Group C

FOIA/PA NO: 2014-0013

RECORDS BEING RELEASED IN PART

Pursuant to the requirements of Vaughn v. Rosen[1], the following types of information are being withheld:

Ex. 3: ☐ Information about the design, manufacture, or utilization of nuclear weapons
☐ Information about the protection or security of reactors and nuclear materials
☐ Contractor proposals not incorporated into a final contract with the NRC
☐ Other____

Ex. 4: ☐ Proprietary information provided by a submitter to the NRC
☐ Other____

Ex. 5: ☐ Draft documents (D.P. Privilege)
☒ Correspondence deliberating a proposed action (D.P. Privilege)
☐ Records prepared by counsel in anticipation of litigation (A.W.P. Privilege)
☐ Privileged communications between counsel and a client (A.C. Privilege)
☐ Other____

Ex. 6: ☐ Agency employee PII, including SSN, contact information, birthdates, etc.
☒ Third party PII, including names, phone numbers, or other identifying information

Ex. 7(A): ☐ Copies of ongoing investigation case files, exhibits, notes, ROI's, etc.
☐ Records that reference or are related to a separate ongoing investigation(s)

Ex. 7(C): ☐ Special Agent or other law enforcement PII
☒ PII of third parties referenced in records compiled for law enforcement purposes

Ex. 7(D): ☒ Witnesses' and Allegers' PII in law enforcement records
☐ Confidential Informant or law enforcement information provided by other entity

Ex. 7(E): ☐ Law Enforcement Technique/Procedure used for criminal investigations
☐ Technique or procedure used for security or prevention of criminal activity

Ex. 7(F): ☐ Information that could aid a terrorist or compromise security
☐ Retired Law Enforcement personnel
☐ Witnesses or unknown individuals who have participated in enforcement activity

Other/Comments: Outside Scope

[1] Vaughn v. Rosen, 484 F.2d 820, 827 (D.C. Cir. 1973), *cert. denied*, 415 U.S. 977 (1974); *See also, Mead Data Central, Inc. v. United States Department of the Air Force*, 566 F.2d 242, 251 (D.C. Cir. 1977) (encouraging agencies to provide requesters "with sufficient detail about the nature of the withheld documents and its exemption claims at the administrative level").

Curators of the University of Missouri
License No.: 24-00513-32
Docket No.: 030-02278

Project Management Determination Criteria

Providing regulatory oversight of decommissioning activities conducted by NRC licensees and former licensees is a joint effort shared by Headquarters and the Regions. In meeting this effort, Headquarters and the Regions share management responsibilities based on the complexity of the decommissioning activities.

NUREG-1757, *Consolidated Decommissioning Guidance*, states that the Regions normally have the lead for Group 1 and 2 sites and Headquarters has the lead for Group 4 to 7 sites. However, before assigning regulatory oversight for Group 3 sites, the Regions and Headquarters will discuss and agree on the appropriate lead office. Although very few sites fall into the Group 3 category, many sites are classified as a Group 4, and the Regions do occasionally project manage these sites. When these decisions are made for the Region to project manage a Group 3 or 4 decommissioning site, the decision is normally based on an ad hoc discussion between the Regional and Headquarters Branch Chiefs with input from staff and Division Directors.

To ensure a thorough and consistent approach when determining whether the Region should assume project management for a Group 3 or 4 decommissioning site, the following criteria should be considered in making that decision.

- Is this an active NRC Region III licensee requesting a partial site release that intends to retain its license? If so, the Region would normally project manage the decommissioning activities.

  Yes. The licensee is a broad scope licensee and has numerous other locations where licensed material is currently being used/stored.

- Have any EPA NRC MOU issues been identified? If so, Headquarters would normally project manage the decommissioning action.

  The licensee has not performed a full site characterization of the building and surrounding soils to determine if groundwater could be an issue. Specifically, the licensee has identified that there could be radiological contamination under the concrete pad of Pickard Hall and the licensee has not identified the extent of contamination nor potential ground water pathways.

  In a letter dated February 17, 2011 (ML110540477), the licensee stated *"There were two small areas of residual radioactivity in surface soils of outside grounds that were remediated and the buried sewer discharge from the building appears to contain elevated activity. There may also be subsurface soil contamination under the basement floor."* No additional characterization was performed to address the subsoil contamination.

C|1

Section 10 titled "Soil Removal" in a letter dated July 16, 2010 (ML102800311), the licensee stated *"Chase removed surface soils in outside grounds and in the steam tunnel feeder. The two elevated areas of surface soil activity identified during Phase 1 were remediated by hand to a depth of approximately one foot. Each excavation was surveyed after remediation, covered with a geotextile fabric to provide a clear interface, and then backfilled with soils provided by MU. The purpose of this remediation was to ensure normal landscaping activities such as thatching and aerating do not disturb soils with residual radioactivity. The steam tunnel feeder soil was removed in an area of 4' x 10' and a depth of approximately one foot. After soil removal, the area was covered with a geotextile fabric and pavers to provide a barrier from radioactive materials."*

Section 9.6.2 titled "Surface Soils" in a letter dated July 16, 2010 (ML102800311), the licensee stated *"Initially, surface soil samples were collected at four locations of elevated activity detected by gamma scans of outside grounds surrounding the building. Additionally, a soil sample was collected at the location of highest activity in the steam tunnel feeder adjacent to mechanical Room 15. Six background soil samples were collected in the Quadrangle. A map showing the locations of samples is provided in Appendix G9. All samples were analyzed by gamma spectroscopy at the contract laboratory. Gamma spectroscopy results were used to select a subset of three background samples and three soil samples for alpha spectroscopy analysis. After remediation of two discreet areas of surface soil contamination, GPS gamma scans were conducted of outside grounds surrounding Pickard Hall to provide better visualization of surface radiation levels. The information provided by the GPS survey provided input to the design of additional surface soil sampling locations. Nineteen additional samples were collected (two of the samples were a composite of four locations in the Quadrangle). The locations of surface soil samples are provided in Appendix G. Analytical results of soil samples are provided in Appendix 0."*

The above indicates that the licensee has identified radiological contamination of accessible and inaccessible and performed limited analysis and/or remediation to address the contamination.

During an NRC inspection, a document titled "A History of the Department of Chemistry University of Missouri-Columbia 1843-1975" contains information that around 1922 Herman Schlundt, Professor of Chemistry and Chairman of Chemistry Department, had established a semi-commercial laboratory at the University of Missouri to extract and purify salts of the radioactive elements from ores. It is NRC's understanding that this extraction process involved radium which now contaminates Pickard Hall and some soil in the surrounding area. The licensee has not determined the chemical composition of the radium contamination. A search of website <u>http://www.chemteam.info/Equations/Solubility-Table.html</u> notes that *"all alkali metal and alkaline earth (Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+}) sulfides are soluble."*

(b)(5)

- Does the site contain buried or mixed waste that will make remediation and disposal particularly challenging? If so, the site may be better project managed by Headquarters, depending on the type and quantity of contamination and/or mixed waste.

The licensee has not do a full characterization of ground contaminants. As found on web link:

http://www.chemistry.pomona.edu/Chemistry/periodic table/Elements/Radium/radium.htm
It states that radium "*...was first isolate by Marie Curie through the electrolysis of a radium chloride solution, using a mercury cathode. Upon distillation in an atmosphere of hydrogen, this amalgam yielded the pure metal!*" This would mean that the soil could potentially be contaminated with mercury making the disposal of soil a mixed waste issue.

However, it is reasonable to assume that chemicals used in the separation and processing of Ra salts also generated chemical contaminants which are in the soil under the building.

- o Is the company financially viable; does the Company have any financial instruments in-place; will a revised decommissioning funding plan be needed? If any outstanding financial issues exist that may impact the completion of the decommissioning, then the activities would normally be project managed by Headquarters.

  The licensee has stated that financial resources could be made available for decommissioning through the State of Missouri. No other issues have been identified.

- o Is groundwater contamination an issue? Due to the potential complexity in assessing and modeling radioactive contaminates in groundwater, these sites would normally be project managed by Headquarters.

  Based upon known soil contamination in the surrounding soil, unknown contamination and/or migration of contaminated soil under the building and the Ra was being processed and sold in a soluble form, (b)(5) (b)(5)

- o Is the decommissioning action expected to be completed in a reasonable timeframe, e.g., less than 1-1½ years? Decommissioning activities that can be completed in a timely manner, including the time for Decommissioning Plan (DP) review and approval, through the review and approval of the Final Status Survey, could reasonably be expected to be project managed by the Region.

  The licensee is requesting an indefinite Alternate Work Schedule for the issuance of the DP and decommissioning of the building because of the historical nature and valuable/irreplaceable items within the building that could be damaged during decommissioning. It is also expected that if decommissioning activities started immediately (soil contamination, highly inaccessible building areas, etc...), the timeframe involved would exceed 2 years.

- o Is this a site with a significant level of public or congressional interest? Sites that may require a high level of public outreach should normally be project managed by Headquarters.

  The site has not experienced significant public or congressional interest. However, the NRC held a public meeting on June 23, 2011 and type press, members of the public and workers in the building attended. There also have been two allegations directly related to the decommissioning of Pickard Hall in the last 12 months.

- o Does this site have any unique disposal issues? For example, is onsite mixing going to be employed, or is there a request for an optional disposal method under CFR 20.2002?

If retained by Region, appropriate TARS and QA of Regional work will be coordinated with HQ.

If significant quantities of soil contamination (mixed or non-mixed waste) are *found, it might be exceedingly difficult for the licensee to dispose of the soil via* standard disposal avenues.

- Are site specific DCGLs being generated or are the default screening values being used? If site specific DCGLs are derived, are the pathway analyses limited, e.g. direct exposure and or inhalation that have no groundwater impacts. If the screening values are selected for the DCGLs, or if simplistic modeling is used to develop site specific DCGLs, and the decommissioning action is for the release for unrestricted use, the Region would normally project manage the action.

  The licensee is not at the DCGL stage of decommissioning at this time.

Conclusion:

Due to the; 1) high potential for significant soil contamination; 2) (b)(5) (b)(5) 3) high potential for mixed waste; and 4) significant quantity of time involved in the decommissioning of the building, Region III recommends that HQ Project Manage the decommissioning of Pickard Hall with Regional inspections and additional assistance as needed.

(b)(6)

Senator Blunt.
1:30 [illegible] West side Pickard Hall, [illegible] (back side)
3:00 mtg. [illegible] auditorium & student union
[illegible] mtg.

CC large [illegible] OK call
FRN
CC IR [illegible]
[illegible] hire

Q. Can you explain, what the issue with Pickard Hall is?

Student / Staff / Public

Is decomm funding correct for Pickard Hall?

In November 2009, the NRC was notified that residual radioactivity from naturally occurring radioactive material had been identified in Pickard Hall from research and development activities from the 1900's. The NRC was notified since we gained regulatory authority over discrete sources of radium beginning in October of 2008 from the energy policy act. After the notification, the university began a characterization survey in December of 2009, which identified localized areas that contained residual radioactivity in excess of NRC release limits but determined that individuals in the building were not received radiation exposure over the NRC's public dose limits. The NRC conducted a reactive inspection in January 2010 and verified the university's dose assessments and survey results and ensured the university controls were adequate to protect public health and safety.

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ADAMS [illegible]
how to
feedback form
cards
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contact slide

Would we add a lic. condition req. the controls if approved?

Since Pickard Hall is building which does not use radioactive material under the university's NRC license, decommissioning timeliness rule apply. This rule requires licensees which need new procedures to remediate a building, to either submit a decommissioning plan within 1 year of notification and immediately begin decommissioning upon approval of that plan or submit an alternative schedule for decommissioning. We are here today to inform you that the NRC has received and is reviewing an alternative schedule request from the university to postpone decommissioning to a later date since the university has a NRC license and radiation protection program to keep building occupants and the public safe.

Q. What type of radioactive research was done in Pickard Hall? For how many years?

40 [illegible]
Nick help

The university's historical site assessment has identified the building was used for Radium-226 extraction and research of Thorium-232 daughters in the early 1900's, with activity ceasing in the 1930s. Since the type of research is difficult to determine due to the length of time that as passed, a larger scale survey was completed to identify all areas of the building with potential contamination.

Q. What contamination/isotopes are in Pickard Hall? Exactly where is the contamination? Is this publically available?

The residual radioactivity identified in the building is from radium-226 and thorium-232 and their associated decay chain daughters. The material has been found in localized areas throughout the building, mostly under floor tiles, walls, historic brick duct work, the attic, and a steam chase tunnel connected to the building. In addition to the building, very low levels of localized contamination were identified in the soil outside the building, but these areas have been remediated by a licensed service contractor. The licensee's full characterization survey can be located on the NRC website under access number ML102800579 in ADAMs search.

Q. Is Pickard hall safe for people to be in it? How/why is it safe?
Yes, Pickard Hall is under appropriate controls to ensure building occupants and the public's health and safety. The NRC initiated a reactive inspection on January 2010, which verified the university's conclusions that individuals in the building have not exceeded NRC's annual public dose limits under the conditions the building was found in. During this inspection and review of the characterization plan, the NRC verified the university has controls in place to ensure the public health and safety for continued use of the building.

C|2

Q. Is the building safe for the staff who works every day at the museum? What about visitors and students?

Yes, the building is safe to be in today under the controls established under the university license. The NRC conducted a reactive inspection in January 2010 and verified the building condition and university operational controls ensure all areas of the building are safe for the visitors, students, and workers. Additionally, monitoring of staff working in the basement over the past year has indicated an additional dose equal to approximately dosage one receives from consumption of natural radioactive material in food and water, or approximately 13 mrem per quarter. This is for below the NRC public annual dose limit of 100 mrem per year and is considered safe.

Q. What is/has the NRC done in response to this discovery of contamination?

Once the NRC became aware of the situation, they quickly contacted the licensee to ensure adequate controls and necessary surveys were being implemented to ensure the safety of the individuals working in the building and the public. In January 2010, the NRC initiated a reactive inspection to perform a confirmatory survey to verify the university's survey and observe the university's controls. The NRC has further reviewed the licensee's final characterization survey and is now in the process of reviewing the licensee's request to delay decommissioning. Documentation of these conversations and inspection reports may be found in ADAMs.

Q. Is radium dangerous?
Radium-226 is a radioactive material, which can be dangerous if appropriate radiation protection practices are not used and an individual is overexposed to the material. However, the radium located in Pickard Hall is localized and controlled under the university's license and NRC approved radiation protection procedures to ensure public health and safety.

Q. Have people been exposed to this contamination? What's been the exposure?

Low levels of residual radioactivity have been identified in occupied areas. The NRC verified the university's dose assessment completed in December 2010 which determined occupants of the building have not exceeded the NRC annual public dose limits in the buildings as found and current configuration. Additionally, monitoring of staff working in the basement over the past year has indicated exposures to the residual radioactivity are approximately the same equal as what one receives from consumption of natural radioactive material in food and water, or approximately 13 mrem per quarter.

Q. How does the NRC ensure people's working are safe?

NRC ensures the safety of workers by completing technical reviews of license applications and amendments to ensure adequate radiation protection policies and procedures are being proposed and conducting periodic safety inspections to ensure these procedures are being appropriately implemented to protect the safety of the workers and the public.

Q. When did the university put in safety protocols?

The university began implementing safety protocols when the material was identified as licensed material in November 2009 and the NRC verified the university protocols adequately protected the workers and the public during the reactive inspection in January 2010. The university's dose assessment conducted in December 2009 determined that individuals working in the building did not likely exceed NRC public dose limits with the building and the material in its as found configuration. The NRC has focused on the current and future safety of the workers and the public since the notification, specifically since the material was not under NRC authority in the State of Missouri prior to October 2008.

Q. Can you say people were safe in the building before the protocols were in place?
It is unlikely that anyone received a dose above the NRC's public dose limit due to the configuration of the building and the material as it was found. The NRC has verified the university's dose assessment conducted in December 2009, which determined that individuals working in the building did not likely exceed NRC public dose limits with the building and the material in its as found configuration. The NRC is focused on the current and future safety of the workers and public in the building since the notification, since the material was not under NRC authority in the State of Missouri prior to October 2008.

Q. What other buildings have radiological contamination? Are they safe?
The University maintains a NRC broadscope material license which authorizes the university to use of radioactive material for specific university activities as defined in the license in facilities around campus. The university's controls and radiation protection program to ensure safety have been approved by the NRC and are reviewed during periodic safety inspections.

In addition to Pickard Hall, another university building, Schweitzer Hall, is known to have been used in the early 1900s for similar type of research. NORM has been identified at Schweitzer Hall but university and NRC surveys indicate the building is also safe for use under the university's license. This building does not fall under the decommissioning timeliness rule since the building also contains a scientific laboratory which uses radioactive material under the NRC license.

Q. Why are we only learning about this contamination now? How did it go unknown for so long?

The radioactive material was used in the building at a time prior to knowledge that radiological material can be hazardous and regulations were put in place concerning its use. The NRC had determined during the reactive inspection in January 2009 that the university informed the NRC in a timely fashion when they became aware of the residual radioactivity in 2009. Since the NRC did not have regulatory authority of material prior to October 2008 in the State of Missouri, the NRC cannot speak to the history of the building, but can assure you that future regulatory decisions regarding the building will be conducted in an open forum including public involvement.

Q. Did the university conceal this information? Did the Univ. violate of NRC rules?

The NRC has no indications that the university concealed information regarding this building or violated any NRC regulations. The NRC had determined during the reactive inspection in January 2009 that the university informed the NRC in a timely fashion when they became aware of the residual radioactivity in 2009. Since the material was not under NRC regulatory authority until October 2008, prior university knowledge of the material would not have needed to have been reported.

Q. Why does the university want to change the date when they are supposed to submit their decommissioning plans?

I cannot speak to the reasons why the university wished for an alternative schedule, but NRC do have regulations which allows a licensee to submit an alternative schedule for decommissioning if conditions arise that make a different schedule necessary for the conduct of decommissioning, is in the public's interest, and facility does not present an undue risk to public health and safety. The university has submitted a request which provides justifications has to why Pickard Hall fits these criteria which the NRC will review to make a decision of whether an alternative schedule is allowed.

Q. What does the university's request state?

The university's license amendment request states that the building is currently in a safe condition and that the university will continue to conduct periodic surveys and control the building to ensure it stays in a safe condition. The request is asking for an alternative schedule based on the justification that the building is safe and that operation of the building would be affected during decommissioning and due to the educational, cultural, and historical value of the museum and building it would be in the public's best interest to postpone decommissioning.

Q. What do the university decommissioning plans call for?

The university wishes to use operational controls to ensure the building's occupants safety and compliance with the NRC regulations and postpone decommissioning until the museum and its artifacts can be moved to a new adequate location. The university's operational controls include restricting access to unnecessary rooms which contain residual radioactivity, monitoring the workers in the basement of pickard hall, instituting periodic surveys to ensure stable conditions, and restricted access to necessary personnel in elevated areas of residual radioactivity.

Q. Pickard is currently used as a museum? Does it need to be shutdown?

Currently, the museum does not need to be shutdown and is a safe area. There have been very low levels of residual radioactivity identified on the first and second floors of Pickard Hall, which if one were to stand in the area with the highest exposure for a total of 2000 hours it would equate to 1 medical x-ray or the a dose one receives from consuming average amounts of natural radiation in food and water.

However, if the university needs or decides to decommission, conditions in the building could change which could result in the need for the museum to shutdown.

Q. What about the museum artifacts? Are they contaminated?

There is no indication that any museum artifacts have been contaminated or that removable contamination is present near the artifacts. The building's contamination appears to be limited to underneath the floor boards or on concrete floors, in the walls, in the attic, or in the steam chase tunnel.

Q. What type of review will the NRC be doing? Please provide high level details. How long will it take?

We are conducting a full technical review of the licensee's request to ensure that the public and individuals working in the building will have adequate protection and that the university has adequate justification to postpone the decommissioning to a later date. To ensure that we have all necessary information, we may ask the licensee for more information to complete the review. The goal of the NRC is to complete reviews of requests of this nature within 1 year.

Q. What is Naturally Occurring Radioactive Material (NORM)?

Naturally Occurring Radioactive Material is radioactive material found in the environment, such as the earth's crust. Radium-226 is a natural material found in the earth's crust from natural decay of Uranium. By the Energy Policy Act of 2005, the NRC has gained regulatory authority over discrete sources of Radium-226, which is defined as produced, extracted, or converted after extraction for use for a commercial, medical, or research activity. The Radium-226 found in Pickard Hall is believed to be contamination from historic radium-226 extraction research, and therefore now falls under NRC regulatory authority.

Q. Who was responsible for this material before the NRC?

Prior to the NRC gaining regulatory authority over the material by the energy policy act of 2005, each state had different regulatory controls over the material. (The NRC will not comment on the States activities prior to 2008, or I would like to turn this question over to the state).

Q. Is this the first time a University has had to decommission a building? What have other universities done?

No, universities occasionally decommission buildings when they are no longer being used for licensed activities. Decommissioning is generally completed by performing a characterization survey to determine the amount of residual radioactivity in the building; remediation to reduce dose rates, if necessary; and a final status survey.

Lipa, Christine

From: Katie Strei (b)(6)
Sent: Tuesday, May 25, 2010 7:21 AM
To: Lipa, Christine
Subject: Regional Dicussion Slides
Attachments: region III regional issues.ppt

Christine,

Attached are some slides discussing University of Missouri for our regional discussion section. It appears some time as been set aside by HQ to discuss military remediation such as LCAAP, but we can talk about it a little if needed during this time as well.

Please let me know if you have any questions or comments.

Thank you,
Katie

---------- Forwarded message ----------
From: **Katie Streit** (b)(6)
Date: Tue, May 25, 2010 at 7:29 AM
Subject:
To: Katie Streit (b)(6)

C/3

NRC FORM 241 (3-2006) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0013 EXPIRES: 11/30/2011

Estimated burden per response to comply with this mandatory collection request: 16 minutes. This notification is required so that NRC may schedule inspection of the activities to ensure that they are conducted in accordance with requirements for protection of the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0013), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

REPORT OF PROPOSED ACTIVITIES IN NON-AGREEMENT STATES, AREAS OF EXCLUSIVE FEDERAL JURISDICTION, OR OFFSHORE WATERS

(Please read the instructions before completing this form)

1. NAME OF LICENSEE (Person or firm proposing to conduct the activities described below)
Chase Environmental Group, Inc.

2. TYPE OF REPORT
☐ INITIAL ☑ CHANGE

3. ADDRESS OF LICENSEE (Mailing address or other location where license may be located)
11450 Watterson Court
Louisville, KY 40299-2389
Chase Site Rep. - Ken Gavil (b)(6)

4. LICENSEE CONTACT AND TITLE
Manuel Díaz de León, Radiation Safety Officer

5. TELEPHONE NUMBER (Include Area Code)
(865) 481-8801

6. FACSIMILE NUMBER (Include Area Code)
(865) 481-8818

7. ACTIVITIES TO BE CONDUCTED UNDER THE GENERAL LICENSE GIVEN IN 10 CFR 150.20

☐ WELL LOGGING ☐ LEAK TESTING AND/OR CALIBRATIONS ☐ TELETHERAPY/IRRADIATOR SERVICE

☐ PORTABLE GAUGES ☑ OTHER (Specify) ⇒ Scarification and encapsulation of accessible surfaces

☐ RADIOGRAPHY ⇒ REGISTERED AS USER OF PACKAGING (CERTIFICATES OF COMPLIANCE NUMBERS)

8. CLIENT NAME, ADDRESS, CITY/COUNTY, STATE, ZIP CODE
University of Missouri-Columbia
8 Research Park Development Building
Columbia, MO 65211
Client Contact - Jack Crawford (573) 882-0931

9. ACTUAL PHYSICAL ADDRESS OF WORK LOCATION (Street and Number or other location. Give as complete an address or directions as possible.)
University of Missouri-Columbia
1 Pickard Hall
Columbia, MO 65211

10. CLIENT TELEPHONE NUMBER (Include Area Code)

11. WORK LOCATION TELEPHONE NUMBER (Include Area Code)

12. DATES SCHEDULED FROM	TO	13. NUMBER OF WORK DAYS	14. ADD	15. DELETE	16. LOCATION REFERENCE NUMBER
06/21/2010	06/24/2010	3			NUMBER TO BE ASSIGNED BY NRC 000254

LIST ADDITIONAL WORK SITES ON SEPARATE SHEET(S) TO INCLUDE ALL INFORMATION CONTAINED IN ITEMS 8-16 ABOVE.

17. LIST RADIOACTIVE MATERIAL, WHICH WILL BE POSSESSED, USED, INSTALLED, SERVICED, OR TESTED (Include description of type and quantity of radioactive material, sealed sources, or devices to be used.)
Nuclides present include Ra-226 and Th-232 at concentrations of 2,000 pCi/g and 269 pCi/g respectively.

18. AGREEMENT STATE SPECIFIC LICENSE WHICH AUTHORIZES THE UNDERSIGNED TO CONDUCT ACTIVITIES WHICH ARE THE SAME, EXCEPT FOR LOCATION OF USE, AS SPECIFIED IN ITEM 9. ABOVE (One copy of the specific license must accompany the initial NRC Form 241.)

LICENSE NUMBER	STATE	EXPIRATION DATE
201-605-90	KY	12/31/2010

19. CERTIFICATION *(MUST BE COMPLETED BY APPLICANT)*

I, THE UNDERSIGNED, HEREBY CERTIFY THAT:

a. All information in this report is true and complete.

b. I have read and understand the provision of the general license 10 CFR 150.20 reprinted on the instructions of this form; and I understand that I am required to comply with those provisions as to all byproduct, source, or special nuclear material which I possess and use in non-Agreement States or offshore waters under the general license for which this report is filed with the U.S. Nuclear Regulatory Commission.

c. I understand that activities, including storage, conducted in non-Agreement States under general license 10 CFR 150.20 are limited to a total of 180 days in calendar year. With the exception of work conducted in off-shore waters, which is authorized for an unlimited period of time in the calendar year.

d. I understand that I may be inspected by NRC at the above listed work site locations and at the Licensee home office address for activities performed in non-Agreement States or offshore waters.

e. I understand that conduct of any activities not described above, including conduct of activities on dates or locations different from those described above or without NRC authorization, may subject me to enforcement action, including civil or criminal penalties.

CERTIFYING OFFICER - RSO or Management Representative (Name and Title): Manuel Díaz de León, Radiation Safety Officer
SIGNATURE: [signature]
DATE: 06/08/2010

WARNING: False statements in this certificate may be subject to civil and/or criminal penalties. NRC regulations require that submissions to the NRC be complete and accurate in all material respects. 18 U.S.C. Section 1001 makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

FOR NRC USE ONLY — REVIEWING OFFICIAL (Typed/Printed Name and Title): Steven R. Courtemanche Health Physicist — SIGNATURE: Steven R. Courtemanche — DATE: 6/15/10 — TOTAL USAGE - DAYS TO DATE: 11

S 6/8/2010

C|H

Orlikowski, Robert

From: Rodriguez, Lionel
Sent: Friday, June 21, 2013 1:12 PM
To: Chandrathil, Prema
Cc: Stone, AnnMarie; Boland, Anne; Orlikowski, Robert; LaFranzo, Michael
Subject: Status of Pickard Hall Alternate Schedule Request and other Information
Attachments: Timeline for Pickard Hall.docx; Regulations and Guidance governing the Decommissioning Process that the University of Missouri is Following for Pickard Hall.docx

Hello Prema,

I apologize for taking longer than expected to put this information together. However, please see the two attached documents.

The first document provides a timeline of what I was able to piece together by going through all of the information I had available to me. The bottom line is that we are still reviewing the licensee's alternate schedule request.

The second document provides more detailed information as to what the regulations require and where in the decommissioning process the licensee is. In addition, I provided references to the guidance documents that we are using to perform the review, and a short discussion on the somewhat undefined timeliness requirements for completing the review.

I would suggest the following answers for our stakeholder's questions:

What is the latest official status for remediating the radiation in Pickard Hall on the University of Missouri-Columbia campus?

The NRC is still reviewing the licensee's alternate schedule request and has not yet made a determination. The licensee must adhere to the regulations in 10 CFR 30.36(g) if any remediation is planned to be undertaken while the alternate schedule request is under review. 10 CFR 30.36(g) limits the remediation activities a licensee can perform before a decommissioning plan is approved by the NRC.

Did the NRC ever issue a decision on MU's request for an indefinite timeline? Is Dec. 31st, 2013, the date the NRC gave MU to have the building vacated?

As stated above, the NRC is still reviewing the licensee's alternate schedule request and has not yet made a determination.

If not, is the Dec. 31, 2013 date for vacating the building something MU came up with on its own?

The NRC cannot speak for the licensee as to what was reported in the media. As stated above, the NRC is still reviewing the licensee's alternate schedule request and has not yet made a determination.

I hope this helps. Please let me know if you have any additional questions.

Thanks,
Lionel Rodriguez
NRC/RIII/DNMS/MCID
630-829-9609

-----Original Message-----

C|5

From: Boland, Anne
Sent: Thursday, June 20, 2013 5:30 PM
To: Orlikowski, Robert; Rodriguez, Lionel; LaFranzo, Michael
Cc: Stone, AnnMarie
Subject: FW: Univ of MO Pickard Hall radiation

Would one of your please get back with Vika.

-----Original Message-----
From: Resource, OPA3
Sent: Thursday, June 20, 2013 1:58 PM
To: Boland, Anne
Subject: FW: Univ of MO Pickard Hall radiation

Anne,

Can you have someone from the Division chat with me about this inquiry?
Thanks,
Prema

-----Original Message-----
From (b)(7)(C),(b)(7)(D)
Sent: Wednesday, June 19, 2013 5:42 PM
To: Resource, OPA3
Subject: Univ of MO Pickard Hall radiation

Below is the result of your feedback form. It was submitted by
(b)(7)(C),(b)(7)(D) on Wednesday, June 19, 2013 at 18:41:31

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comments: I am wondering what the latest official status is for remediating the radiation in Pickard Hall on the University of Missouri-Columbia campus. The last I heard was that the university had asked the NRC for an indefinte timeline to devise a remediation plan and actually remove the radiation. But I also have recently read in the media that the university plans to vacate Pickard Hall (people and contents) by Dec. 31st of this year so that testing on the radiation contamination can begin. Did the NRC ever issue a decision on MU's request for an indefinite timeline? Is Dec. 31st, 2013, the date the NRC gave MU to have the building vacated? If not, is the Dec. 31, 2013 date for vacating the building something MU came up with on its own? I would appreciate hearing back from you on this matter. Any information you can provide would be appreicated. Thank you.

organization: a Missouri citizen

address1:

address2:

city: Columbia

state: MO

zip:

country: USA

phone:

Regulations and Guidance governing the Decommissioning Process that the University of Missouri is Following for Pickard Hall

1. **Below are the decommissioning steps the University of Missouri followed to get to where we are today:**

10 CFR 30.36(d)(4) –

Requires, among other things, that a licensee begin the decommissioning process for a separate building when that building has residual radioactivity that makes it unsuitable for release (would exceed 25 mrem/year to a member of the public per 10 CFR 20.1402) and when no principal activities have been performed for a period of 24 months in the building. Principal activities is defined in 10 CFR 30.4 as activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activity incidental to decontamination or decommissioning are not principal activities.

10 CFR 30.36(d) –

Requires that a licensee notify the NRC within 60 days of the occurrence of the requirement stated above [10 CFR 30.36(d)(4)] and initiate the decommissioning process by either:

1 Beginning to decommission the site if a decommissioning plan is not required per 10 CFR 30.36(g)(1)

2 Or submitting a decommissioning plan within 12 months if required by 10 CFR 30.36(g)(1) **[The University of Missouri falls into this category]**

10 CFR 30.36(g)(1) –

Requires a licensee to submit a decommissioning plan if the procedures and activities necessary to carry out decommissioning of the separate building have not been previously approved by the NRC and the procedures could increase potential health and safety impacts to workers or the the public, such as in any of the cases listed under 10 CFR 30.36(g)(1)(i-iv).

10 CFR 30.36(g)(2) –

Allows the NRC to approve an alternate schedule for submitting a decommissioning plan [extends the 12 month timeframe required by 10 CFR 30.36(d)] if the NRC determines that the alternative schedule is necessary to the effective conduct of decommissioning operations and presents no undue risk from radiation to the public health and safety and is otherwise in the public interest.

10 CFR 30.36(g)(3) –

Does not allow licensees to carry out decommissioning procedures, such as those listed in 10 CFR 30.36(g)(1) that have potential health and safety impacts, prior to the approval of a decommissioning plan.

We are currently reviewing the licensee's Alternate Schedule request to ensure that it complies with the requirements in 10 CFR 30.36(g)(2). If the NRC finds the request to be acceptable, a license amendment would be issued incorporating their commitments and extending the timeframe by which the decommissioning plan is due.

2. Below is the NRC Guidance for performing a review of the Alternate Schedule request:

NUREG 1757 Volume 3, Section 2.6 -

The NRC's review should include the following:

- Acceptance review;
- Detailed review;
- Request for additional information;
- Documentation of the safety and environmental review.

Guidance is provided in the section which guides the review process.

Hence, we are currently in the Detailed Review phase of the review and have issued a Request for Additional Information (RAI). At the conclusion of our review, we would issue a Safety Evaluation Report (SER) and most likely a documentation of the Environmental Review. 10 CFR 51 contains the requirements for what the Environmental Review will consist of; however, it will most likely be an Environmental Assessment. NUREG 1748 provides the guidance for the Environmental Review process and the documentation for it (Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement).

3. Below are the timeliness metric requirements I am aware of for decommissioning actions:

I don't know of any specific "hard" metrics for completing an Alternate Schedule review.

However, for decommissioning plan reviews, the guidance in NUREG 1757 Volume 1 suggests that the acceptance review be completed within 90 days. The 90 day acceptance review period is also spelled out in a DNMS/MCID branch instruction as a "should." Our HQ counterparts in FSME/DWMEP have an Office Procedure which also states acceptance reviews be completed within 90 days. Our FSME/DWMEP also have in their Office Procedure that the detailed technical review of a Decommissioning Plan be completed within 1 year. However, from my experience that is seldom the case. The "statements of consideration" when the "Timeliness Rule" was issued (Federal Register July 15, 1994) estimated that decommissioning plan reviews would take 6 months.

Finally, the region does have metrics for the completion of materials licensing actions in general. Actions are tracked for completion within 90 days, and also for completion within 2 years. However, these metrics are not tracked by our MCID branch, they are tracked by MLB. However, I don't know whether or not these metrics directly apply to decommissioning licensing actions.

Timeline for University of Missouri – Columbia Campus
Pickard Hall Alternate Decommissioning Schedule Request

11/17/2009	Initial Licensee letter to NRC providing notification of contamination above unrestricted use screening values at Pickard Hall	ML093270544	Public
2/24/2010	NRC Inspection Report – Reactive inspection to assess licensee's actions in addressing radiological contamination identified at Pickard Hall (and Schweitzer Hall)	ML100600810	Public
7/6/2010	Licensee submitted to NRC a radiological characterization survey of Pickard Hall	ML102800311, ML102800322, ML102800330, ML102800336, ML102800398, ML102800412, ML102800452, ML102800455, ML102800458, ML102800463, ML108200467, ML102800563	Public (at least the first one)
2/17/2011	License submittal requesting Alternate Decommissioning Schedule (formal license amendment request)	ML110540477	Public
3/21/2011	NRC Acknowledgment / Acceptance Review Letter for Alternate Schedule Request	ML11081A022	Public
4/13/2011	Federal Register Notice which provides Opportunity to Comment, Request a Hearing, and Petition for Leave to Intervene	ML11005A012 and FR 2011–11113, pages 26322-26324 (Vol. 76, No. 88, 5/6/2011)	Public
6/7/2011	Public Meeting Notice	ML111580553	Public
6/23/2011	Public Meeting to discuss licensee's request for Alternate Decommissioning Schedule	ML11194A073	Public
9/16/2011	NRC Decommissioning Inspection at Pickard Hall	ML11264A063	Public
9/27/2012	NRC Decommissioning Trip Report discussing Alternate Schedule Request for Pickard Hall	ML12296A135	Public
10/16/2012	NRC Decommissioning Inspection at Pickard Hall	ML12292A248	Public
11/6/2012	NRC Letter Requesting Additional Information on Alternate Schedule Request	ML12312A095	Public
2/6/2013	Licensee response to RAIs on Alternate Schedule Request	ML13126A170	Public
5/10/2013	Licensee additional response to RAIs on Alternate Schedule Request	ML13135A616	Public
6/19/2013	NRC Acknowledgement Letter for Receipt of RAI responses	ML13171A235	Public

NRC FORM 241 (8-2008) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0013 EXPIRES: 11/30/2011

Estimated burden per response to comply with this mandatory collection request: 16 minutes. This notification is required so that NRC may schedule inspection of the activities to ensure that they are conducted in accordance with requirements for protection of the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0013), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

REPORT OF PROPOSED ACTIVITIES IN NON-AGREEMENT STATES, AREAS OF EXCLUSIVE FEDERAL JURISDICTION, OR OFFSHORE WATERS

(Please read the instructions before completing this form)

1. NAME OF LICENSEE (Person or firm proposing to conduct the activities described below)
Chase Environmental Group, Inc.

2. TYPE OF REPORT
☐ INITIAL ☑ CHANGE

3. ADDRESS OF LICENSEE (Mailing address or other location where licensee may be located)
11450 Watterson Court
Louisville, KY 40299-2389
Chase Site Rep. Ken Gavill (b)(6)

4. LICENSEE CONTACT AND TITLE
Manuel J. Diaz de Leon, Radiation Safety Officer

5. TELEPHONE NUMBER (Include Area Code)
(865) 481-8801

6. FACSIMILE NUMBER (Include Area Code)
(865) 481-8818

7. ACTIVITIES TO BE CONDUCTED UNDER THE GENERAL LICENSE GIVEN IN 10 CFR 150.20

☐ WELL LOGGING ☐ LEAK TESTING AND/OR CALIBRATIONS ☐ TELETHERAPY/IRRADIATOR SERVICE

☐ PORTABLE GAUGES ☑ OTHER (Specify) ⇒ Scarafication and encapsulation of accesible surfaces

☐ RADIOGRAPHY ⇒ REGISTERED AS USER OF PACKAGING (CERTIFICATES OF COMPLIANCE NUMBERS)

8. CLIENT NAME, ADDRESS, CITY/COUNTY, STATE, ZIP CODE
University of Missouri-Columbia
8 Research Park Development Building
Columbia, MO 65211
Contact: Jack Crawford 573-882-0931

9. ACTUAL PHYSICAL ADDRESS OF WORK LOCATION (Street and number or other location. Give as complete an address or location as possible.)
University of Missouri-Columbia
1 Pickard Hall
Columbia, MO 65211

10. CLIENT TELEPHONE NUMBER (Include Area Code)

11. WORK LOCATION TELEPHONE NUMBER (Include Area Code)

12. DATES SCHEDULED FROM	TO	13. NUMBER OF WORK DAYS	14. ADD	15. DELETE	16. LOCATION REFERENCE NUMBER (NUMBER TO BE ASSIGNED BY NRC)
06/21/2010	06/24/2010	3		3	000256

LIST ADDITIONAL WORK SITES ON SEPARATE SHEET(S) TO INCLUDE ALL INFORMATION CONTAINED IN ITEMS 9-16 ABOVE.

17. LIST RADIOACTIVE MATERIAL WHICH WILL BE POSSESSED, USED, INSTALLED, SERVICED, OR TESTED (Include description of type and quantity of radioactive material, sealed sources, or devices to be used.)

18. AGREEMENT STATE SPECIFIC LICENSE WHICH AUTHORIZES THE UNDERSIGNED TO CONDUCT ACTIVITIES WHICH ARE THE SAME, EXCEPT FOR LOCATION OF USE, AS SPECIFIED IN ITEM 7 ABOVE (One copy of the specific license must accompany the initial NRC Form 241.)

LICENSE NUMBER	STATE	EXPIRATION DATE
201-605-90	KY	12/31/2010

19. CERTIFICATION *(MUST BE COMPLETED BY APPLICANT)*

I, THE UNDERSIGNED, HEREBY CERTIFY THAT:

a. All information in this report is true and complete.

b. I have read and understand the provision of the general license 10 CFR 150.20 reprinted on the instructions of this form; and I understand that I am required to comply with those provisions as to all byproduct, source, or special nuclear material which I possess and use in non-Agreement States or offshore waters under the general license for which this report is filed with the U.S. Nuclear Regulatory Commission.

c. I understand that activities, including storage, conducted in non-Agreement States under general license 10 CFR 150.20 are limited to a total of 180 days in calendar year. With the exception of work conducted in off-shore waters, which is authorized for an unlimited period of time in the calendar year.

d. I understand that I may be inspected by NRC at the above listed work site locations and at the Licensee home office address for activities performed in non-Agreement States or offshore waters.

e. I understand that conduct of any activities not described above, including conduct of activities on dates or locations different from those described above or without NRC authorization, may subject me to enforcement action, including civil or criminal penalties.

CERTIFYING OFFICER - RSO or Management Representative (Name and Title)	SIGNATURE	DATE
Manuel J. Diaz de Leon, Radiation Safety Officer	[signature]	07/01/2010

WARNING: False statements in this certificate may be subject to civil and/or criminal penalties. NRC regulations require that submissions to the NRC be complete and accurate in all material respects. 18 U.S.C. Section 1001 makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

FOR NRC USE ONLY	REVIEWING OFFICIAL (Typed/Printed Name and Title)	SIGNATURE	DATE	TOTAL USAGE – DAYS TO DATE
	Sheryl Villar, Team Leader	Sheryl Villar	07/01/2010	7

(S) 7/1/2010

C|6

ALLEGATION RECEIPT FORM *Please email the following information to OAC3, JKH, PRP*	
Received By: Michael LaFranzo	Receipt Date: 7/15/2011
Receipt Method: (meeting, phone call, letter)	Public Meeting/Telephone
FACILITY	
Facility Name Curators of the University of Missouri	
Location Columbia, Missouri	
Docket(s) 030-02278	
CONCERN *Records of conversations for receipt of allegations should contain the following information as a minimum. Obtain as many concern specifics as possible.*	
1. What is the concern? The licensee is concerned that the whole body dosimetry devices provided to certain members of the Museum staff are not being used correctly to measure accurately the doses received from working in the Museum. Specifically, there are no guidelines provided by the licensee regarding where to store the dosimeter while not working in the building. For example, some individuals take the dosimeters home with them and some leave the dosimeters within the building after the individual leaves the building.	
2. When did the concern occur? No specific date but it started when the CI was issued to the dosimeter.	
3. Is this an ongoing concern? Yes, the on going concern is that doses assigned to individuals within the building are not the actual doses that the individual is receiving.	
4. Who was involved? The CI and all other individuals issues dosimeters within the Museum.	
5. Were there any witnesses? NA	
6. What is the potential safety impact? None, the CI stated that he and others in the Museum are wearing the dosimeters within the building.	

3

C/7

7. Ask the CI what requirement/regulation does the individual believe governs this concern? (If the CI does not have this information, please document this response. If the CI does not provide this information and the individual receiving the allegation can obtain the information within the 3 day deadline for forwarding the information to EICS, the information should be provided by the NRC staff member) The CI was informed that the licensee requires dosimeters to be worn during work within the building.
8. Ask the CI what records should the NRC review? NA
9. Ask the CI what other individuals could the NRC contact for information? The CI stated that there are other individuals in the building that were issued dosimeters that the NRC could talk to.
10. How did the individual find out about the concern? The individual was issued the dosimeter and provided no guidance on where the store the device.
11. Was the concern brought to management's attention? If so, what actions have been taken; if not, why not? Yes. (b)(7)(C),(b)(7)(D) According to the CI, management did not provide additional guidance.
12. Was a condition report (or other corrective action document) initiated in response to the issue? If so, what was the resolution? NA
13. Is the individual satisfied with the licensee's response? If not, why? No. The licensee has not given information associated with the storage of the dosimeters while in storage.
14. If the licensee has not responded, does the individual wish to wait on the licensee's response before NRC pursues the issue? If not, why? NA
15. What does the individual believe NRC should do in regard to this concern? The CI would like NRC to follow up with the licensee to ensure that dosimeter results are appropriate and additional guidance to the CI and others in the museum are given regarding storage of the dosimeters.
16. What is the inspector's recommended follow up action? (Also indicate whether the BC has approved the recommended actions.) Request information from the licensee on guidance provided to individuals issued dosimeters working within the museum regarding storage of dosimeters and how the licensee assigns exposures based upon the times the dosimeter is worn by the individual.

17. Inspector Assessment of the Issue/Background Information:

(b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D) Initially, the NRC did not fully understand the CI concern and did not follow up (b)(7)(C),(b)(7)(D) The inspector contacted the CI on July 15, 2011 to gain additional and clarifying information.

ALLEGER INFORMATION

Full Name	(b)(7)(C),(b)(7)(D)	Employer	(b)(7)(C),(b)(7)(D)
Mailing Address (Home)	(b)(7)(C),(b)(7)(D)	Occupation	
Telephone	(b)(7)(C),(b)(7)(D)	Relationship to facility	
Preference for method and time of contact	After normal working hours;	Was the individual advised of limitations on identity protection?	

Referral: ***Explain that if the concerns are referred to the licensee, that the NRC will review and evaluate the thoroughness and adequacy of the licensee's response. If the concerns are an agreement state issue or the jurisdiction of another agency, explain that we will refer the concern to the appropriate agency. If the CI agrees, we will provide the CI's identity for follow up by the agreement state or other agency.***

Does the individual object to referral?	No	Does the individual object to releasing their identity?	NA
If the issue involves another agency, does the individual object to referral to the agency and release of identity to that agency?	No	Was the individual informed that objecting to referral to another agency might impact review of the concern?	NA

Discrimination: ***Regulations prohibit NRC licensees (including contractors and subcontractors) from discriminating against individuals who engage in protected activities (alleging violations of regulatory requirements, refusing to engage in practices made unlawful by statues, etc.).***

1. Does the concern involve discrimination? If so, was the CI informed that identity will be released during an investigation?	No	2. Was the individual advised of the DOL process and the 180 day restriction on filing?	NA

3. What adverse actions have been taken? When? NA
4. Why does the individual believe the actions were taken as a result of engaging in a protected activity? NA
5. What does the individual believe was the protected activity? NA What safety issues did the individual raise? When? (DOCUMENT ABOVE) NA Did you contact the NRC about these safety issues? Was/Is your management aware that you informed the NRC? NA
Provide the CI with the OAC contact information (names of OACs) and RIII switchboard number (1-800-522-3025) Explain the allegation process (CI will receive an acknowledgment letter within 30 days and will be advised of NRC's resolution of the issue(s) via letter.)

ALLEGATION RECEIPT FORM *Please email the following information to OAC3, JKH, PRP*	
Received By: Michael LaFranzo	Receipt Date: 7/15/2011
Receipt Method: (meeting, phone call, letter)	Public Meeting/Telephone
FACILITY	
Facility Name Curators of the University of Missouri	
Location Columbia, Missouri	
Docket(s) 030-02278	
CONCERN *Records of conversations for receipt of allegations should contain the following information as a minimum. Obtain as many concern specifics as possible.*	
1. What is the concern?	
The licensee is concerned that the licensee is using a mathematical manupulation to assign doses to the CI and other working within the Museum, the manupulation is not appropriate and the licensee has not explained why the mathematical formula is being used. Specifically, the CI claims that the licensee is dividing the exposure values by 4 and the licensee has not explained why to the CI or others working in the Museum issued dosimetry.	
2. When did the concern occur?	
No specific date but it started when the CI was issued to the dosimeter.	
3. Is this an ongoing concern?	
Yes, the on going concern is that doses assigned to individuals within the building are not the actual doses that the individual is receiving.	
4. Who was involved?	
The CI and all other individuals issues dosimeters within the Museum.	
5. Were there any witnesses?	
NA	
6. What is the potential safety impact?	
None, the CI stated that he and others in the Museum are wearing the dosimeters within the building and the radiation levels in the areas would not exceed regulatory limits.	

C|8

7. Ask the CI what requirement/regulation does the individual believe governs this concern? (If the CI does not have this information, please document this response. If the CI does not provide this information and the individual receiving the allegation can obtain the information within the 3 day deadline for forwarding the information to EICS, the information should be provided by the NRC staff member)

The CI was informed that the licensee requires dosimeters to be worn during work within the building.

8. Ask the CI what records should the NRC review?

Dosimetry records

9. Ask the CI what other individuals could the NRC contact for information?

The CI stated that there are other individuals in the building that were issued dosimeters that the NRC could talk to.

10. How did the individual find out about the concern?

The individual was issued the dosimeter and was informed, by an individual from the Radiation Safety Staff (does not remember at this time), that the exposures from the dosimeters were being divided by 4.

11. Was the concern brought to management's attention? If so, what actions have been taken; if not, why not?

Yes. (b)(7)(C),(b)(7)(D) According to the CI, management did not provide additional information on why the exposures were being divided by 4.

12. Was a condition report (or other corrective action document) initiated in response to the issue? If so, what was the resolution?

NA

13. Is the individual satisfied with the licensee's response? If not, why?

No

14. If the licensee has not responded, does the individual wish to wait on the licensee's response before NRC pursues the issue? If not, why?

NA

15. What does the individual believe NRC should do in regard to this concern?

The CI would like NRC to follow up with the licensee to ensure that dosimeter results are appropriate and explain why the original exposure results are being divided by 4.

16. What is the inspector's recommended follow up action?
(Also indicate whether the BC has approved the recommended actions.)

Request Information from the licensee on why the licensee is dividing exposure results by 4.

17. Inspector Assessment of the Issue/Background Information:

(b)(7)(C),(b)(7)(D) The licensee was

(b)(7)(C),(b)(7)(D) Initially, the NRC did not fully understand the CI concern and did not follow up (b)(7)(C),(b)(7)(D) The inspector contacted the CI on July 15, 2011 to gain additional and clarifying information.

ALLEGER INFORMATION

Full Name	(b)(7)(C),(b)(7)(D)	Employer	(b)(7)(C),(b)(7)(D)
Mailing Address (Home)		Occupation	
Telephone		Relationship to facility	
Preference for method and time of contact		Was the individual advised of limitations on identity protection?	

Referral: ***Explain that if the concerns are referred to the licensee, that the NRC will review and evaluate the thoroughness and adequacy of the licensee's response. If the concerns are an agreement state issue or the jurisdiction of another agency, explain that we will refer the concern to the appropriate agency. If the CI agrees, we will provide the CI's identity for follow up by the agreement state or other agency.***

Does the individual object to referral?	No	Does the individual object to releasing their identity?	NA
If the issue involves another agency, does the individual object to referral to the agency and release of identity to that agency?	No	Was the individual informed that objecting to referral to another agency might impact review of the concern?	NA

Discrimination: ***Regulations prohibit NRC licensees (including contractors and subcontractors) from discriminating against individuals who engage in protected activities (alleging violations of regulatory requirements, refusing to engage in practices made unlawful by statues, etc.).***

1. Does the concern involve discrimination? If so, was the CI informed that identity will be released during an investigation?	No	2. Was the individual advised of the DOL process and the 180 day restriction on filing?	NA

3. What adverse actions have been taken? When?

NA

4. Why does the individual believe the actions were taken as a result of engaging in a protected activity?

NA

5. What does the individual believe was the protected activity?

NA

What safety issues did the individual raise? When? (DOCUMENT ABOVE)

NA

Did you contact the NRC about these safety issues? Was/Is your management aware that you informed the NRC?

NA

Provide the CI with the OAC contact information (names of OACs) and RIII switchboard number (1-800-522-3025) Explain the allegation process (CI will receive an acknowledgment letter within 30 days and will be advised of NRC's resolution of the issue(s) via letter.)

ALLEGATION RECEIPT FORM

Please email the following information to OAC3, JKH, PRP

Received By: Michael LaFranzo	Receipt Date: 7/15/2011
Receipt Method: (meeting, phone call, letter)	Public Meeting/Telephone

FACILITY

Facility Name	Curators of the University of Missouri
Location	Columbia, Missouri
Docket(s)	030-02278

CONCERN ***Records of conversations for receipt of allegations should contain the following information as a minimum. Obtain as many concern specifics as possible.***

1. What is the concern?

The licensee has a sign in/out sheet for those individuals entering and exiting elevated radiation areas within the Museum. The CI is concerned that the licensee has provided insufficient guidance to the staff using those sign in/out sheets and have placed them in confusing locations which do to facilitate the use of those forms. Specifically, the licensee has forms at multiple access points to the elevated radiation areas, no signs to remind staff to sign in and out and no guidance on who is required to sign in and out.

2. When did the concern occur?

No specific date. However, the forms were added when the licensee determined elevated radiation areas were identified.

3. Is this an ongoing concern?

Yes, the on going concern is that individuals are forgeting to sign in and out of the areas and that confusion exists on who is required to use the forms.

4. Who was involved?

The CI and all other individuals with access to the elevated radiation areas.

5. Were there any witnesses?

NA

6. What is the potential safety impact?

None, the CI stated that he and others are doing their best to sign in and out. The NRC has not identified significant elevated radiation or contamination levels which could exceed NRC limits.

C/9

7. Ask the CI what requirement/regulation does the individual believe governs this concern? (If the CI does not have this information, please document this response. If the CI does not provide this information and the individual receiving the allegation can obtain the information within the 3 day deadline for forwarding the information to EICS, the information should be provided by the NRC staff member)

The CI was informed that all individuals that go in and out of the room are required to sign in and out.

8. Ask the CI what records should the NRC review?

Sign in and out forms

9. Ask the CI what other individuals could the NRC contact for information?

The CI stated that there are other individuals in the building that have access to the elevated radiation areas the NRC could talk to.

10. How did the individual find out about the concern?

The individual was informed by the radiation safety office that the forms were required to be completed.

11. Was the concern brought to management's attention? If so, what actions have been taken; if not, why not?

Yes. (b)(7)(C),(b)(7)(D) According to the CI, management did not clarify the situation on who is to use the forms nor provide additional resources to ensure the forms were used appropriately.

12. Was a condition report (or other corrective action document) initiated in response to the issue? If so, what was the resolution?

NA

13. Is the individual satisfied with the licensee's response? If not, why?

No, the licensee has clarified the situation on who is to use the forms nor provided additional resources to ensure the forms were used appropriately.

14. If the licensee has not responded, does the individual wish to wait on the licensee's response before NRC pursues the issue? If not, why?

NA

15. What does the individual believe NRC should do in regard to this concern?

The CI would like NRC to follow up with the licensee to define who is required to use the forms and provide additional resources to ensure the forms are completed appropriately.

16. What is the inspector's recommended follow up action?
(Also indicate whether the BC has approved the recommended actions.)

Request information from the licensee to define who is required to use the forms and provide whether additional resources are necessary to ensure the forms are completed appropriately.

17. Inspector Assessment of the Issue/Background Information:

(b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D) Initially, the NRC did not fully understand the CI concern and did not follow up (b)(7)(C),(b)(7)(D) The inspector contacted the CI on July 15, 2011 to gain additional and clarifying information.

ALLEGER INFORMATION

Full Name	(b)(7)(C),(b)(7)(D)	Employer	(b)(7)(C),(b)(7)(D)
Mailing Address (Home)		Occupation	
Telephone		Relationship to facility	
Preference for method and time of contact		Was the individual advised of limitations on identity protection?	

Referral: ***Explain that if the concerns are referred to the licensee, that the NRC will review and evaluate the thoroughness and adequacy of the licensee's response. If the concerns are an agreement state issue or the jurisdiction of another agency, explain that we will refer the concern to the appropriate agency. If the CI agrees, we will provide the CI's identity for follow up by the agreement state or other agency.***

Does the individual object to referral?	No	Does the individual object to releasing their identity?	NA
If the issue involves another agency, does the individual object to referral to the agency and release of identity to that agency?	No	Was the individual informed that objecting to referral to another agency might impact review of the concern?	NA

Discrimination: ***Regulations prohibit NRC licensees (including contractors and subcontractors) from discriminating against individuals who engage in protected activities (alleging violations of regulatory requirements, refusing to engage in practices made unlawful by statues, etc.).***

1. Does the concern involve discrimination? If so, was the CI informed that identity will be released during an investigation?	No	2. Was the individual advised of the DOL process and the 180 day restriction on filing?	NA

3. What adverse actions have been taken? When?

NA

4. Why does the individual believe the actions were taken as a result of engaging in a protected activity?

NA

5. What does the individual believe was the protected activity?

NA

What safety issues did the individual raise? When? (DOCUMENT ABOVE)

NA

Did you contact the NRC about these safety issues? Was/Is your management aware that you informed the NRC?

NA

Provide the CI with the OAC contact information (names of OACs) and RIII switchboard number (1-800-522-3025) Explain the allegation process (CI will receive an acknowledgment letter within 30 days and will be advised of NRC's resolution of the issue(s) via letter)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

August 10, 2011

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0054

Dear (b)(7)(C),(b)(7)(D)

This letter refers to a telephone call with Michael LaFranzo, U.S. Nuclear Regulatory Commission (NRC) Inspector, in which you expressed concerns related to activities within Pickard Hall at the University of Missouri. You are concerned that the: (1) whole body dosimetry provided to museum staff is not being stored correctly when the staff leaves the museum; (2) licensee is using mathematical manupulation to assign dose to workers within the museum that wear dosimetry; and (3) licensee has not provided sufficient guidance to the staff on the use of the sign in/out sheets when entering and exiting elevated radiation areas within the museum.

Enclosure 1 to this letter documents your concerns as we understand them. If we have misunderstood or mischaracterized your concerns as described in the enclosure, please contact one of the NRC Region III Office Allegation Coordinators at the address provided below.

Enclosure 2 to this letter is the NRC brochure, "Reporting Safety Concerns to the NRC." The brochure contains information that you may find helpful in understanding our process for reviewing safety concerns. It includes an important discussion of the NRC's identity protection procedures and limitations on pages 5-7.

Mr. LaFranzo discussed our identity protection program on July 15, 2011, and you indicated that you **did not object** to having the concerns provided to the licensee. We will provide your concerns to the licensee with a request for information and an evaluation to be performed by an individual who is independent of the concerns. In evaluating your concerns, we intend to take all reasonable efforts not to disclose your identity as the source of the concerns. The NRC Region III technical staff will evaluate the licensee's response to determine the next step in our evaluation. After we complete our evaluation, you will be provided the results.

Thank you for notifying us of your concerns. If you have any questions, please contact Paul Pelke, Magdalena Gryglak, Sarah Bakhsh or me. You can contact us by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending

C|10 6

(b)(7)(C),(b)(7)(D)

an e-mail to our common e-mail address which is Allegations.RegionIII@nrc.gov. Your cooperation is appreciated.

Sincerely,

James Heller
Senior Allegation Coordinator

Enclosures:
1. Summary of Concerns
2. NUREG/BR-0240, "Reporting Safety Concerns to the NRC"

Our current understanding of your concerns is summarized below. If you have any additional or clarifying information related to these concerns, please contact one of the U.S. Nuclear Regulatory Commission (NRC) Region III Office Allegation Coordinators at the addresses or telephone number provided in the letter.

Concern 1:

You are concerned that the whole body dosimetry provided to museum staff within Pickard Hall is not being used correctly to accurately measure the dose received while working in the museum. Specifically, the staff have not been instructed where to store the dosimeter while not working in the building. For example, some staff take the dosimeter home and some leave the dosimeter within the building when they leave the museum.

Concern 2:

You are concerned that the licensee is using mathematical manupulation to assign dose to workers within the museum. Specifically, you claim the licensee is dividing the exposure values by 4 of the workers who are wearing dosimetry while working in the museum. You stated that individuals have questioned if the mathematical manupulation is appropriate and the licensee has not explained why the mathematical formula is used.

Concern 3:

You are concerned that the licensee has not provided sufficient guidance to the staff on the use of sign in/out sheets when entering and exiting elevated radiation areas within the museum. Specifically, the sign in/out sheets are located at multiple access points to the elevated radiation areas with no signs to remind staff to sign in/out and no guidance on who is required to sign in/out. Additionally, the sign in/out sheets were placed in confusing locations which do not facilitate their use. Lastly, staff do not appear to be consistently using the sign in/out sheets.

(b)(7)(C),(b)(7)(D)

an e-mail to our common e-mail address which is Allegations.RegionIII@nrc.gov. Your cooperation is appreciated.

Sincerely,

James Heller
Senior Allegation Coordinator

Enclosures:
1. Summary of Concerns
2. NUREG/BR-0240, "Reporting Safety Concerns to the NRC"

bcc w/enclosure 1: AMS File No. RIII-11-A-0054

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DATE	08/10/11	08/10/11	08/ /11	

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

August 22, 2011

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This letter refers to your telephone call with Michael LaFranzo, Inspector, U.S. Nuclear Regulatory Commission (NRC), on July 29, 2011, in which you expressed a concern related to activities at the University of Missouri. You are concerned that, within Pickard Hall the licensee is aware of several "hot spots" that have not been labeled as "Radioactive;" and radiation is present in the ventilation system.

Enclosure 1 to this letter documents your concern as we understand it. If we have misunderstood or mischaracterized your concern as described in the enclosure, please contact one of the NRC Region III Office Allegation Coordinators at the address provided below.

Enclosure 2 to this letter is the NRC brochure, "Reporting Safety Concerns to the NRC." The brochure contains information that you may find helpful in understanding our process for reviewing safety concerns. It includes an important discussion of the NRC's identity protection procedures and limitations on pages 5-7. Mr. LaFranzo discussed our identity protection program with you on July 29, 2011. You indicated that you (1) **did object** to having your identity released, and (2) **did object** to having your concern provided to the licensee. Your concern will be evaluated during a future NRC inspection. After we complete our inspection, you will be provided the results. During our inspection we will implement reasonable measures to not release your name as the source of the concern.

Thank you for notifying us of your concern. We will advise you when we have completed our review. If you have any questions, please contact a Region III Office Allegation Coordinator. The Region III Office Allegation Coordinators are Paul Pelke, Magdalena Gryglak, Sarah Bakhsh, and me. We can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352;

C|11 6

(b)(7)(C),(b)(7)(D)

(2) calling the NRC Region III switchboard toll free at (800) 522-3025, or (3) sending an e-mail to our common e-mail address which is **Allegations.RegionIII@nrc.gov.** Your cooperation is appreciated.

Sincerely,

James Heller
Senior Allegation Coordinator

Enclosures:
1. Summary of Concern
2. NUREG/BR-0240, "Reporting Safety Concerns to the NRC"

((

File No. RIII-2011-A-0059

Our current understanding of your concern is summarized below. If you have any additional or clarifying information related to this concern, please contact one of the U.S. Nuclear Regulatory Commission (NRC) Region III Office Allegation Coordinators at the addresses or telephone number provided in this letter.

Concern:

You are concerned that the licensee is aware of several "hot spots" (elevated levels of radiation) that have not been labeled as "Radioactive." Specifically, over the last year, you were in the following areas of Pickard Hall while members of the Radiation Safety Staff were performing radiation surveys and you heard clicking, from the radiation survey instrument, indicating elevated radiation levels. The areas included, but were not limited to: (a) the walls of McLoran or Eilenberg gallery; (b) the storage room on the second level; (c) the Preparation Lab/Storage area; and (d) Room 106 (lecture hall) near the speaker system.

In addition, you are concerned that radiation is present in the ventilation ducts located behind the walls in the McLoran or Eilenberg galleries, the storage room on the second level, and Room 106 near the speaker system.

ENCLOSURE 1

(b)(7)(C),(b)(7)(D)

(2) calling the NRC Region III switchboard toll free at (800) 522-3025, or (3) sending an e-mail to our common e-mail address which is **Allegations.RegionIII@nrc.gov.** Your cooperation is appreciated.

Sincerely,

James Heller
Senior Allegation Coordinator

Enclosures:
1. Summary of Concern
2. NUREG/BR-0240, "Reporting Safety Concerns to the NRC"

bcc w/enclosure 1: AMS File No. RIII-11-A-0059

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DATE	8/18/11	8/18/11	8/22/11	

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

November 29, 2011

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This is in reference to our letter dated August 22, 2011, that stated we would review your concern about activities at the University of Missouri. You were concerned that within Pickard Hall the licensee was aware of several unlabeled areas that contained radiation and radiation was present in the ventilation system. Your concern was the subject of an onsite U.S. Nuclear Regulatory Commission (NRC) inspection that was conducted August 25 and 26, 2011. We have completed our inspection and substantiated your concern. Based on the results of the inspection, we identified a violation of NRC requirements. Enclosure 1 to this letter provides the results of our evaluation. The violation and the inspection activities were documented in Inspection Report 030-02278/11-02 (Enclosure 2).

