantlement program.

## CHAPTER 6

### 6. TECHNICAL AND ENVIRONMENTAL SPECIFICATIONS IN PLACE DURING DECOMMISSIONING

The University of Kansas (KU) has previously submitted a letter of application for amendment No. 15 dated September 23, 1986, addressed to the NRC pursuant to 10 CFR 50.90, for changing the status of KU's operating license No. R-78, Docket No. 50-148 to a "possession only" status. The letter included a copy of The University of Kansas proposed changes to their Technical Specifications to support the KU amendment change to a "possession only" status. The NRC sent a letter in response dated January 28, 1987 converting the KU operating license to a "possession only" status in accordance with the KUTR Technical Specifications. Therefore, the same Technical Specifications will be in place and adhered to during the decommissioning activities.

## CHAPTER 7

### 7. QUALITY ASSURANCE PROVISIONS IN PLACE DURING DECOMMISSIONING

The Decommissioning Contractor (DC) will be chartered with the responsibility of performing the preparatory engineering, decommissioning work, waste packaging and disposal and final radiation survey. The DC will be required to perform his own radiological control program and quality assurance program. However, the University of Kansas will conduct its own overcheck of the DC's programs to ensure that the work is performed in a safe and controlled manner.

#### 7.1 Organization

The DC is responsible for implementation of his own QA and radiological program. The DC will be responsible for his personnel to adhere with the written procedures or DC will stop the work activities. The KU Reactor Director will conduct his own overcheck of the DC's QA and radiological programs to ensure that the work is performed in a safe and controlled manner. The Reactor Director may delegate these overchecks of the DC to the Executive Engineer or a designate to verify procedural compliance.

The procedures for the KUTR decommissioning plan activities will be written by the DC, and will be reviewed by the KU Reactor Committee and the Executive Engineer.

Responsibility for the Reactor Facility is within the chain of command shown in the organizational chart in Figure 2-2 in Section 2.3.

#### 7.2 Quality Assurance Program

##### 7.2.1 Scope

The Decommissioning Contractor will be responsible for preparing and implementing the following documents for the Quality Assurance Program applicable to the DC's workscope for controlling the decontamination and decommissioning of the KUTR:

1. Quality Assurance Manual
2. Radiological Control Procedures
  - Radiation Work Permit Procedure
  - Surface Contamination Control Survey Procedure
  - Airborne Radioactivity Control Procedure
  - Calibration & Maintenance of Survey Instruments Procedure
  - Radioactive Check Source Accountability Procedure
3. Radioactive Waste Procedures
  - Radioactive Waste Packaging Procedure
  - Handling, Storage and Shipping of Radioactive Materials Procedure
  - Solidification of Radioactive Liquids Procedure
4. Health, Safety and Emergency Procedures
  - General Industrial Safety Procedure
  - Health and Safety Procedure

- Housekeeping Procedure
  - Emergency Action Procedure
  - Waste Transportation Emergency Procedure
5. Work Procedures
- Aluminum Tank Removal Procedure
  - Activated and Contaminated Concrete Removal Procedure
  - Removal of Beam Tubes and Pneumatic Tube Procedure
  - Surface Decontamination Procedure
  - Construction of Contamination Control Envelope (CCE) Procedure
  - Final Site Radiation Survey Procedure
  - Final Site Clean-up Procedure

#### 7.2.2 Decommissioning Contractors Quality Assurance Manual

The DC shall include the following information in his Quality Assurance Manual:

1. Responsibility and Scope
2. Organization
3. Documentation
4. Design Control
5. Procurement Control
6. Document Control
7. Material Control
8. Process Control
9. Inspection
10. Test Control
11. Control of Measuring and Testing Equipment
12. Corrective Action
13. Quality Assurance Records
14. Audits

#### 7.2.3 Applicability

This QA program is applicable during the performance of any decontamination and decommissioning activities through the completion of the DC's work scope and the project.

#### 7.2.4 Records and Reports

Accurate and complete records and reports shall be maintained by KU of the performance and completion of all activities which may result in exposure of workers or the public to radiation or other hazardous/toxic materials.

##### 1. Records

Records which will be maintained during DECON activities are listed below.