Allegations are an important source of information in support of the NRC's safety mission. We take our nuclear safety responsibility to the public seriously and will continue to do so within the bounds of our lawful authority. We believe that our actions have been responsive to your concern. If, however, new information is provided that suggests our conclusion should be altered, we will evaluate that information to determine if additional evaluation is needed.

Thank you for notifying us of your concern. If you disagree with our conclusion or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

Anne T. Boland, Director
Division of Nuclear Materials Safety

Enclosures:
1. Summary of NRC Evaluation
2. NRC Inspection Report 030-02278/11-02

C|12 15

File No. RIII-2011-A-0059

Summary of U.S. Nuclear Regulatory Commission (NRC) Evaluation

Concern:

You were concerned that the licensee was aware of several "hot spots" (elevated levels of radiation) that have not been labeled as "Radioactive." Specifically, over the last year, you were in the following areas of Pickard Hall while members of the Radiation Safety staff were performing radiation surveys and you heard clicking, from the radiation survey instrument, indicating elevated radiation levels. The areas included, but were not limited to: (a) the walls of McLoran or Eilenberg Gallery; (b) the storage room on the second level; (c) the preparation lab/storage area; and (d) Room 106 (lecture hall) near the speaker system.

In addition, you were concerned that radiation was present in the ventilation ducts located behind the walls in the McLoran or Eilenberg Galleries, the storage room on the second level, and Room 106 near the speaker system.

NRC Evaluation and Conclusion for Concern:

An NRC Region III inspector evaluated your concern during an onsite inspection that was conducted on August 25 and 26, 2011. During the inspection, the inspector interviewed members of the licensee staff, reviewed select records, and performed independent radiological surveys of selected rooms/areas within Pickard Hall. The selection included rooms/areas that the licensee had identified with elevated levels of radiation and ones that were not identified as having elevated radiation levels. The inspection did not identify any immediate safety hazards, but did identify violations of NRC requirements.

The inspector identified slightly elevated radiation levels in the areas identified in your concern. Slightly elevated radiation levels were also found in Research Laboratory 17, outside Staff Office 9 in the corridor, above the nine foot level of Offices 111 and 112, and in the Julius Carlebach Gallery (Room 206).

The inspector interviewed licensee personnel regarding the vents behind the walls in McLoran or Eilenberg Galleries and was informed that the vents were old brick chimneys that were isolated from the rest of the building. The licensee staff indicated that the inside of the chimneys was contaminated with radioactive material and access to the chimneys was controlled. Due to the location of the chimneys and the physical hazards associated with performing radiological surveys within the chimneys, the inspector did not perform independent radiation surveys within the chimneys. However, the inspector did verify that the licensee staff controlled access to the chimneys as required by NRC regulations.

ENCLOSURE 1

Based on the results of our inspection, we substantiated your concern in that the licensee was aware of several areas within Pickard Hall that contained slightly elevated levels of radiation and those areas were not properly posted. While the licensee failed to perform surveys to assure compliance with the NRC regulations, the inspector did not identify any radiation levels that would be considered an immediate health and safety hazard.

The details of the violation and the inspection activities were documented in Inspection Report 030-02278/11-02. The violation will prompt the licensee to identify elevated radiation areas, determine if posting or additional controls are required, and post/control the areas as necessary.

We have enclosed a copy of the inspection report (Enclosure 2). In accordance with our administrative procedures, the inspection report is also available from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Thank you for notifying us of your concern. We believe our actions have been responsive to your concern and plan no additional inspection activities at this time. The licensee's corrective actions to address the notice of violation will be reviewed during a subsequent inspection. If you disagree with our conclusion or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator by any of the means provided in the letter.

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This is in reference to our letter dated August 22, 2011, that stated we would review your concern about activities at the University of Missouri. You were concerned that within Pickard Hall the licensee was aware of several unlabeled areas that contained radiation and radiation was present in the ventilation system. Your concern was the subject of an onsite U.S. Nuclear Regulatory Commission (NRC) inspection that was conducted August 25 and 26, 2011. We have completed our inspection and substantiated your concern. Based on the results of the inspection, we identified a violation of NRC requirements. Enclosure 1 to this letter provides the results of our evaluation. The violation and the inspection activities were documented in Inspection Report 030-02278/11-02 (Enclosure 2).

Allegations are an important source of information in support of the NRC's safety mission. We take our nuclear safety responsibility to the public seriously and will continue to do so within the bounds of our lawful authority. We believe that our actions have been responsive to your concern. If, however, new information is provided that suggests our conclusion should be altered, we will evaluate that information to determine if additional evaluation is needed.

Thank you for notifying us of your concern. If you disagree with our conclusion or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

/RA/

Anne T. Boland, Director
Division of Nuclear Materials Safety

Enclosures:
1. Summary of NRC Evaluation
2. NRC Inspection Report 030-02278/11-02

bcc w/encls 1 and 2: AMS File No. RIII-11-A-0059
*See previous concurrence
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DATE	11/15/11		10/31/11		11/17/11		11/21/11		11/[illegible]/11		11/29/11	

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(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This is in reference to our letter dated August 22, 2011, that stated we would review your concern about activities at the University of Missouri. You were concerned that within Pickard Hall the licensee was aware of several unlabeled areas that contained radiation and radiation was present in the ventilation system. Your concern was the subject of an onsite U.S. Nuclear Regulatory Commission (NRC) inspection that was conducted August 25 and 26, 2011. We have completed our inspection and substantiated your concern. Based on the results of the inspection, we identified a violation of NRC requirements. Enclosure 1 to this letter provides the results of our evaluation. The violation and the inspection activities were documented in Inspection Report 030-02278/11-02 (Enclosure 2).

Allegations are an important source of information in support of the NRC's safety mission. We take our nuclear safety responsibility to the public seriously and will continue to do so within the bounds of our lawful authority. We believe that our actions have been responsive to your concern. If, however, new information is provided that suggests our conclusion should be altered, we will evaluate that information to determine if additional evaluation is needed.

Thank you for notifying us of your concern. If you disagree with our conclusion or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

Anne T. Boland, Director
Division of Nuclear Materials Safety

Enclosures:
1. Summary of NRC Evaluation
2. NRC Inspection Report 030-02278/11-02

bcc w/encls 1 and 2: AMS File No. RIII-11-A-0059

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

November 30, 2011

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0054

Dear (b)(7)(C),(b)(7)(D)

This refers to our letter dated August 10, 2011, regarding activities within Pickard Hall at the University of Missouri. You were concerned that: (1) whole body dosimetry provided to museum staff is not being stored correctly when the staff leaves the museum; (2) the licensee is using mathematical manipulation to assign dose to workers within the museum that wear dosimetry; and (3) the licensee has not provided sufficient guidance to the staff on the use of the sign in/out sheets when entering and exiting elevated radiation areas within the museum. The summary of our evaluation of your concerns is enclosed. We did not substantiate Concerns 1 and 2, and we substantiated Concern 3. However, we did not identify any violations of U.S. Nuclear Regulatory Commission (NRC) requirements.

We plan no further action regarding your concerns at this time. If you disagree with our conclusions or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

Anne T. Boland, Director
Division of Nuclear Materials Safety

Enclosure:
Summary of NRC Evaluation

C|13 13

Summary of U.S. Nuclear Regulatory Commission (NRC) Evaluation

As part of our assessment of your concerns, we requested information and an evaluation from the University of Missouri (licensee) regarding your concerns. The licensee's Radiation Safety Officer prepared a written response which was reviewed by the licensee's independent consultant prior to its submittal to the NRC.

Concern 1:

You were concerned that the whole body dosimetry provided to museum staff within Pickard Hall is not being used correctly to accurately measure the dose received while working in the museum. Specifically, the staff have not been instructed where to store the dosimeter while not working in the building. For example, some staff take the dosimeter home and some leave the dosimeter within the building when they leave the museum.

Summary of Licensee Evaluation of Concern 1:

The licensee has monitored members of the Pickard Hall faculty and staff since January 2010, and provided radiation worker training to these individuals in December of 2009. The training included recommendations for storing dosimetry in or near work stations or storage locations, but did not normally provide specific direction on exact locations for storage as different options and preferences of storage could be utilized by workers. To ensure that there was a clear understanding of how to store dosimetry, the Radiation Safety Officer and the assigned health physicist for Pickard Hall conducted training emphasizing the proper storage of dosimetry while not in use (after receipt of our Request for Information).

The licensee acknowledged that one individual requested storage of his/her dosimeter at home, which was approved by the radiation safety staff. However, that individual now stores his/her dosimeter at work.

The licensee randomly observed and interviewed 12 members of the Pickard Hall faculty and staff to determine whether they possessed appropriate knowledge regarding the storage and wearing of dosimetry. All 12 individuals correctly explained how to wear and store their dosimeters, and were observed to be appropriately wearing and storing their dosimeters.

NRC Evaluation and Conclusion for Concern 1:

An NRC inspector reviewed the licensee's response, Pickard Hall faculty and staff dose and training records, and the radiation safety training outline. We determined that adequate information was provided to the Pickard Hall faculty and staff regarding the correct usage and storage of dosimetry. However, specific storage recommendations were not provided in the training, which could have led to confusion on the proper storage of dosimetry. One individual did take his/her dosimeter home; however, that storage location was approved by the radiation safety staff. In addition, the licensee did not identify any misuse or improper storage of the dosimetry. During our review of the training records, we noted that you received the "Introduction to Radiation Safety" training on December 14, 2009, and specific training emphasizing the proper storage of dosimetry on August 19, 2011 (after the licensee received our Request for Information).

Based on the above, we did not substantiate your concern that the whole body dosimetry provided to museum staff within Pickard Hall was not being used correctly to accurately measure the dose received while working in the museum. We did not identify any violations of NRC requirements. We plan no further action regarding Concern 1 at this time.

Concern 2:

You were concerned that the licensee is using mathematical manipulation to assign dose to workers within the museum. Specifically, you claim the licensee is dividing the exposure values by four of the workers who are wearing dosimetry while working in the museum. You stated that individuals have questioned if the mathematical manipulation is appropriate and the licensee has not explained why the mathematical formula is used.

Summary of Licensee Evaluation of Concern 2:

The licensee stated that they do not use mathematical manipulation to assign dose to workers. The licensee identified that in 2010, three dosimeters from Pickard Hall faculty and staff were lost. However, based upon the consistently low doses received, no adjustments were recommended or made for those individual's doses for 2010. The licensee also stated that, at no time, did they divide exposures by four for any workers wearing dosimetry. The licensee provided independent exposure reports which did not indicate any request for dividing exposures for any workers wearing dosimetry in the museum.

The licensee randomly interviewed 12 members of the Pickard Hall faculty and staff to determine whether they possessed appropriate knowledge regarding how dose was assigned. Eleven of the twelve correctly explained how dose was assigned. None of the 12 believed that dose was mathematically manipulated.

NRC Evaluation and Conclusion for Concern 2:

An NRC inspector reviewed the licensee's response and Pickard Hall faculty and staff dose records. We noted that the licensee performed an evaluation in three instances where museum staff had lost dosimeters; however, such evaluations using previous data and interviews are required to ensure the best possible dose estimate is included as part of an individual's permanent dose record. We did not identify any indication that the licensee or the dosimetry vendor, inappropriately modified exposures for workers who were assigned dosimetry in the museum.

Based on the above, we did not substantiate your concern that the licensee was using mathematical manipulation to assign dose to workers within the museum. We did not identify any violations of NRC requirements. We plan no further action regarding Concern 2 at this time.

Concern 3:

You were concerned that the licensee has not provided sufficient guidance to the staff on the use of sign in/out sheets when entering and exiting elevated radiation areas within the museum. Specifically, the sign in/out sheets are located at multiple access points to the elevated radiation areas with no signs to remind staff to sign in/out and no guidance on who is required to sign in/out. Additionally, the sign in/out sheets were placed in confusing locations which do not facilitate their use. Lastly, staff do not appear to be consistently using the sign in/out sheets.

Summary of Licensee Evaluation of Concern 3:

The licensee indicated that the initial escort (sign in/out) log was put in place to assist in determining how often certain locations in Pickard Hall are entered and how long access was needed. The log form was placed at both the south and north entrances to Room 12. These are the only two entrances to Room 12, and the only way to gain access to Rooms 13 and 15.

The licensee determined from a review of 18 months of log entries that 8 percent of the entries were not in accordance with established procedures. The instructions for using the log are printed on the top of the form itself. However, as a means to improve the accuracy of its use, the licensee developed a new form and created a standard operating procedure (RSIP-A-10-F1, "Escort Log for Pickard Hall Restricted Areas, Rooms 12, 13, 15 and Attic," dated September 2, 2011). The licensee has provided training on the use of the new form to the Pickard Hall faculty and staff who were issued dosimetry.

NRC Evaluation and Conclusion for Concern 3:

The NRC inspector reviewed the licensee's response, Procedure RSIP-A-10-F1, and Pickard Hall faculty and staff training records. Based on the above, we substantiated that the licensee had not provided sufficient guidance to the staff on the use of sign in/out sheets when entering and exiting elevated radiation areas within the museum. The licensee determined that 8 percent of the entries were not in accordance with established procedures. The licensee created Procedure RSIP-A-10-F1, developed a new log form, and provided training on the use of the form to the Pickard Hall faculty and staff who were issued dosimetry.

During our review of the training records, we noted that you received specific training on the use of the log on August 4 and 19, 2011 (after the licensee received our Request for Information).

The NRC does not require the use of the log; therefore, no violations of NRC requirements were identified. We plan no further action regarding Concern 3 at this time.

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0054

Dear (b)(7)(C),(b)(7)(D)

This refers to our letter dated August 10, 2011, regarding activities within Pickard Hall at the University of Missouri. You were concerned that: (1) whole body dosimetry provided to museum staff is not being stored correctly when the staff leaves the museum; (2) the licensee is using mathematical manipulation to assign dose to workers within the museum that wear dosimetry; and (3) the licensee has not provided sufficient guidance to the staff on the use of the sign in/out sheets when entering and exiting elevated radiation areas within the museum. The summary of our evaluation of your concerns is enclosed. We did not substantiate Concerns 1 and 2, and we substantiated Concern 3. However, we did not identify any violations of U.S. Nuclear Regulatory Commission (NRC) requirements.

We plan no further action regarding your concerns at this time. If you disagree with our conclusions or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

Anne T. Boland, Director
Division of Nuclear Materials Safety

Enclosure:
Summary of NRC Evaluation

bcc w/enclosure: AMS File No. RIII-2011-A-0054

G:\ORAIII\EICS\ALLEGATIONS\AMS-LTRS\11 AMS\110054 University of Missouri\110054 Closure Letter.docx

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	RIII	N	RIII	N	RIII	N	RIII	N	RIII	N
NAME	[illegible]		Lipa		Heck		Orth		Boland	
DATE	11/[illegible]/11		11/[illegible]/11		11/[illegible]/11		11/[illegible]/11		11/[illegible]/11	

OFFICIAL RECORD COPY

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

March 6, 2012

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This is in reference to our letter dated November 29, 2011, that provided you the results of the U.S. Nuclear Regulatory Commission's (NRC) evaluation of your concern associated with activities at the University of Missouri. You were concerned that the licensee was aware of several unlabeled areas in the Pickard Hall that contained radiation and radiation was present in the ventilation system.

As we informed you in our letter dated November 29, 2011, we conducted an inspection and substantiated your concern. Based on the results of the inspection, we identified a violation of NRC requirements. Details of the violation and the inspection activities were documented in Inspection Report 030-02278/11-02. Subsequnt to our letter dated November 29, 2011, the licensee provided additional information surrounding the violation. After consideration of the new information, the NRC revised the violation in a letter to the licensee dated Februaury 6, 2012. Attached is a copy of the letter with the revised violation enclosed.

Thank you for notifying us of your concern. If you have any questions or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Paul Pelke, Magdalena Gryglak, Sarah Bakhsh, and me. We can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

James K Heller

James Heller,
Senior Allegation Coordinator

Enclosure:
Letter, "Revised Notice of Violation, NRC Inspection Report No. 030-02278/11-02(DNMS) University of Missouri-Columbia"

C/14

17

February 6, 2012

EA-11-281

Ms. Jacquelyn K. Jones, Vice Chancellor
Administrative Services
University of Missouri-Columbia
319 Jesse Hall
Columbia, MO 65211-1250

SUBJECT: REVISED NOTICE OF VIOLATION, NRC INSPECTION REPORT NO. 030-02278/11-02(DNMS) UNIVERSITY OF MISSOURI-COLUMBIA

Dear Ms. Jones:

The purpose of this letter is to respond to your letter dated November 2, 2011, in which you contested Example A of the violation cited in the Notice of Violation (Notice), enclosed with the U.S. Nuclear Regulatory Commission (NRC) Inspection Report No. 030-02278/11-02(DNMS) issued on September 16, 2011. The Notice contained two examples, Examples A and B, of a Severity Level IV violation involving Title 10 of the Code of Federal Regulations (CFR) 20.1501.

In your response to the Notice you contested Example A, involving the failure to make surveys to determine the quantity of licensed material which could affect the determination of security of those areas. Specifically, elevated radiation levels were identified by the NRC in McLorn Gallery (room 205), wall of the storage room on the second floor (room 213), Research Laboratory 17, the Lecture Hall (room 106), outside the Staff Office 9 in the corridor, above the 9 foot level of Offices 111 and 112 and the Julius Carlebach Gallery (room 206). You provided additional information regarding Example A of the 10 CFR 20.1501 violation. On December 23, 2011, the NRC acknowledged your November 2, 2011, letter that was received on November 29, 2011, and advised you that we would evaluate the information in your letter and inform you of the results of our evaluation.

In accordance with NRC policy and procedures, Region III has completed an independent assessment and review of the contested matter. Based on the independent review, the NRC has reached a conclusion, as described below.

In your November 2, 2011 letter, you provided information for those areas that had been identified as having elevated radiation levels and indicated that surveys had been performed. Your letter also stated that the identified areas had previously been secured from unauthorized removal or access to licensed material. The independent reviewer considered all information available to the NRC pertaining to this matter, including the Conversation Record describing your 2009 survey results and the additional information you provided with your response. Based on this review, the NRC has concluded that you had performed sufficient surveys to determine the quantity of licensed material that could affect the determination of security of those areas in accordance with 10 CFR 20.1801.

ENCLOSURE

Therefore, Example A of the violation of 10 CFR 20.1501 is withdrawn. Enclosed is the revised violation citing only Example B, which concerns the failure to make surveys to determine the quantity of licensed material which could affect whether posting those areas are required in accordance with 10 CFR 20.1902(e). The violation from the Notice enclosed with NRC Inspection Report No.030-02278/11-02(DNMS), dated September 16, 2011, is superseded by the revised violation in the enclosure to this letter.

Based on your response and actions that you have taken, we do not require any further information concerning the violation.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have any questions regarding this matter please contact Patrick Louden of my staff at (630) 829-9801.

Sincerely,

/RA/

Jennifer L. Uhle
Acting Deputy Regional Administrator

Docket No. 030-02278
License No. 24-00513-32

Enclosure:
Revised Notice of Violation

cc w/encl: Maureen Kotlas, Director,
Environmental Health and Safety
Jack Crawford, Radiation Safety Officer
Silvia Jurisson, MU Radiation Safety
Committee Chair
State of Missouri

Revised Notice of Violation, Inspection Report 030-02278/11-02(DNMS), dated September 16, 2011

Replace the violation from that Notice of Violation (Notice) with the violation below:

REVISED NOTICE OF VIOLATION

Title 10 Code of Federal Regulations (CFR) 20.1501 requires that each licensee make or cause to be made surveys that may be necessary for the licensee to comply with the regulations in Part 20 and that are reasonable under the circumstances to evaluate the extent of radiation levels, concentrations or quantities of radioactive materials, and the potential radiological hazards that could be present.

Contrary to the above, as of August 25, 2011, the licensee did not make surveys to assure compliance with 10 CFR 20.1902(e), which requires posting of areas or rooms in which licensed material is used or stored. Specifically, elevated radiation levels were identified in McLorn Gallery (room 205), wall of the storage room on the second floor (room 213), Research Laboratory 17, the Lecture Hall (room 106), outside the Staff Office 9 in the corridor, above the 9 foot level of Offices 111 and 112, and the Julius Carlebach Gallery (room 206), and the licensee did not make surveys to determine the quantity of licensed material which could affect whether posting in those areas is required.

This is a Severity Level IV violation (Section 6.3).

Enclosure

(b)(7)(C),(b)(7)(D)

SUBJECT: ALLEGATION NO. RIII-11-A-0059

Dear (b)(7)(C),(b)(7)(D)

This is in reference to our letter dated November 29, 2011, that provided you the results of the U.S. Nuclear Regulatory Commission's (NRC) evaluation of your concern associated with activities at the University of Missouri. You were concerned that the licensee was aware of several unlabeled areas in the Pickard Hall that contained radiation and radiation was present in the ventilation system.

As we informed you in our letter dated November 29, 2011, we conducted an inspection and substantiated your concern. Based on the results of the inspection, we identified a violation of NRC requirements. Details of the violation and the inspection activities were documented in Inspection Report 030-02278/11-02. Subsequnt to our letter dated November 29, 2011, the licensee provided additional information sorrounding the violation. After consideration of the new information, the NRC revised the violation in a letter to the licensee dated Februaury 6, 2012. Attached is a copy of the letter with the revised violation enclosed.

Thank you for notifying us of your concern. If you have any questions or wish to provide additional information, please contact an NRC Region III Office Allegation Coordinator. The NRC Region III Office Allegation Coordinators are Paul Pelke, Magdalena Gryglak, Sarah Bakhsh, and me. We can be contacted by: (1) writing to the U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352; (2) calling the NRC Region III switchboard toll free at (800) 522-3025; or (3) sending an e-mail to their common e-mail address, which is **Allegations.RegionIII@nrc.gov.**

Sincerely,

/RA/

James Heller,
Senior Allegation Coordinator

Enclosure:
Letter, "Revised Notice of Violation, NRC Inspection Report No. 030-02278/11-02(DNMS) University of Missouri-Columbia"

bcc w/encl: AMS File No. RIII-11-A-0059

EXPRESS MAIL

DOCUMENT NAME: G:\ORAIII\EICS\ALLEGATIONS\AMS-LTRS\11 AMS\110059 University of Missouri\110059 Letter to CI with Revised Violation.docx
To receive a copy of this document, indicate in the box "C" = Copy w/o attach/encl "E" = Copy w/attach/encl "N" = No copy

OFFICE	RIII	N	RIII	N						
NAME	Gryglak MG		Heller*							
DATE	03/1/12		03/6/12							

OFFICIAL RECORD COPY

Lugaras, Harral

From:	Kozak, Laura
Sent:	Friday, May 24, 2013 9:30 AM
To:	ALL_R3
Subject:	Daily morning meeting notes
Attachments:	Daily Morning Meeting News 05-24-13.docx

The Daily Morning Meeting News for Thursday May 24, 2013
Note: This newsletter may contain pre-decisional information.
Do not distribute outside the NRC.

Support Issues:

Outside of Scope

Materials Events/Issues

Outside of Scope

University of Missouri – Columbia issued a press release yesterday regarding some facility upgrades which include the decommissioning of Pickard Hall (radium contamination) in the next couple of years.

Reactor Events

Plant Status

Outside of Scope

C/15

Outside of Scope

Outside of Scope

INITIAL ARB ALLEGATION NO. RIII-2011-A-0054

July 26, 2011

MEMORANDUM TO: Christine Lipa, Chief, Materials Control, ISFSI, Decommissioning Branch, DNMS

FROM: Sarah Bakhsh, OAC, RIII

SUBJECT: **INITIAL ARB: RIII-2011-A-0054 (University of Missouri)**

On (b)(7)(C),(b)(7)(D) regarding activities at the Curators of the University of Missouri. Your staff's July 21, 2011 email provided a summary of the safety issues, the regulatory bases, and recommended actions to be further discussed during the ARB. **I have scheduled an ARB on Monday, August 1, 2011.** Please review the enclosed information to prepare for the ARB.

cc w/enclosures:

ARB Copy
(b)(7)(C)
Jared Heck
Paul Pelke
Steven Orth
James Heller
Magdalena Gryglak
Rebecca Stricklin
Kenneth Lambert
Michael LaFranzo
David Vito, OE
Lisamarie Jarriel, OE

5

C|16

Licensee: Curators of the University of Missouri
Docket No: 030-02278 License No:
Assigned Division/Branch: DNMS / MCID

ARB Board Membership: Boland / (b)(7)(C) Heck/ Heller/ Bakhsh/ LaFranzo/ Orth/ Lipa

Purpose: Initial ARB to discuss the concerns and recommended evaluation plan
GENERIC CONCERNS: If Yes Explain:
DISCUSSION OF SAFETY SIGNIFICANCE: no immediate health and safety issues

OI ACCEPTANCE: YES NO (Priority: **HIGH** **NORMAL** **LOW**)

Basis for OI Priority:

OI has Accepted Concern(s) No(s). _________ Signature _____________

minutes RDS distributed 8/8/11

MINUTES PROVIDED TO: Pederson / (b)(7)(C) Lipa/

ACKNOWLEDGMENT LETTER: PRINT IN FINAL __ REVISE _____ N/A____

REQUEST FOR EVALUATION: A. Licensee YES ____ 10 CFR 2.390____NO ____
B. State of YES ____ NO __X__
C. DOE YES _____ NO __X__

date received	7/15/2011	due date of 1st ARB	8/14/2011
due date of ACK Ltr	8/14/2011	date - 90 days old	10/13/2011
date - 120 days old	11/12/2011	date - 150 days old	12/12/2011
date - 180 days old	1/11/2012	date - 360 days old	7/9/2012
projected date for the 5 yr statue of limitation			7/12/2016

COMMENTS:

The CI **did not** object to having identity released.

The CI **did not** object to having the concern(s) forwarded to the licensee.

**** Please note: All actions assigned by the ARB must have due dates documented in the minutes. The EICS staff will enter all action items into AMS for tracking.**

[signature]
Allegation Review Board Chairman

08/01/2011
Date

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Concern No. 1: An individual is concerned that the whole body dosimetry devices provided to certain members of the Museum staff are not being used correctly to accurately measure the doses received from working in the Museum. Specifically, there are no guidelines provided by the licensee regarding where to store the dosimeter while not working in the building. For example, some individuals take the dosimeters home with them and some leave the dosimeters within the building after the individual leaves the building.

Regulatory Basis:

10 CFR 20.1501(a): "Each Licensee shall make or cause to be made surveys that may be necessary for the licensee to comply with 10 CFR 20.1201- Occupational dose limits for adults."

10 CFR 201.1502(a): "Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum each licensee shall monitor occupational exposure to radiation from licensed and unlicensed radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices by..."

Assessment of safety significance of this concern:

I. Action Evaluation: The following method of resolution is recommended (circle):

A. **Send to Licensee Requesting Response in 30 Days.**
B. Priority RIII Follow up and Closure Memo to OAC
C. Follow up During Routine Inspection Within _____ Days and Closure Memo to OAC
D. Discrimination (Complete & Attach MD 8.8 Exhibit 3)
   1. Offer ADR.
   2. Reason why ADR should not be offered
   3. Priority for the OI investigation if ADR is not used: HIGH/NORMAL/LOW Recommended Basis:
E. All other OI referrals. (Complete and attach section 7 of RP 8.8) Priority for the OI investigation: HIGH/NORMAL/LOW Recommended Basis:
F. Outside NRC's Jurisdiction. Describe Basis Below.
G. Too General for Follow-up. Describe Basis Below.
H. Other.

Responsible for Action - EICS

II. Special Considerations/Instructions:

The licensee is aware of the concern as the (b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D) The licensee should be able to determine, with minimal effort, should be able to determine where staff is storing the dosimetry and under what circumstances to ensure compliance with NRC requirements.

The CI did not object to the referral of the concern to the licensee.

Potential Questions for the licensee:
How many individuals in the Museum
are wearing whole body dosimetry?
How do those individuals store the dosimetry when not required to wear it? Does the licensee take into account various storage methods when assigning doses to individuals?
How does the licensee document exposures assigned to each individual?

At the August 1, 2011 ARB:

- **M Lafranzo discussed the background of the concern and recommended actions**
- **To address whether or not we provide an answer to the CI's** (b)(7)(C),(b)(7)(D) (b)(7)(C),(b)(7)(D) (b)(7)(C),(b)(7)(D)**, include a question on RFI – "How is the staff educated on the issues (dosimetry storage)"**
- **ARB agreed to send RFI to licensee**

Concern No. 2: An individual is concerned that the licensee is using a mathematical manupulation to assign doses to the CI and others working within the Museum, the manupulation is not appropriate and the licensee has not explained why the mathematical formula is being used. Specifically, the CI claims that the licensee is dividing the exposure values by 4 and the licensee has not explained why to the CI or others working in the Museum issued dosimetry.

Regulatory Basis:

10 CFR 20.1501(a): "Each Licensee shall make or cause to be made surveys that may be necessary for the licensee to comply with 10 CFR 20.1201- Occupational dose limits for adults."

10 CFR 201.1502(a): "Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum each licensee shall monitor occupational exposure to radiation from licensed and unlicensed radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices by..."

Assessment of safety significance of this concern:

I. Action Evaluation: The following method of resolution is recommended (circle):

A. Send to Licensee Requesting Response in 30 Days.
B. Priority RIII Follow up and Closure Memo to OAC
C. Follow up During Routine Inspection Within _____ Days and Closure Memo to OAC
D. Discrimination
   1. Offer ADR.
   2. Reason why ADR should not be offered
   3. Priority for the OI investigation if ADR is not used: HIGH/NORMAL/LOW Recommended Basis:
E. All other OI referrals.
F. Priority for the OI investigation: HIGH/NORMAL/LOW Recommended Basis:
G. Outside NRC's Jurisdiction. Describe Basis Below.
H. Too General for Follow-up. Describe Basis Below.
I. Other.

Responsible for Action - EICS

II. Special Considerations/Instructions:

The licensee is aware of the concern as the [redacted] (b)(7)(C),(b)(7)(D) The licensee should be able to explain the methods used to assign exposures to individuals under their dosimetry program.

The CI did not object to the referral of the concern to the licensee.

Potential Questions for the licensee:
How many individuals in the Museum are wearing whole body dosimetry?
How do those individuals store the dosimetry when not required to wear it?
Is the licensee using a mathematical formula and dividing the exposures documented by the dosimetry vendor by 4?
If so, what is the reason the licensee is dividing the exposures documented by the dosimetry vendor by 4? (make this open ended)
Is the licensee modifying any assigned exposures by the vendor and using those modified assigned exposures to document the exposure to the individual as part of the licensee's dosimetry program?

At the August 1, 2011 ARB:

At the August 1, 2011 ARB:

- **M Lafranzo discussed the background of the concern and recommended actions**
- **ARB agreed with RFI to licensee**

Concern No. 3: The licensee has a sign in/out sheet for those individuals entering and exiting elevated radiation areas within the Museum. The CI is concerned that the licensee has provided insufficient guidance to the staff using those sign in/out sheets and have placed them in confusing locations which do not facilitate the use of those forms. Specifically, the licensee has forms at multiple access points to the elevated radiation areas, no signs to remind staff to sign in and out and no guidance on who is required to sign in and out. Personel appear not to be using these sign in sheets consistently.

Regulatory Basis:

10 CFR 20.1501(a): "Each Licensee shall make or cause to be made surveys that may be necessary for the licensee to comply with 10 CFR 20.1201- Occupational dose limits for adults."

10 CFR 201.1502(a): "Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum each licensee shall monitor occupational exposure to radiation from licensed and unlicensed radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices by..."

Assessment of safety significance of this concern:

I. Action Evaluation: The following method of resolution is recommended (circle):

   A. **Send to Licensee Requesting Response in 30 Days.**
   B. Priority RIII Follow up and Closure Memo to OAC
   C. Follow up During Routine Inspection Within _____ Days and Closure Memo to OAC
   D. Discrimination
      1. Offer ADR.
      2. Reason why ADR should not be offered
      3. Priority for the OI investigation if ADR is not used: HIGH/NORMAL/LOW Recommended Basis:
   E. All other OI referrals.
   F. Priority for the OI investigation: HIGH/NORMAL/LOW Recommended Basis:
   G. Outside NRC's Jurisdiction. Describe Basis Below.
   H. Too General for Follow-up. Describe Basis Below.
   I. Other.

   Responsible for Action - EICS

II. Special Considerations/Instructions:

The licensee is aware of the concern as (b)(7)(C),(b)(7)(D)
(b)(7)(C),(b)(7)(D)
(b)(7)(C),(b)(7)(D)
(b)(7)(C),(b)(7)(D) The licensee should be able to explain how the sign in/out procedure works.

Potential Questions for the licensee:
Who is required/expected to sign in/out of the elevated exposure areas in the Museum?
What is the purpose of the sign in/out sheets?
How many access points does the licensee have into the assigned areas that require sign in/out?
Has the licensee noted any issues regarding individuals forgetting to sign in/out of the areas?
Has the licensee determined whether multiple access points with multiple sign in/out sheets have cause confusion with the individuals gain access or has caused the information gathered via multiple access points to be ineffective with the reason for sign in/out sheets?

At the August 1, 2011 ARB:

- **M Lafranzo discussed the background of the concern and recommended actions**
- **Added following sentence to the end of the concern -** "Personel appear not to be using these sign in sheets consistently."
- **Include on RFI how the licensee ensures consistency amongst staff with the usage of the sign in sheets**
- **ARB agreed with RFI to licensee**

[redacted]

C/17

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August 3, 2011

MEMORANDUM TO: Christine Lipa, Chief, Materials Control, ISFSI, and Decommissioning Branch, DNMS

FROM: Paul Pelke, Office Allegation Coordinator, EICS

SUBJECT: **INITIAL ALLEGATION REVIEW BOARD (ARB) SCHEDULED: RIII-2011-A-0059 (UNIVERSITY OF MISSOURI)**

On July 29, 2011, Michael LaFranzo received an allegation from a concerned individual regarding activities at the University of Missouri (Pickard Hall). The individual is concerned the licensee is aware of several "hot spots" (elevated levels of radiation) that the licensee has not labeled as "Radioactive," and radiation is present in ventilation ducts.

I have added this allegation to the agenda for the ARB that will be conducted on **Monday, August 8, 2011.**

Please review the enclosed information to prepare for the ARB.

Enclosure: As stated

cc w/enclosure:
ARB Copy
(b)(7)(C)
Jared Heck
James Heller
Michael LaFranzo
Wayne Slawinski
Rebecca Stricklin
Magdalena Gryglak
Sarah Bakhsh
David Vito
Lisamarie Jarriel
RIIIDNMS_ADMIN

Licensee: University of Missouri
Docket No. 030-02278
License No. 24-00513-32

Assigned Division/Branch: DNMS/MCID

ARB Board Membership: Louden/ (b)(7)(C) / Heck/ Orth/ Paul Pelke/ LaFranzo/ Heller/ Lipa

Purpose: Initial ARB to discuss the concern
GENERIC CONCERNS: If Yes Explain:
DISCUSSION OF SAFETY SIGNIFICANCE: No immediate health and safety concerns

OI ACCEPTANCE:

Basis for OI Priority:

OI has Accepted Concern(s) No(s). ________ Signature ________

minutes distributed 8/9/11 RDS

MINUTES PROVIDED TO: Pederson/ (b)(7)(C) / Lipa

ACKNOWLEDGEMENT LETTER: **PRINT IN FINAL X**

REQUEST FOR EVALUATION: A. Licensee **NO _X_**
B. State of YES ___ NO _X_
C. DOE YES ___ NO _X_

date received	07/29/2011	due date of 1st ARB	08/28/2011
due date of ACK Ltr	08/28/2011	date - 90 days old	10/27/2011
date - 120 days old	11/26/2011	date - 150 days old	12/26/2011
date - 180 days old	01/25/2012	date - 360 days old	07/23/2012
projected date for the 5 yr statue of limitation			07/26/2016

COMMENTS:

The individual objects to release of his/her identity and objects to a Request for Information to the licensee.

[signature] 8.8.11
Allegation Review Board Chairman Date

5

Concern No. 1:

An individual is concerned the licensee is aware of several "hot spots" (elevated levels of radiation) that the licensee has not labeled as "Radioactive." Specifically, (b)(7)(C),(b)(7)(D) (b)(7)(C),(b)(7)(D) when the Radiation Safety Staff were performing radiation surveys over the last year and (b)(7)(C),(b)(7)(D) from the radiation survey instrument, indicating elevated radiation levels which include, but not limited to: (a) on the wall of McLoran or Eilenberg gallery; (b) in the storage room on the second level; (c) in the Preparation Lab/Storage area; and (d) in Room 106 (lecture hall) near the speaker system. The individual is concerned that radiation is present in the ventillation ducts behind the walls in the McLoran or Eilenberg gallieries, storage room on the second level, and Room 106 near the speaker system.

Regulatory Basis:

The licensee is required to use procedures and engineering controls to achieve occupational doses and doses to members of the public As Low As Reasonably Achievable (ALARA) - 10 CFR 20.1101(b). Also, it is possible that the licensee did not post or label all areas where elevated radiation levels would be in accordance with 10 CFR 20.1902; or the licensee failed to perform adequate radiological surveys to ensure compliance with 10 CFR Part 20 – 10 CFR 20.1501 – concerning occupational dose or dose to a member of the public.

Assessment of safety significance of this concern:

Based upon current information from previous inspections, it is unlikely the elevated radiation areas identified by the individual would exceed levels for posting requirements concerning radiation exposure and also unlikely NRC radiation dose limits have been exceeded. An ALARA issue may be present.

I. Action Evaluation: The following method of resolution is recommended (circle):

A. Send to Licensee Requesting Response in 30 Days.
B. Priority RIII Follow up and Closure Memo to OAC
C. Follow up During Routine Inspection Within 30 Days and Closure Memo to OAC
D. Discrimination
   1. Offer ADR.
   2. Reason why ADR should not be offered
   3. Priority for the OI investigation if ADR is not used: HIGH/NORMAL/LOW
      Recommended Basis:
E. All other OI referrals.
   Priority for the OI investigation: HIGH/NORMAL/LOW Recommended Basis:
F. Outside NRC's Jurisdiction. Describe Basis Below.
G. Too General for Follow-up. Describe Basis Below.
H. Other.

Responsible for Action - DNMS/MCID Branch

II. Special Considerations/Instructions:

The individual objects to having the licensee review the concern (b)(7)(C),(b)(7)(D) (b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D) Due to the number of locations identified, the possible unidentified locations, perceived lack of adequate licensee response, and the individual's objection to having the licensee review the concern, DNMS believes that an on-site inspection is warranted.

An MCID inspector plans to be in the State of Missouri the week of August 22, 2011 and can review the concern at that time.

At the August 8, 2011 ARB:

- **MLaFranzo discussed the intake, the concern, and the evaluation plan.**
- **ARB agreed with the evaluation plan (inspection). The Closure memo to be provided to EICS by October 8, 2011**
- **The results of the evaluation will be documented in an inspection report since aspect of the concern are in ADAMS based on the [redacted] to the decommission plan.** (b)(7)(C),(b)(7)(D)

ALLEGATION RECEIPT FORM

Please email the following information to OAC3, JKH, PRP

Received By: Michael LaFranzo	Receipt Date: 7/29/2011
Receipt Method: (meeting, phone call, letter)	Phone Call

FACILITY

Facility Name	Curators of the University of Missouri
Location	Columbia, Missouri
Docket(s)	030-02278

CONCERN ***Records of conversations for receipt of allegations should contain the following information as a minimum. Obtain as many concern specifics as possible.***

1. What is the concern?

The CI is concerned that the licensee is aware of several "hot spots" (elevated levels of radiation) that the licensee has not labeled as "Radioactive." Specifically, (b)(7)(C),(b)(7)(D) when the Radiation Safety Staff were performing radiation surveys over the last year (b)(7)(C),(b)(7)(D) from the radiation survey instrument, indicating elevated radiation levels: A) On the wall of McLoran or Ellenberg gallery; b) Storage room on the second level; c) Preparation Lab/Storage area; d) and Room 106, (lecture hall) near the speaker system. The CI suspects that radiation in the vents behind the walls in McLoran or Eilenberg gallieries, storage room on the second level and Room 106 near the speaker system. The CI is concerned that these "hot spots" are not labeled which does not provide adequate protection for the people visiting or working in the area to avoid those areas.

2. When did the concern occur?

The CI has been concerned for (b)(7)(C),(b)(7)(D)
(b)(7)(C),(b)(7)(D)

3. Is this an ongoing concern?

Yes

4. Who was involved?

Licensee's Radiation Safety Staff

5. Were there any witnesses?

The CI believes that numerous individuals in Pickard Hall are aware of the elevated radiation levels but, since the locations are not labeled, they do not know specifics.

6. What is the potential safety impact?

As the CI is not familiar with the use of survey instruments or radiation dose, he/she is not sure (b)(7)(C),(b)(7)(D)
(b)(7)(C),(b)(7)(D)

7. Ask the CI what requirement/regulation does the individual believe governs this concern? (If the CI does not have this information, please document this response. If the CI does not provide this information and the individual receiving the allegation can obtain the information within the 3 day deadline for forwarding the information to EICS, the information should be provided by the NRC staff member)

The CI is not sure if a regulation could be violated. Based upon current information, it is unlikely the areas identified by the CI exceed posting regulations for radiation exposure. However, the licensee is required to use procedures and engieerng controls to achieve occupational doses and doses to members of the public As Low As Reasonably Achievable (ALARA) - 10 CFR 20.1101(b). Also, it is possible that the licensee did not post or label all areas where elevated radiation levels would be - 10 CFR 20.1902.

8. Ask the CI what records should the NRC review?

The CI stated that the licensee is aware of the locations concerning the elevated radiation levels - the licensee should have that survey documentation on file.

9. Ask the CI what other individuals could the NRC contact for information?

The CI stated that the Radiation Safety Staff should be aware of the locations of elevated radiation levels.

10. How did the individual find out about the concern?

(b)(7)(C),(b)(7)(D)

11. Was the concern brought to management's attention? If so, what actions have been taken; if not, why not?

(b)(7)(C),(b)(7)(D)

12. Was a condition report (or other corrective action document) initiated in response to the issue? If so, what was the resolution?

(b)(7)(C),(b)(7)(D)

13. Is the individual satisfied with the licensee's response? If not, why?

No, (b)(7)(C),(b)(7)(D)

(b)(7)(C),(b)(7)(D)

14. If the licensee has not responded, does the individual wish to wait on the licensee's response before NRC pursues the issue? If not, why?

(b)(7)(C),(b)(7)(D)

15. What does the individual believe NRC should do in regard to this concern?

The CI would like the NRC to perform a safety inspection to identify elevated radiation levels and to require the licensee to label those areas so he/she and others that work in the area can avoid them.

16. What is the inspector's recommended follow up action?
(Also indicate whether the BC has approved the recommended actions.)

DNMS recommends that an on-site inspection be performed to review those areas where elevated radiation areas are and to review documentation associated with the radiation surveys in those areas.

17. Inspector Assessment of the Issue/Background Information:

The inspector is aware that the licensee has performed radiation surveys and identified numerous areas where elevated radiation levels are located where members of the public and staff within Pickard Hall visit and work. The inspector is aware of several of the elevated radiation areas but not all. A review of the last inspection report, 030-02278/2010-001(DNMS), was not specific enough in the location of elevated radiation levels identified during the inspection to determine whether the CI's concern can be adequately addressed.

<table>
<tr><th colspan="4">ALLEGER INFORMATION</th></tr>
<tr><td>Full Name</td><td>xxxxxxxx</td><td>Employer</td><td>xxxxxxxxxxxxxxxx</td></tr>
<tr><td>Mailing Address (Home)</td><td>xxxxxxxxxxxx</td><td>Occupation</td><td>xxxxxxxxxxxxxxxxxxxxxx</td></tr>
<tr><td>Telephone</td><td>xxxxxxxxxxxxxxxxxxxx</td><td>Relationship to facility</td><td>xxxxxxxxxxxxxxxxxx</td></tr>
<tr><td>Preference for method and time of contact</td><td>xxxxxxxxxxxxxxxxxxx</td><td>Was the individual advised of limitations on identity protection?</td><td>Yes</td></tr>
<tr><td colspan="4">Referral: Explain that if the concerns are referred to the licensee, that the NRC will review and evaluate the thoroughness and adequacy of the licensee's response. If the concerns are an agreement state issue or the jurisdiction of another agency, explain that we will refer the concern to the appropriate agency. If the CI agrees, we will provide the CI's identity for follow up by the agreement state or other agency.</td></tr>
<tr><td>Does the individual object to referral?</td><td>Yes</td><td>Does the individual object to releasing their identity?</td><td>Yes</td></tr>
<tr><td>If the issue involves another agency, does the individual object to referral to the agency and release of identity to that agency?</td><td>Case does not involve referral.</td><td>Was the individual informed that objecting to referral to another agency might impact review of the concern?</td><td>NA</td></tr>
<tr><td colspan="4">Discrimination: Regulations prohibit NRC licensees (including contractors and subcontractors) from discriminating against individuals who engage in protected activities (alleging violations of regulatory requirements, refusing to engage in practices made unlawful by statues, etc.).</td></tr>
<tr><td>1. Does the concern involve discrimination? If so, was the CI informed that identity will be released during an investigation?</td><td>No</td><td>2. Was the individual advised of the DOL process and the 180 day restriction on filing?</td><td>NA</td></tr>
<tr><td colspan="4">3. What adverse actions have been taken? When?
NA</td></tr>
<tr><td colspan="4">4. Why does the individual believe the actions were taken as a result of engaging in a protected activity?
NA</td></tr>
<tr><td colspan="4">5. What does the individual believe was the protected activity?
NA
What safety issues did the individual raise? When? (DOCUMENT ABOVE)
NA
Did you contact the NRC about these safety issues? Was/Is your management aware that you informed the NRC?
NA</td></tr>
<tr><td colspan="4">Provide the CI with the OAC contact information (names of OACs) and RIII switchboard number (1-800-522-3025). Explain the allegation process (CI will receive an acknowledgment letter within 30 days and will be advised of NRC's resolution of the issue(s) via letter.)</td></tr>
</table>

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

August 15, 2011

Ms. Jacquelyn K. Jones
Vice Chancellor for Administrative Services
University of Missouri
319 Jesse Hall
Columbia, MO 65211

SUBJECT: REQUEST FOR INFORMATION: TRACKING NUMBER 11-A-0054

Dear Ms. Jones:

The U.S. Nuclear Regulatory Commission (NRC) recently received information concerning activities at the University of Missouri. The details are enclosed for your evaluation.

We request that the results of your evaluation of this matter be submitted to the NRC Region III within 30 days of the date of this letter. Your response to this request should not be docketed, and should be sent in an envelope addressed to the NRC Region III Enforcement/Investigations Officer, U.S. Nuclear Regulatory Commission, Region III, at 2443 Warrenville Road, Suite 210, Lisle, Illinois 60532-4352.

We also request that your response contain no personal privacy, proprietary, or safeguards information. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response identifying the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by Title 10 of the Code of Federal Regulations (10 CFR) 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

The documented results of your evaluation should include sufficient information for the NRC to determine: (a) if the concern was substantiated; (b) that the organization or individual conducting the evaluation was independent of the concern and was proficient in the related functional area; (c) that the evaluation was of sufficient depth and scope to determine that the appropriate root causes and generic implications were considered; (d) that any corrective

~~The enclosure to this letter is considered "NOT FOR PUBLIC DISCLOSURE." The enclosure should be controlled and distribution should be limited to personnel with a "need to know."~~

C/18 7

actions, both planned and completed, were sufficient to correct the specific example and generic implications and to prevent recurrence; (e) if your evaluation identified any compliance issues with NRC regulatory requirements or commitments, the corrective actions taken or planned, and the corrective action document that addressed the issues; (f) if interviews of individuals were conducted as part of your review, the basis for determining that the number and cross section of individuals interviewed, as well as the scope of the interview, was appropriate to obtain the information necessary to fully evaluate the subject concern, and the interview questions used; and (g) if your evaluation included a sample review of related documentation and/or potentially affected structures, systems, and components, your response should include the basis for determining that the selected sample size was appropriately representative and adequate to obtain the information necessary to fully evaluate the concerns. The NRC will consider these factors in reviewing the adequacy of your evaluation.

The enclosure to this letter should be controlled and distribution should be limited to personnel with a "need to know." The enclosure to this letter is considered "NOT FOR PUBLIC DISCLOSURE." The response requested by this letter and the accompanying enclosure are not subject to the clearance procedures of the Office of Management and Budget as required by the Paperwork Reduction Act of 1980, Pub. L. 96-511.

We appreciate your cooperation and ask that you contact one of the NRC Region III Allegation Coordinators as your review effort begins, to assure a common understanding of the issues discussed in the enclosure, and the NRC's expectations for follow-up and response. The NRC Region III Allegation Coordinators are Jim Heller, Paul Pelke, Magdalena Gryglak, and Sarah Bakhsh. They can be reached at (630) 829-9500.

Sincerely,

Steven K. Orth
Enforcement/Investigations Officer

Enclosure:
Details (NOT FOR PUBLIC DISCLOSURE)

Please reference Tracking Number 11-A-0054 in your response.

Detail 1:

An individual is concerned that the whole body dosimetry provided to members of the museum staff in Pickard Hall is not being used correctly to accurately measure the dose received while working in the museum. Specifically, the staff have not been instructed where to store the dosimeter while not working in the building. For example, some staff take the dosimeter home and some leave the dosimeter within the building when they leave the museum.

In addition to the information requested by the cover letter, please address or provide the following:

A. How many individuals in the museum are wearing whole body dosimetry?

B. How do those individuals store the dosimetry when not required to wear it?

C. Please provide a copy of any instructions or training material that provides guidance to workers on the proper way to wear and proper location to store the dosimetry.

D. If training was provided, please provide the outline and attendance sheets.

E. Please provide the dose each worker has received for the last 12 months, as documented by the vendor who processes the dosimetry.

F. Does the licensee take into account various storage methods when assigning doses to individuals?

G. How does the licensee document exposures assigned to each individual?

Detail 2:

An individual is concerned that the licensee is using mathematical manipulation to assign dose to workers within the museum. Specifically, the individual claimed the licensee is dividing the exposures by four of the workers who are wearing dosimetry while working in the museum. The individual stated that workers have questioned if the mathematical manipulation is appropriate and the licensee has not explained why the mathematical formula is used.

In addition to the information requested by the cover letter, please address or provide the following:

A. Are you dividing the exposures documented by the vendor who processes the dosimetry by four or any other number?

B. If so, please explain why. Please provide a copy of the procedure or evaluation that addresses the manipulation of the exposures.

Detail 3:

An individual is concerned that the licensee has not provided sufficient guidance to the staff on the use of sign in/out sheets when entering and exiting elevated radiation areas within the museum. Specifically, the sign in/out sheets are located at multiple access points to the elevated radiation areas with no signs to remind staff to sign in/out and no guidance on who is required to sign in/out. Additionally, the sign in/out sheets were placed in confusing locations which do not facilitate their use. Lastly, staff do not appear to be consistently using the sign in/out sheets.

In addition to the information requested by the cover letter, please address or provide the following:

A. Who is required/expected to sign in/out of the elevated exposure areas in the museum?

B. How many access points with sign in/out sheets are in place? If there are multiple access points, is there any confusion associated with the use of the sheets? Are there examples of individuals not using (or forgetting to use) the sheets?

C. What is the purpose of the sign in/out sheets and how is the information used?

D. Please provide a copy of the administrative procedure or instruction that addresses the sign in/out sheets.

E. Please provide a copy of any instruction or training material used to instruct workers on the use of the sign in/out sheets.

F. If training was provided, please provide the outline and attendance sheets.

actions, both planned and completed, were sufficient to correct the specific example and generic implications and to prevent recurrence; (e) if your evaluation identified any compliance issues with NRC regulatory requirements or commitments, the corrective actions taken or planned, and the corrective action document that addressed the issues; (f) if interviews of individuals were conducted as part of your review, the basis for determining that the number and cross section of individuals interviewed, as well as the scope of the interview, was appropriate to obtain the information necessary to fully evaluate the subject concern, and the interview questions used; and (g) if your evaluation included a sample review of related documentation and/or potentially affected structures, systems, and components, your response should include the basis for determining that the selected sample size was appropriately representative and adequate to obtain the information necessary to fully evaluate the concerns. The NRC will consider these factors in reviewing the adequacy of your evaluation.

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Sincerely,

Steven K. Orth
Enforcement/Investigations Officer

Enclosure:
Details (NOT FOR PUBLIC DISCLOSURE)

bcc w/encl: AMS File No. RIII-11-A-0054

DOCUMENT NAME: G:\ORA\IEICS\ALLEGATIONS\AMS-LTRS\11 AMS\110054 University of Missouri\110054 Ltr2lic.docx

OFC	RIII	N	RIII	N	RIII	N		
NAME	Heller		Lipa		Orth			
DATE	8/14/11		8/11/11		8/6/11			

OFFICIAL RECORD COPY

University of Missouri
Pickard Hall
Characterization Work Plan

University of Missouri
Museum of Art and Archaeology
1 Pickard Hall Columbia, MO 65211-1420

To Be Performed Under:
Chase Environmental Group, Inc.
Commonwealth of Kentucky
Radioactive Materials
License No. 201-605-90

November 2009

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830

C/19

TABLE OF CONTENTS

1.0 INTRODUCTION

The University of Missouri (MU) has identified residual radioactivity in the basement of Pickard Hall located on campus at 1 Pickard Hall Columbia, MO 65211-1420. Pickard Hall, built in 1892, is currently being used as the Museum of Art and Archaeology and houses the Department of Art History and Archaeology. The museum is located on the first and second floors of the building and the basement is currently used for storage of museum artifacts and office space for faculty. The building is listed on the National Register of Historic Places.

The basement of Pickard Hall was used for separation of radium from uranium ores in the early 1900's. Residual radioactivity exists on structural surfaces and is being routinely monitored by MU. Surveys indicate that residual radioactivity exists on concrete structural surfaces that are mostly covered with flooring materials and are effectively encapsulated. It is fairly certain that residual radioactive materials are limited to the basement. While the presence of these materials is known, the extent and magnitude of residual radioactivity has not been characterized to a degree sufficient to plan decommissioning. The purpose of this plan is to collect additional radiological data regarding the extent and magnitude of residual radioactivity to accommodate decommissioning planning.

Proposed characterization methods involve invasive activities such as removal of small amounts of concrete for external laboratory analysis. Therefore, all work is being completed under the Chase Environmental Group, Inc. (Chase) Commonwealth of Kentucky radioactive materials license number 201-605-90 under a reciprocal agreement with the NRC. All characterization activities will be performed in accordance with this Plan, Chase's Radioactive Materials License requirements and US Nuclear Regulatory Commission (NRC) regulations.

This Plan was developed using the applicable guidance provided in NUREG 1757, "Consolidated NMSS Decommissioning Guidance" and NUREG 1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM) and provides the approach, methods, and techniques for radiological characterization of impacted areas of the facility.

Chase intends to commence licensed activities on December 7, 2009. On-site activities are expected to be completed within one week. If work cannot be completed in this timeframe, Chase will notify the NRC.

2.0 FACILITY DESCRIPTION

The building has a footprint of 8,500 square feet with approximately 25,000 gross square feet of floor area over three elevations. The brick building sits on a stone and mortar foundation. The basement floor is poured concrete with tile and carpet coverings. Floors on the first and second elevations are hardwood. Interior walls are plaster and sheetrock. The interior of the facility underwent a major interior renovation in 1974 that resulted in minor changes to the layout of the basement. The entire ventilation system has been upgraded since the usage of radioactive materials such that there are no original ventilation ducts or components in the building. However, some original drains may exist.

3.0 HISTORICAL OPERATIONS

The building was originally called the Chemical Building. In the early 1900s, a researcher extracted and purified salts of radioactive elements from ores (extracted radium from uranium ores) in a laboratory in the basement. The processes and areas of usage are generally known to MU staff.

4.0 PLANNED ACTIVITIES

The project will be conducted according to the work breakdown structures described below.

4.1 Mobilization

Chase will mobilize personnel and equipment to the site. All crew members will receive MU-required indoctrination, training and testing during the mobilization phase. Additionally all personnel will receive Chase-required indoctrination and training. Technicians will receive specific training on the Characterization Work Plan, health and safety, quality assurance, instrumentation and survey protocols.

4.2 Characterization Surveys

The goal of characterization is to define the extent and magnitude of residual radioactivity at the facility within the constraints of current operational and access restrictions. Additionally, characterization protocols will be designed to collect information regarding the relationship between measurements above and below floor coverings and to determine the ratios and equilibrium states of contaminants. Chase will survey accessible portions of the entire facility including all elevations, attic, roof, roof drains, and outside grounds

Characterization will consist of the following types of measurements:

- Surface scans for alpha, beta, and gamma emissions
- Static measurements for alpha and beta total surface activity
- Large area wipes for alpha and beta removable activity
- Disc smears for alpha and beta removable activity
- External dose rates
- Solid samples of concrete materials for gamma spectroscopy analysis
- Soil samples for gamma spectroscopy analysis
- Air sampling during invasive activities

The survey protocol for building surfaces will consist of scanning, with judgmental static measurements and smears at locations where elevated activity is detected. Scanning is used to identify locations with residual radioactivity. If elevated activity is detected during the scan surveys, then the location will be marked, and total and removable surface activity measurements will be taken to quantify the activity. The scanning percentage will be 100% of accessible floor and lower wall (<2-meter height) surfaces. If activity is detected on lower wall surfaces that indicate a probability of residual radioactivity on upper surfaces, then the survey coverage will be extended to include upper surfaces. Scanning will be performed independently for alpha, beta and gamma radiation. Alpha and beta scans will be performed using large area gas flow proportional counters and gamma scans will be performed with sodium iodide detectors. If elevated activity is detected, the location will be investigated further to attempt to quantify the activity.

At covered floor locations of highest activity, the floor covering will be removed to perform measurements and to collect solid samples for external laboratory analysis. To the extent possible, measurements will be used to establish ratios in order to estimate residual activity under floor coverings based on measurements taken above floor coverings. Solid samples will be analyzed by gamma spectroscopy and used to determine nuclide ratios and equilibrium states.

The protocol for building system surveys will consist of performing total and removable contamination measurements of internal surfaces, and gamma scans of external surfaces of ventilation and drain systems. The ventilation system is not original to the building and is not expected to contain residual radioactivity. However, original drains may be present.

Solid samples will be collected and analyzed by gamma spectroscopy at a contract laboratory. Solid samples will consist of concrete surface samples of floor (and possibly wall) surfaces, soils of outside grounds, and background samples from each media.

Dose rate surveys will be performed using a pressurized ion chamber and/or a tissue-equivalent Microrem meter. These surveys will provide data regarding the external component of doses to building occupants.

Gamma scans will be conducted on outside grounds surrounding the building. If elevated activity is detected, a surface soil sample will be collected.

A survey package will be developed for each survey and will contain the following:

- Survey Instruction Sheets
- General survey requirements
- Instrument requirements with associated MDCs, count times and scan rates
- Survey Maps
- Survey Data Sheets
- Signature of Preparer, Surveyor and Reviewer

Field data will be reviewed and validated to ensure:

- Completeness of forms
- The correct type of survey has been assigned to the survey unit
- The MDCs for measurements meet the established data quality objectives
- Independent calculations will be performed for a representative sample of data sheets and survey areas.
- Instrument calibrations and daily functional checks have been performed accurately and at the required frequency.

4.3 Invasive Sampling

All sampling activities will be conducted in a manner that will control the spread of contamination and maintain personnel exposures ALARA. HEPA-filtered vacuums will be used to control loose radioactive materials during invasive building sampling activities. Personal protective equipment will be prescribed per Chase radiation protection program. Air sampling for radioactive materials will be performed during invasive activities.

4.4 Instrumentation

Radiation detection instruments will be calibrated at least annually with National Institute of Standards and Technology (NIST) traceable sources and to radiation emission types and energies that will provide detection capabilities for nuclides of concern. Laboratory instruments and portable field instruments will be response tested daily when in use. Background and source readings will be taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions. The background, source check, and field measurement count times for radiation detection instrumentation will be specified by the Project Manager to ensure measurements are statistically valid.

Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and counting times for measurement of total and removable contamination will be chosen to provide a minimum detectable concentration (MDC) that meets the criteria specified in this Plan. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100cm². Count times and scanning rates for surface contamination are determined using the following equations:

Static Counting

Static counting MDC at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{static}	=	minimum detectable concentration level in dpm/100cm²
B_r	=	background count rate in counts per minute
t_b	=	background count time in minutes
t_s	=	sample count time in minutes
E_{tot}	=	total detector efficiency for radionuclide emission of interest
A	=	detector probe area in cm²

Ratemeter Scanning

Beta Scanning MDC at a 95% confidence level is calculated using the following equation which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p}\cdot E_{tot}\cdot\frac{A}{100cm^2}}$$

Where:

MDC_{scan}	=	minimum detectable concentration level in dpm/100 cm^2
d'	=	desired performance variable (1.38)
b_i	=	background counts during the residence interval
i	=	residence interval
p	=	surveyor efficiency (0.5)
E_{tot}	=	total detector efficiency for radionuclide emission of interest
A	=	detector probe area in cm^2

Per MARSSIM section 6.7.2.2, it is not practical to determine a fixed MDC for alpha scanning. It is more useful to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates. MARSSIM provides derivations, formulas and probability concepts for alpha scanning in Appendix J. Alpha scan rates will be selected from the probability charts in Appendix J to achieve a 95% probability of detecting 300 dpm/100cm^2.

Smear Counting

Smear counting MDC at a 95% confidence level is calculated using the following equation, which is NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3 + 3.29\sqrt{B_r\cdot t_s\cdot(1+\frac{t_s}{t_b})}}{t_s\cdot E}$$

Where:

MDC_{smear}	=	minimum detectable concentration level in dpm/smear
B_r	=	background count rate in counts per minute
t_b	=	background count time in minutes
t_s	=	sample count time in minutes
E	=	instrument efficiency for radionuclide emission of interest

Instrumentation Specifications

The instrumentation used for decommissioning surveys are summarized in Table 4-1. Alternate or additional instrumentation with similar detection capabilities may be utilized as needed for survey requirements with Radiation Safety Officer approval.

Table 4-1 - Instrumentation Specifications

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Typical Total Efficiency
Ludlum 43-68	Gas Flow Proportional	126 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-37 Floor Monitor	Gas Flow Proportional	582 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-10-1	Phoswich	32 cm^2	Ludlum 2929	0.4 mg/cm^2	10% (Th-230) 20 % (Tc-99)
Ludlum 44-10	2" x 2" Sodium Iodide	N/A	Ludlum 2241	N/A	760 cpm per μR/hr
Bicron MicroRem	Tissue Equivalent Organic Scintillation	N/A	N/A	N/A	N/A

4.5 Data Validation

Field data will be reviewed and validated to ensure:

- Completeness of forms and that the type of survey has correctly been assigned to the survey unit.
- The MDCs for measurements meet the established data quality objectives; independent calculations will be performed for a representative sample of data sheets and survey areas.
- Instrument calibrations and daily functional checks have been performed accurately and at the required frequency.

4.6 Demobilization

Upon completion of on-site work, Chase will survey and release equipment and materials, ship equipment and supplies and demobilize personnel. The Chase Project Manager will walk down the jobsite with the MU representative at the conclusion of work and develop a punchlist prior to demobilizing equipment and personnel. The punchlist will be completed and the project closed out.

4.7 Characterization Report

At the completion of characterization surveys, a Characterization Survey Report will be developed. The report will be reviewed for technical content by Chase personnel and an independent technical person (Certified Health Physicist) prior to submitting to MU. The report will describe all project activities, summarize survey data, and provide the results of all measurements.

5.0 MANAGEMENT ORGANIZATION STRUCTURE

Due to the limited scope of activities, a complex management organization is not required. Chase will implement their Kentucky radioactive materials license at the site under a reciprocal agreement with the NRC. MU will oversee Chase activities and will maintain responsibility for building maintenance, fire and security functions. MU will escort Chase personnel at all times. There will be clear separation of licensed activities between Chase and MU. Chase and MU will coordinate activities such that neither party violates the license of the other party. For the most part, Chase will be conducting surveys. For invasive sampling, Chase will clearly post and control areas to prevent inadvertent entry by MU personnel. The MU contact is Jack Crawford, RSO, who can be reached at 573-882-0931.

The following management structure will be utilized for administration and implementation of this Plan.

5.1 Corporate Radiation Safety Officer (CRSO)

Chase's CRSO is responsible for the corporate management of the radiological control and safety program and for directing the program to limit occupational radiation exposures to levels ALARA as specified in Chase's Radioactive Materials License.

The CRSO has the authority to, and shall, order the suspension of any operation when such operation presents an imminent radiological or safety threat or hazard to the employees, the environment, or the general public. The CRSO's responsibilities include, but are not limited to, the following:

- Establishing standards and guidelines for radiological services operations to comply with Chase policies and applicable federal and state regulatory requirements;
- Providing selection criteria for equipment, supplies and services for radiological control and safety work and personnel exposure monitoring;
- Establishing standards for personnel protection to assure that exposures to ionizing radiation and radioactive contamination are maintained at levels ALARA;

- Implementing the radiological control and safety audit program of individual project as prescribed;
- Establishing company policy to comply with state and federal statutes, rules, regulations and license conditions regarding employee occupational safety and health;
- Ensuring the quality of protective equipment for personnel and prescribing usage standards; and
- Establishing procedures for radiological protection and monitoring, including the ALARA program.

Doug Coble is the CRSO and can be reached at (b)(6)

5.2 Director, Brokerage and Field Services (DBFS)

The DBFS is responsible for assigning Project Managers to individual projects and for providing technical support to projects. This technical support capability encompasses areas of expertise or specific disciplines required by projects. These may include health physics, geo-technical, hydrological, civil engineering, occupational safety, legal and/or administrative support. The DBFS may choose to provide these support capabilities through permanent staffing or by subcontract through outside organizations.

The DBFS is also responsible to ensure projects are completed under the direction of Project Managers in full compliance with the requirements of all applicable licenses, permits, and regulations.

John O'Neil is the DBFS and can be reached a (b)(6)

5.3 Project Manager (PM)

A PM is appointed by the Chase President for each project. The Project Manager is responsible for project operations from initiation through completion. The PM's duties include the following:

- Maintaining compliance with conditions of site operating licenses, permits, rules, regulations and procedures of Chase, and state and federal agencies;
- Maintaining working conditions which assure health, safety and protection for all employees, visitors and the environment;
- Providing physical examinations for employees as required by company policy, local, state and federal regulations;
- Ensuring that employees are instructed regularly, or as required by law, on precautions, procedures and practices to be followed to minimize exposure to radioactive materials and to conduct operations safely;

- Notifying the CRSO, applicable State agency or the NRC, promptly, of any operation or condition which appears to present a radiological hazard to employees, the public or the environment;
- Furnishing proper personnel protective equipment, ensuring that employees are instructed its proper use and enforcing rules for the equipment's utilization;
- Ensuring that sufficient staffing for the project is present and that staffing consists of individuals able to conduct daily operations in compliance with regulatory requirements and to maintain a safe working environment; and
- Maintaining project radiation exposures ALARA.

Dave Culp is the Project Manager and can be reached at (b)(6) Ken Gavlik is the Alternate Project Manager and can be reached a (b)(6) 6

5.4 Radiological Safety Technicians (RSTs)

RSTs act as the PM's representatives in specifically implementing the radiological control and safety practices as assigned by the PM. RSTs and their qualification shall be approved by the CRSO.

6.0 PROJECT TRAINING REQUIREMENTS

This section describes the minimum training that Chase will possess prior to conducting licensed activities.

6.1 Radiological Training

Radiological training will be completed and documented in accordance with Section 4 of the Chase Radiological Services Safety Manual (RSSM). The PM will maintain a copy of each individual's certification in the project file.

6.2 Project Specific Training

Prior to project start-up, personnel will attend an initial project specific training session conducted by the PM. The training session will include the following items:

- Characterization Work Plan
- Scope of work and planned work activities
- Chemical, physical and radiological hazards associated with the project
- Posting requirements
- Types and use of available personal protective equipment
- Respiratory protection requirements

- Project security control and operational work zones
- Emergency response and site evacuation procedures
- Air monitoring and medical monitoring procedures.
- Project communications.
- General safe work practices.
- Data quality and chain of custody procedures
- Review of applicable regulatory standards as applied to project operations.

6.3 General Safety Briefings

General safety meetings will be held by the PM at the beginning of each work shift until project completion. The purpose of these meetings will be to discuss project status, potential problem areas, general safety concerns, and to reiterate Work Plan requirements. Additional meetings will be held if conditions warrant.

7.0 RADIATION SAFETY AND HEALTH PROGRAM

Radiological work will be performed according to the Chase radioactive materials license Radiation Safety Program. Selected sections of particular relevance to this project are discussed below.

7.1 Radiation Work Permit

A Radiation Work Permit (RWP) will be generated for invasive project activities and will provide information on radiological conditions present in the work areas and requirements for personnel protective clothing, respiratory protection, safety and dosimetry. The RWP will include the following information:

- Job description
- Permit Start and Expiration dates
- Work locations
- Radiation and contamination levels
- Airborne radioactivity concentrations
- Personnel Protective Equipment requirements
- Dosimetry requirements
- Respiratory Protection requirements
- Additional permits that may be required
- Survey requirements
- Instructions to workers

7.2 Dosimetry

Each individual who will perform work under the Chase radioactive material license during this project will be monitored by thermoluminescent dosimeters (TLDs) for external doses.

7.3 Air Sampling

Airborne particulate sampling will be performed during invasive work to assess the potential for internal exposures. A limiting airborne concentration limit of 2E-11 µCi/ml gross alpha will be used to estimate doses from airborne radioactivity. This is based on the most limiting uranium or radium DAC value with no correction for the equilibrium state (number of alphas per decay). Bioassays will not be performed unless air sampling indicates a potential to exceed 10% of the gross alpha concentration limit.

7.4 Respiratory Protection

Engineering controls are expected to be sufficient to control airborne radioactivity levels. However respirators will be available for use on-site if necessary. Chase maintains a respiratory protection plan that includes medical surveillance, respiratory testing, maintenance, protection factors, workers responsibilities, and respiratory protection limitations.

8.0 RADIOACTIVE WASTE MANAGEMENT

Chase will turn over any radioactive waste generated to MU for inclusion in their normal waste streams.

9.0 QUALITY ASSURANCE PROGRAM

The quality assurance requirements of this Plan will be supported by Chase's Radiological Services Safety Manual and Corporate Quality Assurance Program Manual.

10.0 SAMPLE CHAIN-OF-CUSTODY

The sample chain-of-custody maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field. Samples sent off-site for analysis will use an approved Chain of Custody Procedure.

11.0 REFERENCES

- NRC Regulations
- Chase radioactive materials license
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
- NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys"
- NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"
- NUREG 1757, Volume 1 "Consolidated NMSS Decommissioning Guidance," September, 2002

University of Missouri
Pickard Hall Phase 2
Characterization Work Plan

University of Missouri
Museum of Art and Archaeology
1 Pickard Hall Columbia, MO 65211-1420

To Be Performed Under:
Chase Environmental Group, Inc.
Commonwealth of Kentucky
Radioactive Materials
License No. 201-605-90

March 23, 2010

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830

C/20

TABLE OF CONTENTS

1.0 Introduction

The University of Missouri (MU) identified residual radioactivity in the basement of Pickard Hall located on campus at 1 Pickard Hall Columbia, MO 65211-1420. Pickard Hall, built in 1892, is currently being used as the Museum of Art and Archaeology and houses the Department of Art History and Archaeology. The museum is located on the first and second floors of the building and the basement is currently used for storage of museum artifacts and office space for faculty. The building is listed on the National Register of Historic Places.

The basement of Pickard Hall was used for separation of radium from uranium ores in the early 1900's. Initial characterization surveys of Pickard Hall conducted in December 2009 indicated that further investigation is needed. Additionally, MU would like to remediate small areas of outdoor surface soils and soils on the floor of the feeder to the steam tunnel. The purpose of this plan is to support collection of additional radiological data regarding the extent and magnitude of residual radioactivity on the roof and outside grounds and to remediate small areas of soil contamination.

The scope of work involves invasive activities such as remediation and sampling of soils. Therefore, all work is being completed under the Chase's Commonwealth of Kentucky radioactive materials license number 201-605-90 under a reciprocal agreement with the NRC. All activities will be performed in accordance with this Plan, Chase's Radioactive Materials License requirements and US Nuclear Regulatory Commission (NRC) regulations.

Chase intends to commence licensed activities on March 30, 2010. On-site activities are expected to be completed within one week. If work cannot be completed in this timeframe, Chase will notify the NRC.

2.0 Planned Activities

The scope of work consists of the following elements:

- Perform characterization surveys of roof surfaces
- Perform GPS gamma scans of outdoor areas surrounding Pickard Hall
- Remediate soils in the steam tunnel feeder
- Remediate two small areas of residual surface soil activity identified during Phase 1 characterization.
- Conduct surface soils sampling as mutually-agreed based on gamma scan results
- Package waste and turn over to MU for incorporation into their normal waste streams

The project will be conducted according to the work breakdown structures described below.

2.1 Mobilization

Chase will mobilize personnel and equipment to the site. All crew members will receive any MU-required indoctrination and training during the mobilization phase. Additionally all personnel will receive Chase-required indoctrination and training.

2.2 Roof Surveys

The survey protocol for roof surfaces will consist of scanning, with judgmental static measurements and smears at locations where elevated activity is detected. Scanning is used to identify locations with residual radioactivity. If elevated activity is detected during the scan surveys, then the location will be marked, and total and removable surface activity measurements will be taken to quantify the activity. The scanning percentage will be 100% of accessible surfaces. Scanning will be performed independently for alpha, beta and gamma emissions. Alpha and beta scans will be performed using large area gas flow proportional counters and gamma scans will be performed with sodium iodide detectors. Chase personnel will use fall protection while on the roof.

2.3 GPS Gamma Walkover Surveys

Chase will subcontract Global Positioning System (GPS) surveys to Auxier and Associates, Inc. Approximately three acres of property will be scanned over a two day period. The information provided by the survey will provide input to design surface soil sampling locations. Performance of these surveys is contingent upon the availability of a GPS signal with a Positional Dilution of Precision (PDOP) less than 6. Should GPS not be available, the site will require measurements on a grid system.

The surveyor will systematically walk over accessible areas of the property with the detector held as close to the ground surface as practical with the meter's audio function active. Radiation measurements and their associated spatial coordinates will be recorded once every second by the GPS system. This will produce an electronic record of the gamma radiation levels encountered during the surface scan. This information will be plotted on an aerial photo of the property.

2.4 Remediation

Chase will remediate surface soils in outside grounds and in the steam tunnel feeder. During Phase 1 characterization, two small areas of elevated activity in the surface soils of outside grounds were identified and sampled with results up to 47 pCi/g Ra-226 and 16 pCi/g Th-232. A surface sample from the steam tunnel feeder had results of 71 pCi/g Ra-226 and 39 pCi/g Th-232.

Remediation is assumed to be less than a one-foot depth. Remediation will be performed by hand and soils will be placed into 55 gallon steel drums provided by MU. Filled drums will be turned over to MU for incorporation into their normal waste streams.

The two elevated area of surface soil activity identified during Phase 1 are assumed to require less than four cubic feet of soil excavation each. Each excavation will be surveyed after remediation and then covered with a geotextile fabric to provide a clear interface and then backfilled with soils provided by MU. The purpose of this remediation is to ensure normal landscaping activities such as thatching and aerating do not disturb soils with residual radioactivity.

The steam tunnel feeder is assumed to require up to forty cubic feet of soil to be removed based on an area of 4' x 10' and a depth of 1'. It is assumed that there is a concrete or brick floor in the feeder. After removal of soils, the floor surface will be surveyed for residual radioactivity.

2.5 Soil Sampling

After GPS surveys and remediation of outside grounds, additional soil sampling may be appropriate. Chase personnel will collect surface soil samples as necessary and deliver to Teledyne Brown Engineering in Knoxville, TN for gamma spectroscopy analysis.

2.6 Demobilization

Upon completion of on-site work, Chase will ship equipment and supplies, and demobilize personnel.

3.0 Instrumentation

Radiation detection instruments will be calibrated at least annually with NIST traceable sources and to radiation emission types and energies that will provide detection capabilities for nuclides of concern. Laboratory instruments and portable field instruments will be response tested daily when in use. Background and source readings will be taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions. The background, source check, and field measurement count times for radiation detection instrumentation will be specified by the Project Manager to ensure measurements are statistically valid.

Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and counting times for measurement of total and removable contamination will be chosen to provide a minimum detectable concentration (MDC) that meets the criteria specified in this

Plan. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100cm^2. Count times and scanning rates for surface contamination are determined using the following equations:

Static Counting
Static counting MDC at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{static}	=	minimum detectable concentration level in dpm/100cm^2
B_r	=	background count rate in counts per minute
t_b	=	background count time in minutes
t_s	=	sample count time in minutes
E_{tot}	=	total detector efficiency for radionuclide emission of interest
A	=	detector probe area in cm^2

Ratemeter Scanning
Beta Scanning MDC at a 95% confidence level is calculated using the following equation which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p} \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{scan}	=	minimum detectable concentration level in dpm/100 cm^2
d'	=	desired performance variable (1.38)
b_i	=	background counts during the residence interval
i	=	residence interval
p	=	surveyor efficiency (0.5)
E_{tot}	=	total detector efficiency for radionuclide emission of interest
A	=	detector probe area in cm^2

Per MARSSIM section 6.7.2.2, it is not practical to determine a fixed MDC for alpha scanning. It is more useful to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates. MARSSIM provides derivations, formulas and probability concepts for alpha scanning in

Appendix J. Alpha scan rates will be selected from the probability charts in Appendix J to achieve a 95% probability of detecting 300 dpm/100cm^2.

Smear Counting

Smear counting MDC at a 95% confidence level is calculated using the following equation, which is NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E}$$

Where:

MDC_{smear} = minimum detectable concentration level in dpm/smear

B_r = background count rate in counts per minute

t_b = background count time in minutes

t_s = sample count time in minutes

E = instrument efficiency for radionuclide emission of interest

Instrumentation Specifications

The instrumentation used for decommissioning surveys are summarized in the table below. Alternate or additional instrumentation with similar detection capabilities may be utilized as needed for survey requirements with RSO approval.

Instrumentation Specifications

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Typical Total Efficiency
Ludlum 43-68	Gas Flow Proportional	126 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-37 Floor Monitor	Gas Flow Proportional	582 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-10-1	Phoswich	32 cm^2	Ludlum 2929	0.4 mg/cm^2	10% (Th-230) 20 % (Tc-99)
Ludlum 44-10	2" x 2" Sodium Iodide	N/A	Ludlum 2241	N/A	680 cpm per μR/hr
Bicron MicroRem	Tissue Equivalent Organic Scintillation	N/A	N/A	N/A	N/A

4.0 Management Organization Structure

Due to the limited scope of activities, a complex management organization is not required. Chase will implement their Kentucky radioactive materials license at the site under a reciprocal agreement with the NRC. MU will oversee Chase activities and will maintain responsibility for building maintenance, fire and security functions. MU will escort Chase personnel at all times. There will be clear separation of licensed activities between Chase and MU. Chase and MU will coordinate activities such that neither party violates the license of the other party. For remediation and invasive sampling, Chase will clearly post and control areas to prevent inadvertent entry by MU personnel. The MU contact is Jack Crawford, RSO, who can be reached at 573-882-0931.

The following management structure will be utilized for administration and implementation of this Plan.

4.1 Corporate Radiation Safety Officer (CRSO)

Chase's CRSO is responsible for the corporate management of the radiological control and safety program and for directing the program to limit occupational radiation exposures to levels ALARA as specified in Chase's Radioactive Materials License.

The CRSO has the authority to, and shall, order the suspension of any operation when such operation presents an imminent radiological or safety threat or hazard to the employees, the environment or the general public. The CRSO's responsibilities include, but not are limited to, the following:

- Establishing standards and guidelines for radiological services operations to comply with Chase policies and applicable federal and state regulatory requirements;
- Providing selection criteria for equipment, supplies and services for radiological control and safety work and personnel exposure monitoring;
- Establishing standards for personnel protection to assure that exposures to ionizing radiation and radioactive contamination are maintained at levels ALARA;
- Implementing the radiological control and safety audit program of individual project as prescribed;
- Establishing company policy to comply with state and federal statutes, rules, regulations and license conditions regarding employee occupational safety and health;
- Ensuring the quality of protective equipment for personnel and prescribing usage standards; and
- Establishing procedures for radiological protection and monitoring, including the ALARA program.

Doug Coble is the CRSO and can be reached at (b)(6)

4.2 Director, Radiological Services (DRS)

The DRS is responsible for providing management and technical support to projects. This technical support capability encompasses areas of expertise or specific disciplines required by projects. These may include health physics, geo-technical, hydrological, civil engineering, occupational safety, legal and/or administrative support. The DRS may choose to provide these support capabilities through permanent staffing or by subcontract through outside organizations.

The DRS is also responsible to ensure projects are completed under the direction of Project Managers in full compliance with the requirements of all applicable licenses, permits, and regulations.

John O'Neil is the DRS and can be reached at (b)(6)

4.3 Project Manager (PM)

The Project Manager is responsible for project operations from initiation through completion. The PM's duties include the following:

- Maintaining compliance with conditions of site operating licenses, permits, rules, regulations and procedures of Chase, and state and federal agencies;
- Maintaining working conditions which assure health, safety and protection for all employees, visitors and the environment;
- Providing physical examinations for employees as required by company policy, local, state and federal regulations;
- Ensuring that employees are instructed regularly, or as required by law, on precautions, procedures and practices to be followed to minimize exposure to radioactive materials and to conduct operations safely;
- Notifying the CRSO, applicable State agency or the NRC, promptly, of any operation or condition which appears to present a radiological hazard to employees, the public or the environment;
- Furnishing proper personnel protective equipment, ensuring that employees are instructed its proper use and enforcing rules for the equipment's utilization;
- Ensuring that sufficient staffing for the project is present and that staffing consists of individuals able to conduct daily operations in compliance with regulatory requirements and to maintain a safe working environment; and
- Maintaining project radiation exposures ALARA.

Dave Culp is the Project Manager and can be reached at (b)(6) Ken Gavlik is the Alternate Project Manager and can be reached

4.4 Health Physics Technicians (HPTs)

HPTs act as the PM's representatives in specifically implementing the radiological control and safety practices as assigned by the PM. HPTs and their qualification shall be approved by the CRSO.

5.0 Project Training Requirements

This section describes the minimum training that Chase will possess prior to conducting licensed activities.

5.1 Radiological Training

Radiological training will be completed and documented in accordance with Section 4 of the Chase Radiological Services Safety Manual (RSSM). The PM will maintain a copy of each individual's certification in the project file.

5.2 Project Specific Training

Prior to project start-up, personnel will attend an initial project specific training session conducted by the PM. The training session will include the following items:

- Review of the Characterization Work Plan.
- Discussion regarding the scope of work and planned work activities.
- Review of chemical, physical and radiological hazards associated with the project.
- Discussion of posting requirements.
- Types and use of available personal protective equipment.
- Discussion of respiratory protection requirements.
- Project security control and operational work zones.
- Emergency response and site evacuation procedures.
- Air monitoring and medical monitoring procedures.
- Project communications.
- General safe work practices.
- Data quality and chain of custody procedures
- Review of applicable regulatory standards as applied to project operations.

5.3 General Safety Briefings

General safety meetings will be held by the PM at the beginning of each work shift until project completion. The purpose of these meetings will be to discuss project status, potential problem areas, general safety concerns, and to reiterate Work Plan requirements. Additional meetings will be held if conditions warrant.

6.0 Radiation Safety and Health Program

Radiological work will be performed according to the Chase radioactive materials license Radiation Safety Program. Selected sections of particular relevance to this project are discussed below.

6.1 Radiation Work Permit

A Radiation Work Permit (RWP) will be generated for invasive project activities and will provide information on radiological conditions present in the work areas and requirements for personnel protective clothing, respiratory protection, safety and dosimetry. The RWP will include the following information:

- Job description
- Permit Start and Expiration dates
- Work locations
- Radiation and contamination levels
- Airborne radioactivity concentrations
- Personnel Protective Equipment requirements
- Dosimetry requirements
- Respiratory Protection requirements
- Additional permits that may be required
- Health Physics coverage requirements
- Instructions to workers

6.2 Dosimetry

Each individual who will perform work under the Chase radioactive material license during this project will be monitored by thermoluminescent dosimeters (TLDs) for external doses.

6.3 Air Sampling

Airborne particulate sampling will be performed during invasive work to assess the potential for internal exposures. A limiting airborne concentration limit of 5E-13 μCi/ml will be used to estimate doses from airborne radioactivity. This is based on the most limiting DAC value of W Class Th-232.

6.4 Respiratory Protection

Engineering controls are expected to be sufficient to control airborne radioactivity levels. However, PAPR respirators will be available for use on-site if necessary. Chase maintains a respiratory protection plan that includes medical surveillance, respiratory testing, maintenance, protection factors, workers responsibilities, and respiratory protection limitations.

7.0 Radioactive Waste Management

Chase will turn over any radioactive waste generated to MU for inclusion in their normal waste streams.

8.0 Quality Assurance Program

The quality assurance requirements of this Plan will be supported by Chase's Radiological Services Safety Manual and Corporate Quality Assurance Program Manual.

9.0 Sample Chain-of-Custody

The sample chain-of-custody maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field. Samples sent off-site for analysis will use an approved Chain of Custody Procedure.

10.0 References

- NRC Regulations
- Chase radioactive materials license
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
- NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys"
- NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"
- NUREG 1757, Volume 1 "Consolidated NMSS Decommissioning Guidance," September, 2002

CHASE
Environmental Group inc.

Waste Management and Remediation Services

June 8, 2010

Regional Administrator
Division of Nuclear Material Safety
ATTN: Reciprocity Request
Nuclear Materials Safety Branch
U.S. Nuclear Regulatory Commission, Region I
475 Allendale Rd.
King of Prussia, PA 17406-1415

Subject: Report of proposed activities under RTS number 000256

Dear Sir or Ma'am,

Chase Environmental Group, Inc. (Chase) is applying for reciprocity to perform scarification and encapsulation of accessible surfaces in the State of Missouri as detailed in the Scarification and Encapsulation Work Plan enclosed in this request.

Please find the enclosed all the applicable documentation as required.

- NRC Form 241
- Scarification and Encapsulation Work Plan
- Current copy of our radioactive materials license
- List of authorized users pursuant to condition 13

Should you have any questions concerning this application, please feel free to contact me at (865) 481-8801 or mdiaz@chaseenv.com.

Best regards,
Chase Environmental Group, Inc.

Manuel Diaz
Radiation Safety Officer

Cc: File

C|21

University of Missouri
Pickard Hall
Scarification and Encapsulation
Work Plan

University of Missouri
Museum of Art and Archaeology
1 Pickard Hall Columbia, MO 65211-1420

To Be Performed Under:
Chase Environmental Group, Inc.
Commonwealth of Kentucky
Radioactive Materials
License No. 201-605-90

June 3, 2010

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830

TABLE OF CONTENTS

1.0 Introduction

During initial characterization surveys, the University of Missouri (MU), identified residual radioactivity, including low levels of removable contamination, on bare concrete floors in mechanical rooms 13 and 15 in the basement of Pickard Hall. MU would like to scarify the concrete floors in these mechanical rooms, and then encapsulate floor and wall surfaces. Additionally, MU would like to scarify floor areas in other rooms for leveling to accommodate floor tile replacement.

The scope of work involves invasive activities such as scarification. Therefore, all work is being completed under Chase's Commonwealth of Kentucky radioactive materials license number 201-605-90 under a reciprocal agreement with the NRC. All activities will be performed in accordance with this Plan, Chase's Radioactive Materials License requirements and US Nuclear Regulatory Commission (NRC) regulations.

Chase intends to commence licensed activities on June 15, 2010. On-site activities are expected to be completed within one week. If work cannot be completed in this timeframe, Chase will notify the NRC.

2.0 Planned Activities

The scope of work consists of the following elements:

- Scarification of accessible floor surfaces in mechanical rooms 13 and 15 in preparation for encapsulation;
- Encapsulation of accessible wall and floor surfaces in mechanical rooms 13 and 15;
- Scarification of several areas of the basement floor to provide a level surface for floor tile replacement;
- Packaging of waste (concrete dust and PPE from scarification) to incorporate into MU's normal waste streams;
- Conducting post scarification radiological surveys; and
- Conducting post encapsulation radiological surveys.

The project will be conducted according to the work breakdown structures described below.

2.1 Scarification of Floors

Scarification will remove small amounts of concrete to provide a rough surface for encapsulant adherence or to level floor surfaces for tile replacement. Chase will use a shrouded floor scarifier for most areas and a shrouded hand-held scarifier for areas not accessible to the floor scarifier. All activities will be conducted in a manner that will control the spread of contamination and maintain personnel exposures ALARA. HEPA-filtered vacuums will be attached to the scarifiers to control loose radioactive materials and a HEPA-filtered ventilation unit will be used to maintain work areas at a negative pressure. Personal protective equipment will be prescribed per the Chase radiation protection program and under the guidance of a task-specific Radiation Work Permit. Air sampling for radioactive materials will be performed during invasive activities.

2.2 Wall Preparation

Chase will prepare all wall surfaces with a HEPA-filtered vacuum prior to encapsulation to ensure surface dust does not interfere with adhesion of the encapsulant. MU will cover any surfaces that will not be encapsulated, such as piping, panels, equipment, etc.

2.3 Encapsulation

Chase will encapsulate floor and wall surfaces to lock down any removable contamination and provide a barrier for worker protection. Chase will encapsulate all accessible wall surfaces in mechanical rooms 13 and 15 with Fiberset PM, an asbestos encapsulant, using an airless sprayer. Floor surfaces will be encapsulated with a rolled-on two-part epoxy floor coating that is commonly used for basement and garage floors. Both products are waterborne and nontoxic. A HEPA-filtered ventilation unit will be used to direct air outdoors if possible. Removable contamination surveys, consisting of large area wipes, will be performed after the coating is dry to verify effectiveness and establish baseline radiological conditions.

2.4 Radiological Surveys

The goal of the radiological surveys is to verify contamination controls, effectiveness of encapsulation and establish baseline radiological conditions. The surveys will be designed to accurately reflect the post scarification and encapsulation radiological conditions. Surveys will consist of the following types of measurements:

- Surface scans for alpha and beta emissions
- Static measurements for alpha and beta total surface activity
- Large area wipes for alpha and beta removable activity
- Disc smears for alpha and beta removable activity
- Air sampling during invasive activities

3.0 Instrumentation

Radiation detection instruments will be calibrated at least annually with NIST traceable sources and to radiation emission types and energies that will provide detection capabilities for nuclides of concern. Laboratory instruments and portable field instruments will be response tested daily when in use. Background and source readings will be taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions. The background, source check, and field measurement count times for radiation detection instrumentation will be specified by the Project Manager to ensure measurements are statistically valid.

Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and counting times for measurement of total and removable contamination will be chosen to provide a minimum detectable concentration (MDC) that meets the criteria specified in this Plan. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100cm^2. Count times and scanning rates for surface contamination are determined using the following equations:

Static Counting

Static counting MDC at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{static} = minimum detectable concentration level in dpm/100cm^2

B_r = background count rate in counts per minute

t_b = background count time in minutes

t_s = sample count time in minutes

E_{tot} = total detector efficiency for radionuclide emission of interest

A = detector probe area in cm^2

Ratemeter Scanning

Beta Scanning MDC at a 95% confidence level is calculated using the following equation which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p}\cdot E_{tot}\cdot \frac{A}{100cm^2}}$$

Where:

MDC_{scan} = minimum detectable concentration level in dpm/100 cm^2
d' = desired performance variable (1.38)
b_i = background counts during the residence interval
i = residence interval
p = surveyor efficiency (0.5)
E_{tot} = total detector efficiency for radionuclide emission of interest
A = detector probe area in cm^2

Per MARSSIM section 6.7.2.2, it is not practical to determine a fixed MDC for alpha scanning. It is more useful to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates. MARSSIM provides derivations, formulas and probability concepts for alpha scanning in Appendix J. Alpha scan rates will be selected from the probability charts in Appendix J to achieve a 95% probability of detecting 300 dpm/100cm^2.

<u>Smear Counting</u>
Smear counting MDC at a 95% confidence level is calculated using the following equation, which is NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3+3.29\sqrt{B_r\cdot t_s\cdot(1+\frac{t_s}{t_b})}}{t_s\cdot E}$$

Where:

MDC_{smear} = minimum detectable concentration level in dpm/smear
B_r = background count rate in counts per minute
t_b = background count time in minutes
t_s = sample count time in minutes
E = instrument efficiency for radionuclide emission of interest

<u>Instrumentation Specifications</u>
The instrumentation used for decommissioning surveys are summarized in the table below. Alternate or additional instrumentation with similar detection capabilities may be utilized as needed for survey requirements with RSO approval.

Instrumentation Specifications

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Typical Total Efficiency
Ludlum 43-68	Gas Flow Proportional	126 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-37 Floor Monitor	Gas Flow Proportional	582 cm^2	Ludlum 2221	0.8 mg/cm^2	10% (Th-230) 20% (Tc-99)
Ludlum 43-10-1	Phoswich	32 cm^2	Ludlum 2929	0.4 mg/cm^2	10% (Th-230) 20 % (Tc-99)
Ludlum 44-10	2" x 2" Sodium Iodide	N/A	Ludlum 2241	N/A	680 cpm per μR/hr
Bicron MicroRem	Tissue Equivalent Organic Scintillation	N/A	N/A	N/A	N/A

4.0 Management Organization Structure

Due to the limited scope of activities, a complex management organization is not required. Chase will implement their Kentucky radioactive materials license at the site under a reciprocal agreement with the NRC. MU will oversee Chase activities and will maintain responsibility for building maintenance, fire and security functions. MU will escort Chase personnel at all times. There will be clear separation of licensed activities between Chase and MU. Chase and MU will coordinate activities such that neither party violates the license of the other party. For remediation and invasive sampling, Chase will clearly post and control areas to prevent inadvertent entry by MU personnel. The MU contact is Jack Crawford, RSO, who can be reached at 573-882-0931.

The following management structure will be utilized for administration and implementation of this Plan.

4.1 Corporate Radiation Safety Officer (CRSO)

Chase's CRSO is responsible for the corporate management of the radiological control and safety program and for directing the program to limit occupational radiation exposures to levels ALARA as specified in Chase's Radioactive Materials License.

The CRSO has the authority to, and shall, order the suspension of any operation when such operation presents an imminent radiological or safety threat or hazard to the employees, the environment or the general public. The CRSO's responsibilities include, but not are limited to, the following:

- Establishing standards and guidelines for radiological services operations to comply with Chase policies and applicable federal and state regulatory requirements;
- Providing selection criteria for equipment, supplies and services for radiological control and safety work and personnel exposure monitoring;
- Establishing standards for personnel protection to assure that exposures to ionizing radiation and radioactive contamination are maintained at levels ALARA;
- Implementing the radiological control and safety audit program of individual project as prescribed;
- Establishing company policy to comply with state and federal statutes, rules, regulations and license conditions regarding employee occupational safety and health;
- Ensuring the quality of protective equipment for personnel and prescribing usage standards; and
- Establishing procedures for radiological protection and monitoring, including the ALARA program.

Manuel Diaz is the CRSO and can be reached at (b)(6)

4.2 Director, Radiological Services (DRS)

The DRS is responsible for assigning Project Managers to individual projects and for providing technical support to projects. This technical support capability encompasses areas of expertise or specific disciplines required by projects. These may include health physics, geo-technical, hydrological, civil engineering, occupational safety, legal and/or administrative support. The DRS may choose to provide these support capabilities through permanent staffing or by subcontract through outside organizations.

The DRS is also responsible to ensure projects are completed under the direction of Project Managers in full compliance with the requirements of all applicable licenses, permits, and regulations.

John O'Neil is the DRS and can be reached at (b)(6)

4.3 Project Manager (PM)

A PM is appointed by the Chase President for each project. The Project Manager is responsible for project operations from initiation through completion. The PM's duties include the following:

- Maintaining compliance with conditions of site operating licenses, permits, rules, regulations and procedures of Chase, and state and federal agencies;
- Maintaining working conditions which assure health, safety and protection for all employees, visitors and the environment;
- Providing physical examinations for employees as required by company policy, local, state and federal regulations;
- Ensuring that employees are instructed regularly, or as required by law, on precautions, procedures and practices to be followed to minimize exposure to radioactive materials and to conduct operations safely;
- Notifying the CRSO, applicable State agency or the NRC, promptly, of any operation or condition which appears to present a radiological hazard to employees, the public or the environment;
- Furnishing proper personnel protective equipment, ensuring that employees are instructed its proper use and enforcing rules for the equipment's utilization;
- Ensuring that sufficient staffing for the project is present and that staffing consists of individuals able to conduct daily operations in compliance with regulatory requirements and to maintain a safe working environment; and
- Maintaining project radiation exposures ALARA.

Ken Gavlik is the Project Manager and can be reached at (b)(6) Mike Culp is the Alternate Project Manager and can be reached at

4.4 Health Physics Technicians (HPTs)

HPTs act as the PM's representatives in specifically implementing the radiological control and safety practices as assigned by the PM. HPTs and their qualification shall be approved by the CRSO.

5.0 Project Training Requirements

This section describes the minimum training that Chase will possess prior to conducting licensed activities.

5.1 Radiological Training

Radiological training will be completed and documented in accordance with Section 4 of the Chase Radiological Services Safety Manual (RSSM). The PM will maintain a copy of each individual's certification in the project file.

5.2 Project Specific Training

Prior to project start-up, personnel will attend an initial project specific training session conducted by the PM. The training session will include the following items:

- Review of the Scarification and Encapsulation Work Plan.
- Discussion regarding the scope of work and planned work activities.
- Review of chemical, physical and radiological hazards associated with the project.
- Discussion of posting requirements.
- Types and use of available personal protective equipment.
- Discussion of respiratory protection requirements.
- Project security control and operational work zones.
- Emergency response and site evacuation procedures.
- Air monitoring and medical monitoring procedures.
- Project communications.
- General safe work practices.
- Data quality and chain of custody procedures
- Review of applicable regulatory standards as applied to project operations.

5.3 General Safety Briefings

General safety meetings will be held by the PM at the beginning of each work shift until project completion. The purpose of these meetings will be to discuss project status, potential problem areas, general safety concerns, and to reiterate Work Plan requirements. Additional meetings will be held if conditions warrant.

6.0 Radiation Safety and Health Program

Radiological work will be performed according to the Chase radioactive materials license Radiation Safety Program. Selected sections of particular relevance to this project are discussed below.

6.1 Radiation Work Permit

A Radiation Work Permit (RWP) will be generated for invasive project activities and will provide information on radiological conditions present in the work areas and requirements for personnel protective clothing, respiratory protection, safety and dosimetry. The RWP will include the following information:

- Job description
- Permit Start and Expiration dates

- Work locations
- Man-Rem estimates
- Radiation and contamination levels
- Airborne radioactivity concentrations
- Personnel Protective Equipment requirements
- Dosimetry requirements
- Respiratory Protection requirements
- Additional permits that may be required
- Survey requirements
- Instructions to workers

6.2 Dosimetry

Each individual who will perform work under the Chase radioactive material license during this project will be monitored by thermoluminescent dosimeters (TLDs) for external doses.

6.3 Air Sampling

Airborne particulate sampling will be performed during invasive work to assess the potential for internal exposures. A limiting airborne concentration limit of 5E-13 µCi/ml will be used to estimate doses from airborne radioactivity. This is based on the most limiting DAC value of W Class Th-232.

6.4 Respiratory Protection

Engineering controls are expected to be sufficient to control airborne radioactivity levels. However, PAPR respirators will be available for use on-site if necessary. Chase maintains a respiratory protection plan that includes medical surveillance, respiratory testing, maintenance, protection factors, workers responsibilities, and respiratory protection limitations.

7.0 Radioactive Waste Management

Chase will turn over any radioactive waste generated to MU for inclusion in their normal waste streams.

8.0 Quality Assurance Program

The quality assurance requirements of this Plan will be supported by Chase's Radiological Services Safety Manual and Corporate Quality Assurance Program Manual.

9.0 Sample Chain-of-Custody

The sample chain-of-custody maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field. Samples sent off-site for analysis will use an approved Chain of Custody Procedure.

10.0 References

- NRC Regulations
- Chase radioactive materials license
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
- NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys"
- NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"
- NUREG 1757, Volume 1 "Consolidated NMSS Decommissioning Guidance," September, 2002

Outside of Scope

Outside of Scope

Outside of Scope

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Outside of Scope

UNIVERSITY *of* MISSOURI
ENVIRONMENTAL HEALTH AND SAFETY

Ms. Christine Lipa
Chief Materials Control, ISFSI, and Decommissioning Branch
Division of Nuclear Materials and Safety
Region III
U.S. Nuclear Regulatory Commission
2443 Warrenville Road
Lisle, Illinois 60532

February 17, 2011

Re: University of Missouri's response to U.S. NRC letter dated November 6th, 2012 (ML12312A095) concerning Pickard Hall Alternate Decommissioning Schedule (Mail Control No. 574562)

Dear Ms. Lipa:

This refers to your letter dated November 6, 2012. Enclosed are our responses to the requests for additional information in regards to Pickard Hall Alternate Decommissioning Schedule. There were several RAI's we were able to provide responses at this time. However, as was discussed with Mr. Lafranzo on January 14, there are several other RAI's that we are requesting an extension for responding too as MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization.

We believe our requests for these extensions are reasonable given that the extensions will enable us to provide more informed responses due to the opportunity to complete a more detailed characterization of Pickard Hall that will ultimately shorten the proposed timeframe of the original alternate schedule request and help us determine if we need to file a new request as part of a Federal Register Notice as was discussed with Mr. Lafranzo.

If you have any questions or concerns please contact me at (573)-882-0931 or crawfordw@missouri.edu.

Sincerely,

Jack Crawford
Radiation Safety Officer

Attachments
cc: J. Jones
S. Jurisson
M. Kotlas
S. Engelhardt
RSO File

8 Research Park Dev Bldg, Columbia, MO 65211 Phone: 573-882-7018 Fax: 573-882-7940 ehs.missouri.edu
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UNIVERSITY OF MISSOURI'S RESPONSE TO U.S. NRC LETTER DATED NOVEMBER 6TH, 2012 (ML12312A095) CONCERNING PICKARD HALL ALTERNATE DECOMMISSIONING SCHEDULE FEBRUARY 6TH 2013 (16 PAGES)

UNIVERSITY OF MISSOURI'S RESPONSE TO U.S. NRC LETTER DATED NOVEMBER 6TH, 2012 (ML12312A095) CONCERNING PICKARD HALL ALTERNATE DECOMMISSIONING SCHEDULE FEBRUARY 6TH 2013

RAI-01a: The licensee should provide specific dates for the proposed Alternate Schedule.

Response: MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: This relocation will facilitate additional characterization of Pickard Hall and allow MU to provide realistic dates for the proposed alternate schedule. MU hopes to move the PHF&S, the museum operations, and the artifacts to other locations sometime near the end of 2013 or early 2014. This presumes there are no unforeseen complications with work that will need to be completed in the new locations or in moving the artifacts. Once Pickard Hall is unoccupied and empty of contents, MU can better assess the radiological status of the building.

If the NRC is unable to grant an extension until December 2, 2013, MU asks for approval to provide periodic updates on progress with requests for extensions for additional time as needed.

The RAIs, proposed plans, associated dates and reasons for the dates were discussed with Mr. Mike Lafranzo per phone conference call on September 27, 2012.

RAI-01 b: The licensee should provide a description of how the University will begin planning for a proposed schedule for the movement of artifacts located within the museum that would allow for the start of decommissioning.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: See response and details provided to RAI-01a.

RAI-01 c: The licensee should demonstrate that conditions of Pickard Hall will not significantly deteriorate and potentially cause a radiological hazard during the proposed Alternate Schedule timeframe.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: MU will continue to perform monthly radiological surveillances of Pickard Hall during the time frame of this extension request. This will also include periodic monitoring of the building's physical condition by Campus Facilities (CF) staff and the Pickard Hall building coordinator throughout that period. Any condition that would require modification to the building would be coordinated between CF and Environmental Health and Safety (EHS) Radiation Safety (RS). Once the building is unoccupied and empty of contents, a more detailed assessment of Pickard Hall's physical condition can be performed to provide a more complete answer to this RAI.

RAI-01d: The licensee should discuss the current decommissioning cost estimate and the potential for increased decommissioning costs, if an Alternate Schedule is approved.

Response: A Decommissioning Funding Plan (DFP) dated May 2011, was submitted to NRC representative Ms. Katie Streit on June 11, 2011. Pickard Hall is specifically addressed in Appendix C, page C.16. The DFP has a conservative 25% contingency added to the calculated overall cost. The DFP is reviewed every 3 years and is tied to our licensing renewal. If during the review periods costs are projected to change significantly due to increased costs of fuel, increased waste disposal costs, or for other economic or financial reasons, MU will re-evaluate the DFP to determine if the current cost structure is still accurate or if adjustments are needed. A copy of the DFP is attached as Attachment 1 – MU's DFP, May 2011.

RAI-02a: The licensee should provide schematics for the ducts to demonstrate that removable contamination does not have a pathway to areas where members of the public or occupation workers are located.

Response: *As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI.* We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: MU has been actively searching for schematics that would allow us to assess and respond to this RAI more completely. The oldest schematics we have are from 1892 and while they show some duct work and some airflow patterns, they do not specifically describe the ducts in question. The other schematics we have located are from a large remodeling project in 1974 that changed the original design to a completely new HVAC system. These schematics do not specifically address the old ductwork with the exception of one central duct on drawing A-2-1 was to be "enclosed existing shaft with existing bricks". See Attachment 2 – Various Schematics of Ductwork for Pickard 1892 (2 drawings), and 1974 (5 drawings).

The only known and visible access to the original ductwork is in the restricted area of the attic. MU does not permit access to those ducts without permission and involvement by EHS Radiation Safety Health Physicists. No construction or demolition activities will be performed that might impact these ducts without further assessment by MU or a qualified consultant in coordination with the NRC. Current radiological surveys of accessible areas

RAI-02b: The licensee should develop, implement and maintain procedures to ensure members of the public or occupation workers do not gain unauthorized access to the ducts within the walls without authorization from the licensee's radiation safety program.

Response: MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs. MU recognizes that PHF&S, Campus Facilities (CF) personnel and other applicable staff will need to be trained on the new procedures once they are approved.

RAI-02c: The licensee should provide documentation to show that the contamination will not migrate from under the basement floor to areas where members of the public or occupation workers could be exposed to radioactive material over the timeframe of the Alternate Schedule.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

MU continues to conduct regular surveys of the basement areas to evaluate the condition of the contamination and verify that the contamination remains fixed.

Detail: MU requests an extension to answer this RAI for the reasons stated in RAI-01a. With the building unoccupied and empty, the sampling of the basement floor areas will be more complete and reliable and will prevent damage of the artifacts from temporary shifting and relocation during the sampling.

RAI-02d: The licensee should demonstrate whether contamination under the soil has the potential to impact the ground water, potable or not, in the area of Pickard Hall.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-02e: The licensee should develop, implement and maintain procedures to ensure members of the public or occupation workers do not gain access to the contamination under the basement floor without authorization from the licensee's radiation safety program.

Response: MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: As stated in the response to RAI-02b, EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

MU has interim controls in place to control access to the impacted areas of Pickard Hall including training of the PHF&S on these expectations. MU has also established additional administrative controls by working with CF to place work restrictions for Pickard Hall into CF's maintenance work order software system "Maximo" so when CF prints out work orders for Pickard Hall they get a notification message. That message is "CONTACT EHS RADIATION SAFETY

AT 882-5024 BEFORE WORKING ON ANY BLDG COMPONENTS TO INCLUDE CEILINGS, WALLS, FLOORS, DRAINS, HVAC, FURNITURE MOVING, ETC." The length of this message has been developed to accommodate the character limit that is available in the system.

RAI-02f: The licensee should provide a detailed description of the workers in Pickard Hall who will be considered occupational radiation workers and what training those individuals are to have received as occupational workers. This includes current and future workers within Pickard Hall.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S) and museum operations. This will eventually result in restricted access to the building by EHS RS to staff who are either fully trained as radiation workers or are under the supervision of EHS RS. Please see Attachment 3a – "Radiation Worker Training Status report for Pickard Hall 55555, for the list of PHF&S who have already been trained as Radiation Workers using our current RS program and Attachment 3b – Radiation Safety for new Radiation Workers at MU" which is the RW training outline tailored for them with emphasis on Pickard Halls special conditions. As new graduate students or museum staff are hired and begins work in Pickard Hall they will be trained by EHS RS. Radiation worker training is conducted as part of the training program managed under the conditions of our broad scope license.

RAI-02g: The licensee should provide a description of what is meant by "invasive activities" and how the licensee plans to control them in accordance with 10 CFR 30.36.

Response: MU uses the term "invasive activities" to mean an activity that may disturb building surfaces such as drilling, scraping, etc. As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

RAI-02h: The licensee should provide a description of how and how often the licensee will inspect the integrity of the encapsulant.

Response: MU uses an administrative authorization, identified internally as #55555, to conduct monthly surveillances. During those surveillances we inspect the physical condition of the encapsulant in Pickard Hall during our routine surveillances/monitoring activities and perform surveys for fixed and removable contamination in all areas of the building.

RAI-02i: The licensee should provide a description of what actions the licensee will take if the encapsulant is determined to be compromised.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

The SOP will include the process for controlling areas where encapsulant has failed. It will also include the process for: 1) re-applying encapsulate in cases where decontamination can be accomplished by nonaggressive means; and 2) in cases where decontamination cannot be accomplished but the area can be controlled and managed for the re-application of a secondary encapsulant.

RAI-02j: The licensee should provide a description of the locations and periodicity of the routine surveillance program that will be used for Pickard Hall.

Response: Please see Attachment 4 – Pickard Hall 55555 January 2013 inspection/survey report. This report has several maps of the areas of Pickard Hall that we physically survey for radiation levels and removable contamination. This surveillance includes the performance of radiation level surveys at the microRem/hr level as well as ~40 removable contamination smear checks which are counted on a sensitive alpha, beta proportional combination NAI gamma counter with triggers for investigation at 200 cpm/100 cm2 for removable beta/gamma and 20 cpm/100 cm2 for removable alpha. MU alternates the locations surveyed by performing a survey of the basement level in one month and a survey of the first and second floors in the alternate month.

RAI-02k: The licensee should provide the type of instruments and capabilities of each instrument that will be used to monitor the building.

Response: MU is using a Ludlum 14C survey meter with a GM pancake 44-9 probe for fixed contamination level readings in CPM, and a Ludlum Model 192 MicroRem meter or similar instrument (Model 9DP) for the ambient radiation levels in uR/hr. The calibration sheets for the most recently used instruments are attached. See Attachment 5 – "Calibrations sheets for most recent used Ludlum's used at Pickard".

RAI-02l: The licensee should provide a description of why the listing of Pickard Hall on the National Register for Historic Buildings affects conduct of decommissioning operations and how this effect will be changed if the Alternate Schedule is granted or denied.

> **Response:** The geographical area where Pickard Hall sits is listed on the National Register of Historic Places as the "Francis Quadrangle Historic District". Pickard Hall itself, however, is not specifically registered as a national historic location. The statement that Pickard Hall itself was listed as a national historic building was an error and we will remove it from future correspondence.

RAI-02m: The licensee should describe how the conduct of decommissioning operations would affect these activities which include, but are not limited to, operation of the museum; undergraduate, graduate, and other instructional programs; current and future museum contracts; and museum artifacts both in the basement and the upper floors storage and viewing areas. Additionally, the licensee should provide an estimated timeline for the length of disruption during decommissioning activities for each area.

> **Response:** Please refer to the response to RAI-01a. MU anticipates that the relocation of building occupants and contents will progress without unforeseen delays and should be able to provide an update on how operations may be impacted and what a schedule for decommissioning activities may look like by December 2, 2013.

RAI-02n: The licensee should provide legible copy of Attachment 1.

> **Response:** Please see Attachment 6 – Original Attachment 1 - Pickard Hall Radon Monitoring Results.

RAI-03a: The licensee should provide documentation that 400 ft2 did not collect a sufficient amount of dust so that no correction was necessary for alpha shielding from dust loading.

> **Response**: MU contracted Chase Environmental Group Inc. (Chase) to perform these surveys. According to Chase, the large area wipes (LAW) are conducted as a qualitative measurement. Since errors associated with LAWs are large, accurate quantification in conventional units is not feasible. The area of coverage was not accurately measured for each wipe, so results are qualitatively reported as activity per wipe. The 400 ft^2 area referred to in the report is an estimate of the area wiped for the LAW covering the least area.
>
> LAWs are a simple method to provide qualitative removable activity data over large areas – more than 3,000 disc smears would be required to cover an area of 400 ft^2. LAWs are generally more sensitive than disc smears because small amounts of removable activity that may be present over large areas are concentrated on the oil impregnated cloth. LAW results were used as inputs for evaluation of the need for further investigation of areas using disc smears.
>
> Beta measurements that are less impacted by dust loading were also performed on LAWs.
>
> In summary, the LAW used by the consultant was a qualitative measure to indicate what level of further evaluation would be required.

RAI-03b: The licensee should provide documentation regarding efficiency corrections for alpha shielding from dust loading, if applicable.

> **Response**: MU contracted Chase to perform the surveys referenced in this RAI. According to Chase no dust loading corrections are made for LAWs as described above.

RAI-03c: The licensee should provide information that clarifies the statements in Section 9.2.2 in relationship to Appendix F and Appendix G.

> **Response**: MU contracted Chase to perform these surveys. According to Chase, the statement regarding all measurements being less than twice background was in reference to outdoor GPS-based gamma scans only. A new paragraph should have been started with the word "subsequently".

RAI-03d: The licensee should provide explanation of how the gamma scans noted in Appendix F and Appendix G relate to dose rates and potential spread of contamination for those individuals who have access to those areas.

Response: MU contracted Chase to perform these surveys. According to Chase, the Gamma scans were used to identify areas with elevated surface exposure rates indicating that residual radioactivity was present. Due to differences in building structural materials, geometry, and other factors, variability is normal. At indoor locations with elevated exposure rates above the normally expected variation, external dose rate measurements were performed. Locations and results of external dose rate measurements are presented in Appendix J and K. Dose rates are compared to annual external doses and occupancy periods at each location in Appendix K. Assessment of the potential for spread of contamination and internal exposures is based on surface contamination measurements.

MU plans to further characterize normally inaccessible areas in coordination with the moving of PHF&S, museum operations, and the artifacts permit. In the meantime MU is controlling exposures by limiting access to these areas and monitoring personnel for external exposures.

RAI-03e: The licensee should provide documented training and/or survey procedures to ensure that scanning techniques could achieve the scanning rates for the Ludlum Model 43-68.

Response: MU contracted Chase to perform these surveys. According to Chase, as part of the initial project training session, all survey personnel completed practical training on survey techniques, including scan rates. Scan rate training consisted of placing a strip of tape approximately six feet long on the floor marked at every one-second interval (i.e., every 5 inches for a scan rate of 5 inches per second). The survey technician then performed timed scans to practice scanning at the desired rate. Survey technicians were assigned only one type of scan to avoid variable scan rates (i.e., one technician performed all the alpha scans with a 43-37 probe and another technician performed all the beta scans with a different 43-37 probe).

When the scan rate becomes less than about ½"/sec, it is increasingly difficult to attain a steady scan rate. Therefore, at scan rates less of ½"/sec or less, scanning is performed by holding the probe at a fixed location for the desired residence interval. For example, the 43-68 detector width is 8.8 cm (3.5 in), so a scan rate of 0.2 in/sec equates to a residence interval of 17.3 seconds, therefore the surveyor would hold the detector in a fixed position and listen for an audible increase in the count rate for a period of 18 seconds before moving to the next contiguous location.

The 43-68 probe was only used to perform concrete surface measurements in conjunction with concrete scarification at locations where vinyl tile had been removed (six locations with an area of $1ft^2$ each).

RAI-03f: The licensee should provide procedures or other documentation used to convert cpm (the readout for a Ludlum 44-10) to pCi/g for Ra-226, Th232 and Unat.

Response: MU contracted Chase Environmental to perform these surveys. Since MU did not perform these surveys, we did not conduct training on the survey procedure.

According to Chase, the correlation of cpm to pCi/g requires laboratory analysis of soil samples or dose modeling. Modeling heavily depends on the geometry of the source term that cannot be accurately determined within the limitations of this characterization effort. Footnote 8 in the report clarifies that the referenced MDAs are from NUREG 1507 and are specific to the geometry assumptions and survey parameters described in NUREG 1507. Because the source term geometry could not be accurately determined, no attempt was made to determine a correlation between activity concentrations and surface exposure rates.

MU plans to conduct further surface and subsurface characterization that will include laboratory analysis of solid samples to more accurately determine activity concentrations.

RAI-03g: The licensee should provide Chain of Custody Procedure.

Response: The chain of custody procedure used by Chase is attached. Please see Attachment 7 – Chase Environmental Group, Inc - QAP 8.2 Chain-of-Custody Procedure.

RAI-03h: The licensee should develop, implement and maintain procedures on how the licensee will ensure the proper control and encapsulation of those and any other areas where radioactive materials are located. The procedures shall include appropriate encapsulation and control verification over time and actions to be taken if encapsulation and/or control have been compromised. Contamination areas identified both inside and outside of the building shall be considered.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-03i: The licensee should develop, implement and maintain training procedures for any and all groups of individuals who have access to any area where residual radioactivity exists that have the ability to compromise the encapsulation and/or control of areas. Contamination areas identified both inside and outside of the building shall be considered.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

The final SOP will address the process to restrict access to areas of known contamination both inside and outside of Pickard Hall. Note that all areas of known contamination are already restricted as per other administrative controls and special conditions in the administrative authorization, identified internally as #55555. Additionally, postings indicate that no one is to enter or disturb any potentially contaminated surfaces without first contacting EHS Radiation Safety (RS). MU Campus Facilities (CF), the museum director, and Pickard Halls' building coordinator are aware of these restrictions and help to maintain the restricted access to those locations.

RAI-03j: The licensee should develop, implement and maintain procedures to limit the intrusion of water into areas where residual radioactivity exists.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

Different types of construction methods have been used in several renovations of Pickard Hall over the years that have reduced the likelihood of water intrusion into the building. MU cannot say with absolute certainly that a building of this age is completely protected against water intrusion. The SOP mentioned above will address in more detail some of the steps that have been taken over the years and the actions we plan to take should there be an intrusion of water.

RAI-03k: The licensee should develop, implement and maintain procedures regarding contingency plans of water intrusion into areas where residual radioactivity exists. These procedures shall address radiological analysis of water, contamination control and disposal of potentially contaminated water.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" that will address this issue.

RAI-03l: The licensee should develop, implement and maintain procedures to ensure unauthorized individuals do not gain access to the Feeder or Steam Tunnels.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Details: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

The final SOP will address these procedures. Generally, all grated and door entrances to the steam tunnel are securely locked and the keys are secured by Campus Facilities (CF) Energy Management (EM). Additionally, the steam tunnels are equipped with security devices, monitored remotely by CF EM, that sense and warn of the presence of an unauthorized person. If an intrusion would occur CF EM would alert the MU Police Department (MUPD) who would respond to the location of the nearest sensor and take appropriate action. The SOP will address additional coordination with EHS should unauthorized individuals enter the steam tunnel near the areas of Pickard Hall.

RAI-03m: The licensee should provide schematics of known and potentially contaminated drain and sewer lines.

Response: A schematic with notes has been provided with this response. Please see Attachment 8 – Sanitary and Storm Sewer line GIS Map for servicing Pickard Hall.

MU plans to perform additional assessments to determine active pipes and flow paths associated with these sanitary and storm sewer pipes. As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: MU is aware of only one sanitary sewer (SS) line (shown in yellow on the map) that originates from inside Pickard Hall and known to be contaminated. This is based on earlier radiological surveys that identified elevated readings near the drain. This drain and a small run of piping was filled in with concrete in a construction project in the 1990's and rendered dormant as part of an earlier water intrusion mitigation activity. The green lines on the attached map are storm sewer runoff lines.

It is our understanding that originally the sanitary sewer line in room 27 started from a drain in that room near the north wall and ran north under the building to tie into an east to west run of main sanitary sewer line transit. That east to west run of piping ties into other sanitary sewer lines in Francis Quadrangle and continues on to the city of Columbia's water processing plant.

The original northern sanitary sewer lines that ran from Pickard Hall to the first maintenance man hole in the Francis Quadrangle were dug up and replaced in a large construction project in the 1990's that replaced nearly all of the old sewer piping around Pickard Hall including most of the storm sewer lines.

RAI-03n: The licensee should develop, implement and maintain procedures to ensure unauthorized individuals do not gain access to known contaminated drain and sewer lines.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-03o: The licensee should develop, implement and maintain procedures to periodically verify contamination from the steam tunnel, drains and sewer lines has not spread beyond the known contamination confines.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-04a: The licensee should develop, implement and maintain procedures to address fire suppression systems in those areas where residual contamination exists.

> **Response:** Pickard Hall is not equipped with fire sprinklers. However, the building is equipped with fire detection and fire extinguishers and should a fire occur we would coordinate the response with the Columbia Fire Department. The Columbia Fire Department has several stations and response to all fires on campus.
>
> **Detail:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-04b: The licensee should provide analysis of potential onsite and off-site radiological contamination and dose to members of the public if a fire were to consume areas where residual contamination exists.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-04c: The licensee should develop, implement and maintain training procedures for any and all responders to an emergency within the building that could involve the release of radiological contamination. (e.g. fire and police departments)

> **Response:** We request the same extension to this RAI-04b above for the same reasons.

RAI-04d: The licensee should provide analysis of potential onsite and offsite radiological contamination and dose to members of the public if a natural disaster were to occur (tornado, flood, earthquake, etc.) and cause damage to the Pickard Hall in areas where residual contamination exists.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request

since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-05a: The licensee should provide radiological evaluations of all areas above concerning fixed and removable contamination.

> **Response:** MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-05b: The licensee should develop, implement and maintain procedures for movement of any and all furniture, mechanical equipment or any other item to address and/or identify any fixed or removable contamination that may have resulted, either directly or indirectly, from such movement.

> **Response:** As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.
>
> **Detail:** EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".
>
> CF personnel who service Pickard Hall are aware that all activities that may impact existing conditions must be coordinated with EHS RS. These restrictions are included in training and are listed in the administrative authorization, identified internally as #55555. The work restrictions for Pickard Hall have been inserted into the MU CF maintenance work order software system "Maximo". That message is "CONTACT EHS RADIATION SAFETY AT 882-5024 BEFORE WORKING ON ANY BLDG COMPONENTS TO INCLUDE CEILINGS, WALLS, FLOORS, DRAINS, HVAC, FURNITURE MOVING, ETC." Note that this message has been developed to accommodate the character limit that is available in the system.

RAI-05c: The licensee should develop, implement and maintain procedures on how to control any fixed or removable contamination, as identified from actions concerning RAI-05b, to ensure members of the general public and occupational workers are not unnecessarily exposed to radiation and/or radioactive material.

> **Response:** As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.
>
> **Detail:** EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

-END-

Attachment 1 – MU's DFP, May 2011 (154 pages)

UNIVERSITY OF MISSOURI - COLUMBIA

DECOMMISSIONING FUNDING PLAN

IN SUPPORT OF
NRC LICENSE NO. 24-00513-32

May, 2011

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830
865-481-8801

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 Introduction

The University of Missouri - Columbia (MU) is required by 10 CFR 30.35(a) to have a decommissioning funding plan (DFP) for their Columbia, MO facilities operated under NRC Broad Scope Type A license number 24-00513-32. MU contracted Chase Environmental Group, Inc. (Chase) to perform an independent decommissioning cost estimate and develop this DFP. Chase developed an order of magnitude cost estimate based on review of facility design features, current/historical processes, and current radiological conditions. This estimate is also based upon physical inspection of facilities, interviews with MU personnel and Chase's experience in performing and estimating decommissioning of similar facilities. As a major provider of facility decommissioning services and as an independent radioactive waste broker, Chase possesses highly reliable information on available decommissioning and waste processing options, and their respective costs - this insight is incorporated into the decommissioning cost estimate.

This DFP provides the four components required by NRC's financial assurance regulations for licensees who use a DFP, as described in Appendix A.3.3, Submitting the Required Documentation, of NUREG-1757, Volume 3, *"Consolidated NMSS Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness:"*

- A site-specific cost estimate for decommissioning (see Section 2).
- A description of the means that will be used to adjust the site-specific cost estimate and associated funding levels periodically over the life of the facility (see Section 3).
- A certification by the licensee that financial assurance for decommissioning has been provided in the amount of the decommissioning cost estimate (see Section 4).
- An originally signed duplicate of the financial instrument that provides financial assurance for decommissioning (see Section 4).

2.0 Cost Estimate

The cost estimate is designed to meet the nine evaluation criteria contained in NUREG 1757 listed below:

1. The cost estimate meets the applicable regulatory requirements in 10 CFR.
2. The cost estimate is based on documented and reasonable assumptions.
3. The unit cost factors used in the cost estimate are reasonable and consistent with NRC cost estimation reference documents.
4. The cost estimate includes costs for labor, equipment and supplies, overhead and contractor profit, sampling and laboratory analysis, and miscellaneous expenses (e.g., license fees, insurance, and taxes).
5. The cost estimate applies a contingency factor of at least 25 percent to the sum of all estimated costs.

6. The cost estimate does not take credit for (a) any salvage value that might be realized from the sale of potential assets during or after decommissioning or (b) reduced taxes that might result from payment of decommissioning costs or site control and maintenance costs.
7. The means identified in the DFP for adjusting the cost estimate and associated funding level over the life of the facility and any storage or surveillance period is adequate.
8. The cost estimate reflects decommissioning under appropriate facility conditions (for a DFP, routine facility conditions should be assumed).
9. The cost estimate includes costs for all major decommissioning and site control and maintenance activities specified in Section A.3, including (a) planning and preparation, (b) decontamination and/or dismantling of facility components, (c) packaging, shipment, and disposal of radioactive wastes, (d) a final radiation survey, (e) restoration of contaminated areas on facility grounds (if necessary), and (f) site stabilization and long-term surveillance (if necessary).

Cost estimates were developed using the guidance contained in NUREG-1757 Volume 3, Appendix A.3 using conservative middle-of-the-road assumptions regarding the likely extent and duration of remediation activities. Remediation is assumed to proceed to unrestricted levels with an endpoint criterion of 25 mrem/yr based on the building occupancy scenario of NUREG/CR-5512 for building structures or the residential scenario of NUREG/CR-5512 for outdoor areas. The series of cost estimating tables provided in NUREG-1757 were used to prepare the decommissioning cost estimate. Regulatory aspects and staffing requirements are much different for the various types of facilities operated under the license. For clarity, separate sets of cost tables were developed for three broad categories of facilities and then summed to obtain the overall level of financial assurance required:

- Group 2 facilities (research and medical labs, sealed source areas, radioactive waste storage areas, and incinerator facilities)
- Facilities with historical usage of alpha-emitting radionuclides
- Outdoor facilities

The assumptions and conclusions presented in this cost estimate represent Chase's best professional judgment based upon the information available. In performing this cost estimate, Chase relied upon information obtained from facility personnel and publicly available information. MU's use of radioactive materials spans more than a century. As such, there is uncertainty regarding the history in some areas. Uncertainty is offset in the cost estimate by using conservative assumptions. MU is continuing assessments of residual radioactivity in areas of historical usage to provide a more accurate basis for estimating decommissioning costs. Several buildings at Sinclair Farm have been surveyed for release for demolition and the Schweitzer Hall attic is currently being characterized to plan replacement of the slate roof. Where limited information is available regarding radiological conditions, conservative assumptions were used to estimate decommissioning costs. As facilities are more thoroughly characterized and areas released, MU will revise the cost estimate as appropriate. It is expected that as more information becomes available, the estimated cost to complete decommissioning will be reduced.