##### Health and Safety Related Activities:

- Radiation work permits
- Work procedures
- Radiation survey reports
- Contamination survey reports
- Airborne survey reports
- Environmental survey reports
- Counting data on air samples, smears, and gamma spectrum analysis
- Instrument calibrations
- Source inventory and storage
- Radioactive material inventory and storage
- Shipment records
- Waste disposal – surveys and records
- Package certifications/records
- Incidents and accidents

##### Personnel Records

- Bioassay analyses
- Personnel exposure records
- Individual dosimeter readings as related to daily tasks and work procedures
- Respiratory protection qualifications (medical clearance and fit test)
- Audiogram results
- Training records
- Visitor logs and exposure information

## 2. Reports

Reports pertaining to DECON activities shall be written and submitted to the proper authorities pursuant to Regulatory Guide 1.86.

### 7.2.5 Audits

Upon issuance of decommissioning activity procedures, the Decommissioning Contractor QA personnel will perform periodic audits prior to, during, and after decommissioning activities to ensure compliance with the requirements with this plan. The Executive Engineer or Reactor Director designee will perform an independent audit as an overcheck of the DC. The respective Audit programs will include but not be limited to:

#### The Decommissioning Contractor's Audit Program -

1. Review of DC's operating personnel health and safety training program
2. Review of DC's radiological control program including ventilation, instrument usage and calibration, personnel monitoring and area monitoring procedures
3. Review of DC's work procedures with regard to public health and safety and the principles of ALARA
4. Audit of contractor records including training, radiation surveys, instrument calibration and shipping data

#### The University of Kansas Audit Program -

1. Review of DC's operating personnel health and safety training program
2. Review of DC's radiological control program including ventilation, instrument usage and calibration, personnel monitoring and area monitoring procedures
3. Review of DC's work procedures with regard to public health and safety and the principles of ALARA
4. Audit of contractor records including training, radiation surveys, instrument calibration and shipping data
5. Independent check of area radiation levels and surface contamination levels
6. Approval chain of documentation to be submitted to NRC

## CHAPTER 8

### 8. PHYSICAL SECURITY PLAN PROVISIONS IN PLACE DURING DECOMMISSIONING

In the referenced letter from the NRC, addressed to The University of Kansas, dated January 28, 1987 in section 6 of this document, in the conclusion a statement is made by the NRC "The staff concludes that amendment of this license to a possession-only status is appropriate and that there is no longer any requirement to maintain implementation of the Physical Security Plan".

During decommissioning activities all accesses to the reactor room will be limited to those personnel required to perform the program. During off hours all entrances and exits to the reactor room will be locked.

In addition, each entrance will be posted to keep inadvertent access of personnel from entering the decommissioning work area.

## REFERENCES

1. C.F. Holoway, J.P. Witherspoon, H.W. Dickson, P.M. Lantz, and T. Wright, "Monitoring for Compliance With Decommissioning Termination Survey Criteria" (prepared for the Nuclear Regulatory Commission by Oak Ridge National Laboratory), NUREG/CR-2082 (ORNL/HASRD-95), July 1981.
2. U.S. Nuclear Regulatory Commission, "Termination of Operating Licenses for Nuclear Reactors," REGULATORY GUIDE 1.86, June 1974.
3. Code of Federal Regulations, "Standards for Protection Against Radiation," 10 CFR Part 20, Revised as of January 1990.
4. Code of Federal Regulations, "Licensing Requirements for Land Disposal of Radioactive Waste," 10 CFR Part 61, Revised as of January 1990.
5. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report related to the renewal of the operating license for the research reactor at the University of Kansas, Docket No. 50-148," NUREG-1051, (prepared by Office of Nuclear Reactor Regulation), May 1984.
6. Letter from Gene A. Budig, Chancellor, University of Kansas, to C.O. Thomas, Chief, USNRC, September 23, 1986, Application for Amendment No. 15 to The University of Kansas Facility Operating License No. R-78, Docket No. 50-148 for conversion of license to Possession-Only status.
7. Letter from Herbert N. Berkow, Director, USNRC, to Dr. Harold Rosson, Reactor Director, University of Kansas, November 6, 1986, NRC review of University of Kansas Possession-Only Amendment Application.
8. Letter from Dr. Harold F. Rosson, Reactor Director, University of Kansas, to Herbert N. Berkow, Director, USNRC, November 24, 1986, Responses to questions from the USNRC letter from Herbert N. Berkow, Director, USNRC, to Dr. Harold Rosson, Reactor Director, University of Kansas, November 6, 1986.
9. Letter from Frank J. Miraglia, Director, USNRC, to Dr. Harold Rosson, Reactor Director, University of Kansas, January 28, 1987, Issuance of Amendment No. 15 to Facility Operating License No. R-78, The University of Kansas - Conversion of License to Possession-Only Status.