2.1 Facility Descriptions

Licensed activities are, or were, conducted within approximately 100 buildings and six separate outdoor areas at the MU campus. The license typically supports approximately 180 authorized users and approximately 850 trained radiation workers in six different categories of schools. Current authorized users by school are presented in Table 2-1.

Table 2-1 Number of Authorized Users by School

School	AUs
Agriculture, Food & Natural Resources	51
Arts and Sciences	20
Engineering	4
Veterinary Medicine	25
School of Medicine	57
Research and Other	15
No School	11
Total	183

Facilities include medical research, hospital, physics, chemistry, geology, waste, incinerator, farm, and disposal facilities. Facilities are sub-divided into five types based on unique characteristics specific to decommissioning:

- Research and Medical Laboratories
- Areas with Historical Usage of Alpha-Emitting Nuclides
- Sealed Source Use and Storage Areas
- Waste Facilities
- Outdoor Facilities

Detailed descriptions of each facility type are provided below.

2.1.1 Research and Medical Laboratories

The majority of work involving unsealed licensed material is in research and medical laboratories. There are approximately 400 laboratories using radioactive materials at any given time and usage is declining. The types of facilities included in the research and medical laboratory category are listed in Table 2-2.

Table 2-2 Research and Medical Laboratory Summary

Facility	Description	Radionuclides
Medical Science Research	Research for diagnostic and therapeutic medicine	Typically high energy beta and gamma emitting nuclides: all are either short-lived (PET nuclides) or sealed sources with no history of leakage
Plant Science	Research using plants for uptake studies	Typically C-14
Life Science Research	Research involving cells, DNA, enzymatic assays, blots, etc.	Typically C-14, H-3, I-125, P-32, P-33, S-35, and short lived gamma emitters as microspheres
Animal Science Research	Research involving animal metabolism, uptake, reproduction, etc.	
Animal Science and Physiology	Research involving animals for human use research applications	
Physics and Chemistry	Physics and experimental chemistry research	Typically long lived beta-gamma emitters or sealed sources

Typical laboratory facilities have ventilated laboratory hoods for control of radioactive and other hazardous vapors and dusts when necessary. Hoods are maintained at negative pressure with face velocities appropriate for each hood design. Tempered outside air is supplied from building heating, ventilation and air conditioning (HVAC) systems. Laboratory air is exhausted through the fume hoods. Exhaust fans are typically located on roof surfaces or in penthouse mechanical rooms. Typical laboratories are fitted with stainless steel or composite material sinks. Wastewater drains connect to the city sanitary system without treatment or retention. All effluents meet the NRC concentration limits of 10 CFR 20, Appendix B. Casework with utilities are provided for bench top operations utilizing portable analytical equipment. A central vacuum system is typically available for each building, but in some cases, portable vacuum pumps are used. Figure 2-1 shows a generalized, typical research laboratory layout.

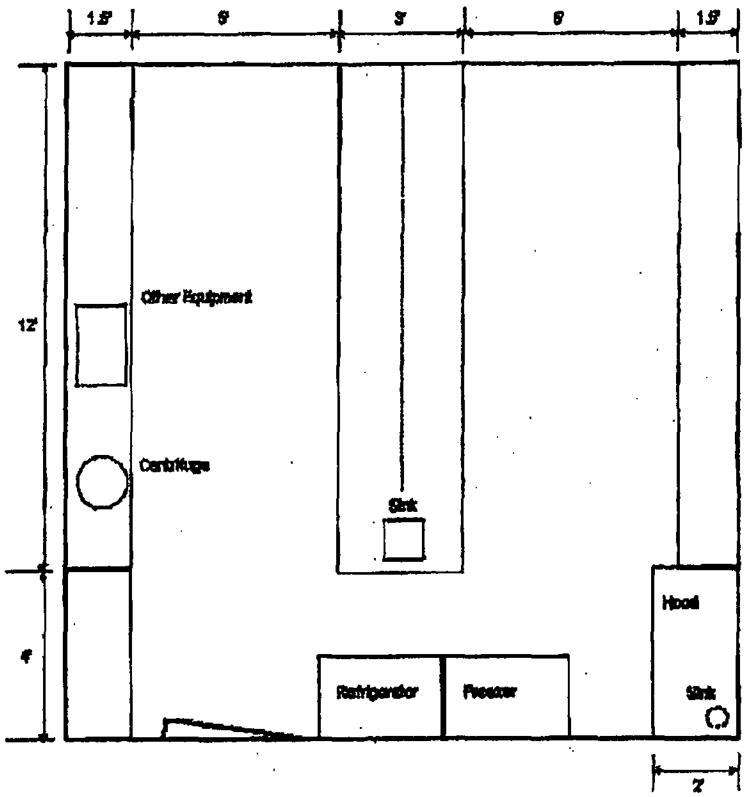


Figure 2-1 Typical Research Laboratory Layout

2.1.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Two buildings on campus had historical use of uranium, radium and thorium; Pickard Hall and Schweitzer Hall. Due to the restrictive screening values and the nature of decommissioning facilities with dispersible forms of alpha emitting nuclides, these areas are treated separately from other areas.[1]

[1] This category only includes usage from historical operations involving radium and thorium separation. Research labs located in Schweitzer Hall that use or used tracer nuclides for research are captured in the Research and Medical Laboratory category.

Pickard Hall
Built in 1894 as a Chemistry Building, Pickard Hall is currently being used as the Museum of Art and Archaeology, and houses the Department of Art History and Archaeology. The building, located at 405 S. Ninth in the St. Francis Quadrangle area of the MU campus, has a footprint of 8,400 square feet with approximately 24,600 gross square feet of floor area over three elevations (not including the attic). The museum is located on the first and second floors, and the basement is used for storage of museum artifacts. Additionally, faculty offices are located on the first floor and in the basement. The building is listed on the National Register of Historic Places.

The brick building sits on a stone and mortar foundation. Originally, the building had wooden floors throughout, including the basement. The current basement floor is poured concrete with tile and carpet coverings. It is suspected, but not known for certain, that the concrete floor is original to the building and that the wooden floors were installed on top of the concrete. Floors on the first and second elevations are primarily carpeted with stone/ceramic tiled foyers and restrooms. Interior walls are plaster and sheetrock.

In the early 1900s, a faculty researcher extracted and purified salts of radioactive elements from ores (extracted radium-226 from uranium ores), and conducted research involving Th-232 daughters in basement laboratories until the 1930's. From 1924-1951 Analytical Chemistry moved to the second floor of Schweitzer Hall, leaving organic and physical chemistry to occupy Pickard Hall until 1951, when physical chemistry moved to a new addition at Schlundt Hall. In 1972, remaining chemistry operations were moved from Pickard Hall, and the interior of the facility underwent a major renovation in 1974 to accommodate its current usage. This resulted in minor changes to the layout of the basement. Some windows on the basement and first floors, and all windows on the second floor have been covered on the inside to prevent ultraviolet damage to artifacts. The entire ventilation system has been upgraded since the cessation of use of radioactive materials; some original ventilation ducts remain, but are not in use. Original drains were terminated at floor level and grouted or re-used (subsequently, the sanitary sewer line from the building was removed and replaced with excavated soils re-used as fill). The Museum of Art and Archaeology moved to Pickard in 1976.

Schweitzer Hall
Schweitzer Hall is located on campus at 503 S. College Ave. Built in 1912, it is currently home to the Department of Biochemistry. The building has a footprint of 8,000 square feet, with approximately 24,000 gross square feet of floor area over three elevations, not including the attic. It is brick faced with a slate roof and has sheetrock interior walls.

In 1913, portions of the Chemistry Department moved to Schweitzer Hall from Pickard Hall and subsequently continued research involving separation of Ra-226 from uranium ores. In 1960, the building underwent extensive decontamination for Ra-226, including removal of drain pipes, and again in approximately 1979 to support renovation that included roof decontamination, chimney removal, and rearranging the layout of walls.

Subsequent verification surveys by MU staff did not reveal any residual radioactivity in laboratories or classrooms, but did identify residual radioactivity in the attic and on the roof.

The north end of the Schweitzer attic is known to have been used to solidify and package radioactive waste in the 1960's. The unfinished attic consists of: a solid, poured concrete floor; structural steel support beams added during remodeling for support of the roof structure; wooden rafters, columns and beams overlaid with diagonal wooden roof sheathing; numerous metal ventilation ducting runs; and a mixture of loose and rolled insulation. The finished portion of the attic consists of an added (not original to the building construction) 20' x 70' poured concrete pad, several electrical cabinets, ventilation exhaust fans, and walls and ceiling covered in sheetrock. The roof consists of slate shingles on sloped portions and a synthetic roofing material on the horizontal portion. Gutters are constructed of copper or stone. Brick chimneys penetrate the roof along with approximately 20 metal ventilation exhausts. There are also several old brick ducts in the attic floor that are thought to be terminated fume hood exhaust ducts.

MU is currently planning to replace Schweitzer Hall's roof surface and install a strobic fan exhaust system. Residual radioactivity exists or is expected to exist on accessible attic surfaces, inside brick ducts and chimneys, inside roof drains and on the top surface of the original slate roof. The Schweitzer Hall attic is in the process of being characterized to support planning for roof replacement.

2.1.3 Sealed Source Use and Storage Areas

The majority of radioactive material possessed by MU is present in a few areas where sealed sources of significant activity are used. These areas include the following sources:

- Instrument Calibration Source (0.58 Ci Cs-137)
- 10 CFR 35.400 Medical Sealed Sources (0.96 Ci, Cs-137), License Item D.
- Amersham X2016, 40666F, EON Corp 64-761 177 (~0.7 Ci, Cs-137), License Item O
- Amersham/Searle in a Type X-92 Capsule (0.193 Ci Am-241), License Item Y

2.1.4 Waste Facilities

The 10,000 ft^2 centralized radioactive waste facility is located at 1710 East Campus Loop, just south of Resource Recovery Center. The facility layout is presented in Figure 2-2. The facility is the consolidation center for disposal of all radioactive wastes and mixed wastes. Wastes are received, transferred for incineration, decayed, consolidated, or otherwise prepared for shipment to off-site disposal facilities. Liquid wastes meeting NRC sewer disposal requirements are discharged to the sanitary sewer system via a drain at the facility.

Wastes are shipped for off-site disposal via a waste broker approximately annually. Additionally, a small amount of legacy waste is stored in a 768 ft^2 storage building adjacent to the Research Park Development Building.

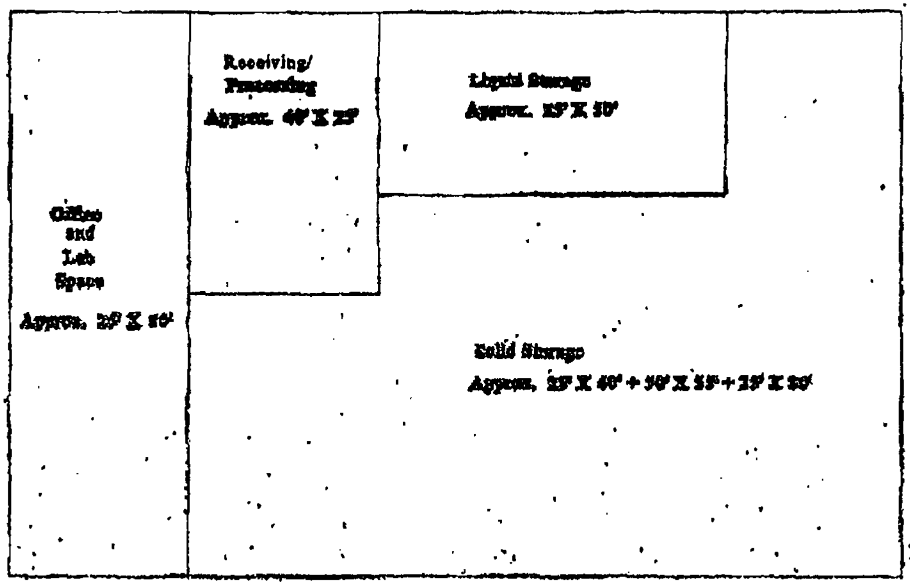


Figure 2-2 Centralized Low Level Radioactive Waste Facility Layout

There are two incineration facilities on campus. The Campus Incinerator, a 12' x 12' unit with two 6' diameter, 12' long chambers, is located at the EH&S Resource Recovery Center and is used for incineration of low level radioactive waste, mainly H-3, C-14, but also Cl-36, Ca-45 and other trace activities. The Veterinary Diagnostic Laboratory Incinerator, a 20' x 20' unit with two chambers, is located at the Veterinary Diagnostic Laboratory and was used for incineration of low level radioactive waste (mainly animal carcasses) containing low levels of H-3, C-14 and short lived beta-gamma emitting isotopes.

Small amounts of waste may be stored in laboratories for short periods of time prior to transfer to the radioactive waste facility. Also, liquid radioactive wastes meeting the effluent sewer disposal criteria may be disposed to the city sanitary system. Room GL-29 of the Main University Hospital Health Sciences Center is used for Decay-in Storage (DIS) of short-lived medical waste.

2.1.5 Outdoor Facilities

2.1.5.1 Sinclair Research Farm

The MU Sinclair Research Farm, located on 543 acres at South Sinclair Road approximately 4.5 miles southwest of the MU campus, was historically used for radioactive materials research, incineration, land disposal, and radioactive materials storage. There are about 25 of the original buildings remaining on site. Most of the remaining buildings were recently surveyed by MU staff with no elevated activity detected. An incineration facility was demolished such that only the concrete pad remains. The Missouri University Research Reactor (MURR) barn was historically used to store contaminated items from the reactor facility, and a small area of contaminated concrete was previously remediated in 2005. All buildings are assumed to meet release criteria without remediation. Trace Analytical operated a for-profit analytical lab at Sinclair and did not use dispersible forms of radioactivity, but historically had a leaking N-63 source.

Two lagoons of two units each are located on site. One lagoon has a potential for C-14 activity via buried piping from rinsing milk, urine, and feces from barn surfaces during C-14 studies. Cl-36 was authorized at the site, but never used. Fields surrounding the lagoons were occasionally sprayed with lagoon water. Lagoons are assumed to be constructed with a compacted clay liner and berm by excavating the native topsoil to the underlying clay and then excavating the clay to form the berms. A sediment layer in each lagoon is assumed to be up to six inches thick.

Phase 1 of the Sinclair Farm characterization is currently being performed. Five Barns and the Necropsy Lab Building have been surveyed for release and are awaiting demolition, pending data validation. Sediment samples were collected at the discharge points from building drains into the lagoon mentioned above and are currently being analyzed by an outside laboratory for C-14, H-3 and gamma spectroscopy.

From 1967 to 1981, a 0.9 acre disposal site was used at Sinclair Farm for disposal of wastes resulting from university research, principally medical research. LLRW consisted primarily of scintillation fluids containing toluene, xylene or dioxane with low levels of radioactivity (predominantly C-14 and H-3). Records indicate that 6,840 gallons of liquid waste with a total of 0.79 curies of activity were accepted and burned during the active disposal period at the site. Solid wastes consisted of paper, plastic, animal bedding and at least 90 large animal carcasses. There were 56 burials totaling 10,412 ft^3 of waste containing 4.5 curies of activity (roughly 53% of the allowable burial limit as then specified in 10 CFR 20.304) performed in trenches 12' deep, 2' to 4' wide, and 5' to 30' long. A minimum of 4' of cover was compacted over the waste after burial. The low level waste consists of mainly H-3 (85%) and C-14 (3.4%). Cows were slaughtered and buried on site and met the requirements of 10 CFR 20.2005, "Disposal of Specific Wastes" (0.05 µCi, or less, of H-3 or C-14 per gram of animal tissue, averaged over the weight of the entire animal). An incinerator facility was constructed and operated after closure of the burial site. The facility was subsequently dismantled and removed, leaving only a concrete pad.

2.1.5.2 Hinkson Creek Waste Site

The Hinkson Creek Waste Site is a 95' x 65' area up to 8' deep containing radioactive waste buried from about 1964 to 1969 under 10 CFR 10.304. Existing records indicate very low levels of relatively short-lived isotopic activity were buried (P-32, Ca-45 and Se-75).

2.1.5.3 South Farm Site

The South Farm site, located approximately four miles southeast of the campus, was operated from 1967-1978 as an incineration and burial facility for chemical wastes from the university's laboratories. The original disposal area of 100' x 50' was expanded to 200' x 75' in 1974. Wastes also included pesticides and herbicides, organic solvents, acids, bases, explosives, and metals. Wastes included 772 gallons of scintillation fluids, containing a total of 47 mCi of predominantly H-3 and C-14. The site was closed in 1978. Closure included implementation of various erosion control measures, including construction of surface-water diversion structures and the establishment of vegetation on the surface of the disposal area.

Additionally, a study was performed in the early 1970s involving moles tagged with 100 μCi Co-60 pellets. All but one of the pellets were recovered in 1971. The lost pellet was reported missing in July 1971 (nearly eight half-lives ago). After an exhaustive search for the pellet over a five acre area, it was assumed the mole was either taken by a predator, or burrowed deep enough to avoid detection of the source from the surface. Considering the quantity and half-life of the pellet, this area is considered non-impacted for decommissioning and no level of effort is captured in this cost estimate.

2.1.5.4 Bradford Farm

The Bradford Research and Extension Center (BREC) is a 591-acre research farm located eleven miles from the campus. AmBe soil density gauges were placed into 20' deep tubes for soil density measurements. In 1973, there was also a C-14 plant uptake study performed at the site inside a portable 72 cubic foot plastic enclosure. Plants were exposed to 1 mCi of C-14 as CO_2 gas on four occasions. After the study, the plants were removed and disposed as radioactive waste. Because there was no history of leakage from the AmBe sources and the limited scope of the plant uptake study, this area is considered non-impacted for decommissioning.

2.1.5.5 Sanborn Field

Sanborn Field is located on campus and bounded on three sides by Rollins Street, College Avenue and Bouchelle Avenue. C-14 was used for studies involving wheat. The wheat was grown in two gallon containers in a greenhouse and then planted in a 25 square foot area in plot number 10. The study was limited to a soil depth of seven inches and all impacted soils were removed and disposed after the experiment. Due to the limited scope of the study, it is assumed that the area meets the unrestricted release criteria and the level of effort for decommissioning is assumed to consist of collection and analysis of soil samples.

2.1.5.6 Tucker Prairie

Tucker Prairie is a 160 acre research facility located about 16 miles east of Columbia alongside Interstate 70 in Callaway County. In 1976, an experiment was performed to study the carbon cycle in strip mines involving 2 μCi packets of C-14. After the study, all materials were removed and disposed as radioactive waste. Due to the limited scope of the study, Tucker Prairie is considered non-impacted for decommissioning.

2.2 License History

Facilities operate under NRC Type A broad scope medical use license No. 24-00513-32, Issued to the Curators of the University of Missouri, amendment 108 dated February 4, 2011 with an expiration date of January 31, 2014. Licensed material is authorized for usage at the following addresses:

- The University of Missouri-Columbia, Columbia, MO campus, Columbia, MO
- Ellis Fischel Cancer Center, 115 Business Loop 70 West, Columbia, MO
- Missouri's Women's and Children's Hospital, 404 Keene Street, Columbia, MO
- Portable moisture density gauges may be used at temporary job sites anywhere in the US under NRC regulatory jurisdiction

Licensed materials are used in the following general ways:

- Medical procedures permitted by 10 CFR 35.100, 10 CFR 35.200, 10 CFR 35.300, 10 CFR 35.400.
- Diagnostic and medical use of sealed sources permitted by 10 CFR 35.500
- Research and development as defined in 10 CFR 30.4
- Instrument calibration
- Student instruction
- Sample analysis
- Sealed sources for calibration and moisture/ density measurements
- Sealed sources for medical and veterinary medical brachytherapy
- Depleted uranium for shielding

- Waste storage, decay and processing; including wastes from other licenses issued to the Curators of the University of Missouri
- Sealed sources for medical radiography in humans
- Ra-226 possession incidental to decommissioning activities
- Disposal by incineration
- Transport of licensed material

A copy of the current radioactive materials license is provided as Appendix A.

2.3 Previous Decommissioning

The NRC concurred with release of the Sinclair Farm Waste Site and Hinkson Creek Waste Site for unrestricted use in a letter dated August 7, 1997 to Susan Langhorst (RSO). Therefore, no level of effort for decommissioning is captured in this cost estimate.

2.4 Radiological Status of Facilities

During operation, accessible building surfaces are maintained less than 200 dpm/100cm^2 removable surface activity. All radioactive materials entering and exiting the site are packaged for shipment according to DOT and IATA requirements. Personnel that enter areas containing dispersible radioactive materials are required to wear appropriate personal protective equipment and monitor themselves for skin/clothing contamination upon exit. Facility personnel conduct routine periodic surveys, which are performed by researchers and radiation safety personnel. Laboratory closeout procedures are used when authorized users cease possession and use of radioactive materials. Uncontained radioactivity in volatile forms is confined to ventilated hoods.

There are several locations with known residual radioactivity that must be remediated in order to achieve unrestricted release. The radiological status of each type of facility is described below.

MU is continuing to make progress accomplishing thorough characterization of indoor and outdoor facilities in a phased approach. For example, MU is currently collecting radiological information at Sinclair Farm buildings, Schweitzer Hall attic, Sinclair Farm lagoons, and outside grounds around the MURR Barn.

2.4.1 Research and Medical Laboratories

Research and medical laboratories are assumed to contain low levels of residual radioactivity with removable contamination less than 200 dpm/100cm^2 as demonstrated by routine survey results. Small, discreet areas of elevated activity on building structural surfaces and in building ventilation, vacuum and drain systems are expected to exist, but at levels less than the NRC Default Screening Values (DSVs). Laboratories are authorized and closed-out with Radiation Safety Committee authorization as needed to support research activities. Estimated decommissioning costs are mainly for planning, surveying, and reporting. Minor amounts of remediation are assumed for ALARA purposes.

2.4.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Two buildings have known residual radioactivity above NRC DSVs from historical work involving the separation of alpha-emitting radionuclides from ores containing uranium and thorium, Pickard Hall and Schweitzer Hall.

<u>Pickard Hall</u>

Pickard Hall was characterized for residual radioactivity to the extent possible due to its use as a museum. Characterization results indicate that the nuclides of concern are U-238, Th-232 and their progeny (particularly Ra-226) and that low levels of residual radioactivity exists in the following locations:

- On basement concrete floor surfaces that are covered with vinyl tiles.
- On concrete floor surfaces in basement mechanical rooms. These surfaces were subsequently encapsulated with epoxy paint.
- In the steam tunnel feeder adjacent to Mechanical Room 15. The top foot of soil in the steam tunnel feeder was removed and then geotextile and pavers were placed in the feeder.
- In buried drain lines under the basement floor.
- In a small inaccessible area under the stage in Room 106 – this area is also detectable in the basement ceiling in Room 1B.
- In a small area inside a wall in Room 213.
- In the attic on one small location on the floor and in open joist areas.
- Inside two brick ducts (assumed to be fume hood exhaust ducts) that are open in the attic and likely extend to the basement.
- In soils immediately outside the northwest corner of the building.

Characterization results are available in the Pickard Hall Characterization Survey Report dated July 16, 2010.

<u>Schweitzer Hall</u>

Areas of Schweitzer Hall are known to have or suspected of having elevated residual radioactivity from operations similar to those at Pickard Hall in the following locations:

- On attic concrete floor surfaces
- On roof surfaces
- Inside brick ducts and chimneys
- Inside roof drains

Accessible roof surfaces of Schweitzer Hall were characterized in 2010. The results are available in the Schweitzer Hall Roof Survey Report dated March 3, 2010. MU plans to replace Schweitzer Hall's roof. As part of the preparation for roof replacement, the University has initiated radiological characterization of attic surfaces and currently inaccessible layers of roofing material. Costs for removal and disposal of the roofing materials are captured in this Plan.

2.4.3 Sealed Source Use and Storage Areas

Sealed source usage areas are not expected to contain residual radioactivity because sources are periodically leak checked and have never indicated leakage. Decommissioning costs are captured for removal and disposal of sources and verification/administration of leak test data.

2.4.4 Waste Facilities

Waste and Incinerator facilities are assumed to meet the NRC DSVs based on routine survey results. Decommissioning costs are mainly for disposal of existing waste as well as planning, surveying, and reporting. Minor amounts of remediation are assumed for ALARA purposes.

2.4.5 Outdoor Facilities

Outdoor areas have not been fully characterized, but are assumed to meet NRC release criteria using a site-specific dose model. Minor amounts of remediation are assumed for ALARA purposes. The level of effort for dose modeling assessments is captured in this estimate. MU will continue to collect radiological information in outdoor facilities in a phased approach and update this DFP as appropriate. Inactive disposal sites and lagoons are also impacted for chemical contaminants and regulated by Missouri Department of Natural resources (MDNR).

2.5 Radiological Release Criteria

Facility release criteria for unrestricted use are those of NRC 10CFR20 Subpart E. Specifically, the facility will be surveyed in accordance with the guidance contained in MARSSIM to demonstrate compliance with the criteria of 10CFR20.1402, "Radiological Criteria for Unrestricted Use." The criteria are that residual radioactivity results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem per year, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

2.6 Decommissioning Groups

All indoor facilities, except Pickard Hall and Schweitzer Hall, are expected to be decommissioned using the screening approach because it is expected that residual radioactivity will be surficial (up to a 1 cm depth). These facilities are expected to be decommissioned as Group 2 under NUREG 1757: "Unrestricted Release Using Screening Criteria; No Decommissioning Plan Required." From NUREG 1757: "Group 2 facilities may have residual radiological contamination present in building surfaces and soils. However, licensees are able to demonstrate that their facilities meet the provisions of 10

CFR 20.1402 ("Radiological Criteria for Unrestricted Use") by applying the screening approach dose analysis described in Chapter 6. Additionally, licensees in Group 2 typically possess historical records of material receipt, use, and disposal, such that quantifying past radiological material possession and use may be developed with a high degree of confidence. Furthermore, these licensees have radiological survey records that characterize the residual radiological contamination levels present within the facilities and at their sites. That is, they are able to demonstrate residual radiological contamination levels without more sophisticated survey procedures (greater than those used for operational surveys) or dose modeling. These licensees do not need to use site-specific parameters or establish site-specific DCGLs in order to demonstrate acceptability for release of their sites. For Group 2 facilities, a DP is not required, but licensees will have to demonstrate that the site meets the screening criteria assumptions described in Chapter 6. A DP is not required because worker cleanup activities and procedures are consistent with those approved for routine operations, and no dose analysis is required."

Pickard Hall, Schweitzer Hall, and outdoor areas are assumed to require site-specific DCGLs and/or a dose model and will be decommissioned under a formal decommissioning plan. This will require long (~ 1-2 yr) planning and regulatory review times. These facilities are expected to be decommissioned as Group 4 under NUREG 1757: "Unrestricted Release with Site-Specific Dose Analysis and No Ground Water Contamination; Decommissioning Plan Required." From NUREG 1757: "Group 4 facilities have residual radiological contamination present in building surfaces and soils, but the licensee cannot meet, or chooses not to use, screening criteria, and the ground water is demonstrably not contaminated. The licensees are able to demonstrate that residual radioactive material may remain at their site but within the levels specified in NRC criteria for unrestricted use (10 CFR 20.1402, "Radiological Criteria for Unrestricted Use") by applying site-specific criteria in a comprehensive dose analysis. A site DP is required and should characterize the location and extent of radiological contamination. The DP should also identify the land use, exposure pathways, and critical group for the dose analysis."

2.7 Nuclides of Concern

2.7.1 Research and Medical Laboratories

Research and medical laboratories use tracers and short-lived imaging nuclides. After considering quantities, locations of usage, and the impact of radioactive decay, the nuclides of concern for these types of facilities are typically C-14 and H-3 that have very high DSVs. However, survey design for this cost estimate assumes detection sensitivities of 5,000 dpm/100cm^2 gross total beta activity and 200 dpm/100cm^2 gross removable beta activity to ensure adequate costs are captured for beta-gamma emitting nuclides of concern with more restrictive DSVs. Removable contamination analysis is assumed to be performed by liquid scintillation counting.

2.7.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

The nuclides of concern in Pickard Hall and Schweitzer Hall are natural uranium, natural thorium, and their progeny, particularly Ra-226. Solid samples at Pickard Hall indicate a nuclide distribution of approximately 80% Ra-226 and 20% Th-232, and solid samples of Schweitzer roof materials indicate a distribution almost entirely due to Ra-226 (>90%).

2.7.3 Sealed Source Use and Storage Areas

Nuclides of concern for sealed source areas are Cs-137, Co-60, and Am-241. It may be possible to decommission these areas after removal of sources without performing surveys for residual activity. However, this cost estimate assumes that surface contamination surveys are performed in these areas, but assumes no remediation is required.

2.7.4 Waste Facilities

Radioactive waste facilities could contain any of the nuclides used at any of the facilities. Therefore it is assumed that facilities will be surveyed to demonstrate compliance with the most limiting alpha and beta nuclides possessed on site (assumed to be Th-232 and Co-60).

2.7.5 Outdoor Facilities

The nuclides of concern for impacted outdoor areas are primarily C-14 and H-3. Facilities that have been historically released with NRC concurrence are classified as non-impacted. The area around the MURR Barn is also impacted for fission and activation products.

2.8 Derived Concentration Guideline Levels

The Derived Concentration Guideline Level (DCGL) is the radionuclide-specific surface contamination or volumetric concentration that could result in a dose equal to the release criterion. $DCGL_W$ is the concentration limit if the residual activity is essentially evenly distributed over a large area.

2.8.1 Research and Medical Facilities

DCGLs for research and medical facilities are assumed to be the Default Screening Value (DSV) for the most limiting nuclide for a particular area. The NRC has published default screening values in NUREG 1757 for commonly used radionuclides. The DSV for unlisted nuclides can be calculated using NRC-approved DandD software under default conditions of the building occupancy scenario. Research and medical laboratories are assumed to use the C-14 DSV of 3.7E6 dpm/100cm^2. However, survey design for this plan assumes detection sensitivities of 5,000 dpm/100cm^2 gross total beta activity and 200 dpm/100cm^2 removable activity to ensure adequate costs are captured for beta-gamma emitting nuclides of concern with more restrictive DSVs than C-14.

2.8.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Areas with a history of using alpha emitting nuclides are assumed to have site-specific DCGLs for surfaces and soils of outside grounds.

2.8.3 Sealed Source Use and Storage Areas

Sealed source areas are assumed to use a gross beta-gamma DCGL equal to the Co-60 DSV of 7.1E3 dpm/100cm^2 and an alpha DCGL based on the Am-241 DSV of 27 dpm/100cm^2.

2.8.4 Waste Facilities

The radioactive waste facility is assumed to use a gross beta-gamma DCGL equal to the Co-60 DSV of 7.1E3 dpm/100cm^2 and a gross alpha DCGL based on the Th-232 DSV of 7.3 dpm/100cm^2.

2.8.5 Outdoor Areas

The nuclides of concern for impacted outdoor areas are primarily C-14 (DSV=12 pCi/g) and H-3 (DSV=110 pCi/g). The area around the MURR Barn will also be impacted for fission and activation products, so other beta-gamma emitter screening values will be used as well. Site-specific DCGLs are assumed to be developed for outdoor areas.

2.9 Equipment and Materials Release Limits

The release criteria specified in FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses" is assumed to be used for release of loose equipment and materials.

2.10 Area Classifications

For the purpose of decommissioning cost estimation, the guidance in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), was used to divide the facility into areas with similar contamination potential based on results of radiological surveys, radionuclides used, activities conducted and the potential for tracking residual radioactivity:

- Non-impacted areas (not surveyed) – medical and research laboratory building structural surfaces above a two meter height, outside grounds, and building exteriors.

- Class 1 – areas with historical usage of alpha emitters, areas of known contamination, and lagoon/disposal sites

- Class 2 – medical and research laboratories with a history of radioactive materials usage

- Class 3 (buffer areas) - areas with no history of radioactive materials usage, but bordering Class 1 and Class 2 areas, and sealed source storage areas with no history of leakage.

- Building systems (ventilation, vacuum and drain systems) are not within the scope of MARSSIM, but are assumed to be surveyed at each accessible inlet and inside equipment.

2.11 Cost Estimate Procedure

Because of significant design, regulatory and operational differences, common assumptions and thumb rules cannot be applied to all facilities in the same way. Therefore, facilities have been grouped into three independent projects and separate cost estimates are provided for clarity of presentation. The three separate cost estimates are summed to obtain the required level of financial assurance estimated for the license. Facilities were divided into three categories in order to estimate costs:

- Group 2 facilities (research and medical labs, sealed source areas, radioactive waste storage areas, and incinerator facilities)
- Facilities with residual alpha radioactivity
- Outdoor facilities – disposal sites and farms

To estimate facility decommissioning costs, a bottom-up approach was used consistent with the guidance provided in NUREG 1757. Specifically, a typical layout for each type of facility was obtained and the principal features and equipment identified. The work scope and activity sequence necessary to support unrestricted release of the facility was then developed. A project schedule was created from the activity sequence and expected duration of each task. Cost estimates are based on anticipated time-and-materials rates for goods, labor and services necessary to complete the project.

Overall, conservative assumptions were made concerning the likely extent and duration of necessary remediation activities. Remediation to unrestricted levels (i.e., the facility could be released for any future use without restrictions) was assumed. This assumption means there are no long term costs associated with site surveillance and monitoring following decommissioning.

Contamination present in each building was assumed to be limited to the portions of the building posted and controlled as "radioactive materials" areas. In particular, contamination was presumed not to be present beneath the concrete floors or walls or on the roof or other external surfaces (except for Pickard Hall and Schweitzer Hall). Facility restoration of Group 2 facilities is limited to patching a few openings on roof surfaces as a result of removal of ventilation ducts and fans. Restoration of Group 4 facilities includes only the restoration necessary to place the site in a safe condition (make buildings weather-tight and back-fill excavations).

Schedules of equipment, features and characteristics were developed for each category of facility. The schedules systematically capture the size of each area and key features relevant to estimating decommissioning costs. The schedules for all facility categories were then summed to a total facility schedule.

Labor estimates were derived from the expected work scope and a conceptual project plan. A project plan was developed that detailed the sequence of tasks required to decommission the facilities and terminate the radioactive material license. Crew sizes were developed based on the numbers and locations of tasks to be performed. In addition to the actual facility decontamination and decommissioning, labor estimates were made for pre-planning activities and performing the final radiation survey. Since the assumed endpoint of the decontamination effort was unrestricted release of the facility, there was no labor or other costs associated with long term site surveillance and maintenance.

Labor estimates for planning and preparation include time for document preparation, decommissioning plan submittal to regulatory agencies, work plan development, equipment procurement, staff training and mobilization. Pre-planning labor estimates assume straightforward internal and external document, plan, and procedure reviews and approvals.

The duration of field activities for decontaminating and/or dismantling facilities was estimated based on the task sequence and project schedule. Crew sizes and number of workers were limited to those that could be efficiently utilized in the field.

Radioactive waste estimates were based upon the volume and weight of equipment and of material in the laboratories, storage areas, and supporting systems as well as waste generated as a result of remediation of building structures and soils. The site is assumed to have a waste storage inventory similar to that which would be on-site immediately prior to a routine waste shipment. For decommissioning purposes, installed equipment with contamination levels expected to be in excess of release criteria was assumed to be disposed of as radioactive waste rather than being decontaminated and released. This is due to the cost of labor required to decontaminate and survey equipment typically exceeding the cost of disposal. However, costs are captured for decontamination of equipment and surfaces that are below release criteria for ALARA purposes. ALARA is assumed to mean removable contamination on surfaces is remediated (NUREG-1757, Volume 2, Appendix N).

Estimates for the level of effort required for the final radiation survey were based on previous experience with facilities of comparable complexity. As noted above, the assumed endpoint for the facility is license termination and unrestricted release. This implies that removal of all radioactive materials from the facility has been confirmed.

Marketplace rates (including overhead and contractor profit) were obtained for each element of the project including labor, materials, supplies, sampling, construction activities, waste packaging, waste processing and disposal. The unit rates were extended through the estimated quantities to determine total cost for each line item. Costs were summed by each element of the project to determine subtotals by element. Element subtotals were summed to total project cost.

Annual labor rates were estimated for the Project Manager, Health Physics Supervisor, Foreman, Health Physicist, Shipper, Draftsman, Health Physics Technicians, Equipment Operators, Laborers, and Administrative Assistant. Labor rates include base salary and fringe benefits (e.g., vacation, health insurance, etc.). A rate of 50% was applied for overhead costs, consisting of 18% for labor overhead, 15% for general and administrative costs and 10% profit. The base annual labor rate plus the overhead expenses was divided by the number of workdays per year (taken as 260) to determine a daily cost for each category of employee.

Living expenses were taken from current allowable government per diem rates. For the Columbia area, this is $129 per day. Project management and technical staff are paid the daily living allowance since they are assumed to be from outside the local area. Administrative and support staff are not paid a living allowance. The daily living expenses were multiplied by 7 days per week then divided by 5 workdays per week to correctly incorporate living expenses into the daily rate. This is a variation from the NUREG 1757 methodology in that NUREG 1757 format does not explicitly account for living expenses.

The completed cost estimate schedules for Group 2 facilities are included in Appendix B. The completed cost estimate schedules for alpha emitter facilities are included in Appendix C. The completed cost estimate schedules for outdoor facilities are included in Appendix D. The cost estimate summary tables are summed and presented in Section 2.15.

2.12 Project Overviews

Facilities are expected to be decommissioned as three separate projects. Each project is assumed to be performed by a third party, non-local decommissioning contractor that will provide the qualified staff, on-site and off-site labor, materials and equipment needed to complete the project. The projects are assumed to be performed using the contractor's Agreement State license under a reciprocal agreement with the NRC in order to capture costs associated with reciprocity. The projects will be conducted according to the phases described below. A detailed description of each phase follows.

- Historical Site Assessment (HSA) and Scoping Surveys
- Characterization
- Decommissioning Plan and Supporting Documents

- Equipment and Material Removal / Decontamination
- Remediation of Building Structures and Soils of Outside Grounds
- Waste Disposal
- Final Status Surveys and Report

Each of these project elements are described below.

2.12.1 Historical Site Assessment

The purpose of the HSA is to determine the current status of the site including potential, likely, or known sources of radioactive contamination by gathering data from various sources. This data includes physical characteristics of the site as well as information found in site operating records, including radiological surveys. A records review will include: radioactive materials licenses, license applications, amendment requests, Radiation Safety Committee meeting minutes, radiological surveys, radionuclide receipt and distribution records, radioactive waste records, incident reports, decommissioning records, facility renovation records, blueprints, plans and design specifications. Personnel interviews will include radiation safety, maintenance, operations, and facilities personnel. Limited scoping surveys and sampling are assumed to be performed to augment the HSA and help plan characterization.

2.12.2 Characterization

Characterization surveys will be designed to identify areas of elevated activity that require remediation. Building characterization consists primarily of surface scans and smears of building structural surfaces and systems internal surfaces. Outside grounds characterization consists of gamma scans and soil sampling.

2.12.2.1 Group 2 Facilities

Facility survey records are assumed to be sufficient to plan decommissioning for Group 2 facilities.

2.12.2.2 Alpha Emitter Facilities

Existing characterization data and facility routine surveys will be used to plan decommissioning activities, but additional information regarding the activity in soils is required. Additional characterization data will be collected of soils of outside grounds of Pickard and Schweitzer Halls and under the basement slab of Pickard Hall. A track-mounted geoprobe core sampler will be used to collect samples at depths up to two feet below the Pickard Hall basement floor slab and up to twelve feet in the soils of outside grounds around Pickard Hall and Schweitzer Hall. Samples will be analyzed by gamma spectroscopy and/or alpha spectroscopy.

2.12.2.3 Outdoor Areas

Characterization of outdoor areas will be conducted by performing surface gamma scans and collecting soil samples for laboratory analysis. A track-mounted geoprobe core sampler or hand auger will be used to collect soil and sediment samples at depths up to six inches in surface soils, up to two feet in lagoon sediments, and up to twelve feet in burial grounds. Samples will be analyzed by gamma spectroscopy, C-14 and H-3.

2.12.3 Decommissioning Plan and Supporting Documents

The information gained from the HSA and Characterization will be used to develop a Decommissioning Plan (DP) for each project. While a Group 2 decommissioning project does not require a formal DP, a comprehensive plan is assumed to be developed. A formal NRC-approved Decommissioning Plan is required for Group 4 decommissioning projects. The checklists provided in NUREG 1757 Appendix D are used to develop the DPs. Project plans and procedures supporting the DP will also be developed in this phase. Costs have been captured in the planning phases for regulatory discussions, particularly in regards to development of decommissioning plans and site-specific DCGLs for Group 4 facilities.

2.12.4 Equipment and Material Removal / Decontamination

The decommissioning contractor will remove all loose equipment and materials from the facilities such that only permanent fixtures remain (fixtures attached to structural components of the facilities). Loose equipment and materials will be surveyed for release using the release limits of FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses." Items not meeting FC 83-23 limits are assumed to be disposed as radioactive waste.

2.12.5 Remediation

2.12.5.1 Group 2 Facilities

Remediation of laboratory surfaces is expected to consist of wiping, scrubbing and scouring or removal of surfaces, such as vinyl floor coverings. A small amount of equipment, drains and ventilation systems are assumed to be removed for ALARA purposes. Several small areas of persistent contamination are assumed to be remediated in waste storage areas by removing a thin layer of the concrete floor surface. An average of 150 lb of waste for each of 400 labs, and each of 25 farm buildings is assumed. Additionally, six drums of liquid scintillation vial waste are assumed to be generated from decommissioning activities.

2.12.5.2 Alpha Emitter Facilities

Pickard Hall is assumed to require the following remediation:

- Remove and dispose all insulation and loose materials in the attic.
- Remove attic wooden decking.
- Power plane contaminated wooden structural supports in attic – joists and rafters. Assume up to 1/8" of materials must be removed over 50% of area.
- Remove two contaminated brick ducts from the attic to the basement. The walls will be demolished on each elevation to provide access.
- Demolish small wall area on 2^{nd} floor (room 213).
- Demolish stage area on the 1^{st} floor (room 106).
- Demolish several wall areas in the basement.
- Remove an average of 1/8" of the basement floor surface over an area of 4200 ft^2.
- Remove basement floor slab over an area of 4200 ft^2 to access underlying soils – concrete assumed to be releasable for unrestricted use.
- Remove buried drain lines.
- Remove average of 1 ft depth of soils over an area of 4200 ft^2.
- Remove an additional 1,000 ft^3 of soil in outside grounds.

Schweitzer Hall is assumed to require the following remediation:

- Remove and dispose all insulation and loose materials in the attic (currently being performed, but costs captured in this estimate).
- Remove slate roof and wooden plank roof surfaces.
- Power plane contaminated wooden structural supports – joists and rafters. Assume up to 1/8" of materials must be removed over 50% of area.
- Remove 2400 ft^2 of six inch thick concrete attic floor.
- Remove an additional 1,000 ft^3 of soil in outside grounds.

2.12.5.3 Outdoor Areas

Outdoor areas are assumed to meet release criteria as demonstrated using a site-specific dose model. However, removal and disposal of 40 cubic yards of soils is assumed in order to capture additional costs to offset uncertainty associated with lack of characterization data.

2.12.6 Waste Disposal

Radioactive waste packaging, shipping, processing and disposal costs were determined based upon the expected volume generation and disposal facility waste acceptance criteria. Waste processing activities for soils, slate, and rubble from Pickard Hall and Schweitzer Hall are assumed to take place in Richland, WA. Other waste processing activities are assumed to take place in Oak Ridge, TN to ensure adequate transportation costs are captured for a number of available processors.

In addition to wastes generated during decommissioning, costs are captured for disposal of sealed sources and existing waste on site at the time of cessation of licensed activities. Disposal cost estimates for sealed sources is based on the assumption that there is no leakage from the sealed sources and no external contamination. Sealed sources will be shipped to a facility for recycling of the sources. The majority of the cost associated with disposal of the sources will be for transportation and disposal. The sources will be placed in a cask and loaded onto a conveyance for transportation to the disposal facility. Transportation and disposal costs for sealed sources are presented in Table 2-3.

Table 2-3 Sealed Source Transportation and Disposal Estimates

Item	Cost Basis	Unit Cost	Qty.	Total
Transportation and Permits	$/mile	$3.80	2850	$10,830
Cask Rental	$/day	$1,800.00	7	$12,600
Recycling Charges	$/item	$8,000.00	1	$8,000
Labor (Engineers)	$/day	$3,667.00	3	$11,001
Labor (Cask Operators)	$/day	$2,250.00	2	$4,500
Labor (Riggers)	$/day	$4,500.00	2	$9,000
			Total:	**$55,931**

The cost for disposal of operational waste at the time of cessation of operations is assumed from a typical annual waste inventory based on average data from waste disposal shipments over the past three years. A breakdown of waste assumed to be on site at cessation of operations is presented in Table 2-4.

Table 2-4 Operational Waste at Cessation of Licensed Activities

Item	Quantity	Unit Rate	Total
Incinerator Ash	7.5 ft^3	$200/$ft^3$	$1,500
Non-Hazardous Liquid Scintillation Vials	7.5 ft^3	$180/$ft^3$	$1,350
Dry Active Waste	500 lb	$6/lb	$3,000
Animal Carcasses	30 lb	$20/lb	$600
Liquids	400 lb	$6/lb	$2,400
		Total:	**$8,850**

2.12.7 Final Status Surveys and Report

Final status surveys are performed to demonstrate that residual radioactivity in each survey unit satisfies the predetermined criteria for release for unrestricted use. Final status surveys will be conducted by performing the appropriate combination of scan surveys, total activity measurements, dose rate measurements, soil samples and removable contamination measurements.

2.12.7.1 Group 2 Facilities

Final status survey will consist of surface scans, static measurements and smears for all areas. Scan percentages are assumed to be: 100% for Class 1 areas, 50% for Class 2 areas, and 10% for Class 3 areas. Fifteen sample locations per survey unit are assumed in medical and research laboratories. For conservatism, each Class 1 and Class 2 room is assumed to be an individual survey unit.

Survey design for building systems is out of the scope of MARSSIM. For the purpose of identifying potential residual contamination within these systems, the following survey protocol is assumed: Surveys of building ventilation and fume hood ventilation consist of scan surveys, total activity measurements, and removable contamination measurements of accessible ventilation exhaust points and at locations of potential collection/buildup. Removable contamination surveys will be taken in sink drains, sink drain traps, floor drains and vacuum pumps/nozzles.

2.12.7.2 Alpha Emitter Facilities

Final status surveys will consist of surface scans, static measurements and smears for all areas. Additionally, soil samples are assumed to be performed for impacted soils. Scan percentages are assumed to be: 100% for Class 1, 50% for Class 2 areas, and 10% for Class 3 areas. 20 sample locations per survey unit are assumed in structure and soil survey units.

2.12.7.3 Outdoor Areas

Final status surveys will consist of surface scans, and soil samples for all areas. Scan percentages are assumed to be: 100% for Class 1 areas, 50% for Class 2 areas, and 10% for Class 3 areas. 20 sample locations per survey unit are assumed in soil survey units.

2.12.8 Schedules

A breakdown of the estimated schedule for each project is presented in Table 2-5.

Table 2-5 Schedule Breakdown[2]

Project Element	Cost Estimate Table[3]	Group 2 Facilities (Weeks)	Alpha Facilities (Weeks)	Outdoor Facilities (Weeks)
Decommissioning Planning	Table 3.6	3	7	7
Characterization Surveys	Table 3.6	1	1	1
Equipment Removal, Remediation, Waste Disposal	Table 3.7 Table 3.14	12	18	1
Final Status Surveys	Table 3.9	13	3	4
Final Status Report	Table 3.9	3	3	2
Restoration	Table 3.8	0.5	2.5	0.5
	Total	**32.5**	**34.5**	**15.5**

2.13 Staffing and Labor

2.13.1 Group 2 Facilities

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), six Health Physics Technicians (HPT), and two Laborers. Part time on-site and off-site support is provided by a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The PM is responsible for the overall management of the project and provides the daily interface with MU management, vendors and subcontractors. The PM is also responsible for coordination of decommissioning activities and for arranging any needed support items as well as ensuring that the project is completed within required parameters with respect to cost, timeliness, safety, quality, and compliance. The Health Physics Supervisor provides day-to-day supervision of field operations. Health Physics Technicians provide labor for radiological surveys, remediation, waste packaging, and final status surveys. Laborers are radiation workers that provide labor for decontamination, dismantlement and waste handling activities. The Health Physicist is responsible for developing appropriate techniques, controls, and monitoring for the work being performed. This position is also responsible for ensuring that appropriate instrumentation and procedures are utilized for performing remedial support and final status surveys. The Shipper is responsible for packaging, classifying and shipping all radioactive materials from the project as well as scheduling shipments and ordering shipping containers as necessary. The Draftsman creates, documents and indexes facility drawings and radiation surveys. The administrative assistant provides support to the Project Manager for cost-tracking, timekeeping, procurement and recordkeeping functions.

[2] Project elements are not contiguous and do not include regulatory review periods.
[3] The cost estimate table numbers refer to the tables contained in Appendices B, C and D.

2.13.2 Alpha Emitter Facilities

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), six Health Physics Technicians (HPT), a Foreman, an Equipment Operator and six Laborers. Part time on-site and off-site support is provided by a Structural Engineer, a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The functions and responsibilities are the same as above for common positions. The Structural Engineer is a part-time position responsible for evaluating the effect of remediation on the structural integrity of the buildings and stability of outside grounds. The Structural Engineer also designs and inspects shoring of building structures. The Equipment Operator operates heavy equipment required for movement, excavation, and loading of remediation wastes. The Foreman provides day-to-day supervision of the laborer crew. Laborers are radiation workers that provide labor for decontamination, dismantlement, lifting, rigging and waste handling activities.

2.13.3 Outdoor Areas

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), two Health Physics Technicians (HPT), a Foreman, two Equipment Operators and two Laborers. Part time on-site and off-site support is provided by a Structural Engineer, a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The functions and responsibilities are the same as above.

2.14 Additional Assumptions

- All labor estimates are expressed in workdays. Workdays are actual days on the job excluding weekends, holidays, etc. Project schedules were based on 5-day workweeks consisting of 8 hours per day.
- No credit is taken in these estimates for any salvage value of any material or equipment.
- It is assumed that all facilities are decontaminated for unrestricted use and are not demolished.
- Inventories of materials and wastes at the time of decommissioning will be in amounts consistent with routine facility conditions over time.
- Decommissioning activities take place immediately on cessation of operations without multiyear storage-for-decay periods.
- Work will be performed by an independent third-party contractor. All labor, services, equipment and supply costs are based on third party costs.
- Activities will be conducted under the contractor's Agreement State license utilizing a reciprocal agreement with the NRC.

- Group 4 activities will be conducted under the contractor's Agreement State license over a period of two years (long development and regulatory review periods are assumed) such that two annual reciprocity fees are captured.
- Group 2 activities will be conducted under the contractor's Agreement State license and can be completed in a single year.
- The licensee operated the facility according to all license conditions and industry standard radiological practices.
- There is no contamination on the external surfaces of Group 2 buildings, including the roof.
- There is no contamination of building structural surfaces in laboratories above a two-meter height.
- There are no subsurface drain lines in Group 2 facilities that must be remediated.
- Radioactive wastes from consumables used in the decommissioning process are captured in waste estimates under Dry Active Waste (DAW).
- Building footers will not be impacted to a degree that would require building demolition.
- No structural engineering or shoring is required during demolition work. However, costs are captured for a Structural Engineer's evaluation.
- Groundwater is not impacted.
- No costs are captured for removing museum items or protection of museum artifacts.
- Museum artifacts are assumed to have no salvage value used to offset decommissioning costs.

2.15 Cost Estimate Results

The overall estimated cost to achieve unrestricted release of the facility is $9,046,453 including a contingency of 25%. Table A.3.18 data from each of the independent cost estimates were summed and presented in Table 2-6 below.

Table 2-6 Total Decommissioning Cost Breakdown

Task/Component	Cost	Percentage
Planning and Preparation	$359,380	5.0%
Decontamination and/or Dismantling of Radioactive Facility	$1,723,199	23.8%
Restoration of Contaminated Areas on Facility Grounds	$84,420	1.2%
Final Radiation Survey	$806,180	11.1%
Packing Material Costs	$29,080	0.4%
Shipping Costs	$179,831	2.5%
Waste Disposal Costs	$3,337,920	46.1%
Equipment/Supply Costs	$416,152	5.8%
Laboratory Costs	$291,000	4.0%
Miscellaneous Costs	$10,000	0.1%
SUBTOTAL	**$7,237,162**	**100.0%**
25% Contingency	$1,809,291	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	**$9,046,453**	**125.0%**

3.0 Periodic Adjustment of Decommissioning Cost Estimate and Funding Levels

The decommissioning cost estimate will be updated with the current prices of goods and services at least every three years, and the decommissioning funding will be adjusted as needed at that time. Additionally, annually, as part of the annual program review, the Radiation Safety Committee will review the need for updating based on operational changes such as adding or deleting facilities as well as significant changes in quantities, usage, and/or radiological conditions.

4.0 Certification of Financial Assurance and Financial Instrument

A copy of the Statement of Intent that provides financial assurance for decommissioning is attached as Appendix E.

5.0 References

- 10 CFR 20, Standards For Protection Against Radiation
- NUREG-1757, Volume 1, Rev. 2 "Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees," September, 2006
- NUREG-1757, Volume 2, Rev. 1 "Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria," September, 2006

- NUREG-1757, Volume 3 "Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness," September, 2003
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
- NUREG/CR-6477, "Revised Analyses of Decommissioning Reference, Non-Fuel-Cycle Facilities," December 2002
- NUREG-1505, Revision 1, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys," June 1998
- NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998
- NUREG/CR-5512, "Residual Radioactivity from Decommissioning: Parameter Analysis," August 1999.
- NUREG-1549, "Decision Methods for Dose Assessment to Comply with Radiological Criteria for License Termination," July 1998
- ANL/EAD/03-1 "User's Manual for RESRAD-BUILD Version 3," June 2003
- "Decommissioning Health Physics, A Handbook for MARSSIM Users," Abelquist, 2001
- "Handbook of Health Physics and Radiological Health", 3rd Edition, 1998
- FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses."
- Pickard Hall Characterization Survey Report, July 16, 2010 (ML102800311, ML102800322, ML102800330, ML102800336, ML102800398, ML102800412, ML102800427, ML102800430, ML102800436, ML102800441, ML102800450, ML102800452, ML102800455, ML102800458, ML102800463, ML102800467, and ML102800563)
- Schweitzer Hall Roof Survey Report, March 3, 2010

Appendix A
MU NRC License
Number 24-00513-32

U.S. NUCLEAR REGULATORY COMMISSION Amendment No. 108

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. The Curators of the University of Missouri	In accordance with letter dated November 1, 2010
	3. License number 24-00513-32 is amended in its entirety to read as follows:
2. 311 Jesse Hall Columbia, MO 65211	4. Expiration date January 31, 2014
	5. Docket No. 030-02278 Reference No.

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Any byproduct material permitted by 10 CFR 35.100	A. Any	A. As needed
B. Any byproduct material permitted by 10 CFR 35.200	B. Any	B. As needed
C. Any byproduct material permitted by 10 CFR 35.300	C. Any	(b)(7)(F)
D. Any byproduct material permitted by 10 CFR 35.400	D. Any	(b)(7)(F)
E. Any byproduct material permitted by 10 CFR 35.500	E. Any	(b)(7)(F)
F. Any byproduct material with Atomic Numbers between 3 through 92, inclusive; except as specified below:	F. Any	(b)(7)(F)
G. Hydrogen-3	G. Any	G. 15 curies
H. Molybdenum-99	H. Mo-99/Tc99m Generator	H. 12 curies
I. Technetium-99m	I. Any	I. 6 curies

License Number
24-00513-32

Docket or Reference Number
030-02278

MATERIALS LICENSE
SUPPLEMENTARY SHEET

Amendment No. 108

J. Gold-198	J. Any	J. 1 curie
K. Polonium-210	K. Any	K. 5 millicuries
L. Neptunium-237	L. Any	L. 2 millicuries
M. Americium-241	M. Any	(b)(7)(F)
N. Phosphorus-32	N. Any	N. 5 curies
O. Cesium-137	O. Sealed source (registered pursuant to 10 CFR 32.210 or an Agreement State)	(b)(7)(F)
P. Americium-241	P. Sealed source	(b)(7)(F)
Q. Americium-241	Q. Sealed source	(b)(7)(F)
R. Americium-241/Cesium-137	R. Sealed source	(b)(7)(F)
S. Americium-241	S. Sealed source	(b)(7)(F)
T. Curium-244	T. Calibration sources	T. Not to exceed 0.001 millicuries per source; total possession not to exceed 0.005 millicuries
U. Americium-241	U. Sealed source	(b)(7)(F)

License Number
24-00513-32

MATERIALS LICENSE
SUPPLEMENTARY SHEET

Docket or Reference Number
030-02278

Amendment No. 108

V. Americium-241	V. Sealed source	(b)(7)(F)
W. Americium-241	W. Sealed source	(b)(7)(F)
X. Americium-241	X. Sealed source	(b)(7)(F)
Y. Americium-241	Y. Sealed source	(b)(7)(F)
Z. Uranium (depleted in uranium-235)	Z. Stainless steel covered metal	Z. 4 shields not to exceed 12 kilograms each
AA. Uranium (Natural)	AA. Any	AA. 250 kilograms
BB. Thorium (Natural)	BB. Any	BB. 250 kilograms
CC. Plutonium-239	CC. Sealed source (Mound Laboratory)	(b)(7)(F)
DD. Uranium (Depleted)	DD. Any	DD. 250 kilograms
EE. Californium-252	EE. Sealed source	EE. Total not to exceed 19.0 micrograms
FF. Strontium-90	FF. Sealed source	FF. 500 millicuries
GG. Hydrogen-3	GG. Waste Storage/Processing	GG. 3 curies
HH. Any byproduct material with Atomic Numbers between 3 through 83, inclusive	HH. Waste Storage/Processing	(b)(7)(F)
II. Gadolinium-153	II. Sealed sources (North American Scientific, Inc. Model MED 3601)	II. 12 sources not to exceed 250 millicuries each; total possession not to exceed 3 curies.
JJ. Cesium-137	JJ. Sealed sources (Isotope Products Model HEG-137)	JJ. 8 sources not to exceed 30 millicuries each; not to exceed 240 millicuries total

License Number
24-00513-32

Docket or Reference Number
030-02278

Amendment No. 108

MATERIALS LICENSE
SUPPLEMENTARY SHEET

KK. Any byproduct material with a half-life less than or equal to 6 hours	KK. Any	KK. Total possession not to exceed 10 curies
LL. Americium-241	LL. Sealed source (ICN Model 400)	(b)(7)(F)
MM. Radium-226	MM. Any	MM. 100 millicuries

9. Authorized use:

A. Any uptake, dilution and excretion procedure permitted by 10 CFR 35.100.

B. Any imaging and localization procedure permitted by 10 CFR 35.200.

C. Any diagnostic or therapy procedure permitted by 10 CFR 35.300.

D. Any manual brachytherapy procedure permitted by 10 CFR 35.400.

E. Diagnostic medical use of sealed sources permitted by 10 CFR 35.500 in compatible devices registered pursuant to 10 CFR 30.32(g).

F. through N., AA., BB., DD., EE., KK. and LL. Research and development as defined in Section 30.4 of 10 CFR Part 30, instrument calibration, student instruction and sample analysis as described in application dated June 18, 2003.

O. Sealed sources to be used in J.L. Shepherd 28-6A 5071; Amersham X2016 40666F; EON Corp. 64-761 177 for calibration and density measurements and for medical and veterinary medical brachytherapy use.

P. To be used in Troxler Electronics Labs, Inc., Model 1257 soil moisture/density gauge.

Q. To be used in Troxler Electronics Labs, Inc., Model 1257 soil moisture/density gauge.

R. To be used in Troxler Electronics Labs, Inc., Model 1403 and Model 3411B soil moisture/density gauges.

S. To be used for laboratory moisture/density measurement of soil samples Amersham/Searle in a type X-92 capsule.

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

T. Electroplated calibration sources to be used in an E G & G Model Let -SE 1/2 counter and a Far West Technologies Tissue Equivalent Proportional Counter (TEPC), Model Number LET-SW5.

U. To be used in Campbell Pacific Nuclear Model 500 Series moisture gauges (CPN-131).

V. To be used in Troxler electronics 3220 series moisture gauges, Troxler Drawing No. A-102700.

W. To be used in a Siemens Model SS10244 anatomical marker, Amersham Model AMC24, also for calibration and research.

X. To be used in a Siemens Model 035-423000 dual Isotopic Motion Correction Point Source Holder, Amersham Model AMC24, also for calibration and research.

Y. To be used for research and development, as defined in Section 30.4 of 10 CFR Part 30, and for student instruction; Amersham/Searle in a Type X-92 capsule, AMC-26X108-3875LV.

Z. Shielding in ADAC Laboratories MCD-AC attenuation correction system.

CC. To be used for laboratory research, student instruction and instrument calibration.

FF. To be used in Tracer Lab model 772 for veterinary medical therapy.

GG. and HH. Short term waste inventory for including waste materials transferred from other licenses issued to the Curators of the University of Missouri.

II. Six sources to be used in ADAC Laboratories Transmission Line Source Housing VANTAGE devices for medical radiography in humans. Six sources in shipping containers for replacement of the sources.

JJ. Four sources to used in ADAC Laboratories MCD-AC attenuation correction system for medical radiography in humans. Four sources in shipping containers for replacement of the sources.

MM. For possession only, incident to decommissioning activities.

CONDITIONS

10. Licensed material may be used at the licensee's facilities located at **The University of Missouri, Columbia Missouri campus, Columbia, Missouri**; Ellis Fischel Cancer Center, 115 Business Loop 70 West, Columbia, Missouri; and at **Women's and Children's Hospital**, 404 Keene Street, Columbia, Missouri. Portable moisture density gauges may be used at temporary job sites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

11. The Radiation Safety Officer for this license is Willie (Jack) M. Crawford, M.S.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

12\. A. The use of licensed material in or on humans shall be by an authorized user as defined in 10 CFR 35.2.

B. Individuals designated to work as authorized users, authorized nuclear pharmacists, or authorized medical physicists, as defined in 10 CFR 35.2, shall meet the training, experience and recentness of training criteria established in 10 CFR 35, and shall be designated, in writing, by the licensee's Radiation Safety Committee.

C. Licensed material for other than human use shall be used by, or under the supervision of, individuals designated by the Radiation Safety Committee. The licensee shall maintain records of individuals designated as users for three years after the individual's last use of licensed material.

13\. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the limits specified in 10 CFR 30.72 which require consideration of the need for an emergency plan for responding to a release of licensed material.

14\. For sealed sources not associated with 10 CFR Part 35 use, the following conditions apply:

A. Sealed sources shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to primarily emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.

C. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

D. In the absence of a certificate from a transferor indicating that a leak test has been made within the intervals specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State, prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested and the test results received.

E. Sealed sources need not be leak tested if they contain only hydrogen-3; or they contain only a radioactive gas; or the half-life of the isotope is 30 days or less; or they contain not more than 100 microcuries of beta- and/or gamma-emitting material or not more than 10 microcuries of alpha-emitting material.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

F. Sealed sources need not be tested if they are in storage and are not being used; however, when they are removed from storage for use or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

G. The leak test shall be capable of detecting the presence of 0.005 microcurie (185 becquerels) of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie (185 becquerels) or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(c)(2), and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations.

H. Tests for leakage and/or contamination, including leak test sample collection and analysis, shall be performed by the licensee or by other persons specifically licensed by the U. S. Nuclear Regulatory Commission or an Agreement State to perform such services.

I. Records of leak test results shall be kept in units of microcuries and shall be maintained for 3 years.

15. Pursuant to 10 CFR Part 40, "Domestic Licensing of Source Material," the licensee is authorized to possess, use, transfer, and import up to 999 kilograms of depleted uranium contained as shielding material.

16. The licensee shall conduct a physical inventory every six months, or at other intervals approved by the U.S. Nuclear Regulatory Commission, to account for all sources and/or devices received and possessed under the license

17. A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperature from exceeding that specified by the manufacturer and approved by U.S. Nuclear Regulatory Commission.

B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

18. Notwithstanding the requirements of License Condition No. 32, the licensee is authorized to make program changes and changes to procedures specifically identified in the application June 18, 2003, which were previously approved by the Commission and incorporated into the license without prior Commission approval as long as:

    A. the proposed revision is documented, reviewed, and approved by the licensee's Radiation Safety Committee, in accordance with established procedures prior to implementation;

    B. the revised program is in accordance with regulatory requirements, will not change the license conditions, and will not decrease the effectiveness of the Radiation Safety Program;

    C. the licensee's staff is trained in the revised procedures prior to implementation; and,

    D. the licensee's audit program evaluates the effectiveness of the change and its implementation.

19. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee except as authorized by the Radiation Safety Committee and as described in the facsimile dated May 30, 2007, transmitted May 31, 2007, to permit the removal of sealed sources from liquid scintillation counting devices, or other similar types of equipment, for disposal pursuant to 10 CFR 30.41, 10 CFR 30.51, Subpart K in 10 CFR 20, and the conditions of this license.

20. The licensee is authorized to hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash provided:

    A. Before disposal as ordinary trash, byproduct material shall be surveyed at the container surface with the appropriate meter set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

    B. Generator columns shall be segregated so that they may be monitored separately to ensure decay to background levels prior to disposal.

    C. A record of each disposal permitted under this License Condition shall be retained for 3 years. The record must include the date of disposal, the date on which the byproduct material was placed in storage, the radionuclides disposed, the survey instrument used, the background dose rate, the dose rate measured at the surface of each waste container, and the name of the individual who performed the disposal.

    D. Radioactive waste being held for decay shall not be stored for a period greater than 4 years.

21. Radioactive waste other than that specified in Condition 20. shall not be stored for a period greater than 2 years.

22. Notwithstanding Conditions 20. and 21., radioactive waste transferred from other University of Missouri Licenses shall be disposed of within one year of receipt.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

23. A. Pursuant to 10 CFR 20.1302(c), and 10 CFR 20.2002, the licensee is authorized to dispose of licensed material by incineration provided the gaseous effluent from incineration does not exceed the limits specified for air in Appendix B, Table II, Column 1, 10 CFR Part 20.

B. Pursuant to 10 CFR 20.2002, the licensee may dispose of incinerator ash containing radioactive materials with Atomic Nos. 1-83, other than those isotopes listed below, as ordinary waste in a landfill, provided the concentrations of the isotopes, expressed in microcurie (μCi) per gram of ash, at the time of disposal, do not exceed the numerical values listed in Table II, Column 2, 10 CFR 20, Appendix B. Isotopes not included are hydrogen-3, carbon-14, aluminum-26, chlorine-36, silver-108m, niobium-94, iodine-129, technetium-99, and thallium-204, for which the concentrations must not exceed 10 percent of the values listed in Table II, Column 2, 10 CFR Part 20, Appendix B.

C. Pursuant to 10 CFR 20.2002, the licensee may incinerate tritium waste without the requirement for removing any ash previous to or following tritium waste incineration, provided the ash is not used for the dilution of subsequently incinerated waste containing other licensed materials.

24. The licensee shall not use licensed material in or on human beings except as provided otherwise by specific condition of this license.

25. Experimental animals, or the products from experimental animals, that have been administered licensed materials shall not be used for human consumption.

26. The licensee shall not acquire licensed material in a sealed source or device that contains a sealed source unless the source or device has been registered with the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or with an Agreement State.

27. The licensee is authorized to transport licensed material only in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

28. The licensee shall maintain records of information related to decommissioning at the EHS Main Offices, 1306 Research Park Drive, Columbia, Missouri as specified in 10 CFR 30.35(g) until this license is terminated by the Commission.

29. Each portable nuclear gauge shall have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The gauge or its container must be locked when in transport. A minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal whenever the portable gauge is not under the control and constant surveillance of the licensee are required.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 24-00513-32

Docket or Reference Number: 030-02278

Amendment No. 108

30. A. If the licensee uses unshielded sealed sources extended more than 3 feet below the surface, the licensee shall use surface casing that extends from the lowest depth to 12 inches above the surface and other appropriate procedures to reduce the probability of the source or probe becoming lodged below the surface. If it is not feasible to extend the casing 12 inches above the surface, the licensee shall implement procedures to ensure that the cased hole is free of obstruction before making measurements.

B. If a sealed source or a probe containing sealed sources becomes lodged below the surface and it becomes apparent that efforts to recover the sealed source or probe may not be successful, the licensee shall notify the U. S. Nuclear Regulatory Commission and submit the report required by 10 CFR 30.50(b)(2) and (c). The licensee shall not abandon the sealed source or probe without obtaining the Commission's prior written consent.

31. (b)(7)(F)

NRC FORM 374A	U.S. NUCLEAR REGULATORY COMMISSION	PAGE 11 of 11 PAGES
	MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

32. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below, except for minor changes in the medical use radiation safety procedures as provided in 10 CFR 35.31. The U.S. Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Application June 18, 2003;

B. Letters dated October 23, 2003, November 25, 2003, and October 25, 2010; and,

C. Facsimiles dated April 12, 2007 (excluding items 1, 2, 3, 5 and 10), April 25, 2007, and May 30, 2007, transmitted on May 31, 2007.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

ate FEB 04 2011

By Colleen Carol Casey
Colleen Carol Casey
Materials Licensing Branch
Region III

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.				
Name of room, laboratory, or area:	Area 1: Research and Medical Laboratories (400 Laboratories)			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods	400	144	57,600	ft^3
Lab Benches	400	270	108,000	ft^3
Sinks	800	8	6,400	ft^3
Drains	800	3.75	3,000	ft^3
Floors	400	256	102,400	ft^2
Walls	400	640	256,000	ft^2
Ceiling	400	256	102,400	ft^2
Ventilation/Ductwork	400	30	12,000	ft^3
Hot Cells				ft^3
Equipment/Materials	400	7.5	3,000	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: Farm Buildings (25 Buildings)			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks	50	8	400	ft^3
Drains	250	3.75	937.5	ft^3
Floors	25	5,000	125,000	ft^2
Walls	25	6,000	150,000	ft^2
Ceiling	25	5,000	125,000	ft^2
Ventilation/Ductwork	100	30	3,000	ft^3
Hot Cells				ft^3
Equipment/Materials	25	7.5	187.5	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 3: Radioactive Waste Areas (satellite collection areas included with labs)			
Level of Contamination:	MARSSIM Class 1			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods	2	144	288	ft^3
Lab Benches	2	270	540	ft^3
Sinks	6	8	48	ft^3
Drains	10	3.75	38	ft^3
Floors	2	256	512	ft^2
Walls	2	640	1,280	ft^2
Ceiling	2	256	512	ft^2
Ventilation/Ductwork	6	30	180	ft^3
Hot Cells				ft^3
Equipment/Materials	2	96	192	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan						
Development of Work Plans	10	5	1	0	0	5
Procurement of Special Equipment	1	1	0	0	0	1
Staff Training	1	1	1	6	2	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	20	13	4	24	2	7

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS
(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of

Name of room, laboratory, or area:	Research and Medical Labs, Radwaste Areas, Farm Buildings
Level of Contamination:	From background levels to DCGLs

Component	Decon Method	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Glove Boxes							
Fume Hoods/ Hot Cells	Decon				120	20	
Lab Benches	Decon				60	10	
Sinks	Decon						
Drains	Remove/Disp				120	20	
Floors	Decon				60	10	
Walls	Decon				60	10	
Ceilings							
Ventilation/Ductwork	Remove/Disp				120	20	
Hot Cells							
Equipment/Materials	Sur/Rem/Disp				102	34	
Soil Plots							
Storage Tanks							
Storage Areas							
Radwaste Areas							
Scrap Recovery Areas							
Maintenance Shop							
Equipment Decon Areas							
Other (specify) Shipping				10			
Other (specify) Supervision		62	62				
TOTALS		62	62	10	642	124	

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.						
Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Restore Roof Penetrations	2	2			4	
TOTALS	2	2	0	0	4	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.

Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
FSS Setup	10	5		10		5
Survey Packages	10	5		10		5
Class 2 Research Labs	40	40		240		40
Class 2 Farm Buildings	10	10		60		10
Class 1 Waste Storage Area	5	5		30		5
Class 3 Buffer Areas	10	10		60		10
Report	15		3	3		3
TOTALS	100	75	3	413	0	78

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.						
Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 *through* A.3.10).

Task	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	20	13	4	24	2	7
Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7)	62	62	10	642	124	0
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	2	2	0	0	4	0
Final Radiation Survey (TOTALS from Table A.3.9)	100	75	3	413	0	78
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including *Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.*

Labor Cost Component	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,046	$959	$786	$375	$260

[1] *Per Diem Rate:* $129 *per day.*
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$23,804	$13,598	$3,838	$18,873	$750	$1,817	$62,680
Decontamination or Dismantling of Radioactive Facility Components	$73,793	$64,851	$9,594	$504,849	$46,500	$0	$699,588
Restoration of Contaminated Areas on Facility Grounds	$2,380	$2,092	$0	$0	$1,500	$0	$5,972
Final Radiation Survey	$119,022	$78,449	$2,878	$324,770	$0	$20,250	$545,369
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES (Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE from Decomm.	3188	119	1 m^3 Sacks	$80	$9,520
LSC Vials	45	6	Drum	$70	$420
All DAW/PPE/LSC Vials	2,560	2	Rented Seavan	$2,000	$4,000
TOTAL					$13,940

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges ($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE from Decomm.	1.5	$3.50	0	0	600	$3,150
LSC Vials	0.25	$3.50	0	0	600	$525
Annual Waste Inventory	0.25	$3.50	0	0	600	$525
Self-Shielded Irradiator	1					$55,931
TOTAL	3					$60,131

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/$ft^3$ or $/container)	Total Disposal Costs
DAW/PPE from Decomm.	3,188	20	63,750	6.00	0	$382,500
LSC Vials	45	40	1,800	5.00	0	$9,000
Annual Waste Inventory	885	10	8,850	6.00	0	$53,100
TOTAL	3,233					$444,600

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	144	$8	$1,152
Instrumentation Rental (per week)	15	$2,000	$30,000
Misc Tools (per week)	15	$1,000	$15,000
LSC Supplies (per sample)	15,000	$1	$15,000
Consumables (per week)	15	$1,000	$15,000
TOTAL			$76,152

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.			
Activity	Quantity	Unit Cost	Total Item Cost
Sampling			
Transport of Samples			
Testing and Analysis			
Other (specify)			
TOTAL			

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (reciprocity)	$2,000
Insurance (included in unit rates)	
Taxes (included in unit rates)	
Other (specify)	
TOTAL	$2,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in

Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$62,680	3.3%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$699,588	36.6%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$5,972	0.3%
Final Radiation Survey (From Table A.3.13)	$545,369	28.5%
Packing Material Costs (TOTAL from Table A.3.14(a))	$13,940	0.7%
Shipping Costs (TOTAL from Table A.3.14(b))	$60,131	3.1%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$444,600	23.3%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$76,152	4.0%
Laboratory Costs (TOTAL from Table A.3.16)	$0	0.0%
Miscellaneous Costs (TOTAL from Table A.3.17)	$2,000	0.1%
SUBTOTAL	$1,910,432	100.0%
25% Contingency	$477,608	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$2,388,040	125.0%

Appendix C
Pickard / Schweitzer Halls
Cost Estimate Tables

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.				
Name of room, laboratory, or area:	Area 1: Pickard Hall			
Level of Contamination:	MARSSIM Class 1			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains	10	3.75	38	ft^3
Floors	1	33,600	33,600	ft^2
Walls	1	134,400	134,400	ft^2
Ceiling	1	33,600	33,600	ft^2
Ventilation/Ductwork	7	60	420	ft^3
Hot Cells				ft^3
Equipment/Materials	1	98	98	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Roof	1	12,600	12,600	ft^2
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: Schweitzer Hall			
Level of Contamination:	*MARSSIM Class 1*			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains	2	3.75	8	ft^3
Floors	1	9,900	9,900	ft^2
Walls	1	4,950	4,950	ft^2
Ceiling	1	9,900	9,900	ft^2
Ventilation/Ductwork	2	60	120	ft^3
Hot Cells				ft^3
Equipment/Materials	1	96	96	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Roof	1	14,850	14,850	ft^3
Other (specify)				ft^3

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan	20	10	10	20	0	10
Development of Work Plans	10	5	5	10	0	5
Procurement of Special Equipment	4	4	0	0	0	1
Staff Training	1	2	2	8	6	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	43	27	19	56	6	17

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS
(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of							
Name of room, laboratory, or area:		Pickard Hall and Schweitzer Hall					
Level of Contamination:		From background levels to above DCGLs					
Component	Decon Method	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Pickard Hall							
Drains	Remove/Disp				40	30	
Floors	Scabble/Rem				80	60	
Walls	Remove/Disp				20	15	
Ceilings	Plane Attic				60	45	
Ventilation/Ductwork	Remove/Disp				60	45	
Equipment/Materials	Sur/Rem/Disp				8	6	
Soil Plots	Rem Soil				60	45	
Schweitzer Hall							
Drains	Remove/Disp				16	12	
Floors	Scabble/Rem				40	30	
Walls	Remove/Disp				8	6	
Ceilings	Plane Attic				60	45	
Roof	Remove/Disp						
Ventilation/Ductwork	Remove/Disp				60	45	
Equipment/Materials	Sur/Rem/Disp				8	6	
Soil Plots	Rem Soil				20	15	
Other (specify) Shipping				90			
Other (specify) Supervision		90	180				90
TOTALS		90	180	90	540	405	90

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Restore Roof	10	10		10	60	
Backfill Excavations	3	3		6	18	
TOTALS	13	13	0	16	78	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical	
FSS Setup	5	2		2		2	
Survey Packages	5	2		2		2	
Structures	10	10		60		10	10 days
Soils	5	5		30		5	5 Days
Report	15		3	3		3	
TOTALS	40	19	3	97	0	22	

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.						
Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10).

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	43	27	19	56	6	17
Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7)	90	180	90	540	405	90
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	13	13	0	16	78	0
Final Radiation Survey (TOTALS from Table A.3.9)	40	19	3	97	0	22
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Labor Cost Component	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,046	$959	$786	$375	$260

[1] Per Diem Rate: $129 per day.
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$51,179	$28,242	$18,229	$44,037	$2,250	$4,413	$148,350
Decontamination or Dismantling of Radioactive Facility Components	$107,119	$188,277	$86,350	$424,639	$151,875	$23,365	$981,627
Restoration of Contaminated Areas on Facility Grounds	$15,473	$13,598	$0	$12,582	$29,250	$0	$70,903
Final Radiation Survey	$47,609	$19,874	$2,878	$76,278	$0	$5,712	$152,350
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES (Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE	162	6	1 m^3 Sacks	$80	$480
Wood Floor, Roof	7680	3	Rented Seavan	$2,000	$6,000
Soil, Slate and Rubble	8100	15	Rented Roll-Off	$500	$7,500
TOTAL					$13,980

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE	1	$3.50	0	0	600	$2,100
Wood Floor, Roof	3	$3.50	0	0	600	$6,300
Soil, Slate and Rubble	15	$3.50	0	0	2000	$105,000
TOTAL	19					$113,400

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/$ft^3$ or $/container)	Total Disposal Costs
DAW/PPE	162	20	3,240	6.00	0	$19,440
Wood Floor, Roof	1960	60	117,600	6.00	0	$705,600
Soil, Slate and Rubble	7980	105	837,900	2.00	0	$1,675,800
TOTAL	2,122					$2,400,840

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	3600	$8	$28,800
Instrumentation Rental (per week)	22	$2,000	$44,000
Misc Tools (per week)	22	$1,000	$22,000
Heavy Equipment Rental	18	$10,000	$180,000
Consumables (per week)	22	$1,000	$22,000
TOTAL			$296,800

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.			
Activity	Quantity	Unit Cost	Total Item Cost
Sampling			Labor captured in remediation / FSS
Transport of Samples	10	$500	$5,000
Testing and Analysis (gamma)	200	$150	$30,000
Testing and Analysis (alpha)	20	$300	$6,000
Other (specify)			
TOTAL			$41,000

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (2 yrs reciprocity)	$4,000
Insurance (Included in unit rates)	
Taxes (Included in unit rates)	
Other (specify)	
TOTAL	$4,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in

Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$148,350	3.5%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$981,627	23.2%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$70,903	1.7%
Final Radiation Survey (From Table A.3.13)	$152,350	3.6%
Packing Material Costs (TOTAL from Table A.3.14(a))	$13,980	0.3%
Shipping Costs (TOTAL from Table A.3.14(b))	$113,400	2.7%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$2,400,840	56.8%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$296,800	7.0%
Laboratory Costs (TOTAL from Table A.3.16)	$41,000	1.0%
Miscellaneous Costs (TOTAL from Table A.3.17)	$4,000	0.1%
SUBTOTAL	$4,223,250	100.0%
25% Contingency	$1,055,813	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$5,279,063	125.0%

Outdoor Facility
Cost Estimate Tables

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.				
Name of room, laboratory, or area:	Area 1: Sinclair Farm			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains				ft^3
Floors				ft^2
Walls				ft^2
Ceiling				ft^2
Ventilation/Ductwork				ft^3
Hot Cells				ft^3
Equipment/Materials				ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Lagoons	2	2	4	acre
Other (specify) Impacted Grounds	1	100	100	acre

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: South Farm			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains				ft^3
Floors				ft^2
Walls				ft^2
Ceiling				ft^2
Ventilation/Ductwork				ft^3
Hot Cells				ft^3
Equipment/Materials				ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Burial Site	1	0.34	0.34	acre
Other (specify) Impacted Grounds	1	5	5	acre

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan	20	10	10	20	0	10
Development of Work Plans	10	5	5	10	0	5
Procurement of Special Equipment	4	4	0	0	0	1
Staff Training	1	2	2	8	6	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	43	27	19	56	6	17

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS
(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of

Name of room, laboratory, or area: Outdoor Areas

Level of Contamination: From background levels to DCGLs

Component	Decon Method	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Glove Boxes							
Fume Hoods/ Hot Cells							
Lab Benches							
Sinks							
Drains							
Floors							
Walls							
Ceilings							
Ventilation/Ductwork							
Hot Cells							
Equipment/Materials							
Soil Plots	Rem/Dispose				20	10	
Storage Tanks							
Storage Areas							
Radwaste Areas							
Scrap Recovery Areas							
Maintenance Shop							
Equipment Decon Areas							
Other (specify) Shipping				5			
Other (specify) Supervision		5	10				5
TOTALS		5	10	5	20	10	5

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Grade Excavations	2	2		2	4	
TOTALS	2	2	0	2	4	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.						
Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
FSS Setup	5	2		2		2
Survey Packages	5	2		2		2
Soils Surveys/Sampling	15	15		30	30	15
Report	10		2	2		2
TOTALS	35	19	2	36	30	21

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.						
Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) *Foreman*	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10).

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	43	27	19	56	6	17
Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7)	5	10	5	20	10	5
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	2	2	0	2	4	0
Final Radiation Survey (TOTALS from Table A.3.9)	35	19	2	36	30	21
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Labor Cost Component	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,046	$959	$786	$375	$260

[1] Per Diem Rate: $129 per day.
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$51,179	$28,242	$18,229	$44,037	$2,250	$4,413	$148,350
Decontamination or Dismantling of Radioactive Facility Components	$5,951	$10,460	$4,797	$15,727	$3,750	$1,298	$41,984
Restoration of Contaminated Areas on Facility Grounds	$2,380	$2,092	$0	$1,573	$1,500	$0	$7,545
Final Radiation Survey	$41,658	$19,874	$1,919	$28,309	$11,250	$5,452	$108,461
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES (Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE	54	2	1 m^3 Sacks	$80	$160
Soil	1080	2	Rented Roll-Off	$500	$1,000
TOTAL					$1,160

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges ($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE	1	$3.50	0	0	600	$2,100
Soil	2	$3.50	0	0	600	$4,200
TOTAL	3					$6,300

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/$ft^3$ or $/container)	Total Disposal Costs
DAW/PPE	54	20	1,080	6.00	0	$6,480
Soil	1080	90	97,200	5.00	0	$486,000
TOTAL	54					$492,480

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	400	$8	$3,200
Instrumentation Rental (per week)	5	$2,000	$10,000
Misc Tools (per week)	5	$1,000	$5,000
Heavy Equipment Rental	2	$10,000	$20,000
Consumables (per week)	5	$1,000	$5,000
TOTAL			$43,200

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.

Activity	Quantity	Unit Cost	Total Item Cost
Sampling			Labor captured in remediation / FSS
Transport of Samples	20	$500	$10,000
Testing and Analysis (gamma)	600	$150	$90,000
Testing and Analysis (C-14/H-3)	600	$250	$150,000
Other (specify)			
TOTAL			$250,000

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (2 yrs reciprocity)	$4,000
Insurance (included in unit rates)	
Taxes (included in unit rates)	
Other (specify)	
TOTAL	$4,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in

Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$148,350	13.4%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$41,984	3.8%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$7,545	0.7%
Final Radiation Survey (From Table A.3.13)	$108,461	9.8%
Packing Material Costs (TOTAL from Table A.3.14(a))	$1,160	0.1%
Shipping Costs (TOTAL from Table A.3.14(b))	$6,300	0.6%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$492,480	44.6%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$43,200	3.9%
Laboratory Costs (TOTAL from Table A.3.16)	$250,000	22.7%
Miscellaneous Costs (TOTAL from Table A.3.17)	$4,000	0.4%
SUBTOTAL	$1,103,480	100.0%
25% Contingency	$275,870	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$1,379,350	125.0%

Office of the Vice Chancellor
for Administrative Services

University of Missouri-Columbia

319 Jesse Hall
Columbia, MO 65211-1250

PHONE (573) 882-4097
FAX (573) 884-4847

June 1, 2011

TO: U.S. Nuclear Regulatory Commission
U.S. NRC Region III
801 Warrenville Road
Lisle, Illinois 60532

STATEMENT OF INTENT

As Vice Chancellor of Administrative Services of the University of Missouri, I exercise express authority and responsibility to request from the Board of Curators of the University of Missouri funds for decommissioning activities associated with operations authorized by U.S. Nuclear Regulatory Commission Material License No. 24-00513-32. This authority is established by the Collected Rules and Regulations of the University of Missouri. Within this authority I intend to request that funds be made available when necessary in the amount of $9,046,453.00 (Nine Million Forty-Six Thousand Four Hundred Fifty-Three Dollars) to decommission the properties owned by the University of Missouri. I intend to request and obtain these funds sufficiently in advance of decommissioning to prevent delay of required activities.

A copy of the University's Collected Rules and Regulations Section 70.010 is attached as evidence that I am authorized to represent the University of Missouri in this transaction.

Sincerely,

Jacquelyn K. Jones
Vice Chancellor for Administrative Services

Attachment: As Stated

University of Missouri System
COLUMBIA | KANSAS CITY | ROLLA | ST. LOUIS

Chapter 70: Execution of Instruments

70.010 General Execution of Corporate or Board Instruments

172.390, R.S.Mo. 1959; Bd. Min. 4-11-58, p. 12,512; Amended 5-20-77, p. 37,690 and 3-28-80, p. 38,100; Revised Bd. Min. 6-14-85; 1-21-98, Revised Bd. Min. 5-5-06.

A. **All Instruments**—All instruments affecting The Curators of the University of Missouri, the Board of Curators of the University of Missouri, or the University generally shall be executed on behalf thereof as provided in this section unless execution thereof shall have otherwise been specifically provided for and directed by the Board.

B. **Real Estate**

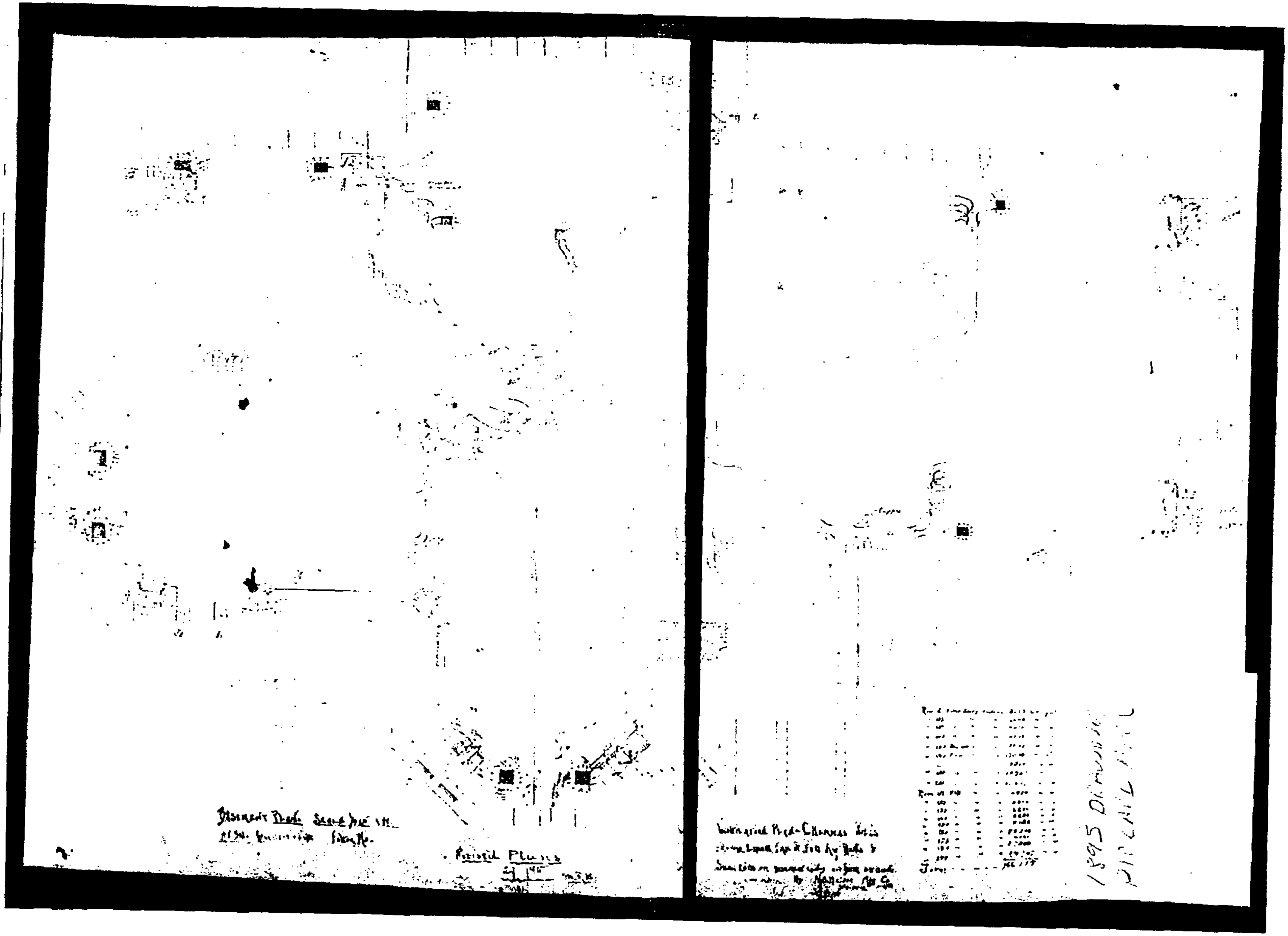
   1. Any of the lands donated by the Atlantic & Pacific Railroad Company to the State of Missouri by deed dated the sixteenth day of February, 1871, and all other lands conveyed by corporations or individuals to the State of Missouri for sale in aid of the state university, may be sold and conveyed by the board of curators, and deeds of conveyance to same shall be executed by the president of the board, signed by him, with the seal of the corporation attached thereto, and attested by the secretary of the board; and provided further, that any conveyances of such lands heretofore made by said board in accordance with the provisions of this section shall divest the State of Missouri of all title to the same and vest said title in the grantees, their heirs and assigns forever.
   2. Instruments conveying title to real estate owned by The Curators of the University of Missouri shall, upon approval of same by the Board of Curators or University President as delegated by the Board, be executed in the name of The Curators of the University of Missouri and signed by the President of the University or his/her designee, with the corporate seal affixed, attested by the Secretary.

C. **All Contracts, Other Instruments and Agreements**—All contracts and other instruments and agreements of The Curators of the University of Missouri shall be executed in the name of The Curators of the University of Missouri and signed by the President thereof, the President of the University, the Vice President for Finance and Administration, or such other officer as may be specifically designated by the Board, and the corporate seal may be affixed, attested by the Secretary. The named officers

Attachment 2 – Various Schematics of Ductwork for Pickard Hall (7 pages)

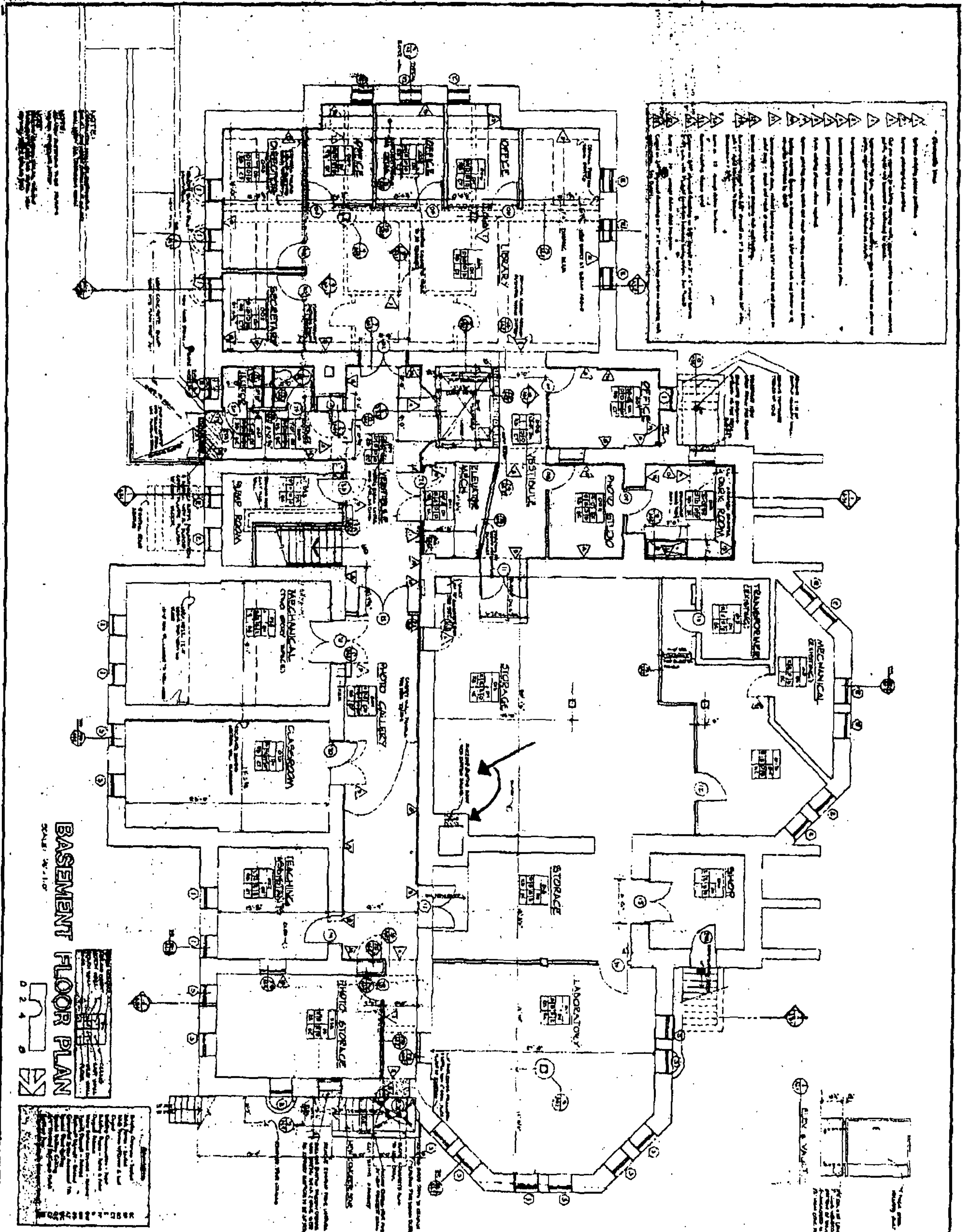
1895 DRAWINGS
PICKARD HALL

-1-



Plans

RC 020 A-2-14 74 00

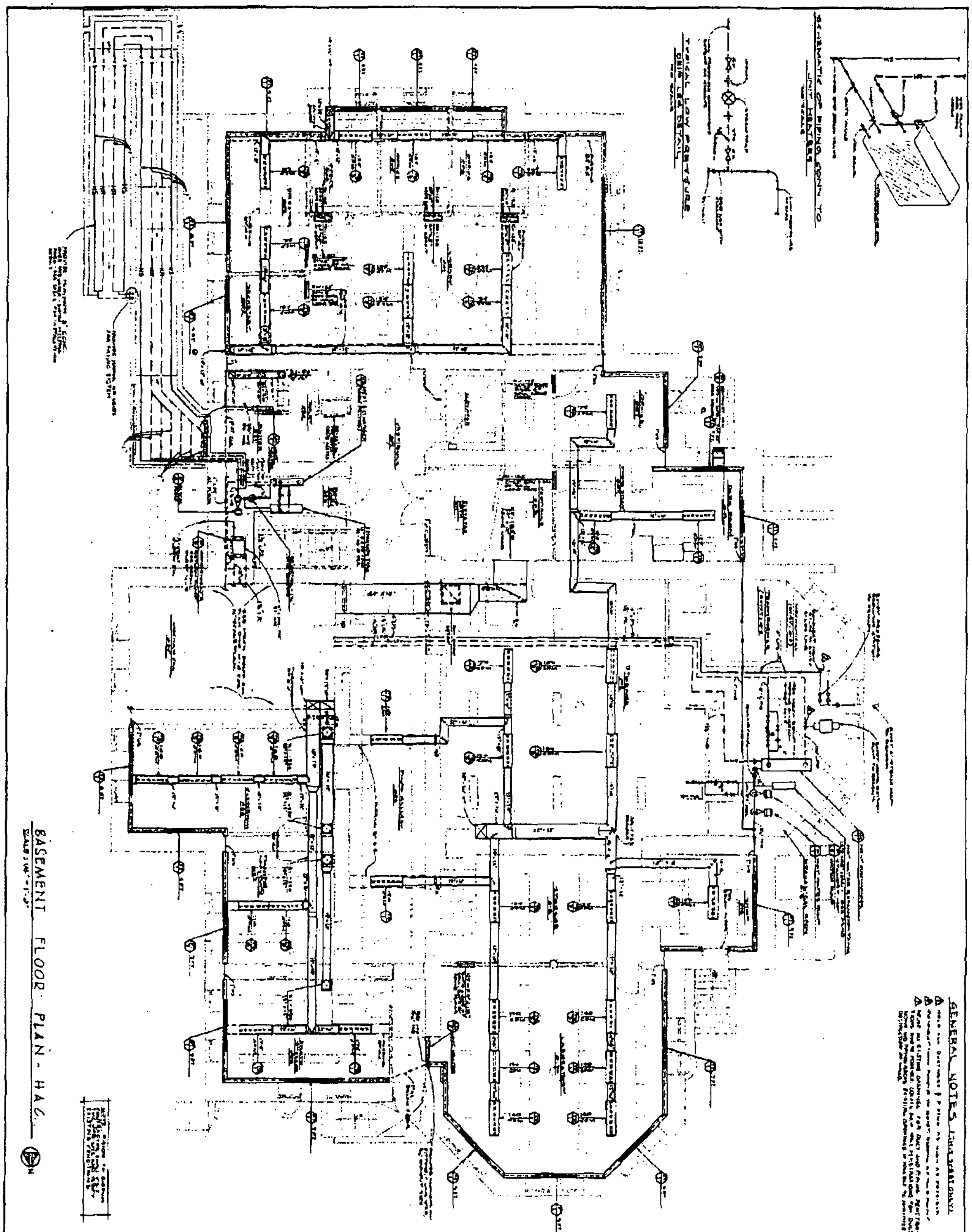


HS/A HOFFMANN/SAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS

A-2-1

OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA
COLUMBIA, MISSOURI
HS/A № 722

RC 020 H02 74 00

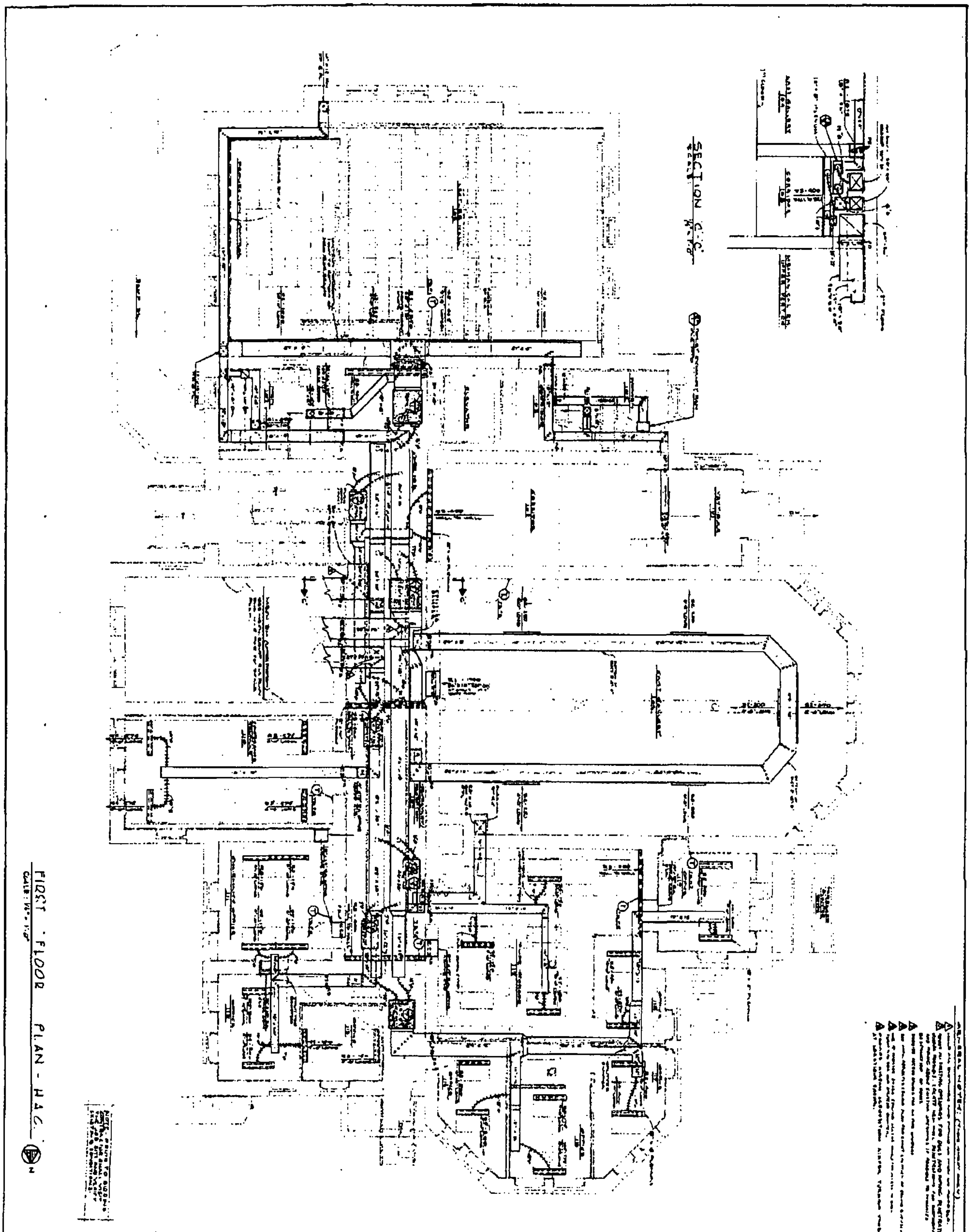


HS/A HOFFMANN/SAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS

OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA
COLUMBIA, MISSOURI
HS/A Nº 722
JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER - SANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

H-2

RC 020 H03 74 00



HS/A HOFFMANN/SAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS

7777 BONHOMME AVENUE/SUITE 2000 ST. LOUIS MISSOURI

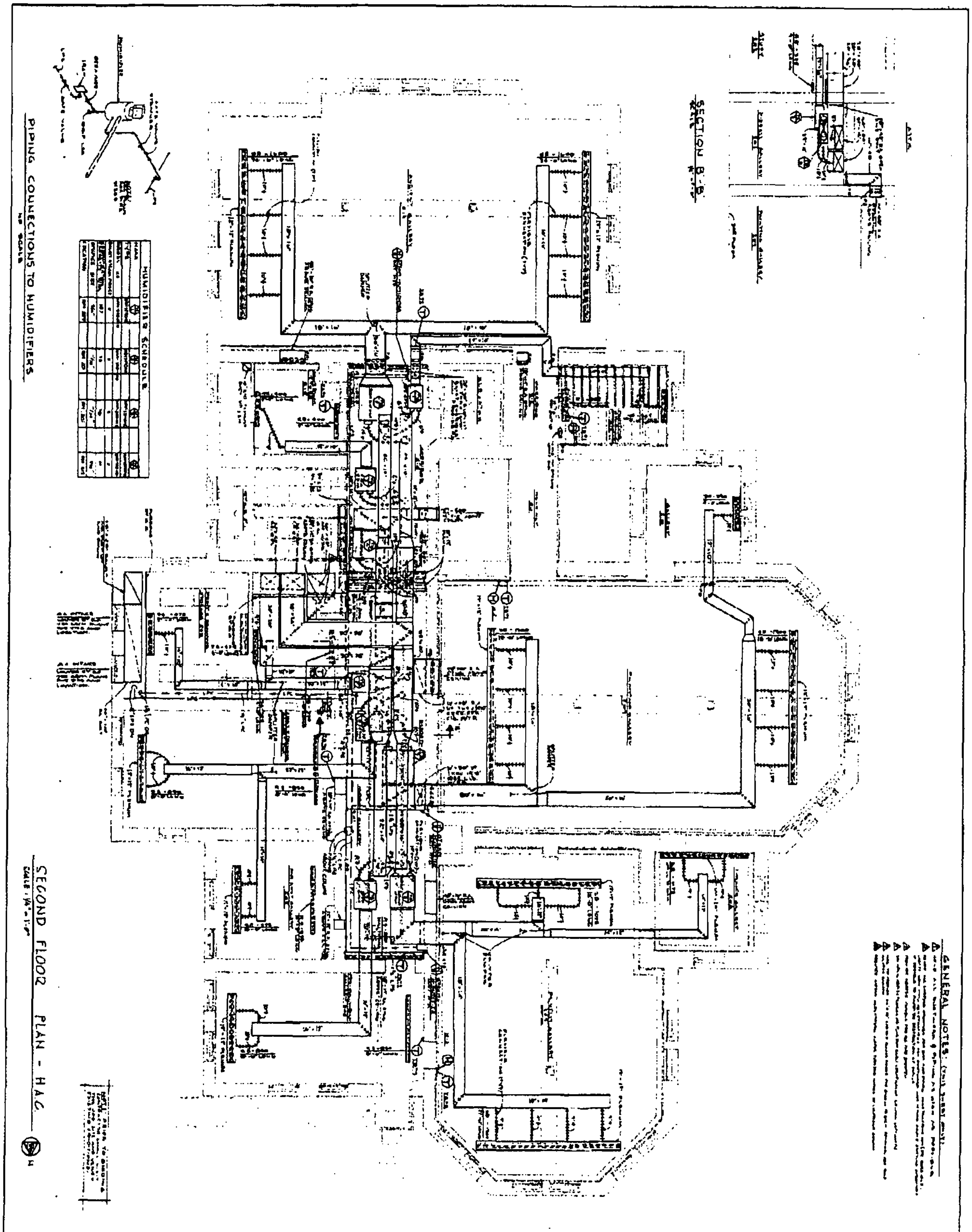
OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA

COLUMBIA, MISSOURI HS/A Nº 722

JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER - BANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

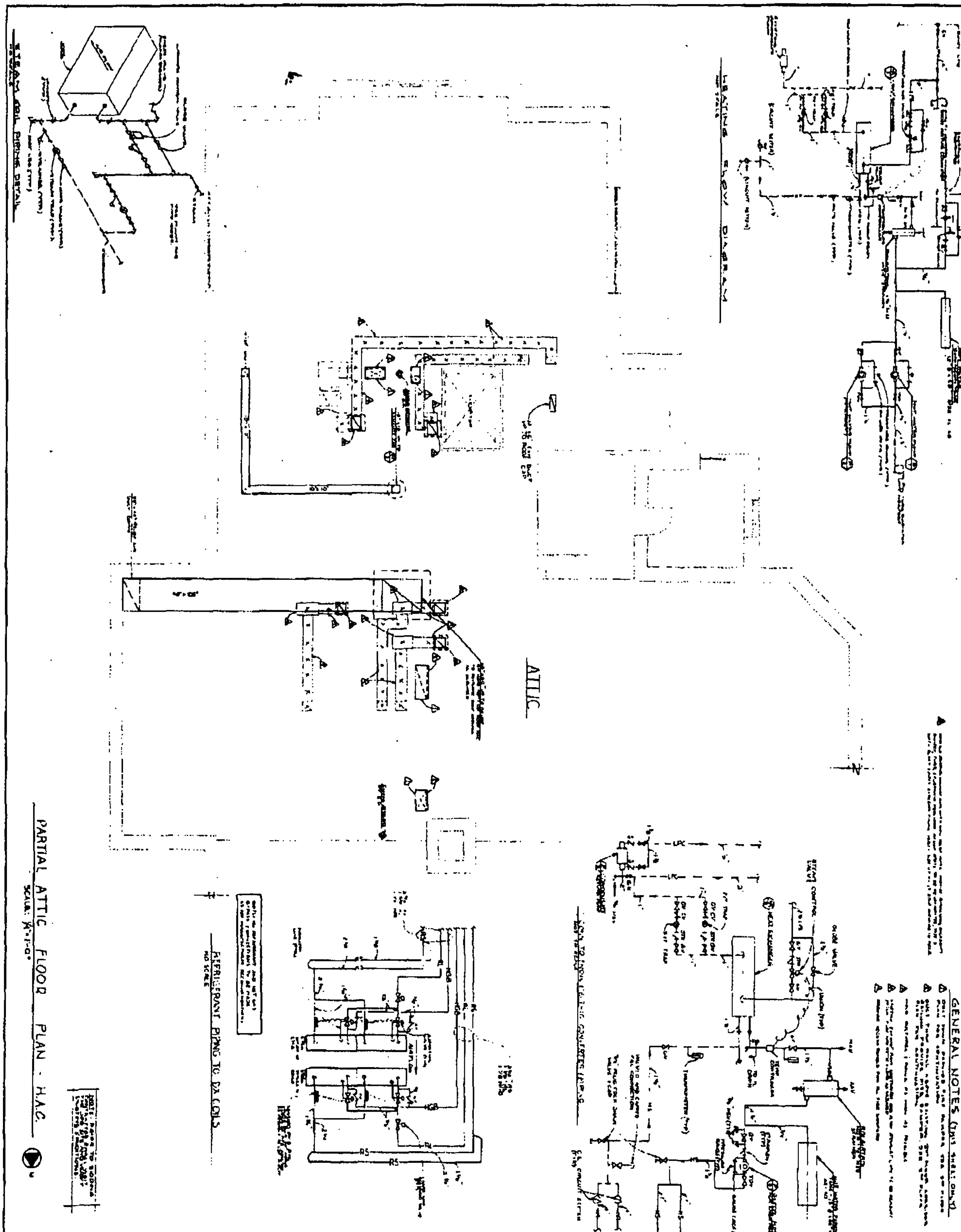
CATEGORY H-3

JOB NO 722



CATEGORY H-4	HS/A HOFFMANN/SAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS 7777 BONHOMME AVENUE/SUITE 2000 ST LOUIS MISSOURI
JOB NO 722	OLD CHEMISTRY BUILDING RENOVATION UNIVERSITY OF MISSOURI - COLUMBIA COLUMBIA, MISSOURI HS/A NO 722 JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER — BANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

RC 020 H05 74 00



HS/A HOFFMANN/BAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS

OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA
COLUMBIA, MISSOURI

HS/A NO 722

JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER - BANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

H-5

Attachment 3a – Radiation Worker Training Status report for Pickard Hall 55555 (1 page)

ORIGINAL TRAIN DATE

Name	Start	Last Training	Training Date	Training Due
Alex Barker	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Amanda Maloney	09/12/11	INTRO. TO RAD SAFETY AT MU	09/08/11	09/08/14
Anne Stanton	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Antone Pierucci	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Barbara Smith	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Brandy Tumnire	09/19/12	INTRO. TO RAD SAFETY AT MU	09/18/12	09/18/15
Bruce Cox	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Carol Geisler	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Cathy Asbury	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Cathy Callaway	12/15/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Christina Schappe	07/11/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Christopher Ruff	10/04/11	INTRO. TO RAD SAFETY AT MU	10/01/11	10/01/14
Danielle Gibbons	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Devyn Hunter	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Donna Dare	09/19/12	INTRO. TO RAD SAFETY AT MU	09/18/12	09/18/15
Emani Castro	09/24/12	INTRO. TO RAD SAFETY AT MU	09/20/12	09/20/15
George Szabo	12/15/09	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
James Van Dyke	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Jeffrey Wilcox	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Jillian Hartke'	02/07/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
JosephKidd	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
June Davis	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Katharine Mascari	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Katherine Iselin	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Kathleen Slane	11/04/11	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Kenyon Reed	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Kristen Harris	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Kristie Lee	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Kristin Schwain	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Linda Garrison	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Lorenz Lepper	02/07/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Lorinda Roorda	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Lucas Gabel	07/11/11	INTRO. TO RAD SAFETY AT MU	07/05/11	07/05/14
Marcus Rautman	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Mary Conley	11/04/11	INTRO. TO RAD SAFETY AT MU	10/25/11	10/25/14
Michael Yonan	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Nancy Alexander	11/14/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Norman Land	12/14/09	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Paul Stebbing	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Rebecca Pursley	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Ryan Johnson	09/12/11	INTRO. TO RAD SAFETY AT MU	09/08/11	09/08/14
Sarah Jones	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Sarah Williams	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Shelby Wolfe	09/12/11	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Susan Langdon	05/25/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Susan Lowrey	12/27/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Wayne Mehrhoff	12/14/09	INTRO. TO RAD SAFETY AT MU	08/19/11	08/19/14

Attachment 3b – Radiation Safety for new Radiation Workers at MU (25 pages)

Radiation Safety

[redacted]

New Radiation Workers

[redacted]

Presented By

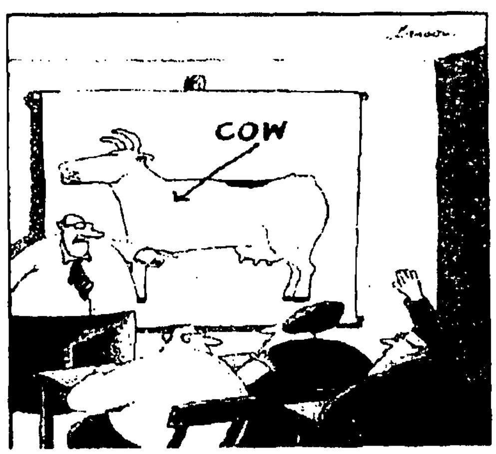
David

Burgess

882-7221

MISSOURI. MISSOURI.

"Yes...I believe there is a question in the back."



There are no dumb questions!!!

Radiation Safety Manual

©2000 The Curators of the University of Missouri

published by the

MU Radiation Safety Committee

in cooperation with

Environmental Health and Safety

of the

University of Missouri – Columbia

Fourth Edition 2009

http://ehs.missouri.edu/rad

N C

Nuclear Regulatory Commission

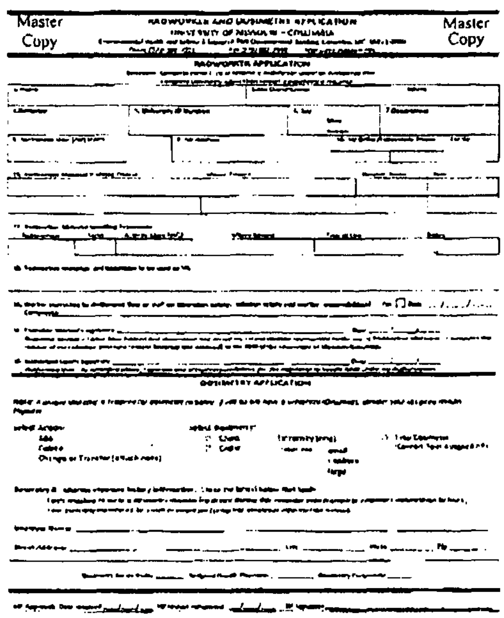
BECOMING

A

RADIATION

WORKER

R A D I A T I O N


Master Copy

Master Copy

W O R K E R

Safety Responsibilities

Radiation Safety Committee

- Comprised of members representing departments where radiation or radioactivity is used
- Shall approve all use of radioactive materials and radiation producing equipment within the university
- Establish and review an effective, safe Radioactive Protection plan in compliance with MU's NRC license and the Radiation Safety Manual
- Review the activities of the Radiation Safety Office

Safety Responsibilities

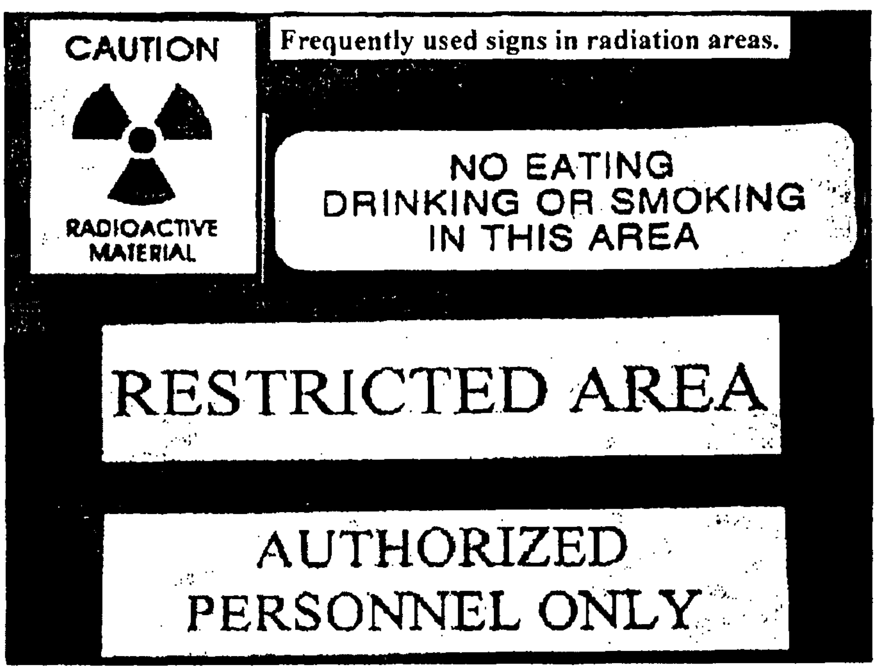
Radiation Safety Officer

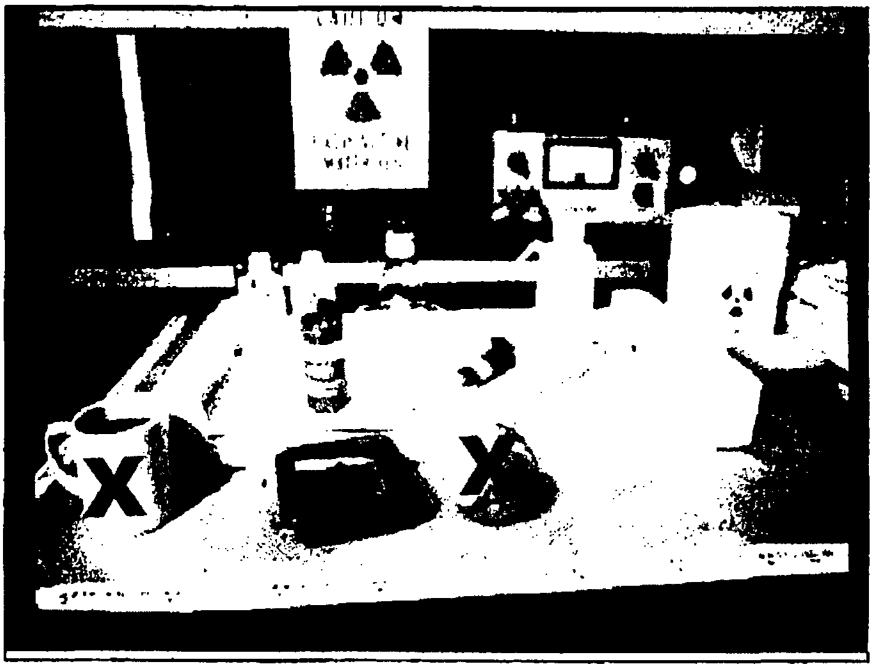
- Has been delegated authority to ensure the implementation of the Radiation Protection Program and is responsible for the day to day conduct of the program
- Is a member of the RSC, and brings issues of compliance, efficiency and safety to the committee for resolution
- Provides technical assistance and guidance to all users of radioactive material or radiation producing equipment

Safety Responsibilities

Authorized User

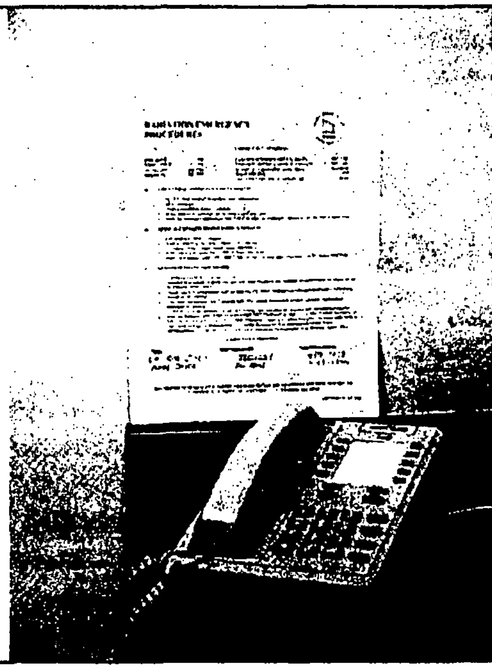
- Individuals authorized by the RSC to use radiation producing equipment or possess radioactive material, and supervise their use
- Responsible for compliance with all guidelines, policies, and safety procedures set forth in MU's Radiation Safety Manual and Broad scope License
- Supervisory person directly responsible for training and safety in the lab





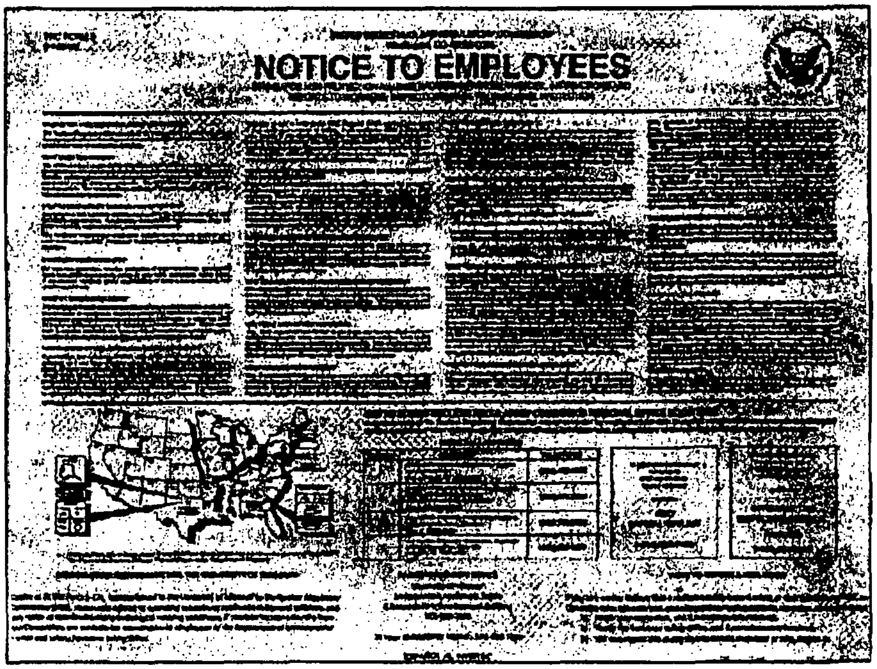
Security of Radioactive Material

- Restricted Area
  - **<u>All</u>** material is required to be attended or locked up.
- Unrestricted Area
  - **<u>All</u>** material, if not in locked storage, must be attended .



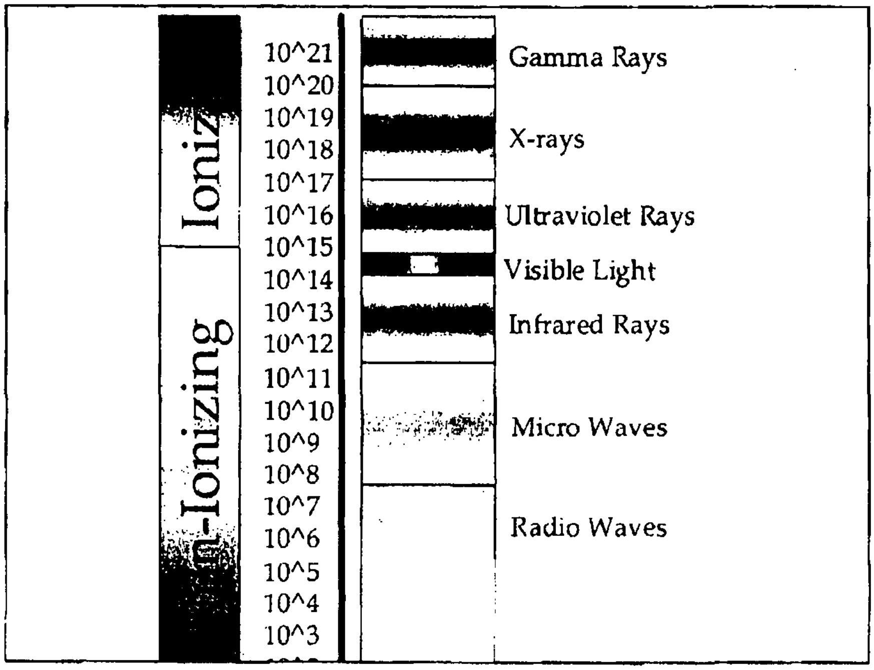
Emergency Procedures

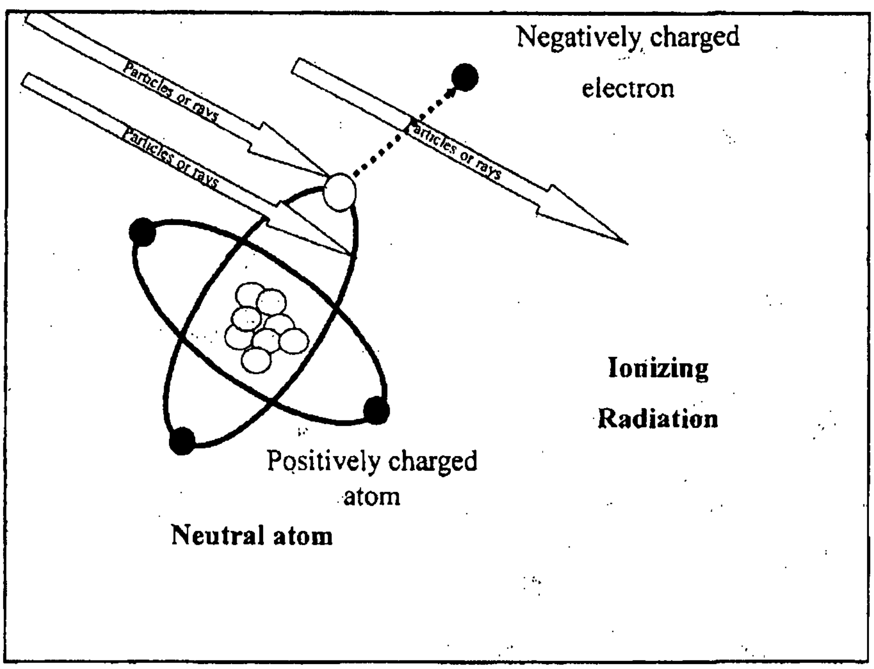
- Fire emergencies with radiation
- Medical emergencies with radiation
- Radiation only
- Laboratory contact personnel
- During business hours call Radiation Safety at 882-7221
- After hours call MU Police at 882-7201


NOTICE TO EMPLOYEES

NRC FORM 3 NOTICE TO EMPLOYEES

- Spells out rights as a Rad Worker
- Rights are listed in 10 CFR
- How to report a violation
- For MU 10 CFR , NRC License, and NRC inspection can be viewed at the Radiation Safety Office


Ioniz
n-Ionizing
10^21
10^20
10^19
10^18
10^17
10^16
10^15
10^14
10^13
10^12
10^11
10^10
10^9
10^8
10^7
10^6
10^5
10^4
10^3
Gamma Rays
X-rays
Ultraviolet Rays
Visible Light
Infrared Rays
Micro Waves
Radio Waves


Particles or rays
Particles or rays
Particles or rays
Negatively charged
electron
Ionizing
Radiation
Positively charged
atom
Neutral atom

Definitions

Radioactivity

- That property of certain unstable material where ionizing radiation is spontaneously emitted

Contamination

- Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence may be harmful

Radioactivity Basics

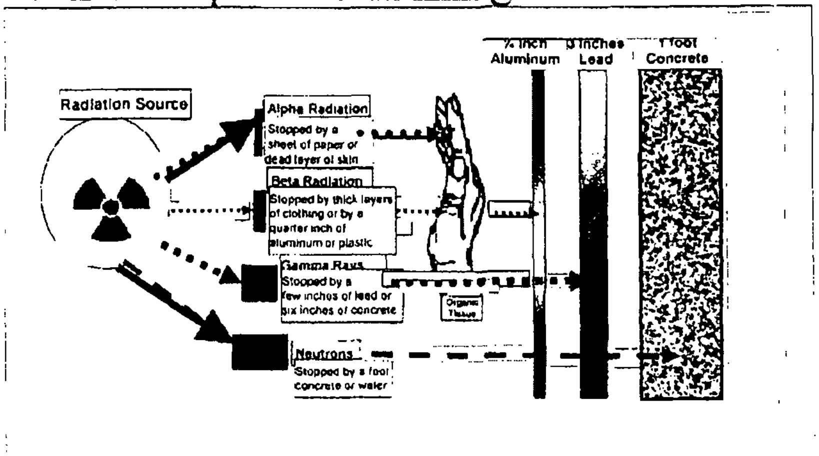
Radioactivity – The spontaneous nuclear transformation of an unstable atom that often results in the release of radiation, also referred to as disintegration or decay.

Units

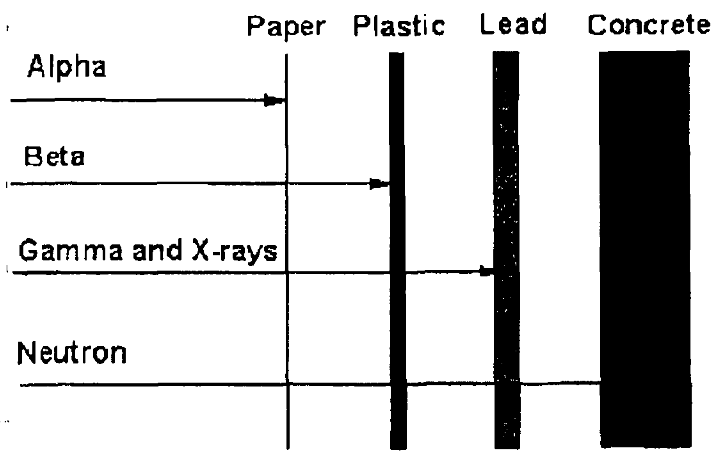
Curie (Ci) the activity in one standard gram of Radium = 3.7×10^{10} disintegrations per second

Becquerel (Bq) 1 disintegration per second – International Units (SI)

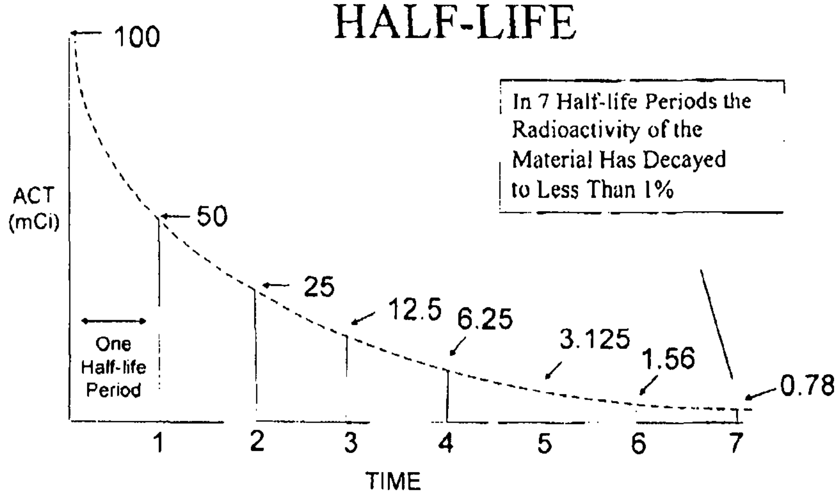
Comparison of Ionizing Radiation and acceptable shielding



Penetrating Distances



HALF-LIFE



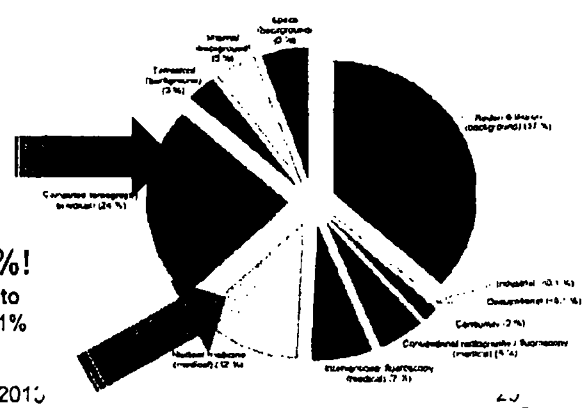
DEFINITION: TIME FOR 1/2 THE ATOMS TO DECAY AWAY

Average Annual Radiation Exposure in the U.S. (Approximate)

Man Made Sources		Combined Total (old - 1980) = *360 mRem*
X-Rays	39	
Medical Studies (CT/Nuc)	~(275)	
Consumer Products	10	
Other	2	
TOTAL Man Made	*326*	
Natural Sources		
Radon	~200	
Own Body	40	
Sun	26	
Earth	28	
TOTAL Natural	*~294*	

Average Annual Radiation Exposure in the U.S. (NEW)

(Approximate)



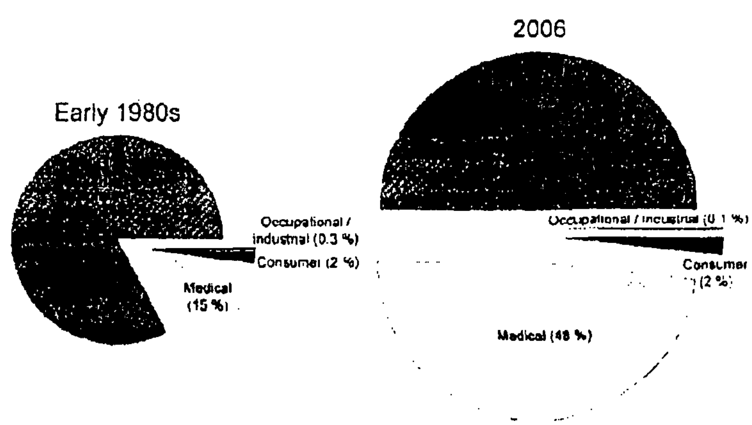
36%!

Use to be 11%

2/4/201

2006 NCRP Annual Report and the Press Release for NCRP Report No. 160 on *Ionizing Radiation Exposure of the Population of the United States.*

NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States*



	Early 1980s	2006
Collective effective dose (person-Sv)	835,000	1,870,000
Effective dose per individual in the U.S. population (mSv)	3.6	6.2

Radiation effects on the Cell

- **Indirect Effect** - radiation that interacts with the water of the cytoplasm of the cell, not the nucleus, and breaks the bonds holding the molecules together forming hydrogen ions and hydroxyls. These molecular fragments may recombine and form water or may form to make other substances like hydrogen peroxide.

Direct effect

- Direct effect can cause immediate damage to the most important part of the cell, the genetic material.
- Damage to genetic material can cause immediate problems to the cell and to the daughter cells it creates.
- Damage to genetic material is highly dependent on the cell cycle.

Radiation Exposure Limits (PART 19)

For Occupationally Exposed Individuals

GENERAL RADIATION EXPOSURE GUIDES 1

Type of Exposure	Annual Limit*
Whole body (head & trunk), active blood forming organs, gonads	5 rem/year, total effective dose equivalent
Lens of eye	15 rem/year
Extremities	50 rem/year
Skin	50 rem/year

1 Based on USNRC Regulations, Title 10, Part 20 Code of Federal Regulations and adopted by many states. Limits on declared pregnant workers and minors will differ; see 10CFR20 for details. Certain states and other regulatory agencies may adhere to different limits.
* Note: 1 rem = 1,000 mrem

Whole Body = 5,000 mrem
Lens of Eye = 15,000 mrem
Skin of WB = 50,000 mrem
Extremity = 50,000 mrem

10%

AT MU we have new Dosimetry

New Dosimetry by Mirion

MIRION TECHNOLOGIES

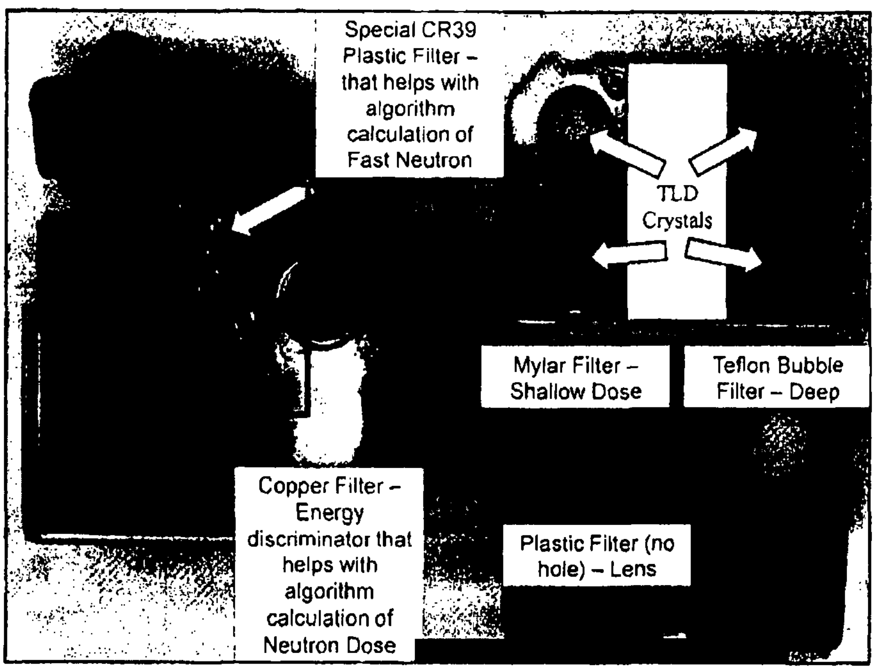
TLD – Thermoluminescent Dosimetry

Requirement of Dosimetry

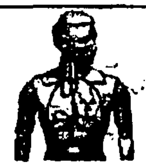
- Adult Workers
  - 10% of any applicable limit
- Declared Pregnant Workers
  - 100 mrem over course of pregnancy
- Minors
  - DDE of 100 mrem
  - LDE of 150 mrem
  - SDE of 500 mrem
- High Radiation Area (>100 mR/hr)

To Assure Accurate Dosimeter Readings:

- wear badge at sternum level
- keep badge away from heat sources
- store badge away from radiation sources
- do not wear your badge when having personal medical or dental x-rays
- notify the Radiation Safety Staff if anything unusual happens to your dosimeter
- only wear the dosimetry assigned to you
- assigned dosimetry should be worn at only one institution



Dosimetry Continued



- If you are assigned dosimtery from the university which is used to monitor your work related occupational exposure to ionizing radiation, and you plan to receive a diagnostic or therapeutic treatment with RAM (radiopharmaceuticals) then you MUST inform the RS Office PRIOR to the treatment so we can advise you on the particulars associated with how we are going to continue to monitor your occupational exposure without it being affected by the radiation from your treatment or scan.
- Dosimetry issued by the RS Office of the University of Missouri should also not to be worn home, to the store, to lunch etc but rather kept at work to be donned and doffed when you are working around sources of ionizing radiation unless prior arrangements have been made with RS.

35

Dosimetry Continued

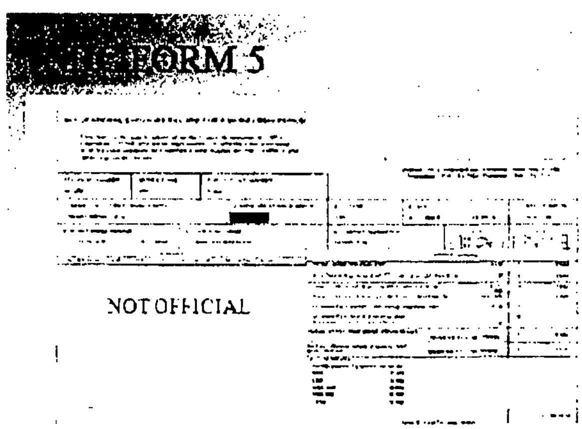
- Do not store your personal dosimeter close to sources of radiation. If you leave them on your lab coat or desk drawer as an example make for sure they are reasonably away from sources of ionizing radiation. In other words don't store you dosimeter near the Radioactive Waste storage containers.
- Ensure that you are wearing YOUR assigned dosimeter, wearing it correctly as identified on the dosimeter itself, "Chest", "Collar", and wearing the correct color and date on dosimeter associated with wear period. If you questions concerning this call EHS RS at 882-7018.

36

Measure Your Radiation Dose -Dosimeters-

Used to measure the occupational dose equivalent from x-ray, gamma, and high energy beta emitters. Dosimeters cannot detect radiation from low energy beta emitters.

	Global Whole Body	Ring Dosimeter	Fetal Dosimeter
Measures...	Whole body exposure	Extremity exposure	Exposure to a fetus
Is worn...	On the torso between the neck and waist	On either hand under the gloves with the name facing the radiation source	At the waist line
Can detect...	X-rays & gamma rays	X-rays & gamma rays	
	High energy beta emitters	High energy beta emitters	



Your official dose report is provided IAW the law at least once a year if you receive greater than 100 mRem as part of your occupational dose. You can request it more often if you want it. But we HAVE to provide it at least annually.

MU Radiation Safety Program
2009 Annual Dose Data

10%	**5,000mrem**
Dose mrem	Whole Body
Minimal	169
1-100	102
101-200	2
201-500	3
501-1000	1
1001-2000	0
2001-3000	0

Risk in Focus

CAUSE	DAYS
SMOKING 1 PACK OR MORE OF CIGARETTES/DAY (MALE)	2409
DRIVING A SMALL CAR	290
DRIVING A LARGE CAR	145
AVERAGE EXPOSURE FROM NATURAL RADIATION	**39**
PARACHUTING	25
CONTINUOUS EXPOSURE TO 100 MREM/YR/ LIFE	**10**
SMOKE DETECTORS	-9
SEAT BELTS	-69

Bottom Half of The Form

is for requesting dosimetry.

Previous dose history can be requested.

New dosimeters are issued quarterly.

There is an extra charge for late and lost dosimetry.

DOSIMETRY APPLICATION

Select Action:
- Add
- Delete
- Change or Transfer (attach note)

Select Dosimetry:
- Chest
- Collar
- Extremity (ring)
- small
- medium
- large
- Fetal Dosimeter (Contact Your Assigned HP)

Employer Name:

Street Address: City State Zip

ALARA STATEMENT

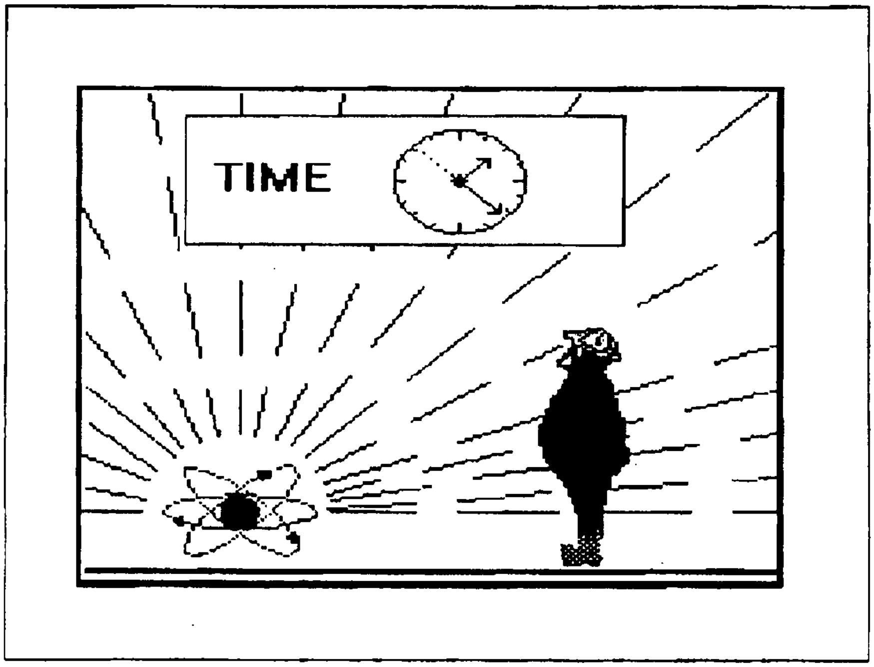
As

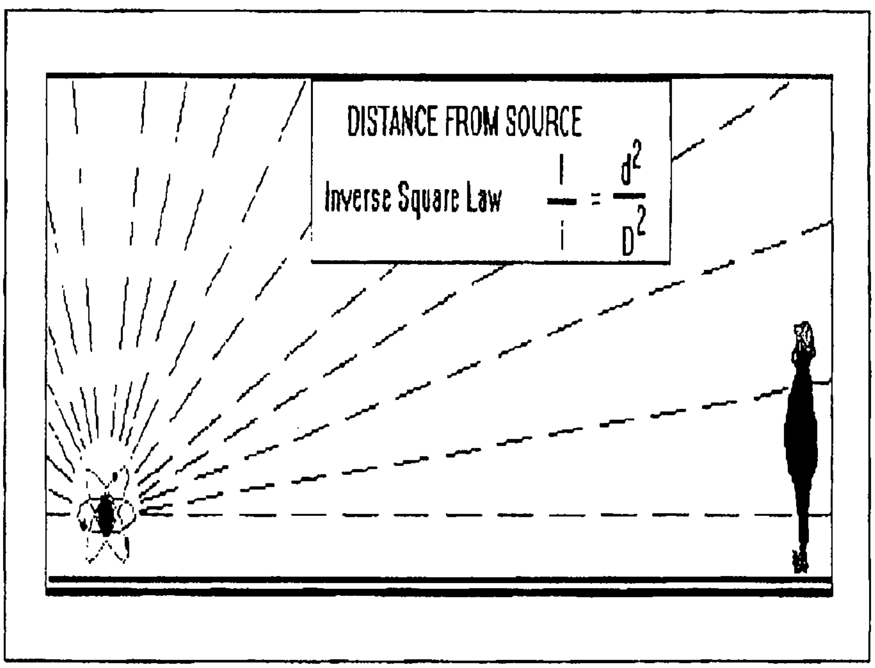
Low

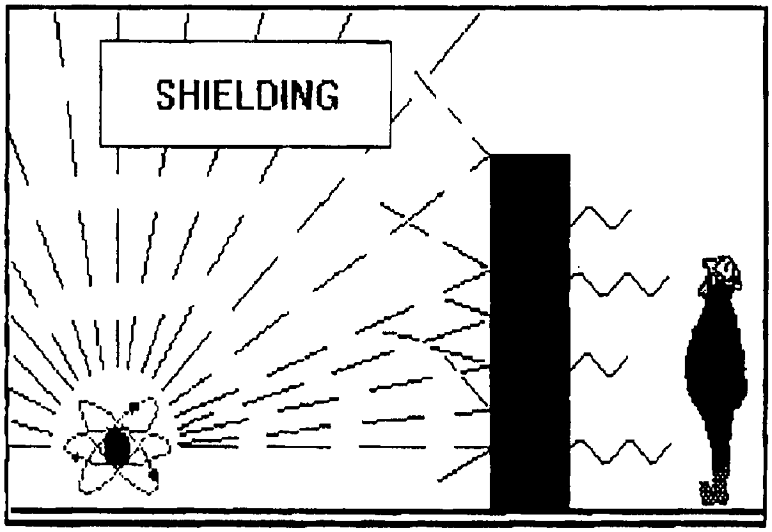
As

Reasonably

Achievable


TIME

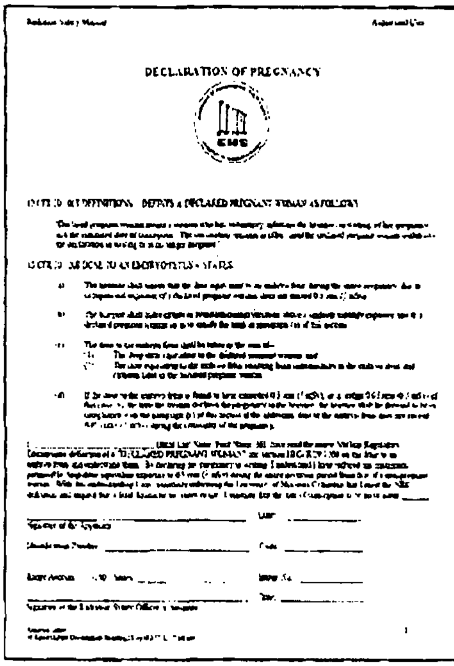

DISTANCE FROM SOURCE
Inverse Square Law
$\frac{I}{i} = \frac{d^2}{D^2}$



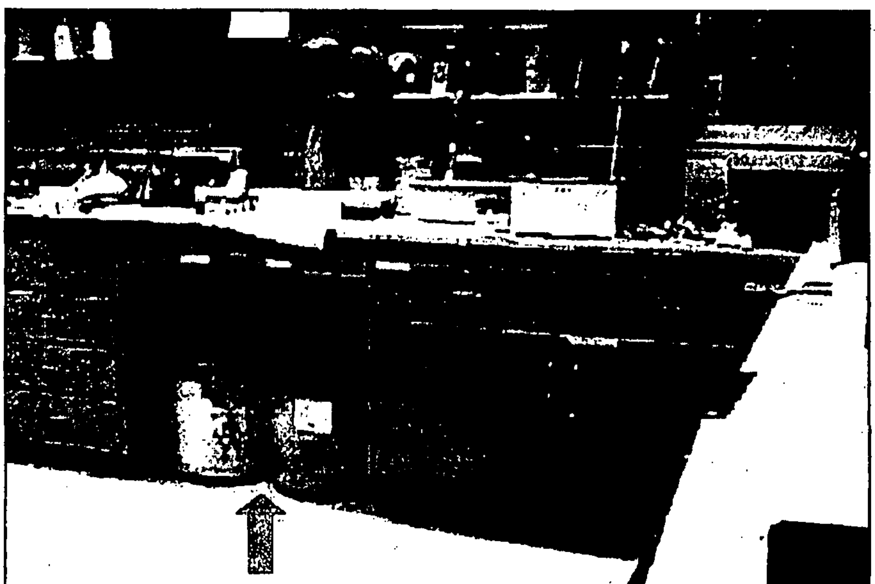
ALARA LEVELS

Monthly and Quarterly

- DDE - 100 mrem * Whole Body
- LDE - 300 mrem * Lens of Eye
- SDE - 400 mrem * Skin Whole Body
- SDE-ME - 400 * Extremity



- 10 CFR 20.1003 states: A "...declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception."
  - 500 mRem during gestation period



Containers for solid radioactive waste.

Working in Pickard – things to know

- Do not disturb surfaces
- Call EHS if CF needs to make a repair or amendment that will disturb a surface
- For entry into artifact storage 12 - Staff without dosimetry must be escorted
- Posted areas (room17, 27, 12) are no eating drinking areas
- Postings are on the rise
- Call EHS with questions
- Direct questions form the public to EHS or Christian Basi 2-4430
- Security
  - Security guards in the galleries
  - Physical barriers in place
  - Prevent disturbance, removal, or access to contamination.

EHS: Contact 573-529-2385
Jack Crawford, Radiation Safety Officer
Mary Aldrich, Health Physicist
David Burgess, Health Physicist

Attachment 4 – Pickard Hall 55555 Jan 2013 inspection/survey report (7 pages)

UNIVERSITY OF MISSOURI - COLUMBIA
AUTHORIZATION INSPECTION REPORT

This is a summary of the authorization inspection conducted on the date indicated below. The status of the numbered items below indicates your authorization's compliance with the MU Campus Radiation Safety Program: an S - Satisfactoryl a U = Unsatisfactory; or an N = Not applicable or not checked. For unsatisfactory items a re-inspection date may be listed below; for those unsatisfactory items which also require a response by the authorized user, the response guidelines and a response due date will also be listed.

AUTHORIZED USER: Willie M Crawford **AU NUMBER:** 55555 **EXPIRATION DATE:** 01/12/2013
INSPECTION DATE: 01/07/2013 **RISK CATEGORY:** I

ROOM(S) AND BUILDING: **INSPECTION CONTACT(S):** Donna Dare

106 stage PICKARD HALL
12 PICKARD HALL
12A PICKARD HALL
13 PICKARD HALL
15 PICKARD HALL
17 PICKARD HALL
17A PICKARD HALL
1B PICKARD HALL
1st floor PICKARD HALL
205 PICKARD HALL
206 PICKARD HALL
213 PICKARD HALL
23 PICKARD HALL
25 PICKARD HALL
27 PICKARD HALL
2nd floor PICKARD HALL
Attic PICKARD HALL
C000C hall PICKARD HALL
C101-Ciel PICKARD HALL
Feeder ST PICKARD HALL

* Inactive Room

A. [S] **Records of Receipts, Inventory, and Transfers**
B. [S] **Survey Documentation**
C. [S] **Radionuclide Waste Disposal**
D. [S] **Posting and Labeling**
E. [S] **Radionuclide Use and Storage**
F. [S] **Safety and Prudent Practice**
G. [S] **Training**
H. [N] **Other Inspection Items:**

I. [S] **Performance Based Evaluations(s)**

J. [S] **Radiation Survey Results- See Attached EHS/RSO Survey Form(s)**
All survey results were within limits for removable contamination; radiation levels were largely consistent with previous surveys.

Overall Inspection Results: Satisfactory

Deficiencies Found:
None.

UNIVERSITY OF MISSOURI - COLUMBIA
AUTHORIZATION INSPECTION REPORT

This is a summary of the authorization inspection conducted on the date indicated below. The status of the numbered items below indicates your authorization's compliance with the MU Campus Radiation Safety Program: an S - Satisfactoryl a U = Unsatisfactory; or an N = Not applicable or not checked. For unsatisfactory items a re-inspection date may be listed below; for those unsatisfactory items which also require a response by the authorized user, the response guidelines and a response due date will also be listed.

Comments and Recommendations:
This inspection is conducted to ensure the radiation safety group regularly reviews Pickard Hall for radiation safety program issues and conducts a regular survey. The inspection shall review the controls that have been put into place and shall evaluate whether they are still functional and useful; changes over time may be required and should be brought to the RSO for consideration.

General statements:
Maintenance or other work in the museum that might disturb surfaces (nailing/drilling into walls, floors etc.) must be coordinated with Museum and EHS staff. Maintenance workers must be escorted into restricted areas by Radiation Safety staff.
Staff in Pickard Hall are trained as radiation workers and staff with office or primary duties on the basement level are provided with dosimetry.

During this inspection it appeared that all work projects with the potential to disturb building surfaces are being routed through EHS for evaluation.

Surveys were limited to the first and second floors during this month's inspection.

EHS attempted to select survey points that would allow for better reproducibility and therefore better trending.

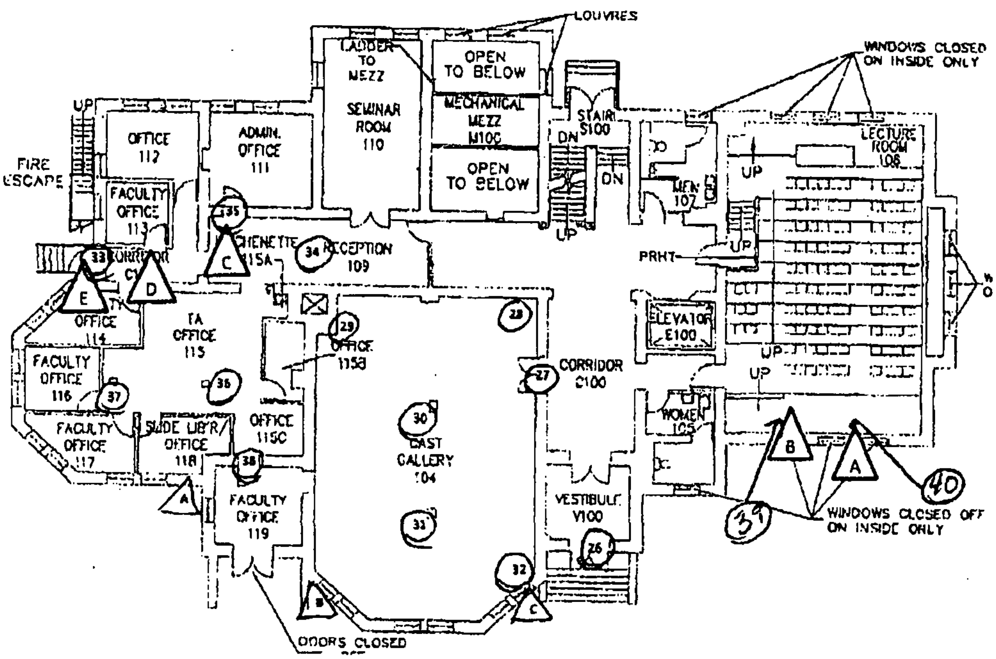
CC:
Alex Barker, Museum Director, Co-authorization #01041
Bruce Cox, Assistant Director, Museum Operations.
Susan Langdon, PhD. Chair Department of Art History & Archeology

Assigned HP Review Comments(optional):

Report Date: 01/10/2013 Inspected By: Mary Aldrich Assigned HP: Mary Aldrich

UNIVERSITY OF MISSOURI
RADIATION AND AREA CONTAMINATION SURVEY

Room & Building: Pickard Floor 1 | Authorized User: RSO | Authorization #: 55555



Not To Scale

Radiation Survey	Denotes Location

☐ Dose rates less than 0.03 mR/hr, except:

Surveys performed with GM and MN 192.

	uR/hr	cpm		uR/hr	cpm		uR/hr	cpm	
26	12	40	36	9	40	A	12	40	•
27	22	40	37	5	40	B	13	40	•
28	20	4	38	11	40	C	12	40	•
29	25	40	39	10	40				
30	18	40	40	10	40				
31	18	40							
32	15	40							
33	10	40							
34	11	40							
36	15	40							

Instrument: Ludlum MN: 14C; SN: 92302 Cal. Date: 10/8/12; MN: 192, SN: 294944 Cal. Date: 10/3/12

Contamination Survey	Denotes Location

☐ Removable activity less than:

200 dpm/100cm2 beta/gamma
20 dpm/100cm2 alpha

POSTINGS ARE LOCATED AT:

A	wall 106	C	ceiling access
B	lecturn base 106	D	ceiling access
		E	ceiling access

Instrument: Gamma 5000

NOTES: locations are generally in corners, dead center doorways for reproducability. Classes in session, therefore several areas were not attempted.

* Dose rate measurements only at this location, no wipe test conducted in outdoor areas.

Date 1/7/13 | By [signature] | Assigned HP or Radiation Safety Officer

4/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2 **Group Date/Time** 2013/01/07 13:01:33.00
USER ID: RSO **System Serial #:** 2000-120399

Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	1	1.00	26	26.0	207	207.0
2	wipe test	tamination_E	1 Min 0 Sec	0	0.0	33	52.239	215	50.0
3	wipe test	tamination_E	1 Min 0 Sec	0	0.0	20	0.0	203	0.0
4	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	197	0.0
5	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	199	0.0
6	wipe test	tamination_E	1 Min 0 Sec	1	0.0	22	0.0	207	0.0
7	wipe test	tamination_E	1 Min 0 Sec	0	0.0	26	0.0	224	106.25
8	wipe test	tamination_E	1 Min 0 Sec	0	0.0	25	0.0	207	0.0
9	wipe test	tamination_E	1 Min 0 Sec	2	4.034	33	52.239	199	0.0
10	wipe test	tamination_E	1 Min 0 Sec	1	0.0	19	0.0	240	206.25 SA
11	wipe test	tamination_E	1 Min 0 Sec	0	0.0	20	0.0	206	0.0
12	wipe test	tamination_E	1 Min 0 Sec	0	0.0	30	29.851	212	31.25
13	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	214	~~43.75~~
14	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	189	0.0
15	wipe test	tamination_E	1 Min 0 Sec	0	0.0	32	44.776	213	37.5
16	wipe test	tamination_E	1 Min 0 Sec	1	0.0	23	0.0	185	0.0

Collected By: [signature] **Date:** 1/7/13

Approved BY: **Date:**

5/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2
USER ID: RSO

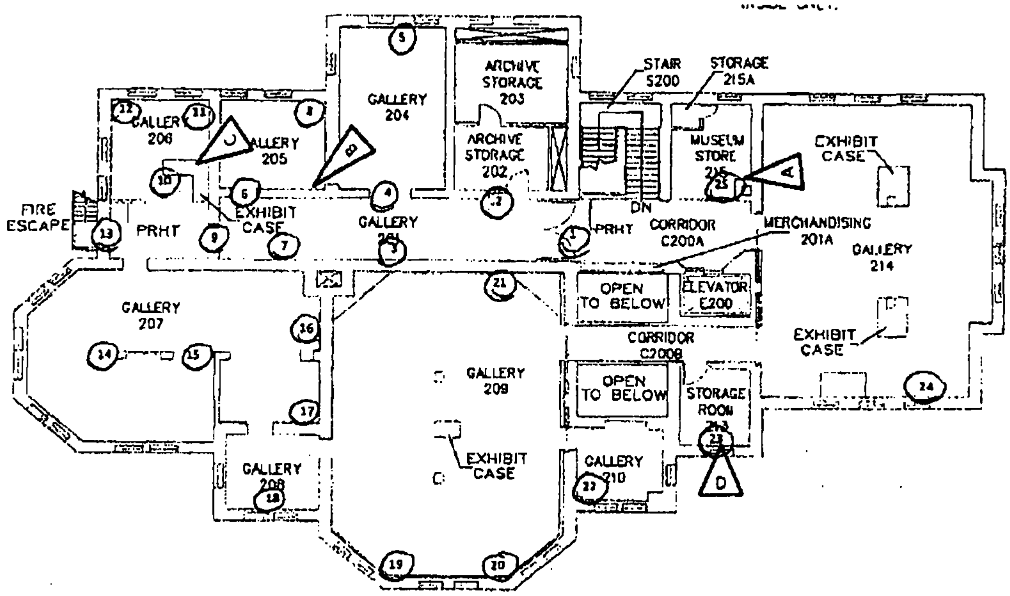
Group Date/Time 2013/01/07 16:31:08.00
System Serial #: 2000-120399

Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	0	0.0	22	22.0	218	218.0
10	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	228	62.5

Collected By:	[signature]	Date:	1/7/13
Approved BY:		Date:	

UNIVERSITY OF MISSOURI
RADIATION AND AREA CONTAMINATION SURVEY

Room & Building: Pickard Floor 2 Authorized User: RSO Authorization #: 55555



Not To Scale

Radiation Survey	Denotes Location
☐ Dose rates less than 0.03 mR/hr, except:	8, 23

Surveys performed with GM and MN 192.

	uR/hr	cpm		uR/hr	cpm		uR/hr	cpm
1	15	40	11	22	40	21	20	40
2	19	40	12	20	40	22	21	40
3	20	40	13	12	40	23	120*	350
4	18	40	14	17	40	24	13	40
5	18	30	15	12	40	25	15	40
6	28	60	16	15	40			
7	20	40	17	19	40			
8	34	60	18	18	40			
9	16	40	19	19	40			
10	15	40	20	17	40			

Instrument: Ludlum MN: 14C; SN: 92302 Cal. Date: 10/8/12; MN: 192, SN: 294944 Cal. Date: 10/3/12

Contamination Survey	Denotes Location
☐ Removable activity less than:	

200 dpm/100cm2 beta/gamma
20 dpm/100cm2 alpha

POSTINGS ARE LOCATED AT:
A ladder to attic
B wall 205
C wall 206
D wall 213

Instrument: Gamma 5000

NOTES: locations are generally in corners, dead center doorways for reproducability. 18 is dead center of the walls, 23 is on a marked area of wall. 25 is at ladder
* survey point moved lower on wall below sign for higher reading, confirmed 90 mR/hr reading in November 2012 (closer to sign)

Date 1/8/13 By [signature] Assigned HP or Radiation Safety Officer

7/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2 **Group Date/Time** 2013/01/09 08:25:38.00
USER ID: RSO **System Serial #:** 2000-120399

Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	5	5.0	35	35.0	211	211.0
2	wipe test	tamination_E	1 Min 0 Sec	2	0.0	20	0.0	223	75.0
3	wipe test	tamination_E	1 Min 0 Sec	0	0.0	33	0.0	209	0.0
4	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	184	0.0
5	wipe test	tamination_E	1 Min 0 Sec	0	0.0	26	0.0	220	56.25
6	wipe test	tamination_E	1 Min 0 Sec	0	0.0	31	0.0	224	81.25
7	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	219	50.0
8	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	228	106.25
9	wipe test	tamination_E	1 Min 0 Sec	0	0.0	22	0.0	216	31.25
10	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	242	193.75
11	wipe test	tamination_E	1 Min 0 Sec	1	0.0	24	0.0	212	6.25
12	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	206	0.0
13	wipe test	tamination_E	1 Min 0 Sec	1	0.0	24	0.0	229	112.5
14	wipe test	tamination_E	1 Min 0 Sec	0	0.0	31	0.0	215	25.0
15	wipe test	tamination_E	1 Min 0 Sec	0	0.0	25	0.0	194	0.0
16	wipe test	tamination_E	1 Min 0 Sec	0	0.0	17	0.0	218	43.75
17	wipe test	tamination_E	1 Min 0 Sec	1	0.0	16	0.0	218	43.75
18	wipe test	tamination_E	1 Min 0 Sec	0	0.0	15	0.0	212	6.25
19	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	196	0.0
20	wipe test	tamination_E	1 Min 0 Sec	0	0.0	30	0.0	230	118.75
21	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	212	6.25
22	wipe test	tamination_E	1 Min 0 Sec	1	0.0	19	0.0	195	0.0
23	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	209	0.0
24	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	212	6.25
25	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	222	68.75
26	wipe test	tamination_E	1 Min 0 Sec	0	0.0	15	0.0	212	6.25

Collected By: [illegible signature] **Date:** 1/9/13

Approved BY: ______ **Date:** ______

University of Missouri - Columbia Environmental Health & Safety Radiation Safety Office

Authorization Inspection Check List

(Heading Boxes: S - Satisfactory, U - Unsatisfactory, N - Not Applicable. Numbered Items: Check deficient items)

Authorized User: Crawford **AU#** 55555 **Individual Contacted:** ~~L. Loepper~~ Donna Dare

Building: Pickard **Rooms:** see auth / insp report

N Receipt, Inventory and Transfer

____1. Radionuclide Shipment Receipt Log Incomplete
____2. Use of radionuclides inadequately recorded
____3. Inventory records incorrect / incomplete
____4. Transfer(s) performed improperly

N Survey Meter and Survey Documentation

____5. Survey Meter Functional Checks
____A. Battery Check
____B. Response Check
____C. Past calibration date.
____6. Survey frequency not adequate (see Table 1)
____7. Area survey map inadequate
____8. Meter survey inadequate
____A. Meter survey not performed
____B. Meter results not in mR/hr
____9. Contamination survey(s) inadequate
____A. Swipe survey not performed / documented
____B. Results not in dpm and not converted.
____C. LSC past calibration date.
____D. Swipe locations not indicated.
____10. Corrective Action(s) not taken Table 2 / Table 3

N Radionuclide Waste Disposal

____11. Waste disposal records not kept
____12. Solid Waste not stored properly
____13. Liquid Waste not stored properly
____A. No secondary containment
____B. Not capped
____C. Funnels not stored properly
____14. Improper disposal of waste
____A. Sink disposal
____B. In Bio/regular trash
____15. No RML label or improperly filled out
____16. Waste not picked up or request not submitted within 6 months of start date.

S Posting and Labeling

____17. NRC Form 3 not posted
____18. Restricted area warning signs inadequate
____19. Food items for experimental use not labeled
____20. Emergency Procedures not posted / filled out
____21. Isotope equipment/containers/storage unlabeled

S Radionuclide Use and Storage

____22. Isotope improperly stored or shielded
____23. Radioactive Material unsecured or unattended
____24. Unlocked storage in unrestricted area

S Safety and Prudent Practices

____25. Fume Hood Flow Check performed within yearly periodicity
____26. Evidence of food or drink in restricted area
____27. Protective clothing not used
____28. Open toed shoes worn in lab
____29. Assigned dosimetry not properly worn

S Training

____30. AU, RW, AW training adequate and timely

N Other Inspection Items

____31. ____________________

S Initial Survey Results

____32. Exposure rate in excess of Table 3
____33. Removable contamination in excess of Table 2

N Performance-Based Evaluation

Comments / Communications:

Insp started
1/7/13 @ Floor 1
1/8/13 @ Floor 2

(Put additional comments on the back of this form)

Initial Inspection Results: (CIRCLE ONE)

Excellent E

Satisfactory S

Deficiency level: A B C D

Donna Dare 1/8/13
Authorized User or Representative Date

[signature] 1/8/~~12~~ 13 rk
EH&S Inspector Date

Initial inspection results may be modified upwards or downwards by the Assigned Health Physicist.

Health Physicist final review:

HP ____ Compliance Level ____ Date: / /

Revision 02/2008

Attachment 5 – Calibrations sheets for most recent used Ludlum's used at Pickard Hall (4 pages)

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street, 325-235-5494, Sweetwater, TX 79556, U.S.A.
☐ 231 Sam Rayburn Parkway, 865-270-8982, Lenoir City, TN 37771, U.S.A.

CUSTOMER UNIV OF MISSOURI ENV HEALTH — ORDER NO. 20208275

Mfg. Ludlum Measurements, Inc. — Model 192 Micro R — Serial No. 294944

Mfg. NA — Model NA — Serial No. NA

Cal. Date 3-Oct-12 — Cal Due Date 3-Oct-13 — Cal. Interval 1 Year — Meterface 202-333

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 32 % Alt 704.8 mm Hg

☑ New Instrument — Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 600 V Input Sens. 30 mV Det. Oper. NA V at NA mV Threshold Dial Ratio NA = NA mV

☐ HV Readout (2 points) Ref./Inst. NA / NA V Ref./Inst. NA / NA V

COMMENTS:
Alarm is range dependent. (alarm set to full scale).

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	4000 µR/hr	NA	4
x1000	1000 µR/hr		0.99
x100	400 µR/hr= 295000cpm		4
x100	100 µR/hr		1.1
x10	25900 cpm		4
x10	6480 cpm		1
x1	2590 cpm		4
x1	648 cpm		1
NA	NA		NA
NA	NA		NA

*Uncertainty within ± 10% C.F. within ± 20% — X10,X1 Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	NA	NA	NA
Log Scale	NA	NA	NA

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 — State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☑ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

500 S/N 38120 ☐ Oscilloscope S/N ☑ Multimeter S/N 84260131

Calibrated By: Liam Ortega — Date 3-Oct-12

Reviewed By: Diana Ahrens — Date 3 Oct 12

FORM C22A 06/12/2012 Page 1 of 1

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway
865-270-8982
Lenoir City, TN 37771, U.S.A.

CUSTOMER UNIV OF MISSOURI ORDER NO. 20204392/380793

Ludlum Measurements, Inc. Model 9DP Serial No. 25003027

Mfg. ______ Model ______ Serial No. ______

Cal. Date 15-Sep-12 Cal Due Date 15-Sep-13 Cal. Interval 1 Year Meterface R/hr

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 76 °F RH 44 % Alt 698.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☑ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☐ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☐ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 7.2 VDC
☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set ______ V Input Sens. ______ mV Det. Oper. ______ V at ______ mV Threshold Dial Ratio ______ = ______ mV

☐ HV Readout (2 points) Ref./Inst. ______ / ______ V Ref./Inst. ______ / ______ V

COMMENTS:

Instrument is Auto-Ranging.
Peak Dose Rate & Integrated Dose are the available functions.
All undocumented features are currently set to off (0).

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
Auto	4 R/hr	N/A	4.00 R/hr
Auto	1 R/hr		0.95
	400 mR/hr		400 mR/hr
	100 mR/hr		99.7
	40 mR/hr		40.0
	10 mR/hr		9.99
	4 mR/hr		4.00
	1 mR/hr		1.01
	400 μR/hr		400 μR/hr
	100 μR/hr		94.0

*Uncertainty within ± 10% C.F. within ± 20%

Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout				Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☑ 059 ☑ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☑ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☑ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ______ ☐ Beta S/N ______ ☐ Other ______

☐ m 500 S/N ______ ☐ Oscilloscope S/N ______ ☑ Multimeter S/N 15060230

Calibrated By: [signature] Date 15SEP12

Reviewed By: [signature] Date 17 Sep 12

FORM C22A 06/12/2012 Page 1 of 1

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed: ______

UNIVERSITY OF MISSOURI - COLUMBIA
RADIATION SAFETY OFFICE
SURVEY INSTRUMENT CALIBRATION SHEET

User: RSO

Building: 8 RPDB

Room: Mary

Instrument Background: 0.015 mR/Hr; 50 CPM

Manufacture: LUDLUM

Model: Model 14C

Serial No.: 92302

Shield: Fixed

Probe: 44-9 & Internal Window Facing Beam Port

Cs-137 Calibrator, Model: 28-6A, SN: 5071

EFFICIENCIES IN %

Measured

C-14 @ 1 cm:	1.47
IPL, # 1094-21	
SI-32 @ 1 cm:	23.11
IPL,# 548-6	

Interpolated

S-35 @ 1 cm:	2.1
P-32 @ 1 cm:	23.1
P-33 @ 1 cm:	5.7
Ca-45 @ 1cm:	6.0
Tc-99 @ 1cm:	7.2
Cl-36 @ 1cm:	15.2

GROSS CPM

C-14 @ 1 cm:	8500
SI-32 @ 1 cm:	24000

CALIBRATION POINTS mR/hr	ATTENUATOR	DISTANCE cm	SCALE X	INSTRUMENT RESPONSE mR/hr	POINT CORRECTION FACTORS	AVERAGE CORRECTION FACTORS
0.05	X2000	138	0.1	0.06	1.11	
0.15	X2000	80	0.1	0.16	1.03	1.07
0.5	X200	141	1	0.5	1.00	
1.5	X200	82	1	1.5	1.00	1.00
5	X20	142	10	5	1.00	
15	X20	82	10	15	1.00	1.00
50	X2	145	100	50	1.00	
150	X2	84	100	150	1.00	1.00
			1000	Not Calibrated for this range.		
			1000	Not Calibrated for this range.		

Check Source Response: 7.00 **mR/hr** **Battery Check:** OK

Comments: **Do not use X1000 setting.**

Signature of Calibrator: Jim G Canady **Date:** 10/8/2012

EHS/RSO10(6/97)

SOURCE CK:	7.00 mR/hr
Calibrated:	10/8/2012

Do not use X1000 setting.

USER:	RSO	P-32 Eff (%):	23.1
INSTRUMENT:	LUDLUM MOD 3	C-14 Eff (%):	1.5
SERIAL # (sn):	92302	Cs-137 sn:	5071
WINDOW:	Fixed	GEOMETRY:	II
SOURCE CK:	7.00		
SCALE	**AVG CORR FAC**		
0.1	1.07	BATT:	OK
1	1.00		
10	1.00	CAL DATE:	10/8/2012
100	1.00		
INITIALS:	ZA	DUE DATE:	10/8/2013

Attachment 6 – Original Attachment 1 - Pickard Hall Radon Monitoring Results (3 pages)

Attachment 1 – Pickard Hall Radon Monitoring Results

Radon Monitoring Report

LANDAUER

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425
Telephone (800) 528-8327 Facsimile (708) 755-7016

EHS UNIVERSITY OF MISSOURI
ATTN: ROSE LEYKAMP
3 RESEARCH PARK DEV BUILDING
COLUMBIA MO 65211

Acct. No. 0410211

PROGRAM NAME: PICKARD

Detector Number	Detector Type	Starting Date	Ending Date	Field Data · Comments	Exposure pCi/l-days	Avg. Radon Conc pCi/l	
4741886	DRN	21-NOV-08	24-FEB-09	RM 3	55.0 ±5.18	0.6 ±0.05	
4741887	DRN	21-NOV-08	24-FEB-09	RM 26	104.5 ±8.3	1.1 ±0.09	
4741895	DRN	19-NOV-08	24-FEB-09	RM 17A	204.0 ±12.8	2.1 ±0.13	
4741904	DRN	21-NOV-08	24-FEB-09	RM 7	61.3 ±5.62	0.6 ±0.06	
4741918	DRN	19-NOV-08	24-FEB-09	RM 17	227.4 ±13.7	2.3 ±0.14	
4741929	DRN	19-NOV-08	24-FEB-09	RM 6	160.5 ±11.0	1.7 ±0.11	
4741959	DRN	21-NOV-08	24-FEB-09	RM 12	292.3 ±15.9	3.1 ±0.17	
4741974	DRN	19-NOV-08	24-FEB-09	RM 5	129.8 ±9.5	1.3 ±0.10	
4741977	DRN	19-NOV-08	24-FEB-09	RM 18, 18A, 16	215.7 ±13.2	2.2 ±0.14	
4741988	DRN	21-NOV-08	24-FEB-09	RM 27	380.1 ±18.6	4.0 ±0.20	
	②	③	④	⑤	⑥	⑦	⑧

RECEIVED
MAR 17 2009
EHS

RELATED ONLY TO MONITORS
...VED BY LANDAUER.

QC Release	Process No	Report Date	Date Received
DRB	AZ1617	12-MAR-09	27-FEB-09

PAGE 1 OF 1

Radon Monitoring Report

EHS UNIVERSITY OF MISSOURI
ATTN: ROSE LEYKAMP
B RESEARCH PARK DEV BUILDING
COLUMBIA, MO 65211

LANDAUER

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425
Telephone: (800) 528-8327 Facsimile: (708) 755-7[illegible]

Acct. No. 0410211

PROGRAM NAME: PICKARD

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l-days	Avg Radon Conc pCi/l
4741991	DRN	21-NOV-08	24-FEB-09	RM 2	124.6 ±9.3	1.3 ±0.10
4742006	DRN	19-NOV-08	24-FEB-09	RM 2B	246.5 ±14.4	2.5 ±0.15
4742009	DRN	19-JAN-08	24-FEB-09	RM 1A	107.7 ±8.4	0.3 ±0.02
4742019	DRN	21-NOV-08	24-FEB-09	RM 4	119.3 ±9.0	1.3 ±0.10
4742050	DRN	21-NOV-08	24-FEB-09	RM 9	97.1 ±7.85	1.0 ±0.08

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

RESULTS RELATED ONLY TO MONITORS
AS RECEIVED BY LANDAUER

Q C Release	Process No	Report Date	Date Received
DRB	A21617	12-MAR-09	27-FEB-09

PAGE 2 OF 1

Radon Monitoring Report

LANDAUER

[illegible]
9 RESEARCH P[illegible] DEV BLDG
COLUMBIA, MO [illegible]

Landauer Inc. 2 Science Road Glenwood Illinois 60425-1586
Telephone: (800) 528-8327 Facsimile: (708) 755-7048

Acct. No. [illegible]

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l-days	Avg. Radon Conc. pCi/l
4741889	DRN	17 [illegible]	27-DEC-09	PICKARD 13 MBAS	1039.[illegible] ±31.9	[illegible] ±0.[illegible]
4741900	DRN	2[illegible]-NOV-08	[illegible] DEC 09	PICKARD 17 ONE YEAR	1127.4 ±37.4	3.0 ±0.09
4741906	DRN	1[illegible] NOV-08	0[illegible] DEC 09	PICKARD 28 ONE YEAR	9[illegible].5 ±37.5	2.4 ±0.08
4741942	DRN	2[illegible]-NOV-08	[illegible]	PICKARD 27 ONE YEAR	1193.7 ±34.5	3.1 ±0.09
①	②	③	④	⑤	⑥	⑦

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[illegible] 2 2 2009
EHS

RESULTS RELATE ONLY TO MONITORS AS RECEIVED BY LANDAUER.

QC Release	Process No	Report Date	Date Received
DRB	A21795	15-DEC-09	09-DEC-09

PAGE 1 OF 1

Attachment 7 – Chase Environmental Group, Inc - QAP 8.2 Chain-of-Custody Procedure (3 pages)

CHAIN-OF-CUSTODY

1.0 PURPOSE

This Quality Assurance Procedure (QAP) establishes the methods, responsibilities and requirements for item identification and control.

2.0 APPLICABILITY

This QAP applies to items, such as samples, specimens or test materials used in experimentation or testing, when the validity of the corresponding data or results depends on maintaining accurate identification and traceability of the items.

3.0 INSTRUCTIONS

3.1 Periodic surveillances shall be performed by the Project Manager to ensure that item control and identification comply with the following requirements.

Sample Preservation

3.1.1 The Sampling Technician shall ensure that samples will be properly prepared for transportation to the laboratory by refrigeration and chemical preservation, if necessary. The Sample Technician shall verify that the laboratory providing sample containers has added any necessary chemical preservatives to the sealed containers provided.

Container Label

3.1.2 The Sampling Technician shall ensure that all sample container lids will be sealed with tape and a label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- Facility name;
- Monitor well and sample location number (if applicable);
- Sampling date;
- Sampling time; and
- Sample collector's initials.

Sample Shipment

3.1.3 The Sampling Technician shall ensure that the following packaging and labeling requirements for nonhazardous sample materials are appropriate for shipping:

- Package sample so that it does not leak, spill, or vaporize from its packaging;
- Label package with:
  - Sample collector's name, address, and telephone number;
  - Laboratory's name, address, and telephone number;

- Description of sample;
- Quantity of sample; and
- Date of shipment.

If the materials to be shipped are considered hazardous or if their nature is uncertain, the samples will be appropriately labeled and will be transported by sampling personnel directly to the analytical facility or will be shipped using a carrier licensed to transport hazardous materials.

Sampling Records

3.1.4 The Sampling Technician shall ensure that detailed records are maintained during sampling. These records will include the information listed below applicable:

- Sample location (facility name);
- Sample identification (location or boring number and sample number);
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observation of :
  - Sample appearance,
  - Sample odor,
- Weather conditions;
- Sampler's identification; and
- Any other significant information.

Chain-of-Custody

3.1.5 The Sampling Technician shall ensure that the chain-of custody measures are followed to establish a written record concerning sample custody during movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of-custody form (see example Exhibit 1) completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate and sealed in the container. One copy of this form will be maintained at the site, and the other two copies at the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses to Chase.

3.2 All completed sampling documentation (log books, etc.) and chain-of-custody records shall be processed as quality assurance records

4.0 EXHIBITS

1. Chain of Custody Form (Example)

CHAIN-OF-CUSTODY

Chain of Custody Record No.

Chase Environmental Group, Inc.

Project Name:	Project Number	Page ____ of ____
Send Report To:	Sampler (Print Name)	
Address:	Sampler (Print Name)	Purchase Order #: ______________
	Shipment Method:	
	Airbill Number:	
Phone	Laboratory Receiving	
Fax:		

Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested											Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)

Relinquished by: (Signature)	Received by: (Signature)	Date:	Time
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time

Sample Custodian Remarks (Completed By laboratory):

QA/QC level		Turnaround		Sample Receipt	
Level I	↑	Routine	↑	Total # Containers Received?	
Level II	↑	24 Hour	↑	COC Seals Present?	
Level III	↑	1 Week	↑	COC Seals Intact?	
Other	↑	Other ______		Received Containers Intact?	
				Temperature?	

R USE

QUALITY ASSURANCE PROCEDURES MANUAL

QAP 8.2

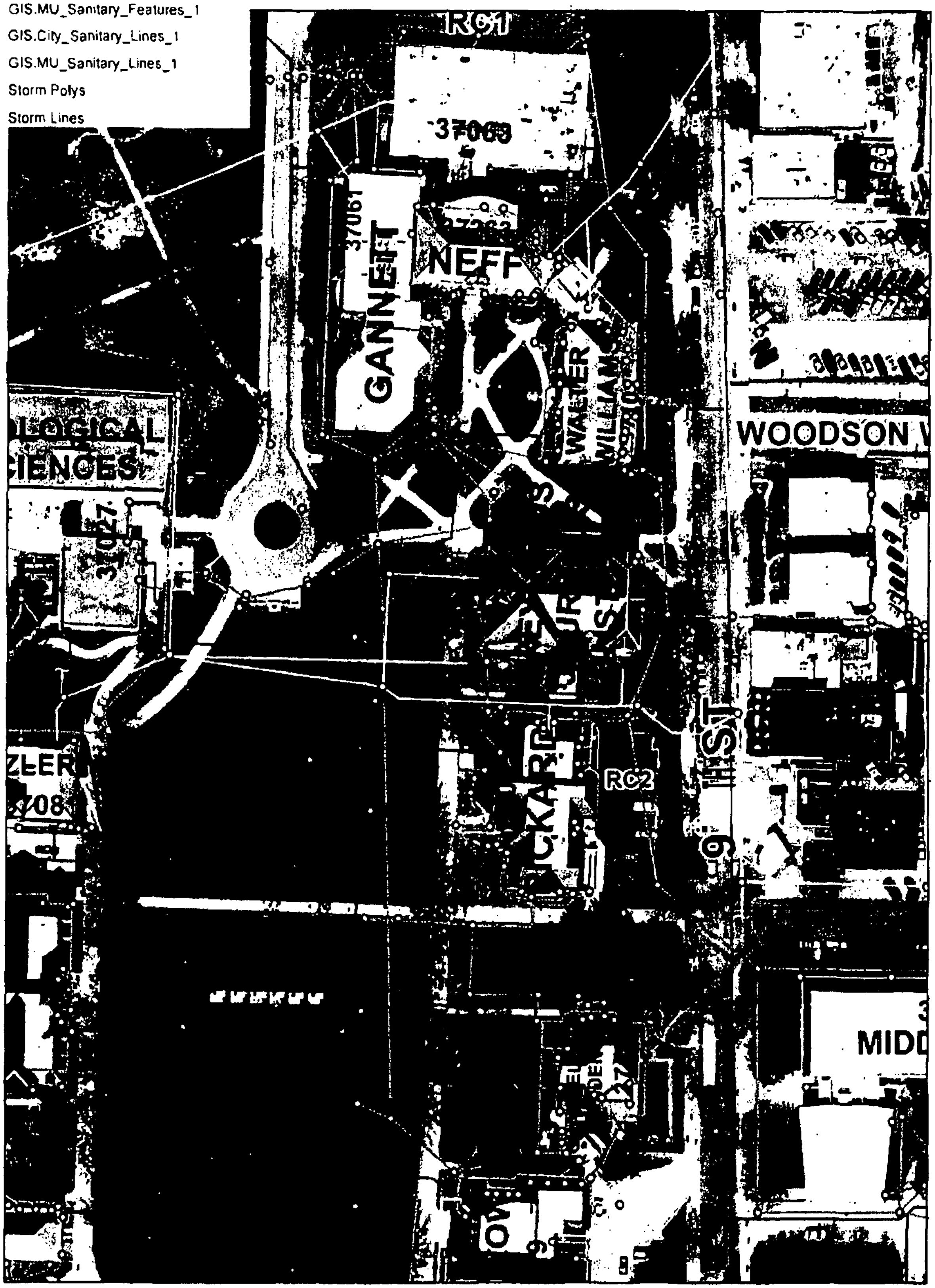
CHAIN-OF-CUSTODY

Revision Number	Effective Date	Quality Assurance Approval	Management Approval

Attachment 8 – Sanitary and Storm Sewer line GIS Map for servicing Pickard (1 page)

Legend

- GIS.City_Sanitary_Features_1
- GIS.MU_Sanitary_Features_1
- GIS.City_Sanitary_Lines_1
- GIS.MU_Sanitary_Lines_1
- Storm Polys
- Storm Lines



Office of the Vice Chancellor
for Administrative Services
University of Missouri–Columbia

Jesse Hall
Columbia, MO 65211-1250
PHONE 573-882-4097
FAX 573-884-4847

September 14, 2011

NRC Region III Enforcement/Investigations Officer
U.S. Nuclear Regulatory Commission, Region III
2443 Warrenville Road
Suite 210
Lisle, IL 60532-4352

RE: Request for Information: Tracking Number 11-A-0054

The enclosed information was prepared in response to the NRC Request for Information dated August 15, 2011.

We have completed an evaluation of the concerns contained in the Request for Information and believe we have fully responded to the questions asked.

If additional information is needed or further clarification needs to be provided, please contact us.

Sincerely

Jacquelyn K. Jones
Vice Chancellor
Administrative Services

8

C/23

Response to the NRC Requests for Information

Tracking Number 11-A-0054

The following information has been prepared by the University of Missouri in response to the Nuclear Regulatory Commission (NRC) Request for Information, Tracking Number 11-A-0054, dated August 15, 2011.

Detail 1:

An individual is concerned that the whole body dosimetry provided to members of the museum staff in Pickard Hall is not being used correctly to accurately measure the dose received while working in the museum. Specifically, the staff have not been instructed where to store the dosimeter while not working in the building. For example, some staff takes the dosimeter home and some leave the dosimeter within the building when they leave the museum.

The University does not agree that this is a well-founded concern and suspects a misunderstanding on the individual's part.

The Radiation Safety Office (RS Office) has been monitoring members (currently 22 - see Attachment A – "Pickard Hall Staff and Faculty Dose Records") of the Pickard Hall Faculty and Staff (PHF&S) since January of 2010. The University has also provided Radiation Worker (RW) training to these individuals as part of our program for issuing dosimetry. This training "Introduction to Radiation Safety", initially conducted in December of 2009, included instruction among other topics on how to wear and store dosimeters with an emphasis of not storing the dosimeters near sources of radiation. Recommendations for storing the dosimeter in or near the work station or storage location are provided during this training, but specific direction on exact location for storage is normally not given to provide for the different options and preferences of storage of dosimeters by users (e.g., desks or racks.)

The assigned Health Physicist (HP) who works directly with the PHF&S and provides RW training has attested that the storage of dosimeters was covered in the initial training. Additionally, the Radiation Safety Officer (RSO) and his staff have not observed improper storage methods or practices during visits to the building or during routine Radiation Safety (RS) inspections. In fact, during those visits different RS inspectors have observed that dosimeters have been stored near the individual's work station or on their desk with only one exception. One monitored PHF&S member specifically requested to take her dosimeter home in lieu of storing it on her desk as she had concerns about losing it. She explained that she felt she could keep better track of it by taking it home with her and we granted her that permission. Currently we have made other arrangements with her to store her

dosimeter at work in her mailbox, but not at her desk so she will not feel the need to take her dosimeter home.

However, to ensure that there is a clear understanding of how to store dosimetry, the RSO and assigned HP for the PHF&S recently conducted "Radiation In-Service" training (last few weeks) emphasizing the proper storage of dosimeters while not in use, as well as other topics. This emphasis on directions on how to wear and store dosimetry will also be part of future training of all new PHF&S. See Attachment B - "Radiation Safety Training Outline and Records" for confirmation that both initial and recent follow-up and focused RS In-Service training has been conducted.

In addition the RS Office recently conducted a random survey of several members of PHF&S to determine the understanding of various concerns related to the use of dosimetry with the following results:

- *Number of staff members observed wearing dosimetry appropriately: 12/12*
- *Number of staff members observed storing dosimetry appropriately: 12/12*
- *Number of staff who correctly explained how to wear dosimetry: 12/12*
- *Number of staff who correctly explained how to store dosimetry: 12/12*
- *Number of staff who correctly explained how dose is assigned: 11/12*
- *Number of staff who believed that dose is mathematically manipulated: 0/12*

Therefore, based on our detailed evaluation, survey and observations, we conclude that there is limited data to substantiate the concern in detail 1. Furthermore, based upon our observations, our random PHF&S survey, and attestations by qualified RS staff, we do not feel there were or currently are any compliance issues with NRC regulatory requirements or commitments.

The NRC also requested that in additional to the information requested by the cover letter, that we also address the following items:

A. How many individuals in the museum are wearing whole body dosimetry?

Currently there are 22 individuals who are provided and wear whole body dosimetry. This has been confirmed by observations.

B. How do those individuals store the dosimetry when not required to wear it?

Based upon discussions with the lead health physicist assigned to Pickard Hall, observations of other Radiation Safety staff, and interviews with several of those monitored staff, we are confident that with the one exception mentioned above, dosimeters are being stored at or near the individuals' desks when not being worn.

C. Please provide a copy of any instructions or training material that provided guidance to workers on the proper way to wear and proper location to store the dosimetry.

See Attachment B - "Radiation Safety Training Outline and Records".

D. If training was provided, please provide the outline and attendance sheets.

See Attachment B - "Radiation Safety Training Outline and Records".

E. Please provide the dose each worker has received for the last 12 months, as documented by the vendor who processes the dosimetry.

See Attachment A – "Pickard Hall Staff and Faculty Dose Records".

F. Does the licensee take into account various storage methods when assigning doses to individuals?

No we do not. The value reported by the dosimetry vendor is the dose that is used for monitoring purposes and is assigned to the monitored worker. The exposures were found to be very low (highest lifetime DEEP dose to date as of Jan 2011 was 13 mrem) so no additional steps were taken. See Attachment A – "Pickard Hall Staff and Faculty Dose Records".

G. How does the licensee document exposures assigned to each individual?

We assign the dose from the dosimetry vendor. No manipulations are made unless there is a lost dosimeter and an evaluation is performed.

Detail 2:

An individual is concerned that the licensee is using mathematical manipulation to assign dose to workers within the museum. Specifically, the individual claimed the licensee is dividing the exposures by four of the workers who are wearing dosimetry while working in the museum. The individual stated that workers have questioned if the mathematical manipulation is appropriate and the licensee has not explained why the mathematical formula is used.

The University does not agree that this is a valid concern and suspects a misunderstanding on the individual's part.

The University does not use a mathematical manipulation of the exposures reported by our dosimetry vendors with the exception to estimate exposures in the case of lost dosimeters. A review of the Lost Dosimetry Report submitted to Landauer for 2010 indicates that there were three (3) individuals from the PHF&S who lost dosimeters for one quarter in 2010. Based upon the consistently low doses received, no adjustments were recommended or made for those individuals dose for 2010.

Therefore based on our detailed evaluation and actions, we conclude that there is limited data to substantiate the concern in detail 2. Additionally we feel that the random survey results discussed above leads support to this conclusion.

The NRC also requested that in additional to the information requested by the cover letter, that we also address the following items:

A. Are you dividing the exposures documented by the vendor who processes the dosimetry by four or any other number?

   No.

   However that is with the understanding that we do review and make estimates for lost dosimetry if needed. However no adjustments were or have been made for PHF&S to date. The dose reported by vendor is dose assigned.

B. If so, please explain why. Please provide a copy of the procedure or evaluation that addresses the manipulation of the exposures.

   N/A

Detail 3:

An individual is concerned that the licensee has not provided sufficient guidance to the staff on the use of sign in/out sheets when entering and exiting elevated radiation areas within the museum. Specifically, the sign in/out sheets are located at multiple access points to the elevated radiation areas with no signs to remind staff to sign in/out and no guidance on who is required to sign in/out. Additionally, the sign in/out sheets were placed in confusing locations which do not facilitate their use. Lastly, staff do not appear to be consistently using the sign in/out sheets.

The University does not dispute that there is some potential validity in this concern however we wish to point out that the sign in /out log was developed as an internal information gathering tool and was not a commitment made to the NRC. The University recognizes the importance of following our established internal procedures and we have conducted a review of the log and its use to determine if changes are warranted. We have reissued the log and provided training on the new form.

We would like to point out that in a review of 18 months worth of log entries; we found that only 8.0% of the entries were not in accordance with our established procedures.

The instructions for using the log are printed on the top of the form itself. However, as a means to further improve the accuracy of its use, the university has developed a new form and created a standard operating procedure for it which has been reviewed and approved by the RSO and the director of the Museum of Art and Archaeology. We have also provided training of PHF&S on this new form and will do so with new PHF&S. See Attachment B - "Radiation Safety Training Outline and Records".

This updated and focused "RS In-service" training was provided on several dates since August 19, 2011 and will continue to be provided for new PHF&S members. See Attachment B - "Radiation Safety Training Outline and Records".

The NRC also requested that in additional to the information requested by the cover letter, that we also address the following items:

A. Who is required / expected to sign in/out of the elevated exposure areas in the museum?

   The initial internal sign in/out log form was put in place by the Radiation Safety program to assist in determining how often certain locations in Pickard Hall are entered and how long access was needed, to help us with future exposure dose modeling if needed. However to date, we have not needed to use the information from the log for additional exposure assessments as we have relied upon the dosimetry assigned to the individuals and monitored areas of those rooms as a more reliable means for assessment of exposures in those areas.

   The log was also initially being used to ensure that we had a means to track the escort of individuals who are not assigned dosimetry but need occasional access to the controlled areas. The doors to these rooms where the logs are stationed are kept locked when not occupied by PHF&S. Access must be coordinated with PHF&S or the Radiation Safety Office.

   The sign in /out log form was placed at both the south and north entrances to room 12 of Pickard Hall. These are the only two entrances to room 12 and the only way to gain access to the back mechanical rooms 13 and 15. It was intended that all individuals who entered the room would record their entry in and out on the log that was closest to their original access point.

B. How many access points with sign in/out sheets are in place? If there are multiple access points, is there any confusion associated with the use of the sheets? Are there examples of individuals not using (or forgetting to use) the sheets?

   The log forms are placed on a hanging clipboard attached to a wall at eye level very near (~ 1 foot) both the south and north entrance doors for room 12.

C. What is the purpose of the sign in/out sheets and how is the information used?

   See answer to A. above

D. Please provide a copy of the administrative procedure or instruction that addresses the sign in/out sheets.

   See Attachment C - "RSIP-A-10-F1 Escort Log for Pickard Hall Restricted Areas Rooms 12, 13, 15 and Attic".

E. Please provide a copy of any instruction or training material used to instruct workers on the use of the sign in/out sheet.

See Attachment C - "RSIP-A-10-F1 Escort Log for Pickard Hall Restricted Areas Rooms 12, 13, 15 and Attic".

If training was provided, please provide the outline and attendance sheets.

See Attachment B - "Radiation Safety Training Outline and Records".

Attachment A - "Pickard Hall Faculty and Staff Dose Records".

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3200	PKD	1010880243	04/28/10	04/16/10	8	1

PARTICIPANT NUMBER	NAME / ID NUMBER, BIRTH DATE, SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:					01/01/10 - 03/31/10				QTR 1			2010						
(b)(6)																		
56195	AREA 12	Pa	AREA NOTE		ABSENT													01/10
56196	AREA 13	Pa	AREA NOTE		ABSENT												1	01/10
56197	AREA 14	Pa	AREA NOTE		ABSENT												1	01/10
56198	AREA 15	Pa	AREA NOTE		ABSENT												1	01/10
FOR MONITORING PERIOD:					01/01/10 - 03/31/10				QTR 1			2010						

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3200	PKD	1010880243	04/29/10	04/16/10	9	2

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		

(b)(6)

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3200	PKD	1010660243	04/29/10	04/16/10	9	3

NUMBER	NAME / ID NUMBER / BIRTH DATE / SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
[redacted] (b)(6)																		
	MONITORING PERIOD:				01/01/10 - 03/31/10				QTR 1			2010						
184	AREA 1	Pa	AREA	P	10	9	4	10	9	4	10	9	4	10	9	4	1	01/10
185	AREA 2	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	1	01/10
186	AREA 3	Pa	AREA	P	M	M	M	M	M	M	M	M	M	M	M	M	1	01/10
187	AREA 4	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	1	01/10
188	AREA 5	Pa	AREA	P	4	3	M	4	3	M	4	3	M	4	3	M	1	01/10
189	AREA 6	Pa	AREA	P	4	3	M	4	3	M	4	3	M	4	3	M	1	01/10
190	AREA 7	Pa	AREA	P	1	M	M	1	M	M	1	M	M	1	M	M	1	01/10
191	AREA 8	Pa	AREA	P	11	11	11	11	11	11	11	11	11	11	11	11	1	01/10
192	AREA 9	Pa	AREA	P	10	9	4	10	9	4	10	9	4	10	9	4	1	01/10
193	AREA 10	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	1	01/10
194	AREA 11	Pa	AREA	P	2	1	M	2	1	M	2	1	M	2	1	M	1	01/10
810	AREA 3	Pa	AREA	P	8	7	2	8	7	2	8	7	2	8	7	2	1	01/10

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3200	PK0	1010860243	04/29/10	04/16/10	9	4

** LAST PAGE **

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		

(b)(6)

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* - NO CONTROL SUBTRACTED, 8 MREM PER MONTH SUBTRACTED

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3200	PKD	1020050885	07/28/10	07/19/10	5	1

PARTICIPANT NUMBER	NAME / ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:							01/01/10 - 03/31/10				QTR 1			2010						
58186	AREA 13			Pa	AREA NOTE		UNUSED												2	01/10
58187	AREA 14			Pa	AREA NOTE		UNUSED												2	01/10
58188	AREA 15			Pa	AREA NOTE		UNUSED												2	01/10
FOR MONITORING PERIOD:							04/01/10 - 06/30/10				QTR 2			2010						[redacted]

(b)(6)

M: MINIMAL REPORTING SERVICE OF 1 MREM
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QUALITY CONTROL RELEASE: JAS

2S - PR 8558 - RPT1305- N1 CF - 58435

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1020050665	07/28/10	07/19/10	5	2

PARTICIPANT NUMBER	NAME / ID NUMBER / BIRTH DATE / SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:					04/01/10 - 06/30/10				QTR 2			2010						
(b)(6)																		
58184	AREA 1	Pa	AREA	P	12	12	13	12	12	13	22	21	17	22	21	17	2	01/10
58185	AREA 2	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	2	01/10
58186	AREA 3	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	2	01/10

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: JAS 2S - PR 9588 - RPT1305- N1 CF - 58436

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1020050865	07/26/10	07/19/10	5	3

** LAST PAGE **

PARTICIPANT NUMBER	NAME	ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD								04/01/10 - 06/30/10			QTR 2			2010							
56187	AREA 4				Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	2	01/10
56188	AREA 5				Pa	AREA	P	2	4	8	2	4	8	6	7	8	6	7	8	2	01/10
56189	AREA 6				Pa	AREA		M	M	M	M	M	M	4	3	M	4	3	M	2	01/10
56190	AREA 7				Pa	AREA		M	M	M	M	M	M	1	M	M	1	M	M	2	01/10
56191	AREA 8				Pa	AREA	P	9	9	8	9	9	8	20	20	19	20	20	19	2	01/10
56192	AREA 9				Pa	AREA	P	4	4	4	4	4	4	14	13	8	14	13	8	2	01/10
56193	AREA 10				Pa	AREA	P	M	2	5	M	2	5	M	2	5	M	2	5	2	01/10
56194	AREA 11				Pa	AREA	P	2	2	4	2	2	4	4	3	4	4	3	4	2	01/10
56195	AREA 12				Pa	AREA	P	M	M	2	M	M	2	M	M	2	M	M	2	2	01/10
56196	AREA 13				Pa	AREA														3	01/10
						NOTE		UNUSED													
56197	AREA 14				Pa	AREA														3	01/10
						NOTE		UNUSED													
56198	AREA 15				Pa	AREA														3	01/10

[redacted]

(b)(6)

M: MINIMAL REPORTING SERVICE OF 1 MREM   QUALITY CONTROL RELEASE: JAS   2S - PR 8658 - RPT1305- N1 CF - 58435

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1029170492	10/25/10	10/18/10	5	1

PARTICIPANT NUMBER	NAME / ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
[redacted]																				

[redacted]

(b)(6)

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: RCH 2S - PR 9820 - RPT1306- N1 CF - 59932
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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1029170492	10/25/10	10/18/10	5	2

PARTICIPANT NUMBER	NAME (ID NUMBER, BIRTH DATE, SEX)	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
[redacted]																		
[redacted] (b)(6)																		
[redacted]																		
58185	AREA 2	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	3	01/10
[redacted]																		
58187	AREA 4	Pa	AREA		M	M	M	M	M	M	M	M	M	M	M	M	3	01/10
[redacted]																		
58189	AREA 6	Pa	AREA		M	M	M	M	M	M	4	3	M	4	3	M	3	01/10
[redacted]																		
58191	AREA 8	Pa	AREA	P	4	4	3	4	4	3	24	24	22	24	24	22	3	01/10
[redacted]																		
58193	AREA 10	Pa	AREA		M	M	M	M	M	M	M	2	5	M	2	5	3	01/10
[redacted]																		
58195	AREA 12	Pa	AREA		M	M	M	M	M	M	M	M	2	M	M	2	3	01/10
[redacted]																		

M: MINIMAL REPORTING SERVICE OF 1 MREM
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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1029170492	10/25/10	10/18/10	5	3

** LAST PAGE **

PARTICIPANT NUMBER	NAME / ID NUMBER, BIRTH DATE, SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
					DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		
FOR MONITORING PERIOD:					07/01/10 - 09/30/10			QTR 3			2010							
66197	AREA 14	Pa	AREA	PH	111	111	111	111	111	111	111	111	111	111	111	111	4	01/10
66198	AREA [illegible]	Pa	AREA	[illegible]	80	80	75	80	80	75	80	80	75	80	80	75	4	01/10

[redacted]
(b)(6)

N: MINIMAL REPORTING SERVICE OF 1 MREM
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QUALITY CONTROL RELEASE: RCH

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RADIATION DOSIMETRY REPORT

ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1102140038	02/09/11	01/21/11	13	1

PARTICIPANT NUMBER	NAME / ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:											QTR 3			2010						

(b)(6)

N: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: SEB 2S - PR 8892 - RPT1305- N1 CF - 81424
* - NO CONTROL SUBTRACTED, 8 MREM PER MONTH SUBTRACTED
ELECTRONIC MEDIA TO FOLLOW THIS REPORT

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	110214003B	02/08/11	01/21/11	13	2

** LAST PAGE **

PARTICIPANT NUMBER	NAME / ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM) DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD: [illegible]							[illegible]													
[redacted] (b)(6)																				
86184	AREA 1			Pa	AREA	*P	24	24	23	24	24	23	54	53	48	54	53	48	4	01/10
[illegible]																				
86186	AREA 3			Pa	AREA	*P	11	11	10	11	11	10	11	11	10	11	11	10	4	01/10
[illegible]																				
86188	AREA 5			Pa	AREA	*P	10	10	9	10	10	9	18	17	17	18	17	17	4	01/10
[illegible]																				
86190	AREA 7			Pa	AREA	*P	7	7	6	7	7	6	8	7	6	8	7	6	4	01/10
[illegible]																				
86192	AREA 9			Pa	AREA	*P	19	19	17	19	19	17	35	34	25	35	34	25	4	01/10
[illegible]																				
86194	AREA 11			Pa	AREA	*P	10	10	8	10	10	8	14	13	12	14	13	12	4	01/10
[illegible]																				
[redacted] (b)(6)																				

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: SEB 2S - PR 9692 - RPT1305- N1 CF - 61424

* - NO CONTROL SUBTRACTED, 6 MREM PER MONTH SUBTRACTED

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1102140053	02/09/11	01/21/11	13	1 OF 1

PARTICIPANT NUMBER	NAME				DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
		ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		
FOR MONITORING PERIOD:								10/01/10 - 12/31/10			QTR 4			2010							
(b)(6)																					
						NOTE		ABSENT													
58197	AREA 14				Pa	AREA								111	111	111	111	111	111	5	01/10
						NOTE		ABSENT													
58198	AREA 18				Pa	AREA								80	80	75	80	80	75	5	01/10
(b)(6)																					

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: RAH 2S - PR 8802 - RPT1305- N1 CF - 61424

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ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1106060138	03/07/11	03/01/11	4	1 OF 1

PARTICIPANT NUMBER	NAME: ID NUMBER	BIRTH DATE	SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:							10/01/10	-	12/31/10		QTR 4			2010						

(b)(6)

M: MINIMAL REPORTING SERVICE OF 1 MREM
* - NO CONTROL SUBTRACTED, 8 MREM PER MONTH SUBTRACTED
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QUALITY CONTROL RELEASE: SEB

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ACCOUNT NO	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
3200	PKD	1104270035	02/21/11	02/11/11	6	1 OF 1

PARTICIPANT NUMBER	NAME (ID NUMBER, BIRTH DATE, SEX)	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:					07/01/10 - 09/30/10				QTR 3			2010						
(b)(6)																		
[redacted]																		
56196	AREA 13	Pa	AREA	*PH	464	464	464	464	464	464	563	563	560	563	563	560	6	01/10
56197	AREA 14	Pa	AREA	*PH	207	207	198	207	207	195	318	318	306	318	318	306	6	01/10
56198	AREA 15	Pa	AREA	*PH	148	148	139	148	148	139	228	228	214	228	228	214	6	01/10

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: JAS 2S - PR 9700 - RPT1305- N1 CF - 61754

* - NO CONTROL SUBTRACTED, 6 MREM PER MONTH SUBTRACTED

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Occupational Radiation Exposure Report

Accredited by the "National Institute of Standards and Technology through NVLAP for the specific scope of accreditation under lab code 100555-0"

REPORT NO: 09454 ACCOUNT NO: 91991 LOCATION: 00000PKD

DATE BADGES RECEIVED:	04/26/2011
DATE BADGES REPORTED:	MAY 4, 2011
PAGE: 1 OF: 2	
LICENSE NO:	
PURCHASE ORDER NO:	C0000123887

NOTIFICATION LEVELS

DEEP	SHALLOW	EXTREMITY

S/I:13

REPORT TO:
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JACK CRAWFORD

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SHIP TO:
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EHS RADIATION SAFETY OFFICE
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COLUMBIA, MO 65211-3050

DOSE EQUIVALENT IN MILLIREMS FOR PERIODS INDICATED BELOW

WEARER NUMBER	SLOT NUMBER	PROCESS CONTROL NUMBER	NAME (LAST) OR OTHER DESIGNATION	F I	M I	ID TYPE	SSN / ID	BIRTH DATE	SEX	BADGE TYPE	BODY REGION	BODY PART	SERVICE	MONITORING PERIOD FIRST DAY	MONITORING PERIOD LAST DAY	CURRENT DEEP	CURRENT EYE	CURRENT SHALL.	CURRENT NEUT.	CURRENT PROC. NOTES	QUARTER TO DATE DEEP	QUARTER TO DATE EYE	QUARTER TO DATE SHALL.	YEAR TO DATE DEEP	YEAR TO DATE EYE	YEAR TO DATE SHALL.	NO RPTG	LIFETIME TO DATE DEEP	DOSE HISTORY ADJUSTMENTS	INCEPTION DATE LIFETIME TOTAL
(b)(6)																														
58494		0201763	AREA 1			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	6		17	'		6		17	6		17	1	6		01/01/2011
58495		0201763	AREA 2			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	14		20	'		14		20	14		20	1	14		01/01/2011
58496		0201763	AREA 3			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	'		'	'		0		0	0		0	1	0		01/01/2011
58497		0201763	AREA 4			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	2		7	'		2		7	2		7	1	2		01/01/2011
58498		0201763	AREA 5			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	'		'	'		0		0	0		0	1	0		01/01/2011
58499		0201763	AREA 6			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	2		8	'		2		8	2		8	1	2		01/01/2011
58500		0201763	AREA 7			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	22		22	'		22		22	22		22	1	22		01/01/2011
58501		0201763	AREA 8			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	3		3	'		3		3	3		3	1	3		01/01/2011
58502		0201763	AREA 9			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	6		13	'		6		13	6		13	1	6		01/01/2011
58503		0201763	AREA 10			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	17		17	'		17		17	17		17	1	17		01/01/2011
58504		0201763	AREA 11			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	6		15	'		6		15	6		15	1	6		01/01/20'
58505		0201763	AREA 12			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	1		6	'		1		6	1		6	1	1		01/01/20
58506		0201763	AREA 13			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	31		31	'		31		31	31		31	1	31		01/01/2011
58507		0201763	AREA 14			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	'		'	'		0		0	0		0	1	0		01/01/2011
58508		0201763	AREA 15			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	6		6	'		6		6	6		6	1	6		01/01/2011
58509		0201763	AREA 16			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	3		3	'		3		3	3		3	1	3		01/01/2011
58510		0201763	AREA 17			1	000000000	20110101		35	ARE		Q	01/01/2011	03/31/2011	16		16	'		16		16	16		16	1	16		01/01/2011
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

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5/19

Occupational Radiation Exposure Report

Accredited by the "National Institute of Standards and Technology through NVLAP for the specific scope of accreditation under lab code 100555-0"

REPORT NO: 09454 ACCOUNT NO: 91991 LOCATION: 00000PKD

DATE BADGES RECEIVED:	04/28/2011
DATE BADGES REPORTED:	MAY 4, 2011
PAGE: 2 OF: 2	
LICENSE NO:	
PURCHASE ORDER NO:	C0000123687

NOTIFICATION LEVELS

DEEP	SHALLOW	EXTREMITY

S/I:13

C 7

REPORT TO:
UNIVERSITY OF MISSOURI CLMBIA
JACK CRAWFORD

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT BLD
COLUMBIA, MO 65211-3050

SHIP TO:
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RADIATION SAFETY

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT BLD
COLUMBIA, MO 65211-3050

DOSE EQUIVALENT IN MILLIREMS FOR PERIODS INDICATED BELOW

WEARER NUMBER	SLOT NUMBER	PROCESS CONTROL NUMBER	NAME (LAST) OR OTHER DESIGNATION	# I	MI	ID TYPE	SSN / ID	BIRTH DATE	SEX	BADGE TYPE	BODY REGION	BODY PART	SERVICE	MONITORING PERIOD FIRST DAY	MONITORING PERIOD LAST DAY	CURRENT DEEP	CURRENT EYE	CURRENT SHALL.	CURRENT NEUT.	CURRENT PROC. NOTES	QUARTER TO DATE DEEP	QUARTER TO DATE EYE	QUARTER TO DATE SHALL.	YEAR TO DATE DEEP	YEAR TO DATE EYE	YEAR TO DATE SHALL.	YEAR TO DATE NO. RPTS	LIFETIME TO DATE DEEP	LIFETIME TO DATE DOSE HISTORY ADJUSTMENTS	LIFETIME TO DATE INCEPTION DATE LIFETIME TO
56530		0201768	AREA 21																											
56531		0201769	AREA 22			1	000000000	20110101		38	WB	CH	Q	01/01/2011	03/31/2011	31	31	31	·		31	31	31	31	31	31	1	31		01/01/201
56532		0201769	AREA 23			1	000000000	20110101		38	WB	CH	Q	01/01/2011	03/31/2011	30	30	30	·		30	30	30	30	30	30	1	30		01/01/2011
56533		0201769	AREA 24			1	000000000	20110101		38	WB	CH	Q	01/01/2011	03/31/2011	27	27	42	·		[illegible]	[illegible]								
56534		0201770	AREA [illegible]			1	000000000	20110101		38	WB	[illegible]																		

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

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117

Occupational Radiation Exposure Report

Accredited by the "National Institute of Standards and Technology through NVLAP for the specific scope of accreditation under lab code 100555-0"

REPORT NO: 09765 ACCOUNT NO: 91991 LOCATION: 00000PKD

DATE BADGES RECEIVED:	07/25/2011	
DATE BADGES REPORTED:	AUG 8, 2011	
PAGE: 1 OF: 2		
LICENSE NO:		
PURCHASE ORDER NO: C0000123887		
NOTIFICATION LEVELS		
DEEP	SHALLOW	EXTREMITY

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REPORT TO:
UNIVERSITY OF MISSOURI CLMBIA
JACK CRAWFORD

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT BLD
COLUMBIA, MO 65211-3050

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RADIATION SAFETY

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT
BLD
COLUMBIA, MO 65211-3050

DOSE EQUIVALENT IN MILLIREMS FOR PERIODS INDICATED BELOW

WEARER NUMBER	SLOT NUMBER	PROCESS CONTROL NUMBER	NAME (LAST) OR OTHER DESIGNATION	F I	M I	ID TYPE	SSN / ID	BIRTH DATE	SEX	BADGE TYPE	BODY REGION	BODY PART	SERVICE	MONITORING PERIOD FIRST DAY	MONITORING PERIOD LAST DAY	CURRENT DEEP	CURRENT EYE	CURRENT SHALL.	CURRENT NEUT.	PROC. NOTES	QUARTER TO DATE DEEP	QUARTER TO DATE EYE	QUARTER TO DATE SHALL.	YEAR TO DATE DEEP	YEAR TO DATE EYE	YEAR TO DATE SHALL.	NO. RPTS	LIFETIME TO DATE DEEP	DOSE HISTORY ADJUSTMENTS	INCEPTION DATE LIFETIME TOTAL
(b)(6)																														
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68502		0203340	AREA 9			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011	6		6			6		6	6		6	1	6		04/01/201'
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68505		0203340	AREA 12			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011						0		0	0		0	1	0		04/01/2011
68506		0203340	AREA 13			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011	20		20			20		20	20		20	1	20		04/01/2011
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68511		0203340	AREA 18			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011						0		0	0		0	1	0		04/01/2011
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Occupational Radiation Exposure Report

Accredited by the "National Institute of Standards and Technology through NVLAP for the specific scope of accreditation under lab code 100555-0"

REPORT NO: 09765 ACCOUNT NO: 91991 LOCATION: 00000PKD

DATE BADGES RECEIVED:	07/26/2011
DATE BADGES REPORTED:	AUG 8, 2011
PAGE: 2 OF: 2	
LICENSE NO:	
PURCHASE ORDER NO: C0000123887	

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REPORT TO:
UNIVERSITY OF MISSOURI CLMBIA
JACK CRAWFORD

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT BLD
COLUMBIA, MO 65211-3050

NOTIFICATION LEVELS

DEEP	SHALLOW	EXTREMITY

SHIP TO:
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RADIATION SAFETY

EHS RADIATION SAFETY OFFICE
8 RESEARCH PARK DEVELPMENT BLD
COLUMBIA, MO 65211-3050

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56512		0203340	AREA 19			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011						0		0	0		0	1	0		04/01/2011
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56523		0203340	AREA 24			1	000000000	20110101		38	ARE		Q	04/01/2011	06/30/2011	4		4			4		4	4		4	1	4		04/01/2011
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

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Attachment B – "Radiation Safety Training Outline and Records".

Outline for Introduction to Radiation Safety

1. **Introduction to class objectives**
    a. Be familiar with the Radiation Safety Manual
    b. Be familiar with MU's Broadscope License
    c. How to become a Radiation Worker
    d. Radiation Safety groups on campus
    e. Signs and postings in restricted areas and worker responsibilities
    f. Types of radiation, definitions, and shielding
    g. Dosimetry how to wear, store, requirements, and how to receive
    h. What is ALARA and what are the applications
    i. Purchasing of radioactive material and associated forms
    j. How to handle radioactive waste
    k. How to use a survey meter and how to conduct a survey
    l. How to use a scintillation counter and how to conduct a survey
    m. Be familiar with personal monitoring after use
    n. What to do in case of a spill
    o. Who do you call in case of a spill
2. **Introduction to the Radiation Safety Manual**
    a. Where the on-line manual is found
    b. Topics and resources covered in the manual
3. **Discussion about the NRC**
    a. MU's Broardscope License
    b. Agreement State vs NRC State
    c. Inspections by the NRC
4. **How to become a Radiation Worker**
    a. Training necessary
    b. Forms necessary
5. **Responsibilities of various radiation safety groups**
    a. Radiation Safety Committee
    b. Radiation Safety Officer
    c. Authorized User
6. **Signs and responsibilities when working with radioactive material**
    a. Postings for restricted areas
    b. No eating, drinking, smoking or cosmetics
    c. Security of radioactive material
    d. Emergency response
    e. NRC Form 3
7. **Ionizing radiation**
    a. Ionizing vs non-ionizing

b. What is ionization

8. Definitions

a. Radioactivity
b. Contamination
c. Units

9. Types of ionizing radiation

a. Appropriate shielding
b. Half-life

10. Average annual exposure

a. Sources of exposure
b. Effects of radiation exposure on cells
c. Exposure limits

11. Dosimetry

a. Types of dosimetry
b. Requirements
c. How to wear dosimetry
d. Explaination of a TLD
e. Responsibilities wearing dosimetry
f. What the dosimetry can measure
g. NRC Form 5
h. Overview of MU's monitoring program
i. How to apply for dosimetry

12. ALARA

a. Time, distance, shielding
b. Declaration of pregnancy

13. Purchasing radioactive material

a. Notification form for Radiation Safety
b. Transfer form
c. Package receipt form

14. Radioactive Waste

a. Solid waste and restrictions
b. Liquid waste and restrictions
c. Labeling of radioactive waste
d. Pickup request form for removal
e. Mixed wastes

15. Documented radiation surveys

a. Terms
b. When to conduct a documented survey
c. Swipe surveys and trigger levels
d. Formula for cpm to dpm
e. Meter survey and trigger levels

16. Use of a survey meter

   a. How does it work and do you know it's working
   b. Basic functions of a survey meter
   c. Operational checks for the survey meter

17. Performing a survey with the meter
   a. Where survey and how

18. Performing a survey with a liquid scintillation counter
   a. How does it work
   b. Where to survey and how

19. Post procedure monitoring
   a. Hands, feet, and whole body
   b. Monitor the area
   c. Decontamination of the person

20. Spills
   a. Minor spills and how to decontaminate
   b. Major spills and how to decontaminate
   c. Who to call and when to call for help

21. Quick review of the Radiation Safety Manual
   a. Call EHS with any safety concern

22. Review exam
   a. Formula to convert cpm to dpm
   b. What is the security requirement for radioactive material
   c. What ate the survey meter operational checks and when do you perform
   d. Three ways to reduce dose (ALARA)
   e. How long can radioactive material be stored in the lab
   f. Who do you call with questions, advise or to report an incident (business hours/non)
   g. Are you allow to contact the NRC directly with a concern
   h. How should dosimety be worn
   i. What are the precautions for working in a restricted area

Radiation Safety

New Radiation Workers

Presented By

David

Burgess

882-7221

MISSOURI MISSOURI

Radiation Safety Manual

http://ehs.missouri.edu/rad

"Yes...I believe there is a question in the back."

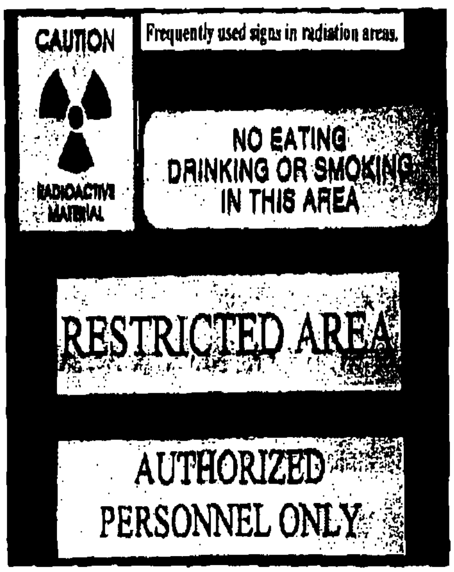
There are no dumb questions!!!

NRC

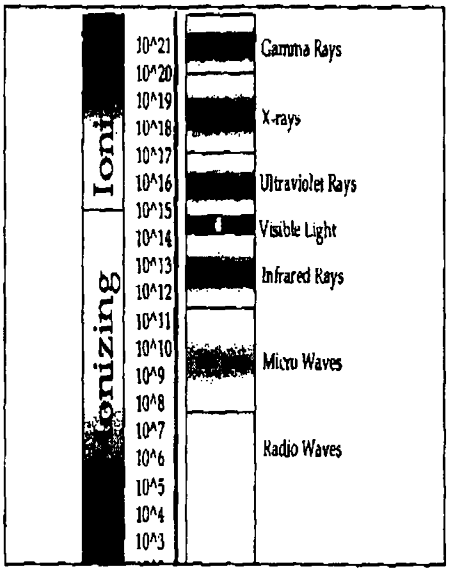
Safety Responsibilities

Authorized User

- Individuals authorized by the RSC to use radiation producing equipment or possess radioactive material, and supervise their use
- Responsible for compliance with all guidelines, policies, and safety procedures set forth in MU's Radiation Safety Manual and Broadscope License
- Supervisory person directly responsible for training and safety in the lab



- Restricted Area
  - All material is required [illegible]
- Unrestricted Area
  - All material [illegible]



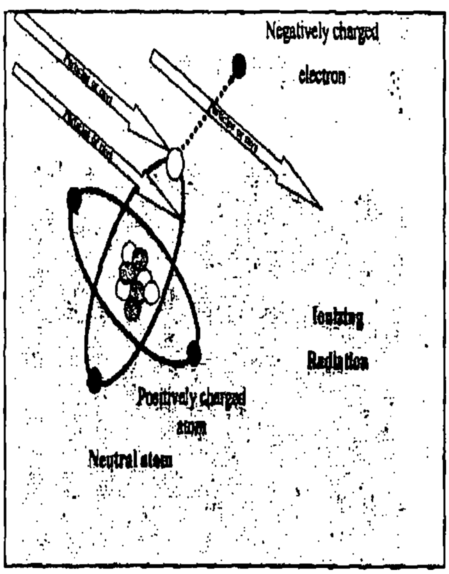
Definitions

Radioactivity

- That property of certain unstable material where ionizing radiation is spontaneously emitted

Contamination

- Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence may be harmful



Radioactivity Basics

Radioactivity – The spontaneous nuclear transformation of an unstable atom that often results in the release of radiation, also referred to as disintegration or decay.

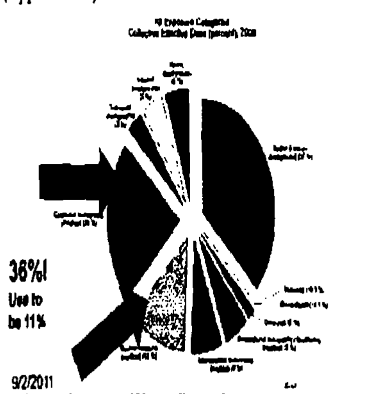
Units

Curie (Ci) the activity in one standard gram of Radium = 3.7×10^{10} disintegrations per second

Becquerel (Bq) 1 disintegration per second – International Units (SI)

Average Annual Radiation Exposure in the U.S. (NEW)

(Approximate)

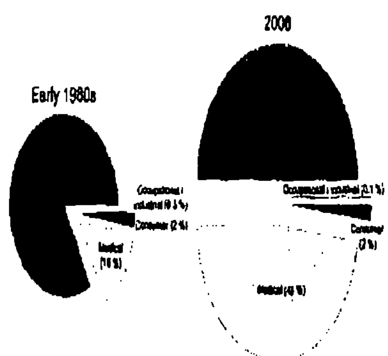


9/2/2011

Radiation effects on the Cell

- **Indirect Effect** - radiation that interacts with the water of the cytoplasm of the cell, not the nucleus, and breaks the bonds holding the molecules together forming hydrogen ions and hydroxyls. These molecular fragments may recombine and form water or may form to make other substances like hydrogen peroxide.

NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States*



	Early 1980s	2006
Collective effective dose (person-Sv)	835 000	1 870 000
Effective dose per individual in the U.S. population (mSv)	3.6	6.2

Direct effect

- Direct effect can cause immediate damage to the most important part of the cell, the genetic material.
- Damage to genetic material can cause immediate problems to the cell and to the daughter cells it creates.
- Damage to genetic material is highly dependent on the cell cycle.

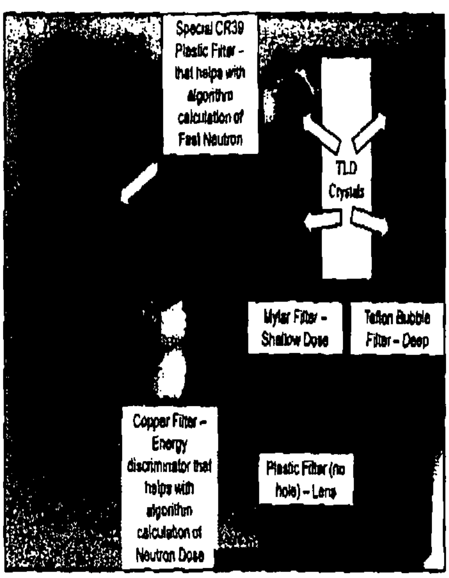
To Assure Accurate Dosimeter Readings:

- wear badge at sternum level
- keep badge away from heat sources
- store badge away from radiation sources
- do not wear your badge when having personal medical or dental x-rays
- notify the Radiation Safety Staff if anything unusual happens to your dosimeter
- only wear the dosimetry assigned to you
- assigned dosimetry should be worn at only one institution

Dosimetry Continued

- If you are assigned dosimtery from the university which is used to monitor your work related occupational exposure to ionizing radiation, and you plan to receive a diagnostic or therapeutic treatment with RAM (radiopharmaceuticals) then you MUST inform the RS Office PRIOR to the treatment so we can advise you on the particulars associated with how we are going to continue to monitor your occupational exposure without it being affected by the radiation from your treatment or scan.
- Dosimetry issued by the RS Office of the University of Missouri should also not to be worn home, to the store, to lunch etc but rather kept at work to be donned and doffed when you are working around sources of ionizing radiation unless prior arrangements have been made with RS.

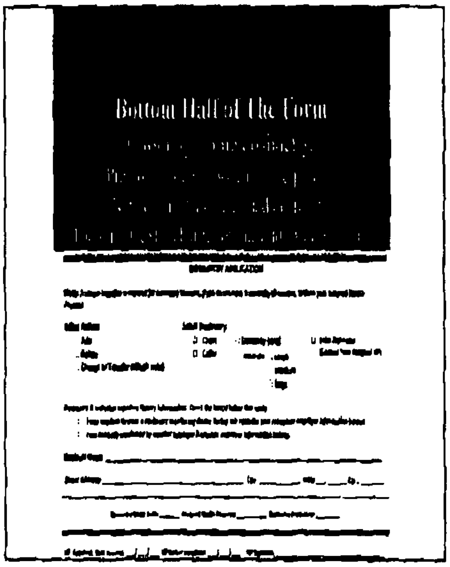
35

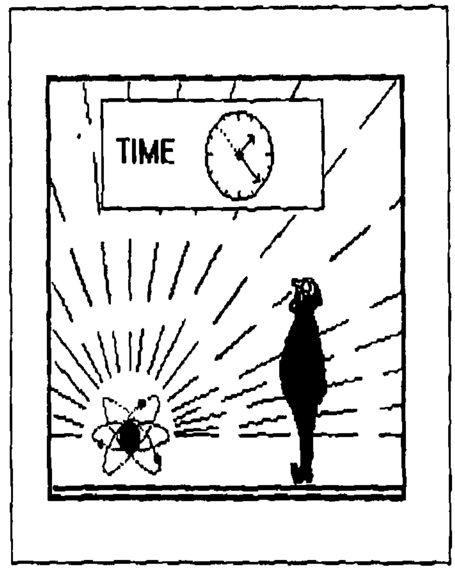


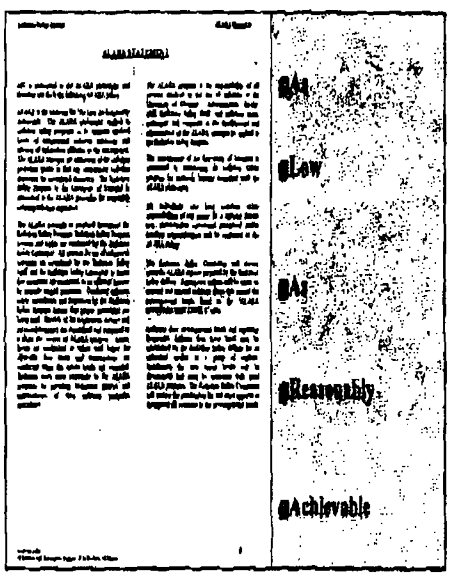
Dosimetry Continued

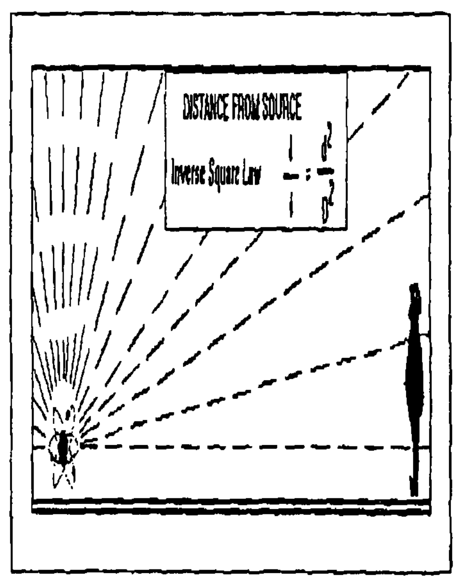
- Do not store your personal dosimeter close to sources of radiation. If you leave them on your lab coat or desk drawer as an example make for sure they are reasonably away from sources of ionizing radiation. In other words don't store you dosimeter near the Radioactive Waste storage containers.
- Ensure that you are wearing YOUR assigned dosimeter, wearing it correctly as identified on the dosimeter itself, "Chest", "Collar", and wearing the correct color and date on dosimeter associated with wear period. If you questions concerning this call EHS RS at 882-7018.

36

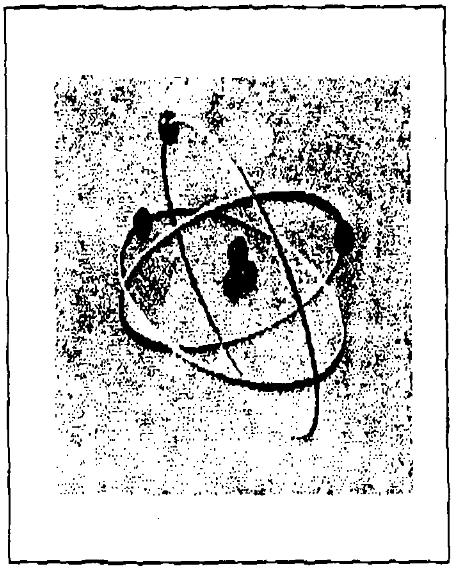

Bottom Half of the Form

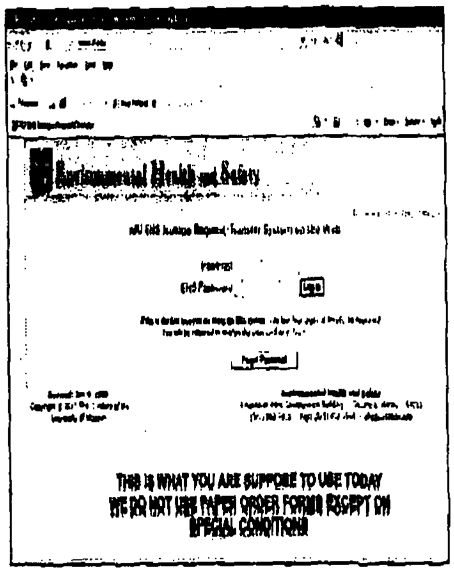

TIME

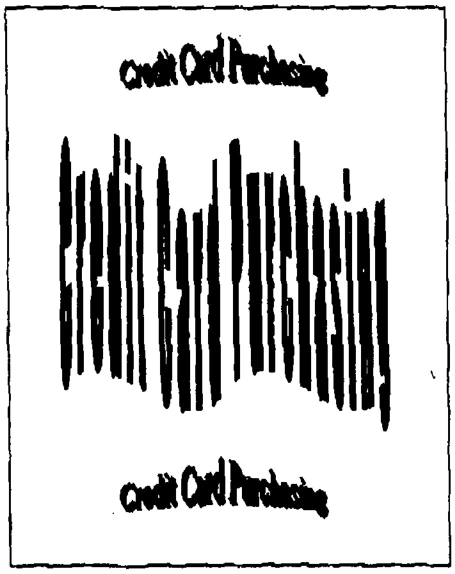

As
Low
As
Reasonably
Achievable

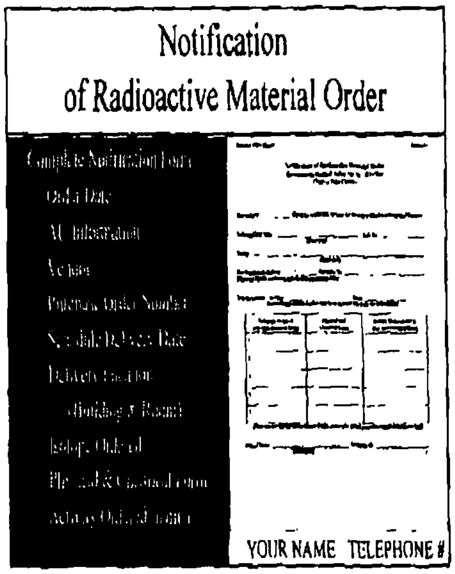

DISTANCE FROM SOURCE
Inverse Square Law

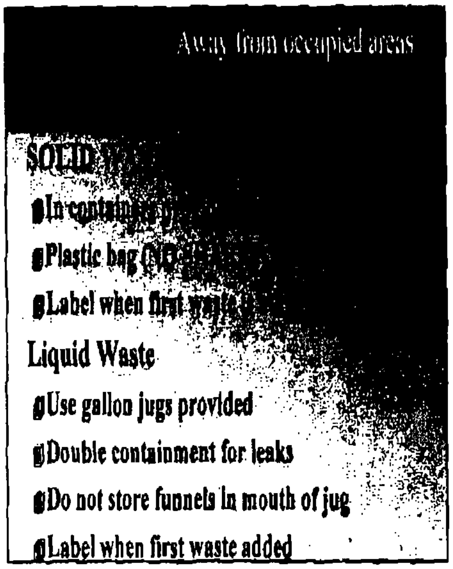
4/3



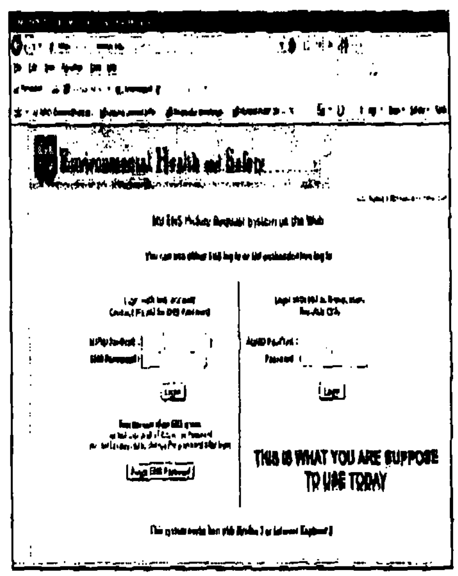

Environmental Health and Safety
THIS IS WHAT YOU ARE SUPPOSE TO USE TODAY
WE DO NOT USE PAPER ORDER FORMS EXCEPT ON SPECIAL CONDITIONS


Credit Card Purchasing
Credit Card Purchasing
Credit Card Purchasing


Notification
of Radioactive Material Order
YOUR NAME
TELEPHONE #


Away from occupied areas
Liquid Waste
Use gallon jugs provided
Double containment for leaks
Do not store funnels in mouth of jug
Label when first waste added


Note shielded
waste area

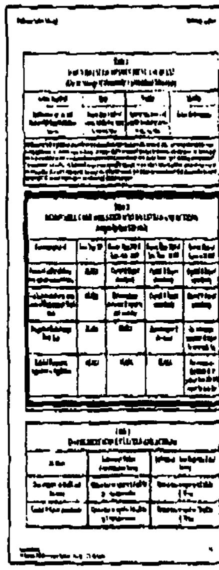

Environmental Health and Safety
THIS IS WHAT YOU ARE SUPPOSE
TO USE TODAY

29

30

SURVEY is DEFINED AS:

- Measurement of surface contamination with the appropriate survey instrument.
- Measurement of removable contamination by swipes.
- Remember documented surveys must be conducted by Radiation Workers.



SURVEY TABLE 2

Swipe Results

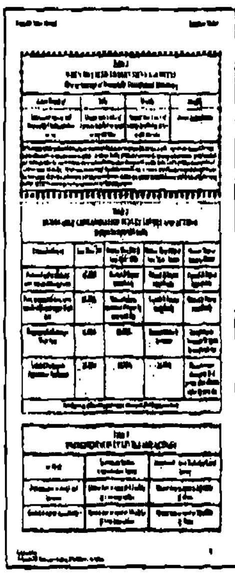
Removable Contamination

Column

Columns to

Contamination DPM

ALARA



SURVEY TABLE 1

Monthly

Weekly

Daily

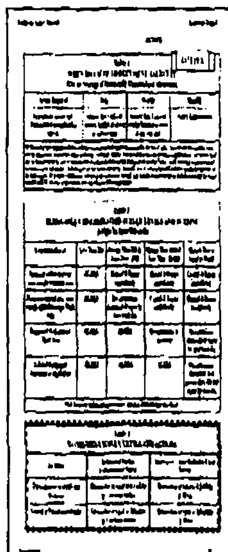
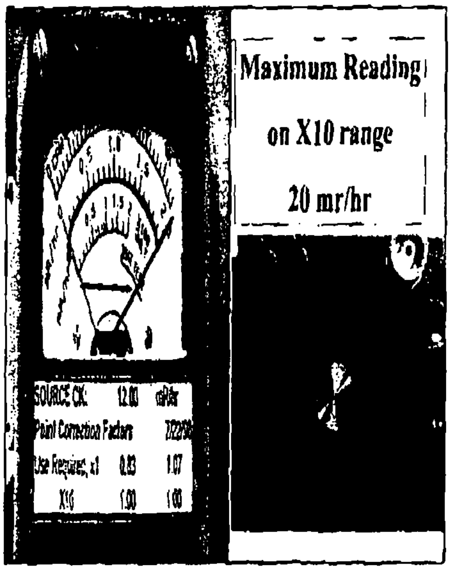
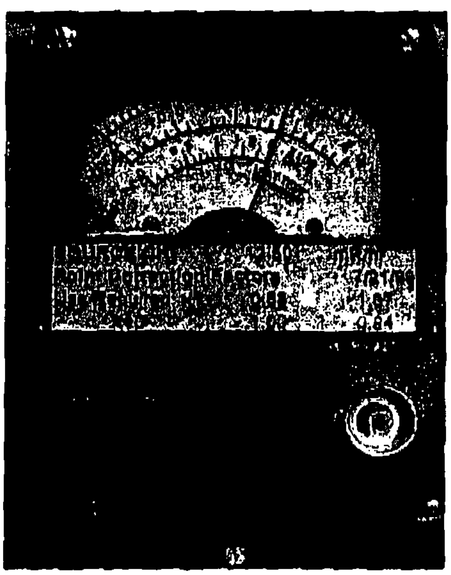
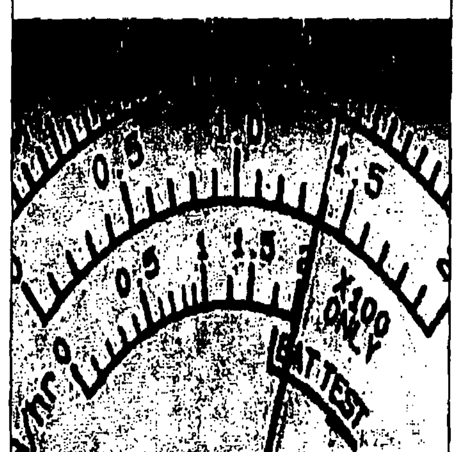


TABLE 3







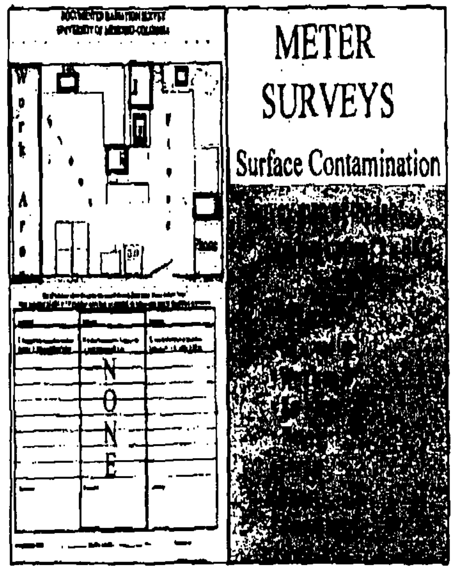
1st operational
Check

37

38

CHEAT SHEET

- HAS INSTRUMENT BEEN CALIBRATED IN THE LAST 12 MONTHS?
- ARE THE BATTERIES O.K.?
- IS SOURCE CHECK WITHIN + OR - 20% OF CALIBRATION STICKER VALUE?
- THIS IS IN THE RSM

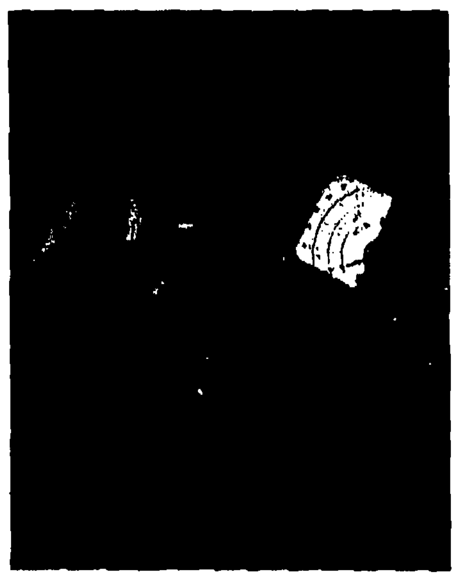


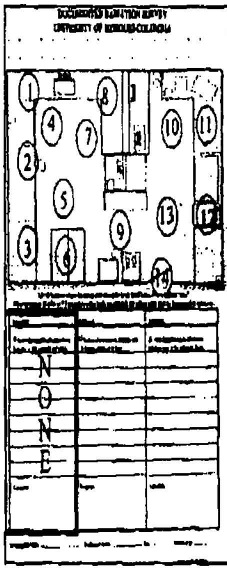
USING

THE

SURVEY

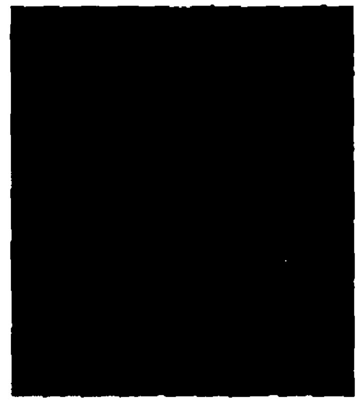
METER





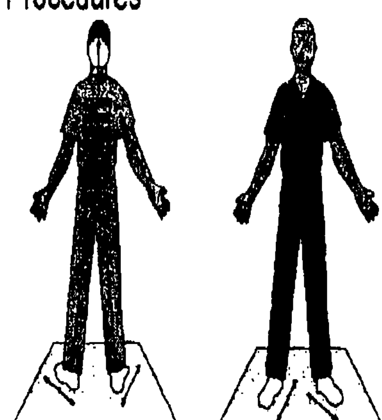
Swipe
Surveys
Removable Contamination

Surveying Shoes



Monitor Your Hands

Personnel Contamination Survey Procedures



- 1) What is the formula to convert cpm to dpm?
- 2) What is the security requirements for radioactive material?
- 3) What are the three survey meter function checks and when must they be performed?
- 4) What are three basic ways to reduce your radiation dose (ALARA)?
- 5) How long can radioactive waste be stored in the lab before removal?
- 6) Who do you call with questions, advise or to report an incident during business hours? After business hours?
- 7) Are you allowed to contact the NRC directly with a concern?

Please do A Critique

- 8) How should your dosimetry be worn?
- 9) What are the precautions for working in a restricted area?

THE END

[redacted]

PROGRAM: Introduction to Radiation Safety INSTRUCTOR: M. Aldrich

DATE: 12.14.09 TIME: 2:30 pm LOCATION: Pickard Hall

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
	(b)(6)	(b)(6)		
			Art Hist. & Arch.	
			Museum	
			Museum	
			Museum	
			Museum	
			Museum	
			Museum	
			Museum	
13				
14				
15				

COURSE ID: RADlecw COURSE HX: 7750 DATE ENTERED: 12/18/2009 INITIALS: [illegible]

COMMENTS: ______________________________

NOT FOR PUBLIC DISCLOSURE

17/35

PROGRAM: Introduction to Radiation Safety INSTRUCTOR: M. Aldrich

DATE: 12.14.09 TIME: 2:30 pm LOCATION: Pickard Hall

2/2

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1			CMUSART	
2	(b)(6)		CMUSART	
3		(b)(6)	"	
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

COURSE ID: ____________ COURSE HX: ____________ DATE ENTERED: ____________ INITIALS: ________

COMMENTS: ____

~~NOT FOR PUBLIC DISCLOSURE~~

Date of Request Authorized User Authorized User Number Registered User Number

DATE: 12.15.09 TIME: 2:30 pm LOCATION: Pickard Hall

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	[redacted] (b)(6)	[redacted] (b)(6)	Art History + Archaeology	
2	[redacted]	[redacted]	Museum of Art + Arch.	
3	[redacted]	[redacted]	Museum of A + A	
4	[redacted]	[redacted]	Prep. Shop	
5	[redacted]	[redacted]	Museum of A+A	
6	[redacted]	[redacted]		
7		[redacted]		
8				
9				
10				
11				
12				
13				
14				
15				

COURSE ID: [illegible] COURSE HX: 775 1 DATE ENTERED: 12/18 2009 INITIALS: [illegible]

COMMENTS:

2nd floor [illegible]

~~NOT FOR PUBLIC DISCLOSURE~~

58/61

[redacted]

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1				Crawford
2	(b)(6)			
3				
4				
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15				

COURSE ID: RADREW COURSE HX: 7777 DATE ENTERED: ______ INITIALS: ______

COMMENTS: mkss trained @ R Pickard new ~~post doc~~ graduate student

ENTERED BY RAB

JAN 2 5 2010

NOT FOR PUBLIC DISCLOSURE

3/00

#	PRINT NAME	STUDENT		
1	(b)(6)		Custodial Services	
2				
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14				
15				

COURSE ID: AORCEW COURSE HX: 778 DATE ENTERED: 01/26/2010 INITIALS: [illegible]

COMMENTS:

NOT FOR PUBLIC DISCLOSURE

21/35

Radiation Safety [illegible] INSTRUCTOR: [illegible]

DATE: 1/27/11 TIME: 2 PM LOCATION: Pickard Hall

#	Print	Name	EMPL. ID or	Department	[redacted] (b)(6)	Authorized User	AU
1	[redacted] (b)(6)			Campus		Crawford	558
2				Museum A+A			
3				Museum A&A ✓			
4				Museum of A+A		↓	↓
5							
6							
7							
8							
9							
10					ENTERED BY RAB		
11							
12					FEB 21 2011		

COURSE ID: RADREW COURSE HX: 8317 DATE ENTERED: ________ INITIALS: ______

COMMENTS: Training for graduate student, housekeeping docent + security guard on R.S. + specifics to Pickard Hall.

NOT FOR PUBLIC DISCLOSURE

2/22/45

DATE: 2/15/11 TIME: [illegible]

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	(b)(6)		Art/Art History	Crawford
2				
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10				
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12				
13				
14				
15				

COURSE ID: RADREW COURSE HX: 8358 DATE ENTERED: ______ INITIALS: ______

ENTERED BY RAB

COMMENTS:

FEB 21 2011

COPY

NOT FOR PUBLIC DISCLOSURE

2/15

PROGRAM: Radiation Safety Introduction INSTRUCTOR: M. [illegible]

DATE: February 18, 2011 TIME: 1:20 pm LOCATION: Pickard Hall

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	(b)(6)		Pickard Hall staff	Crawford (55555)
2				
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14				
15				

ENTERED BY RAB
FEB 2 2011

COPY

COURSE ID: RADREW COURSE HX: 8365 DATE ENTERED: ______ INITIALS: ______

COMMENTS: ______

NOT FOR PUBLIC DISCLOSURE

SE/HC

PROGRAM: [illegible] INSTRUCTOR: [illegible]

DATE: 3/15/11 TIME: 8:30 AM LOCATION: Pickard Hall

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	[redacted] (b)(6)		CSS	
2			CSS	
3				
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13				
14				
15				

COURSE ID: RANREW COURSE HX: 8418 DATE ENTERED: 3/15/2011 INITIALS: [illegible]

COMMENTS: Radiation Safety intro training for house-keeping staff @ Pickard - training specific to Pickard Hall. mlead

NOT FOR PUBLIC DISCLOSURE

COPY

25/5

PROGRAM: Radiation Safety Training - Introduction [illegible]

DATE: 7/5/11 TIME: 11:30 AM [illegible]

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
[redacted] (b)(6)			Pickard	Crawford 55555
			Pickard	Crawford 55555

COURSE ID: RADREW COURSE HX: 8651 DATE ENTERED: ENTERED BY RAB JUL 26 2011 INITIALS: ______

COMMENTS: See attached RW forms

NOT FOR PUBLIC DISCLOSURE

PROGRAM: Intro to Rad Safety INSTRUCTOR: [illegible]

DATE: 8/2/11 TIME: 10:33AM LOCATION: [illegible]

#	PRINT NAME	EMPL. ID or	DEPARTMENT	AUTHORIZED USER
1	(b)(6)		Art History	J. Crawford
2				
3				
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9				
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11				
12				
13				
14				
15				

COURSE ID: RADREW COURSE HX: 6684 DATE ENTERED: ENTERED BY RAB INITIALS:

COMMENTS: AUG 05 2011

NOT FOR PUBLIC DISCLOSURE

27/35

PROGRAM: Intro to RS INSTRUCTOR: [redacted]

DATE: 8/17/11 TIME: 1:00pm LOCATION: R. Pick[illegible]

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	(b)(6)		Archeology	Crawfor
2				
3				
4				
5				
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10				
11				
12				
13				
14				AUG 22 2011
15				ENTERED BY RAB

COURSE ID: RADRRN COURSE HX: 8706 DATE ENTERED: INITIALS:

COMMENTS: RS Intro materials covered + history of Pickard + dosems ~~when~~ wear rules & how to store

NOT FOR PUBLIC DISCLOSURE

PROGRAM: Log Entry SOP INSTRUCTOR: M. Aldrich

DATE: 8/4/11 TIME: 3:30 LOCATION: Pickard

#		EMPL. ID or TUDENT #	DEPARTMENT	AUTHORIZED USER
1			Pickard	Crawford
2			"	
3			Pi "	
4	(b)(6)		"	
5			MenArt+Arh/Pickard	
6				
7				
8			~~SOP~~ EOR	
9				
10				
11				
12				
13				
14				
15				ENTERED BY RAB

COURSE ID: KHDSPEC COURSE HX: 8681 DATE ENTERED: AUG 0 5 2011 INITIALS:

COMMENTS: review SOP for entry log

NOT FOR PUBLIC DISCLOSURE

RADIATION SAFETY TRAINING SIGN-IN SHEET

PROGRAM: RADIATION IN-SERVICE → DOSIMETER STORAGE → LOG → END USE REPORT INSTRUCTOR: RSO / MARY ALDRICH

DATE: 19 AUG 2011 TIME: 9^00 - 9^30 LOCATION: PICKHALL HALL

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1			MUS. ART + ARCH.	
2			" "	
3			" "	
4	(b)(6)			
5			Mus. of A + Arch.	
6			" " " "	
7			Mus of Art & Arch	
8				
9				
10				
11				
12				ENTERED BY RAB
13				SEP 09 2011
14				
15				

COURSE ID: RAD-5 COURSE HX: 8747 DATE ENTERED: 9/8/2011 INITIALS: VS

COMMENTS:

NOT FOR PUBLIC DISCLOSURE

COPY

RADIATION SAFETY TRAINING SIGN-IN SHEET

PROGRAM: RAD INTRO INSTRUCTOR: D. BURGESS

DATE: 8/22/11 TIME: 2:30 LOCATION: PICKARD HALL

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1	(b)(6)		A+P Archaeology	RSO
2				
3				
4				
5				
6				
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8				
9				
10				
11				
12				
13				
14				
15			ENTERED BY RAB	

COURSE ID: RADREV COURSE HX: 8714 DATE ENTERED: AUG 25 2011 INITIALS:

COMMENTS:

NOT FOR PUBLIC DISCLOSURE

PROGRAM: RAD INTRO INSTRUCTOR: D. BURGESS

DATE: 8-23-11 TIME: 3:30 LOCATION: PICKARD

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
(b)(6)			ARHA	RSO
3				
4				
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14				
15				

COPY

COURSE ID: RADIREW COURSE HX: 8719 DATE ENTERED: ENTERED BY RAB AUG 2 6 2011 INITIALS:

COMMENTS:

NOT FOR PUBLIC DISCLOSURE

RADIATION SAFETY TRAINING SIGN-IN SHEET

PROGRAM: Intro to Radiation Safety INSTRUCTOR: M. Aldrich

DATE: 9/8/11 TIME: 3:00pm LOCATION: Pickard

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
1			Museum staff	Crawford 5555
2			Museum Staff	
3	(b)(6)		Museum Staff	
4			Museum staff Security	
5				
6				
7				
8				
9				
10				
11				
12				ENTERED BY RAB
13				SEP 09 2011
14				
15				

COURSE ID: RADREW COURSE HX: 8748 DATE ENTERED: 9/9/2011 INITIALS: Vg

COMMENTS: special emphasis on bldg history, their role in bldg integrity, public interest, possible news coverage, dosim + escort log

NOT FOR PUBLIC DISCLOSURE

RADIATION SAFETY TRAINING SIGN-IN SHEET

PROGRAM: Radiation Inservice Δ INSTRUCTOR: Mary Aldrich

DATE: 8/19 & 9/12 (8) (16) TIME: ______ LOCATION: Pickard Hall

#	PRINT NAME	EMPL. ID or STUDENT #	DEPARTMENT	AUTHORIZED USER
(b)(6)			Pickard/Art history	
	(b)(6)	NA *		
		16 NA *		
		NA *		
		NA *		
		NA *		
	(b)(6)			
			→ last date at Pickard	
			1011 last date at Pickard	
			16	
			Housekeeping → last date at Pickard	
			Pickard/Art History	

8/19 course = 8749

9/12 course = 8750

* training conducted on 8/19/11 for these staff.

** training conducted after 8/19/11

ENTERED BY RAB SEP 16 2011

34/35

ENTERED BY [illegible]

SEP 1 6 2011

COURSE ID: RADIS COURSE HX: 8750 { 8749 DATE ENTERED: ________ INITIALS: ____

COMMENTS: Δ topics → questionaire, how to wear + store dosim, how dose is reported, escort log,

COPY

35/35

Attachment C – "RSIP-A-10-F1 Escort Log for Pickard Hall Restricted Areas Rooms 12, 13, 15 and Attic

Environmental Health & Safety Research Park Development Building
University of Missouri-Columbia Columbia, MO 65211-3050

Escort Log for Pickard Hall Restricted Areas
Rooms 12, 13, 15 and Attic

RSIP-A-10-F1

Prepared by: ______________ Date: 9/2/11
Name

Reviewed by: ______________ Date: 9/2/11
Name

Approved by: ______________ Date: 02SEP2011
RSO

NOT FOR PUBLIC DISCLOSURE

Escort Log for Pickard Hall

Introduction

Entrance to certain areas of Pickard Hall is restricted to University staff that have been provided with radiation safety training and have been assigned dosimetry.

University staff and guests that do not have training/assigned dosimetry may be granted access into these restricted areas if they are provided continuous escort by EHS radiation safety staff or trained Museum staff with dosimetry.

Rules for Escort

- Escort shall be provided by EHS radiation safety staff or trained monitored museum staff.
- Escort shall be provided at all times.
- The escort log shall be completed for each escort into the restricted area.

Escort Log

- The Log must be filled out accurately and completely for each escort.
- Each column shall be completed as described below:
  - Date: Enter the current date of entry.
  - Time In: Enter the current time of entry.
  - Time Out: Enter the accurate time of exit.
  - Name: Print clearly the first name or first initial and full last name of the person to be escorted. (e.g. "D. Johnson").
  - Escort: Print clearly the first name or first initial and full last name of the person providing escort. (e.g. "D. Johnson")

University of Missouri	AU Name: Crawford	Facility: Pickard Hall – Museum of Art and Archeology
Entry Log	AU #: 77777	Questions? Contact: 2-7018, 2-5024, 2-0931

Entrance to this area is restricted to EHS and Museum staff with training and assigned dosimetry.
All other access must be coordinated through EHS and/or Museum of Art and Archeology and logged herein.
Escort shall be provided at all times and the log shall be completed for each time escort is provided.

Posted Area Entry Log				
Date	Time In	Time Out	Name	Escort
(Example) 7 20 11	1:32 am pm	1:42 am pm	D. Johnson	R. Sievert
(Example) 7 20 11	1:32 am pm	1:42 am pm	Joe. Escort	Self

University of Missouri	AU Name: Crawford	Facility: Pickard Hall – Museum of Art and Archeology
Entry Log	AU #: 77777	Questions? Contact: 2-7018, 2-5024, 2-0931

NOT FOR PUBLIC DISCLOSURE

NOT FOR PUBLIC DISCLOSURE

University of Missouri	AU Name: Crawford	Facility: Pickard Hall –Museum of Art and Archeology
Entry Log	AU #: 55555	Questions? Contact: 2-7018, 2-5024, 2-0931

1. **Entrance to this area is restricted to EHS and Museum staff with training and assigned dosimetry.**
2. **All other access must be coordinated through EHS and/or Museum of Art and Archeology and logged herein.**
3. **Escort shall be provided at all times and the log shall be completed for each time escort is provided.**

Posted Area Entry Log

Date	Time In	Time Out	Name	Escort
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		
	am/pm	am/pm		

References.

1. MU Materials License Application
2. MU Materials License, Amendment #110, August 24th, 2011
3. MU Web Radiation Safety Manual
4. Radiation Safety Standard Operating Procedures Manual
5. RS Authorization # 55555

~~NOT FOR PUBLIC DISCLOSURE~~

UNIVERSITY *of* MISSOURI
ENVIRONMENTAL HEALTH AND SAFETY

October 19, 2011

Mr. Michael LaFranzo
Senior Health Physicist
United States Nuclear Regulatory Commission
Region III
Materials control, ISFSI, and Decommissioning Branch
Division of Nuclear Materials and Safety
2443 Warrenville Road, Ste., 210
Lisle, IL 60532-4352

SUBJECT: Additional Responses for Request for Information: Tracking Number 11-A-0054

Dear Mr. Lafranzo:

The enclosed information was prepared in response to your questions from telephone conversation with you on October 12th at 10:00 am CST regarding our original responses for the Request for Information: Tracking Number 11-A-0054.

If additional information is needed or further clarification needs to be provided please contact me at 573-882-0931, or at crawfordw@missouri.edu.

Sincerely,

Jack Crawford
Radiation Safety Officer

Attachments
cc: Jacquelyn K. Jones, Vice Chancellor, Administrative Services
Maureen Kotlas, Director, Environmental Health and Safety
Silvia Jurisson, RSC Chair
RSO File

11

8 Research Park Dev Bldg, Columbia, MO 65211 Phone: 573-882-7018 Fax: 573-882-7940 ehs.missouri.edu
Missouri's Flagship University

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~~ML11297012O~~ - deleted 10/24/11 CL

C/24

Response to NRC Requests for additional clarification of MU's original responses regarding Tracking Number 11-A-0054 transmitted in letter dated September 14, 2011

Per phone call discussion with Mr. Mike LaFranzo held on October 12th, 2011 at 10:00 CST it was brought to our attention that there were additional questions or clarifications requested by Mr. LaFranzo regarding the original responses we supplied in the letter dated September 14, 2001 concerning tracking number 11-A-0054.

Specifically the following clarifications were requested by Mr. LaFranzo for MU to respond to.

1. In the letter dated August 15th, 2011 from the U.S. NRC transmitting the Request for Information: Tracking Number 11-A-0054 Mr. Lafranzo wanted clarification on who generated and submitted the report and why that individual was qualified to meet the intent on page 1, 4th paragraph, item (b) *that the organization or individual conducting the evaluation was independent of the concern and was proficient in the related functional area;..*

   Response:

   Concerning Independence:

   As the Radiation Safety Officer (RSO) for the University of Missouri (MU), I provided the direction and oversight for the response actions and was the primary author for response to the NRC. MU has chosen to use a consultant for radiation safety matters to enhance our program. The radiation consultant conducted a detailed review of MU's responses to Details 1 – 3. This independent review and the consultant's qualifications are documented in the attached letter from Engelhardt & Associates, Inc.

2. Mr. LaFranzo has requested that we specifically identify a root cause for each response for details 1-3.

   Response:

   Detail 1 - Root Cause - Human Error.

   In our original response, we explained that we conducted a survey of randomly selected members of PHF&S which we feel demonstrates that this was a misunderstanding by one

individual. Based on this survey, we were able to show that each of the individuals did understand where to store dosimetry. To reinforce the original training, we added where to store dosimetry into training that was provided in August 2011. These actions have been reviewed by our radiation consultant.

Detail 2 – Root Cause – Human Error.

In our original response, we explained that we conducted a survey of randomly selected members of PHF&S which we feel demonstrates that this was a misunderstanding by one individual. Based on this survey, we were able to show that each of the individuals did understand that exposures are not manipulated by MU and, specifically, that we do not divide the exposures by four. These actions have been reviewed by our radiation consultant.

Detail 3 – Root Cause –Insufficient clear instructions on use of sign in / sign out log.

As stated in the original response, this log was created as an internal tool. To provide more clear instructions for use, a new log form was developed and a standard operating procedure was developed. These actions have been reviewed by our radiation consultant. In addition, training on use of the new form has been provided.

3. Mr. LaFranzo requested that MU provide an outline of the training provided to Pickard Hall Faculty and Staff (PHF&S) on the new Escort Log for Pickard Hall's restricted areas.

   Response: See Attachment 2 – "Outline of Training for RSIP-A-10-F1 Escort Log for Pickard Hall Restricted Areas Rooms 12, 13, 15, and Attic".

4. Mr. LaFranzo requested that MU provide a reason for why there were 22 individuals listed as being issued dosimetry and being initially trained on December 14, 2009 and then why by his accounting only 20 had been trained on the new procedure.

   Response:

   Since the initial training was provided to 22 individuals on December 14 & 15, 2009, two of the individuals left the university before the training on the new procedure was offered in August 2011. Since we continue to provide training, we have included the most recent training matrix which reflects our Introduction to Radiation Safety course and the Escort Log training through September 2011 of PHF&S. Please note that several individuals who were provided with the Introduction to Radiation course left the university before the Escort Log training was offered. The Director of the Museum and the Chair of Art History Department provide us with names of new staff and students and notify us of departures from the university.

Attachment 1

ENGELHARDT & ASSOCIATES, INC.
RADIATION CONSULTANTS

17 October, 2011

Mr. Michael LaFranzo
Senior Health Physicist
United States Nuclear Regulatory Commission
Region III
Materials control, ISFSI, and Decommissioning Branch
Division of Nuclear Materials and Safety
2443 Warrenville Road, Ste., 210
Lisle, IL 60532-4352

Dear Mr. Lafranzo

I am responding to part of a document sent to the University of Missouri-Columbia, dated 15 August, 2011, and titled Request for Information, Tracking Number 11-A-0054. Item (b) on the first page of this document requests "that the organization or individual conducting the evaluation was independent of the concern and was proficient in the related functional area."

I, Susan J. Engelhardt, President, CEO, Engelhardt & Associates, Inc., a radiation safety consulting firm located in Milwaukee, WI and College Station, TX, have worked as the radiation safety consultant for the University of Missouri-Columbia since 1994. In this role, I review documents relating to the radiation safety program and correspondence with regulatory agencies. I also assist in development of procedures and program strategies to assure long term compliance with the Nuclear Regulatory Commission's rules and regulations.

With the Ra-226 project that is currently on-going on campus, I review the documents provided by Chase Environmental on their clean-up activities and plans for future decommissioning activities. Mr. Jack Crawford, RSO, and myself review data collected and procedures put into place at Pickard Hall to assure safety of the public as well as compliance with regulations. On my last visit, on 5-6 October, 2011, I, again, toured the Pickard Hall facility to review all the actions that have been undertaken in that building.

I provide independent review of the decommissioning activities and radiation safety plans for the Pickard Hall project and make recommendations to the Vice Chancellor, Administrative Services, Ms. Jacquelyn K. Jones, as well as the Director of Environmental Health and Safety, Ms. Maureen Kotlas, and the Radiation Safety Officer,

ENGELHARDT & ASSOCIATES, INC.
RADIATION CONSULTANTS

Mr. Jack Crawford. I also work with the radiation safety staff to determine if staff and management of the radiation safety program are in agreement.

My qualifications for this task are as follows:

EMPLOYMENT AT NUCLEAR FUEL SERVICES, ERWIN, TN: I worked as a Health Physicist at NFS, Erwin. One of my duties was to work with the environmental group to decommission a U-233/234 building and a Pu-239 purification facility. These were large scale projects that involved virtual teardown of the U-233/234 facility and containment within the Pu-239 facility. In addition, I worked with the group to upgrade stack sampling strategies and measurement of U-235 within the stack gases. This also included selection of scrubber systems appropriate to trap U-235.Therefore, I have had extensive experience in dealing with the U decay chain.

EMPLOYMENT AT UNIVERSITY OF WISCONSIN-MADISON: As the RSO, I participated in and directed the clean-up of a large Ra-226 spill in an office building in Madison WI. This was a total remediation in parts of this building, removal of the Ra-226 to campus, packaging the Ra-226 for shipment and disposal of it. (Bear in mind that the NRC did not have jurisdiction over Ra-226 at that time, so input from NRC was not available).

As part of my ongoing consulting activities, I have stayed current with all decommissioning strategies, air sampling, and decontamination strategies.

If you wish to speak with me further, please feel free to call me at 608-213-0113.

Sincerely,

Susan J. Engelhardt
President, CEO

cc Jacquelyn K. Jones, Vice Chancellor, Administrative Services
Maureen Kotlas, Director, Environmental Health and Safety
Jack Crawford, Radiation Safety Officer

Crawford, Jack

From:	sengelhardt@wi.rr.com
Sent:	Tuesday, October 18, 2011 6:15 AM
To:	Crawford, Jack
Cc:	Kotlas, Maureen
Subject:	Letter to Mike LaFranzo of NRC; consultant qualifications and review of the Ra-226 project
Attachments:	lettertomikel.docx
Importance:	High

Dear Jack and Maureen:

Attached, on my letterhead, is the letter to NRC regarding my review of the Ra-226 project at the University of Missouri-Columbia. Please contact me if you need further assistance. Thanks.

Sue Engelhardt
President, CEO
Engelhardt & Associates, Inc.
Radiation Consultants

Attachment 2 – Outline of Training for RSIP-A-10-F1 Escort Log for Pickard Hall Restricted Areas Rooms 12, 13, 15, and Attic

I. Introduction

II. Rules for Escort

III. Elements of the Escort Log

A. The Log must be filled out accurately and completely for each escort.

B. Each column shall be completed as described below:

1. Date: Enter the current date of entry.

2. Time In: Enter the current time of entry.

3. Time Out: Enter the accurate time of exit.

4. Name: Print clearly the first name or first initial and full last name of the person to be escorted. (e.g. "D. Johnson").

5. Escort: Print clearly the first name or first initial and full last name of the person providing escort. (e.g. "D. Johnson")

IV. Presentation of New Log

A. Discussion of physical location of log

B. Pickup and collection of log by RS

C. Review by RS during monthly inspection by RS

V. Review and Questions

Attachment 3 – Pickard Hall Faculty and Staff Training Matrix

No.	Name	Training Sessions: Introduction to Radiation Safety	Training Sessions: Escort Log Form Use
1		12.14.09	08.04.11 / 08.19.11
2		12.15.09	08.19.11 - 09.02.11
3		12.14.09	08.04.11 / 08.19.11 - 09.02.11
4		12.15.09 / 01.27.10	08.19.11 - 09.02.11
5		08.22.11	08.22.11
6		12.15.11	08.09.11
7		01.27.10	08.19.11 - 09.02.11
8		09.08.11	09.08.11
9		12.14.09	08.19.11
10		12.14.11	08.19.11 - 09.02.11
11		12.15.11	08.19.11 - 09.02.11
12		12.14.09	08.19.11 - 09.02.11
13		01.27.10	08.19.11 - 09.02.11
14		09.08.11	09.08.11
15		08.23.11	08.23.11
16		12.14.09	08.19.11
17		08.02.11	08.19.11 - 09.02.11
18		02.18.11	08.19.11 - 09.02.11
19		12.14.09	08.04.11 / 08.19.11
20	(b)(7)(C)	12.14.09	08.19.11
21		09.25.11	09.25.11
22		07.05.11	08.19.11 - 09.02.11
23		12.14.09	08.19.11 - 09.02.11
24		12.14.09	08.19.11 - 09.02.11
25		12.15.09	08.19.11 - 09.02.11
26		03.15.11	08.19.11 - 09.02.11
27		09.08.11	09.08.11
28		12.14.09	08.04.11 / 08.19.11
29		09.08.11	09.08.11
30		03.15.11	Note 1.
31		12.14.09	Left MU before training
32		07.15.11	Left MU before training
33		01.22.10	Left MU before training
34		12.15.09	Left MU before training
35		02.15.11	Left MU before training
36		12.14.09	Left MU before training
37		01.27.10	Left MU before training
38		01.26.10	Left MU before training
39		08.17.11	Left MU before training

(b)(7)(C) was not trained on the entry log as he is the supervisor for who is the RW that needs access

Environmental Health and Safety
8 Research Park Development Building
Columbia MO 65211

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Mr. Michael LaFranzo
US NRC, Region III
Division of Nuclear Materials & Safety
2443 Warrenville Road, Ste 210
Lisle, IL 60532-4352

UNIVERSITY *of* MISSOURI
ENVIRONMENTAL HEALTH AND SAFETY

Ms. Christine Lipa
Chief Materials Control, ISFSI, and Decommissioning Branch
Division of Nuclear Materials and Safety
Region III
U.S. Nuclear Regulatory Commission
2443 Warrenville Road
Lisle, Illinois 60532

February 6, 2013

Re: University of Missouri's response to U.S. NRC letter dated November 6th, 2012 (ML12312A095) concerning Pickard Hall Alternate Decommissioning Schedule (Mail Control No. 574562)

Dear Ms. Lipa:

This refers to your letter dated November 6, 2012. Enclosed are our responses to the requests for additional information in regards to Pickard Hall Alternate Decommissioning Schedule. There were several RAI's we were able to provide responses at this time. However, as was discussed with Mr. Lafranzo on January 14, there are several other RAI's that we are requesting an extension for responding too as MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization.

We believe our requests for these extensions are reasonable given that the extensions will enable us to provide more informed responses due to the opportunity to complete a more detailed characterization of Pickard Hall that will ultimately shorten the proposed timeframe of the original alternate schedule request and help us determine if we need to file a new request as part of a Federal Register Notice as was discussed with Mr. Lafranzo.

If you have any questions or concerns please contact me at (573)-882-0931 or crawfordw@missouri.edu.

Sincerely,

Jack Crawford
Radiation Safety Officer

Attachments
cc: J. Jones
S. Jurisson
M. Kotlas
S. Engelhardt
RSO File

RECEIVED APR 1 6 2013

8 Research Park Dev Bldg, Columbia, MO 65211 Phone: 573-882-7018 Fax: 573-882-7940 ehs.missouri.edu
Missouri's Flagship University

C/25

UNIVERSITY OF MISSOURI'S RESPONSE TO U.S. NRC LETTER DATED NOVEMBER 6TH, 2012 (ML12312A095) CONCERNING PICKARD HALL ALTERNATE DECOMMISSIONING SCHEDULE FEBRUARY 6TH 2013 (16 PAGES)

RAI-01a: The licensee should provide specific dates for the proposed Alternate Schedule.

> **Response:** MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.
>
> **Detail:** This relocation will facilitate additional characterization of Pickard Hall and allow MU to provide realistic dates for the proposed alternate schedule. MU hopes to move the PHF&S, the museum operations, and the artifacts to other locations sometime near the end of 2013 or early 2014. This presumes there are no unforeseen complications with work that will need to be completed in the new locations or in moving the artifacts. Once Pickard Hall is unoccupied and empty of contents, MU can better assess the radiological status of the building.
>
> If the NRC is unable to grant an extension until December 2, 2013, MU asks for approval to provide periodic updates on progress with requests for extensions for additional time as needed.
>
> The RAIs, proposed plans, associated dates and reasons for the dates were discussed with Mr. Mike Lafranzo per phone conference call on September 27, 2012.

RAI-01 b: The licensee should provide a description of how the University will begin planning for a proposed schedule for the movement of artifacts located within the museum that would allow for the start of decommissioning.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.
>
> **Detail:** See response and details provided to RAI-01a.

RAI-01 c: The licensee should demonstrate that conditions of Pickard Hall will not significantly deteriorate and potentially cause a radiological hazard during the proposed Alternate Schedule timeframe.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.
>
> **Detail:** MU will continue to perform monthly radiological surveillances of Pickard Hall during the time frame of this extension request. This will also include periodic monitoring of the building's physical condition by Campus Facilities (CF) staff and the Pickard Hall building coordinator throughout that period. Any condition that would require modification to the building would be coordinated between CF and Environmental Health and Safety (EHS) Radiation Safety (RS). Once the building is unoccupied and empty of contents, a more detailed assessment of Pickard Hall's physical condition can be performed to provide a more complete answer to this RAI.

RAI-01d: The licensee should discuss the current decommissioning cost estimate and the potential for increased decommissioning costs, if an Alternate Schedule is approved.

Response: A Decommissioning Funding Plan (DFP) dated May 2011, was submitted to NRC representative Ms. Katie Streit on June 11, 2011. Pickard Hall is specifically addressed in Appendix C, page C.16. The DFP has a conservative 25% contingency added to the calculated overall cost. The DFP is reviewed every 3 years and is tied to our licensing renewal. If during the review periods costs are projected to change significantly due to increased costs of fuel, increased waste disposal costs, or for other economic or financial reasons, MU will re-evaluate the DFP to determine if the current cost structure is still accurate or if adjustments are needed. A copy of the DFP is attached as Attachment 1 – MU's DFP, May 2011.

RAI-02a: The licensee should provide schematics for the ducts to demonstrate that removable contamination does not have a pathway to areas where members of the public or occupation workers are located.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: MU has been actively searching for schematics that would allow us to assess and respond to this RAI more completely. The oldest schematics we have are from 1892 and while they show some duct work and some airflow patterns, they do not specifically describe the ducts in question. The other schematics we have located are from a large remodeling project in 1974 that changed the original design to a completely new HVAC system. These schematics do not specifically address the old ductwork with the exception of one central duct on drawing A-2-1 was to be "enclosed existing shaft with existing bricks". See Attachment 2 – Various Schematics of Ductwork for Pickard 1892 (2 drawings), and 1974 (5 drawings).

The only known and visible access to the original ductwork is in the restricted area of the attic. MU does not permit access to those ducts without permission and involvement by EHS Radiation Safety Health Physicists. No construction or demolition activities will be performed that might impact these ducts without further assessment by MU or a qualified consultant in coordination with the NRC. Current radiological surveys of accessible areas

RAI-02b: The licensee should develop, implement and maintain procedures to ensure members of the public or occupation workers do not gain unauthorized access to the ducts within the walls without authorization from the licensee's radiation safety program.

Response: MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs. MU recognizes that PHF&S, Campus Facilities (CF) personnel and other applicable staff will need to be trained on the new procedures once they are approved.

RAI-02c: The licensee should provide documentation to show that the contamination will not migrate from under the basement floor to areas where members of the public or occupation workers could be exposed to radioactive material over the timeframe of the Alternate Schedule.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

MU continues to conduct regular surveys of the basement areas to evaluate the condition of the contamination and verify that the contamination remains fixed.

Detail: MU requests an extension to answer this RAI for the reasons stated in RAI-01a. With the building unoccupied and empty, the sampling of the basement floor areas will be more complete and reliable and will prevent damage of the artifacts from temporary shifting and relocation during the sampling.

RAI-02d: The licensee should demonstrate whether contamination under the soil has the potential to impact the ground water, potable or not, in the area of Pickard Hall.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-02e: The licensee should develop, implement and maintain procedures to ensure members of the public or occupation workers do not gain access to the contamination under the basement floor without authorization from the licensee's radiation safety program.

Response: MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: As stated in the response to RAI-02b, EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

MU has interim controls in place to control access to the impacted areas of Pickard Hall including training of the PHF&S on these expectations. MU has also established additional administrative controls by working with CF to place work restrictions for Pickard Hall into CF's maintenance work order software system "Maximo" so when CF prints out work orders for Pickard Hall they get a notification message. That message is "CONTACT EHS RADIATION SAFETY

AT 882-5024 BEFORE WORKING ON ANY BLDG COMPONENTS TO INCLUDE CEILINGS, WALLS, FLOORS, DRAINS, HVAC, FURNITURE MOVING, ETC." The length of this message has been developed to accommodate the character limit that is available in the system.

RAI-02f: The licensee should provide a detailed description of the workers in Pickard Hall who will be considered occupational radiation workers and what training those individuals are to have received as occupational workers. This includes current and future workers within Pickard Hall.

Response: As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S) and museum operations. This will eventually result in restricted access to the building by EHS RS to staff who are either fully trained as radiation workers or are under the supervision of EHS RS. Please see Attachment 3a – "Radiation Worker Training Status report for Pickard Hall 55555, for the list of PHF&S who have already been trained as Radiation Workers using our current RS program and Attachment 3b – Radiation Safety for new Radiation Workers at MU" which is the RW training outline tailored for them with emphasis on Pickard Halls special conditions. As new graduate students or museum staff are hired and begins work in Pickard Hall they will be trained by EHS RS. Radiation worker training is conducted as part of the training program managed under the conditions of our broad scope license.

RAI-02g: The licensee should provide a description of what is meant by "invasive activities" and how the licensee plans to control them in accordance with 10 CFR 30.36.

Response: MU uses the term "invasive activities" to mean an activity that may disturb building surfaces such as drilling, scraping, etc. As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

RAI-02h: The licensee should provide a description of how and how often the licensee will inspect the integrity of the encapsulant.

Response: MU uses an administrative authorization, identified internally as #55555, to conduct monthly surveillances. During those surveillances we inspect the physical condition of the encapsulant in Pickard Hall during our routine surveillances/monitoring activities and perform surveys for fixed and removable contamination in all areas of the building.

RAI-02i: The licensee should provide a description of what actions the licensee will take if the encapsulant is determined to be compromised.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" to address this and several other RAIs.

The SOP will include the process for controlling areas where encapsulant has failed. It will also include the process for: 1) re-applying encapsulate in cases where decontamination can be accomplished by nonaggressive means; and 2) in cases where decontamination cannot be accomplished but the area can be controlled and managed for the re-application of a secondary encapsulant.

RAI-02j: The licensee should provide a description of the locations and periodicity of the routine surveillance program that will be used for Pickard Hall.

Response: Please see Attachment 4 – Pickard Hall 55555 January 2013 inspection/survey report. This report has several maps of the areas of Pickard Hall that we physically survey for radiation levels and removable contamination. This surveillance includes the performance of radiation level surveys at the microRem/hr level as well as ~40 removable contamination smear checks which are counted on a sensitive alpha, beta proportional combination NAI gamma counter with triggers for investigation at 200 cpm/100 cm2 for removable beta/gamma and 20 cpm/100 cm2 for removable alpha. MU alternates the locations surveyed by performing a survey of the basement level in one month and a survey of the first and second floors in the alternate month.

RAI-02k: The licensee should provide the type of instruments and capabilities of each instrument that will be used to monitor the building.

Response: MU is using a Ludlum 14C survey meter with a GM pancake 44-9 probe for fixed contamination level readings in CPM, and a Ludlum Model 192 MicroRem meter or similar instrument (Model 9DP) for the ambient radiation levels in uR/hr. The calibration sheets for the most recently used instruments are attached. See Attachment 5 – "Calibrations sheets for most recent used Ludlum's used at Pickard".

RAI-02l: The licensee should provide a description of why the listing of Pickard Hall on the National Register for Historic Buildings affects conduct of decommissioning operations and how this effect will be changed if the Alternate Schedule is granted or denied.

Response: The geographical area where Pickard Hall sits is listed on the National Register of Historic Places as the "Francis Quadrangle Historic District". Pickard Hall itself, however, is not specifically registered as a national historic location. The statement that Pickard Hall itself was listed as a national historic building was an error and we will remove it from future correspondence.

RAI-02m: The licensee should describe how the conduct of decommissioning operations would affect these activities which include, but are not limited to, operation of the museum; undergraduate, graduate, and other instructional programs; current and future museum contracts; and museum artifacts both in the basement and the upper floors storage and viewing areas. Additionally, the licensee should provide an estimated timeline for the length of disruption during decommissioning activities for each area.

Response: Please refer to the response to RAI-01a. MU anticipates that the relocation of building occupants and contents will progress without unforeseen delays and should be able to provide an update on how operations may be impacted and what a schedule for decommissioning activities may look like by December 2, 2013.

RAI-02n: The licensee should provide legible copy of Attachment 1.

Response: Please see Attachment 6 – Original Attachment 1 - Pickard Hall Radon Monitoring Results.

RAI-03a: The licensee should provide documentation that 400 ft2 did not collect a sufficient amount of dust so that no correction was necessary for alpha shielding from dust loading.

> **Response**: MU contracted Chase Environmental Group Inc. (Chase) to perform these surveys. According to Chase, the large area wipes (LAW) are conducted as a qualitative measurement. Since errors associated with LAWs are large, accurate quantification in conventional units is not feasible. The area of coverage was not accurately measured for each wipe, so results are qualitatively reported as activity per wipe. The 400 ft^2 area referred to in the report is an estimate of the area wiped for the LAW covering the least area.
>
> LAWs are a simple method to provide qualitative removable activity data over large areas – more than 3,000 disc smears would be required to cover an area of 400 ft^2. LAWs are generally more sensitive than disc smears because small amounts of removable activity that may be present over large areas are concentrated on the oil impregnated cloth. LAW results were used as inputs for evaluation of the need for further investigation of areas using disc smears.
>
> Beta measurements that are less impacted by dust loading were also performed on LAWs.
>
> In summary, the LAW used by the consultant was a qualitative measure to indicate what level of further evaluation would be required.

RAI-03b: The licensee should provide documentation regarding efficiency corrections for alpha shielding from dust loading, if applicable.

> **Response**: MU contracted Chase to perform the surveys referenced in this RAI. According to Chase no dust loading corrections are made for LAWs as described above.

RAI-03c: The licensee should provide information that clarifies the statements in Section 9.2.2 in relationship to Appendix F and Appendix G.

> **Response**: MU contracted Chase to perform these surveys. According to Chase, the statement regarding all measurements being less than twice background was in reference to outdoor GPS-based gamma scans only. A new paragraph should have been started with the word "subsequently".

RAI-03d: The licensee should provide explanation of how the gamma scans noted in Appendix F and Appendix G relate to dose rates and potential spread of contamination for those individuals who have access to those areas.

Response: MU contracted Chase to perform these surveys. According to Chase, the Gamma scans were used to identify areas with elevated surface exposure rates indicating that residual radioactivity was present. Due to differences in building structural materials, geometry, and other factors, variability is normal. At indoor locations with elevated exposure rates above the normally expected variation, external dose rate measurements were performed. Locations and results of external dose rate measurements are presented in Appendix J and K. Dose rates are compared to annual external doses and occupancy periods at each location in Appendix K. Assessment of the potential for spread of contamination and internal exposures is based on surface contamination measurements.

MU plans to further characterize normally inaccessible areas in coordination with the moving of PHF&S, museum operations, and the artifacts permit. In the meantime MU is controlling exposures by limiting access to these areas and monitoring personnel for external exposures.

RAI-03e: The licensee should provide documented training and/or survey procedures to ensure that scanning techniques could achieve the scanning rates for the Ludlum Model 43-68.

Response: MU contracted Chase to perform these surveys. According to Chase, as part of the initial project training session, all survey personnel completed practical training on survey techniques, including scan rates. Scan rate training consisted of placing a strip of tape approximately six feet long on the floor marked at every one-second interval (i.e., every 5 inches for a scan rate of 5 inches per second). The survey technician then performed timed scans to practice scanning at the desired rate. Survey technicians were assigned only one type of scan to avoid variable scan rates (i.e., one technician performed all the alpha scans with a 43-37 probe and another technician performed all the beta scans with a different 43-37 probe).

When the scan rate becomes less than about ½"/sec, it is increasingly difficult to attain a steady scan rate. Therefore, at scan rates less of ½"/sec or less, scanning is performed by holding the probe at a fixed location for the desired residence interval. For example, the 43-68 detector width is 8.8 cm (3.5 in), so a scan rate of 0.2 in/sec equates to a residence interval of 17.3 seconds, therefore the surveyor would hold the detector in a fixed position and listen for an audible increase in the count rate for a period of 18 seconds before moving to the next contiguous location.

The 43-68 probe was only used to perform concrete surface measurements in conjunction with concrete scarification at locations where vinyl tile had been removed (six locations with an area of $1ft^2$ each).

RAI-03f: The licensee should provide procedures or other documentation used to convert cpm (the readout for a Ludlum 44-10) to pCi/g for Ra-226, Th232 and Unat.

> **Response:** MU contracted Chase Environmental to perform these surveys. Since MU did not perform these surveys, we did not conduct training on the survey procedure.
>
> According to Chase, the correlation of cpm to pCi/g requires laboratory analysis of soil samples or dose modeling. Modeling heavily depends on the geometry of the source term that cannot be accurately determined within the limitations of this characterization effort. Footnote 8 in the report clarifies that the referenced MDAs are from NUREG 1507 and are specific to the geometry assumptions and survey parameters described in NUREG 1507. Because the source term geometry could not be accurately determined, no attempt was made to determine a correlation between activity concentrations and surface exposure rates.
>
> MU plans to conduct further surface and subsurface characterization that will include laboratory analysis of solid samples to more accurately determine activity concentrations.

RAI-03g: The licensee should provide Chain of Custody Procedure.

> **Response:** The chain of custody procedure used by Chase is attached. Please see Attachment 7 – Chase Environmental Group, Inc - QAP 8.2 Chain-of-Custody Procedure.

RAI-03h: The licensee should develop, implement and maintain procedures on how the licensee will ensure the proper control and encapsulation of those and any other areas where radioactive materials are located. The procedures shall include appropriate encapsulation and control verification over time and actions to be taken if encapsulation and/or control have been compromised. Contamination areas identified both inside and outside of the building shall be considered.

> **Response:** As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.
>
> **Detail:** EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-03i: The licensee should develop, implement and maintain training procedures for any and all groups of individuals who have access to any area where residual radioactivity exists that have the ability to compromise the encapsulation and/or control of areas. Contamination areas identified both inside and outside of the building shall be considered.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

The final SOP will address the process to restrict access to areas of known contamination both inside and outside of Pickard Hall. Note that all areas of known contamination are already restricted as per other administrative controls and special conditions in the administrative authorization, identified internally as #55555. Additionally, postings indicate that no one is to enter or disturb any potentially contaminated surfaces without first contacting EHS Radiation Safety (RS). MU Campus Facilities (CF), the museum director, and Pickard Halls' building coordinator are aware of these restrictions and help to maintain the restricted access to those locations.

RAI-03j: The licensee should develop, implement and maintain procedures to limit the intrusion of water into areas where residual radioactivity exists.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

Different types of construction methods have been used in several renovations of Pickard Hall over the years that have reduced the likelihood of water intrusion into the building. MU cannot say with absolute certainly that a building of this age is completely protected against water intrusion. The SOP mentioned above will address in more detail some of the steps that have been taken over the years and the actions we plan to take should there be an intrusion of water.

RAI-03k: The licensee should develop, implement and maintain procedures regarding contingency plans of water intrusion into areas where residual radioactivity exists. These procedures shall address radiological analysis of water, contamination control and disposal of potentially contaminated water.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions" that will address this issue.

RAI-03l: The licensee should develop, implement and maintain procedures to ensure unauthorized individuals do not gain access to the Feeder or Steam Tunnels.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Details: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

The final SOP will address these procedures. Generally, all grated and door entrances to the steam tunnel are securely locked and the keys are secured by Campus Facilities (CF) Energy Management (EM). Additionally, the steam tunnels are equipped with security devices, monitored remotely by CF EM, that sense and warn of the presence of an unauthorized person. If an intrusion would occur CF EM would alert the MU Police Department (MUPD) who would respond to the location of the nearest sensor and take appropriate action. The SOP will address additional coordination with EHS should unauthorized individuals enter the steam tunnel near the areas of Pickard Hall.

RAI-03m: The licensee should provide schematics of known and potentially contaminated drain and sewer lines.

Response: A schematic with notes has been provided with this response. Please see Attachment 8 – Sanitary and Storm Sewer line GIS Map for servicing Pickard Hall.

MU plans to perform additional assessments to determine active pipes and flow paths associated with these sanitary and storm sewer pipes. As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

Detail: MU is aware of only one sanitary sewer (SS) line (shown in yellow on the map) that originates from inside Pickard Hall and known to be contaminated. This is based on earlier radiological surveys that identified elevated readings near the drain. This drain and a small run of piping was filled in with concrete in a construction project in the 1990's and rendered dormant as part of an earlier water intrusion mitigation activity. The green lines on the attached map are storm sewer runoff lines.

It is our understanding that originally the sanitary sewer line in room 27 started from a drain in that room near the north wall and ran north under the building to tie into an east to west run of main sanitary sewer line transit. That east to west run of piping ties into other sanitary sewer lines in Francis Quadrangle and continues on to the city of Columbia's water processing plant.

The original northern sanitary sewer lines that ran from Pickard Hall to the first maintenance man hole in the Francis Quadrangle were dug up and replaced in a large construction project in the 1990's that replaced nearly all of the old sewer piping around Pickard Hall including most of the storm sewer lines.

RAI-03n: The licensee should develop, implement and maintain procedures to ensure unauthorized individuals do not gain access to known contaminated drain and sewer lines.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-03o: The licensee should develop, implement and maintain procedures to periodically verify contamination from the steam tunnel, drains and sewer lines has not spread beyond the known contamination confines.

Response: As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.

Detail: EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

RAI-04a: The licensee should develop, implement and maintain procedures to address fire suppression systems in those areas where residual contamination exists.

> **Response:** Pickard Hall is not equipped with fire sprinklers. However, the building is equipped with fire detection and fire extinguishers and should a fire occur we would coordinate the response with the Columbia Fire Department. The Columbia Fire Department has several stations and response to all fires on campus.
>
> **Detail:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-04b: The licensee should provide analysis of potential onsite and off-site radiological contamination and dose to members of the public if a fire were to consume areas where residual contamination exists.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-04c: The licensee should develop, implement and maintain training procedures for any and all responders to an emergency within the building that could involve the release of radiological contamination. (e.g. fire and police departments)

> **Response:** We request the same extension to this RAI-04b above for the same reasons.

RAI-04d: The licensee should provide analysis of potential onsite and offsite radiological contamination and dose to members of the public if a natural disaster were to occur (tornado, flood, earthquake, etc.) and cause damage to the Pickard Hall in areas where residual contamination exists.

> **Response:** As stated in the response to RAI-01a, MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a more complete response to this RAI. We believe this is a reasonable request

since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-05a: The licensee should provide radiological evaluations of all areas above concerning fixed and removable contamination.

> **Response:** MU is actively pursuing the relocation of Pickard Hall Faculty and Staff (PHF&S), the museum operations, and the artifacts to facilitate additional characterization. MU therefore requests an extension until December 2, 2013 in order to provide a complete response to this RAI. We believe this is a reasonable request since this will enable us to provide a thoroughly investigated plan that will ultimately shorten the proposed timeframe of the original alternate schedule request.

RAI-05b: The licensee should develop, implement and maintain procedures for movement of any and all furniture, mechanical equipment or any other item to address and/or identify any fixed or removable contamination that may have resulted, either directly or indirectly, from such movement.

> **Response:** As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.
>
> **Detail:** EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".
>
> CF personnel who service Pickard Hall are aware that all activities that may impact existing conditions must be coordinated with EHS RS. These restrictions are included in training and are listed in the administrative authorization, identified internally as #55555. The work restrictions for Pickard Hall have been inserted into the MU CF maintenance work order software system "Maximo". That message is "CONTACT EHS RADIATION SAFETY AT 882-5024 BEFORE WORKING ON ANY BLDG COMPONENTS TO INCLUDE CEILINGS, WALLS, FLOORS, DRAINS, HVAC, FURNITURE MOVING, ETC." Note that this message has been developed to accommodate the character limit that is available in the system.

RAI-05c: The licensee should develop, implement and maintain procedures on how to control any fixed or removable contamination, as identified from actions concerning RAI-05b, to ensure members of the general public and occupational workers are not unnecessarily exposed to radiation and/or radioactive material.

> **Response:** As stated in the response to RAI-02b, MU requests an extension of 90 days until May 10, 2013 to submit a procedure to address this and several other RAIs.
>
> **Detail:** EHS RS is currently developing a Standard Operating Procedure (SOP) DRAFT number RSIP-DC-01.00 "Pickard Hall Radiological Status and Restrictions".

-END-

List of Attachments

Attachment 1 – MU's DFP, May 2011 (154 pages)

Attachment 2 – Various Schematics of Ductwork for Pickard Hall (7 pages)

Attachment 3a – Radiation Worker Training Status report for Pickard Hall 55555 (1 page)

Attachment 3b – Radiation Safety for new Radiation Workers at MU (25 pages)

Attachment 4 – Pickard Hall 55555 Jan 2013 inspection/survey report (7 pages)

Attachment 5 – Calibrations sheets for most recent used Ludlum's used at Pickard Hall (4 pages)

Attachment 6 – Original Attachment 1 - Pickard Hall Radon Monitoring Results (3 pages)

Attachment 7 – Chase Environmental Group, Inc - QAP 8.2 Chain-of-Custody Procedure (3 pages)

Attachment 8 – Sanitary and Storm Sewer line GIS Map for servicing Pickard (1 page)

Attachment 1 – MU's DFP, May 2011 (154 pages)

UNIVERSITY OF MISSOURI - COLUMBIA

DECOMMISSIONING FUNDING PLAN

IN SUPPORT OF
NRC LICENSE NO. 24-00513-32

May, 2011

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830
865-481-8801

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 Introduction

The University of Missouri - Columbia (MU) is required by 10 CFR 30.35(a) to have a decommissioning funding plan (DFP) for their Columbia, MO facilities operated under NRC Broad Scope Type A license number 24-00513-32. MU contracted Chase Environmental Group, Inc. (Chase) to perform an independent decommissioning cost estimate and develop this DFP. Chase developed an order of magnitude cost estimate based on review of facility design features, current/historical processes and current radiological conditions. This estimate is also based upon physical inspection of facilities, interviews with MU personnel and Chase's experience in performing and estimating decommissioning of similar facilities. As a major provider of facility decommissioning services and as an independent radioactive waste broker, Chase possesses highly reliable information on available decommissioning and waste processing options, and their respective costs - this insight is incorporated into the decommissioning cost estimate.

This DFP provides the four components required by NRC's financial assurance regulations for licensees who use a DFP, as described in Appendix A.3.3, Submitting the Required Documentation, of NUREG-1757, Volume 3, *"Consolidated NMSS Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness:"*

- A site-specific cost estimate for decommissioning (see Section 2).
- A description of the means that will be used to adjust the site-specific cost estimate and associated funding levels periodically over the life of the facility (see Section 3).
- A certification by the licensee that financial assurance for decommissioning has been provided in the amount of the decommissioning cost estimate (see Section 4).
- An originally signed duplicate of the financial instrument that provides financial assurance for decommissioning (see Section 4).

2.0 Cost Estimate

The cost estimate is designed to meet the nine evaluation criteria contained in NUREG 1757 listed below:

1. The cost estimate meets the applicable regulatory requirements in 10 CFR.
2. The cost estimate is based on documented and reasonable assumptions.
3. The unit cost factors used in the cost estimate are reasonable and consistent with NRC cost estimation reference documents.
4. The cost estimate includes costs for labor, equipment and supplies, overhead and contractor profit, sampling and laboratory analysis, and miscellaneous expenses (e.g., license fees, insurance, and taxes).
5. The cost estimate applies a contingency factor of at least 25 percent to the sum of all estimated costs.

6. The cost estimate does not take credit for (a) any salvage value that might be realized from the sale of potential assets during or after decommissioning or (b) reduced taxes that might result from payment of decommissioning costs or site control and maintenance costs.
7. The means identified in the DFP for adjusting the cost estimate and associated funding level over the life of the facility and any storage or surveillance period is adequate.
8. The cost estimate reflects decommissioning under appropriate facility conditions (for a DFP, routine facility conditions should be assumed).
9. The cost estimate includes costs for all major decommissioning and site control and maintenance activities specified in Section A.3, including (a) planning and preparation, (b) decontamination and/or dismantling of facility components, (c) packaging, shipment, and disposal of radioactive wastes, (d) a final radiation survey, (e) restoration of contaminated areas on facility grounds (if necessary), and (f) site stabilization and long-term surveillance (if necessary).

Cost estimates were developed using the guidance contained in NUREG-1757 Volume 3, Appendix A.3 using conservative middle-of-the-road assumptions regarding the likely extent and duration of remediation activities. Remediation is assumed to proceed to unrestricted levels with an endpoint criterion of 25 mrem/yr based on the building occupancy scenario of NUREG/CR-5512 for building structures or the residential scenario of NUREG/CR-5512 for outdoor areas. The series of cost estimating tables provided in NUREG-1757 were used to prepare the decommissioning cost estimate. Regulatory aspects and staffing requirements are much different for the various types of facilities operated under the license. For clarity, separate sets of cost tables were developed for three broad categories of facilities and then summed to obtain the overall level of financial assurance required:

- Group 2 facilities (research and medical labs, sealed source areas, radioactive waste storage areas, and incinerator facilities)
- Facilities with historical usage of alpha-emitting radionuclides
- Outdoor facilities

The assumptions and conclusions presented in this cost estimate represent Chase's best professional judgment based upon the information available. In performing this cost estimate, Chase relied upon information obtained from facility personnel and publicly available information. MU's use of radioactive materials spans more than a century. As such, there is uncertainty regarding the history in some areas. Uncertainty is offset in the cost estimate by using conservative assumptions. MU is continuing assessments of residual radioactivity in areas of historical usage to provide a more accurate basis for estimating decommissioning costs. Several buildings at Sinclair Farm have been surveyed for release for demolition and the Schweitzer Hall attic is currently being characterized to plan replacement of the slate roof. Where limited information is available regarding radiological conditions, conservative assumptions were used to estimate decommissioning costs. As facilities are more thoroughly characterized and areas released, MU will revise the cost estimate as appropriate. It is expected that as more information becomes available, the estimated cost to complete decommissioning will be reduced.

2.1 Facility Descriptions

Licensed activities are, or were, conducted within approximately 100 buildings and six separate outdoor areas at the MU campus. The license typically supports approximately 180 authorized users and approximately 850 trained radiation workers in six different categories of schools. Current authorized users by school are presented in Table 2-1.

Table 2-1 Number of Authorized Users by School

School	AUs
Agriculture, Food & Natural Resources	51
Arts and Sciences	20
Engineering	4
Veterinary Medicine	25
School of Medicine	57
Research and Other	15
No School	11
Total	**183**

Facilities include medical research, hospital, physics, chemistry, geology, waste, incinerator, farm, and disposal facilities. Facilities are sub-divided into five types based on unique characteristics specific to decommissioning:

- Research and Medical Laboratories
- Areas with Historical Usage of Alpha-Emitting Nuclides
- Sealed Source Use and Storage Areas
- Waste Facilities
- Outdoor Facilities

Detailed descriptions of each facility type are provided below.

2.1.1 Research and Medical Laboratories

The majority of work involving unsealed licensed material is in research and medical laboratories. There are approximately 400 laboratories using radioactive materials at any given time and usage is declining. The types of facilities included in the research and medical laboratory category are listed in Table 2-2.

Table 2-2 Research and Medical Laboratory Summary

Facility	Description	Radionuclides
Medical Science Research	Research for diagnostic and therapeutic medicine	Typically high energy beta and gamma emitting nuclides: all are either short-lived (PET nuclides) or sealed sources with no history of leakage
Plant Science	Research using plants for uptake studies	Typically C-14
Life Science Research	Research involving cells, DNA, enzymatic assays, blots, etc.	Typically C-14, H-3, I-125, P-32, P-33, S-35, and short lived gamma emitters as microspheres
Animal Science Research	Research involving animal metabolism, uptake, reproduction, etc.	
Animal Science and Physiology	Research involving animals for human use research applications	
Physics and Chemistry	Physics and experimental chemistry research	Typically long lived beta-gamma emitters or sealed sources

Typical laboratory facilities have ventilated laboratory hoods for control of radioactive and other hazardous vapors and dusts when necessary. Hoods are maintained at negative pressure with face velocities appropriate for each hood design. Tempered outside air is supplied from building heating, ventilation and air conditioning (HVAC) systems. Laboratory air is exhausted through the fume hoods. Exhaust fans are typically located on roof surfaces or in penthouse mechanical rooms. Typical laboratories are fitted with stainless steel or composite material sinks. Wastewater drains connect to the city sanitary system without treatment or retention. All effluents meet the NRC concentration limits of 10 CFR 20, Appendix B. Casework with utilities are provided for bench top operations utilizing portable analytical equipment. A central vacuum system is typically available for each building, but in some cases, portable vacuum pumps are used. Figure 2-1 shows a generalized, typical research laboratory layout.

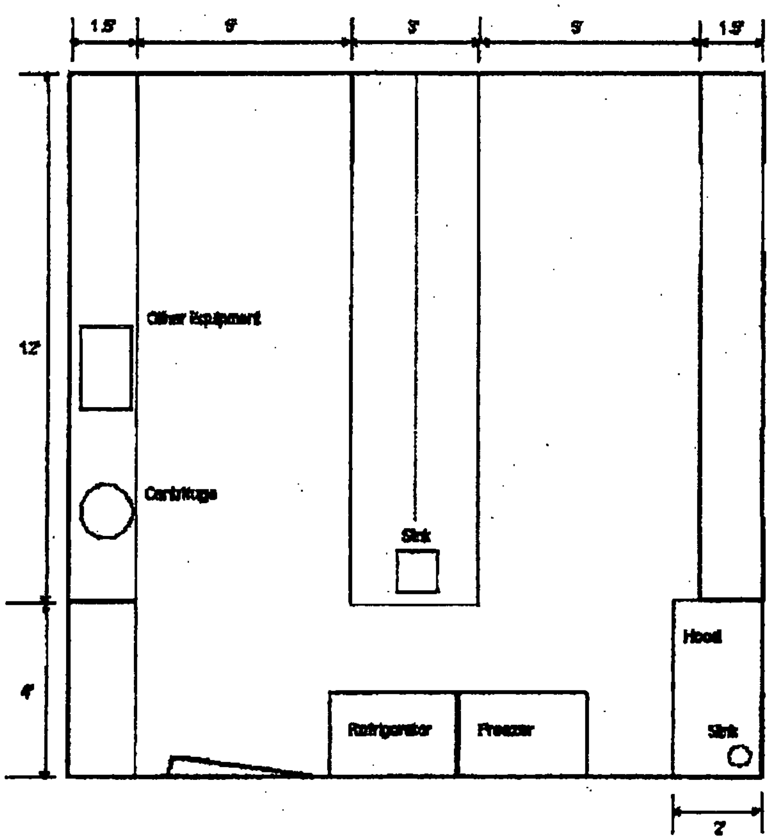


Figure 2-1 Typical Research Laboratory Layout

2.1.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Two buildings on campus had historical use of uranium, radium and thorium; Pickard Hall and Schweitzer Hall. Due to the restrictive screening values and the nature of decommissioning facilities with dispersible forms of alpha emitting nuclides, these areas are treated separately from other areas.[1]

[1] This category only includes usage from historical operations involving radium and thorium separation. Research labs located in Schweitzer Hall that use or used tracer nuclides for research are captured in the Research and Medical Laboratory category.

Pickard Hall

Built in 1894 as a Chemistry Building, Pickard Hall is currently being used as the Museum of Art and Archaeology, and houses the Department of Art History and Archaeology. The building, located at 405 S. Ninth in the St. Francis Quadrangle area of the MU campus, has a footprint of 8,400 square feet with approximately 24,600 gross square feet of floor area over three elevations (not including the attic). The museum is located on the first and second floors, and the basement is used for storage of museum artifacts. Additionally, faculty offices are located on the first floor and in the basement. The building is listed on the National Register of Historic Places.

The brick building sits on a stone and mortar foundation. Originally, the building had wooden floors throughout, including the basement. The current basement floor is poured concrete with tile and carpet coverings. It is suspected, but not known for certain, that the concrete floor is original to the building and that the wooden floors were installed on top of the concrete. Floors on the first and second elevations are primarily carpeted with stone/ceramic tiled foyers and restrooms. Interior walls are plaster and sheetrock.

In the early 1900s, a faculty researcher extracted and purified salts of radioactive elements from ores (extracted radium-226 from uranium ores), and conducted research involving Th-232 daughters in basement laboratories until the 1930's. From 1924-1951 Analytical Chemistry moved to the second floor of Schweitzer Hall, leaving organic and physical chemistry to occupy Pickard Hall until 1951, when physical chemistry moved to a new addition at Schlundt Hall. In 1972, remaining chemistry operations were moved from Pickard Hall, and the interior of the facility underwent a major renovation in 1974 to accommodate its current usage. This resulted in minor changes to the layout of the basement. Some windows on the basement and first floors, and all windows on the second floor have been covered on the inside to prevent ultraviolet damage to artifacts. The entire ventilation system has been upgraded since the cessation of use of radioactive materials; some original ventilation ducts remain, but are not in use. Original drains were terminated at floor level and grouted or re-used (subsequently, the sanitary sewer line from the building was removed and replaced with excavated soils re-used as fill). The Museum of Art and Archaeology moved to Pickard in 1976.

Schweitzer Hall

Schweitzer Hall is located on campus at 503 S. College Ave. Built in 1912, it is currently home to the Department of Biochemistry. The building has a footprint of 8,000 square feet, with approximately 24,000 gross square feet of floor area over three elevations, not including the attic. It is brick faced with a slate roof and has sheetrock interior walls.

In 1913, portions of the Chemistry Department moved to Schweitzer Hall from Pickard Hall and subsequently continued research involving separation of Ra-226 from uranium ores. In 1960, the building underwent extensive decontamination for Ra-226, including removal of drain pipes, and again in approximately 1979 to support renovation that included roof decontamination, chimney removal, and rearranging the layout of walls.

Subsequent verification surveys by MU staff did not reveal any residual radioactivity in laboratories or classrooms, but did identify residual radioactivity in the attic and on the roof.

The north end of the Schweitzer attic is known to have been used to solidify and package radioactive waste in the 1960's. The unfinished attic consists of: a solid, poured concrete floor; structural steel support beams added during remodeling for support of the roof structure; wooden rafters, columns and beams overlaid with diagonal wooden roof sheathing; numerous metal ventilation ducting runs; and a mixture of loose and rolled insulation. The finished portion of the attic consists of an added (not original to the building construction) 20' x 70' poured concrete pad, several electrical cabinets, ventilation exhaust fans, and walls and ceiling covered in sheetrock. The roof consists of slate shingles on sloped portions and a synthetic roofing material on the horizontal portion. Gutters are constructed of copper or stone. Brick chimneys penetrate the roof along with approximately 20 metal ventilation exhausts. There are also several old brick ducts in the attic floor that are thought to be terminated fume hood exhaust ducts.

MU is currently planning to replace Schweitzer Hall's roof surface and install a strobic fan exhaust system. Residual radioactivity exists or is expected to exist on accessible attic surfaces, inside brick ducts and chimneys, inside roof drains and on the top surface of the original slate roof. The Schweitzer Hall attic is in the process of being characterized to support planning for roof replacement.

2.1.3 Sealed Source Use and Storage Areas

The majority of radioactive material possessed by MU is present in a few areas where sealed sources of significant activity are used. These areas include the following sources:

- Instrument Calibration Source (0.58 Ci Cs-137)
- 10 CFR 35.400 Medical Sealed Sources (0.96 Ci, Cs-137), License Item D.
- Amersham X2016, 40666F, EON Corp 64-761 177 (~0.7 Ci, Cs-137), License Item O
- Amersham/Searle in a Type X-92 Capsule (0.193 Ci Am-241), License Item Y

2.1.4 Waste Facilities

The 10,000 ft^2 centralized radioactive waste facility is located at 1710 East Campus Loop, just south of Resource Recovery Center. The facility layout is presented in Figure 2-2. The facility is the consolidation center for disposal of all radioactive wastes and mixed wastes. Wastes are received, transferred for incineration, decayed, consolidated, or otherwise prepared for shipment to off-site disposal facilities. Liquid wastes meeting NRC sewer disposal requirements are discharged to the sanitary sewer system via a drain at the facility.

Wastes are shipped for off-site disposal via a waste broker approximately annually. Additionally, a small amount of legacy waste is stored in a 768 ft^2 storage building adjacent to the Research Park Development Building.

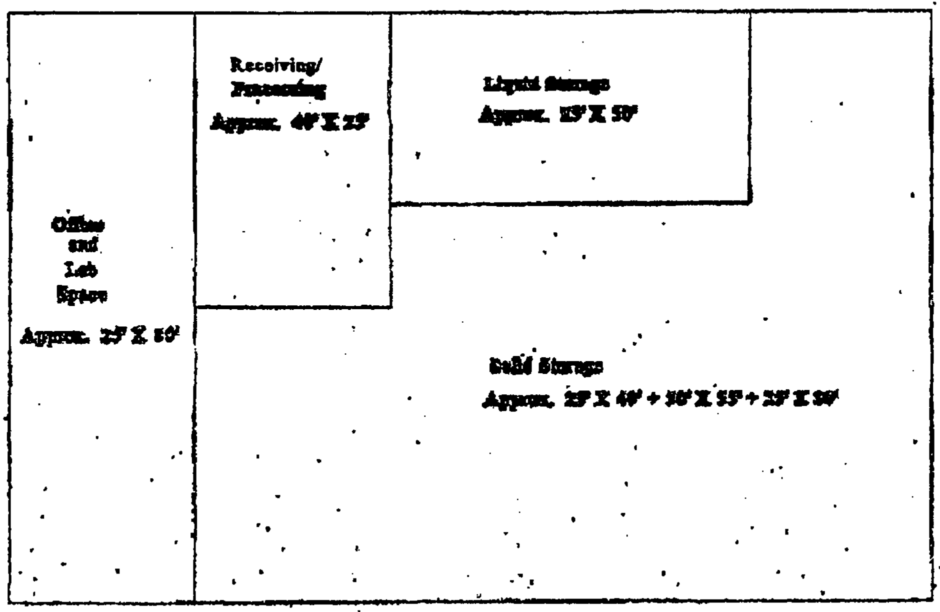


Figure 2-2 Centralized Low Level Radioactive Waste Facility Layout

There are two incineration facilities on campus. The Campus Incinerator, a 12' x 12' unit with two 6' diameter, 12' long chambers, is located at the EH&S Resource Recovery Center and is used for incineration of low level radioactive waste, mainly H-3, C-14, but also Cl-36, Ca-45 and other trace activities. The Veterinary Diagnostic Laboratory Incinerator, a 20' x 20' unit with two chambers, is located at the Veterinary Diagnostic Laboratory and was used for incineration of low level radioactive waste (mainly animal carcasses) containing low levels of H-3, C-14 and short lived beta-gamma emitting isotopes.

Small amounts of waste may be stored in laboratories for short periods of time prior to transfer to the radioactive waste facility. Also, liquid radioactive wastes meeting the effluent sewer disposal criteria may be disposed to the city sanitary system. Room GL-29 of the Main University Hospital Health Sciences Center is used for Decay-in Storage (DIS) of short-lived medical waste.

2.1.5 Outdoor Facilities

2.1.5.1 Sinclair Research Farm

The MU Sinclair Research Farm, located on 543 acres at South Sinclair Road approximately 4.5 miles southwest of the MU campus, was historically used for radioactive materials research, incineration, land disposal, and radioactive materials storage. There are about 25 of the original buildings remaining on site. Most of the remaining buildings were recently surveyed by MU staff with no elevated activity detected. An incineration facility was demolished such that only the concrete pad remains. The Missouri University Research Reactor (MURR) barn was historically used to store contaminated items from the reactor facility, and a small area of contaminated concrete was previously remediated in 2005. All buildings are assumed to meet release criteria without remediation. Trace Analytical operated a for-profit analytical lab at Sinclair and did not use dispersible forms of radioactivity, but historically had a leaking N-63 source.

Two lagoons of two units each are located on site. One lagoon has a potential for C-14 activity via buried piping from rinsing milk, urine, and feces from barn surfaces during C-14 studies. Cl-36 was authorized at the site, but never used. Fields surrounding the lagoons were occasionally sprayed with lagoon water. Lagoons are assumed to be constructed with a compacted clay liner and berm by excavating the native topsoil to the underlying clay and then excavating the clay to form the berms. A sediment layer in each lagoon is assumed to be up to six inches thick.

Phase 1 of the Sinclair Farm characterization is currently being performed. Five Barns and the Necropsy Lab Building have been surveyed for release and are awaiting demolition, pending data validation. Sediment samples were collected at the discharge points from building drains into the lagoon mentioned above and are currently being analyzed by an outside laboratory for C-14, H-3 and gamma spectroscopy.

From 1967 to 1981, a 0.9 acre disposal site was used at Sinclair Farm for disposal of wastes resulting from university research, principally medical research. LLRW consisted primarily of scintillation fluids containing toluene, xylene or dioxane with low levels of radioactivity (predominantly C-14 and H-3). Records indicate that 6,840 gallons of liquid waste with a total of 0.79 curies of activity were accepted and burned during the active disposal period at the site. Solid wastes consisted of paper, plastic, animal bedding and at least 90 large animal carcasses. There were 56 burials totaling 10,412 ft^3 of waste containing 4.5 curies of activity (roughly 53% of the allowable burial limit as then specified in 10 CFR 20.304) performed in trenches 12' deep, 2' to 4' wide, and 5' to 30' long. A minimum of 4' of cover was compacted over the waste after burial. The low level waste consists of mainly H-3 (85%) and C-14 (3.4%). Cows were slaughtered and buried on site and met the requirements of 10 CFR 20.2005, "Disposal of Specific Wastes" (0.05 µCi, or less, of H-3 or C-14 per gram of animal tissue, averaged over the weight of the entire animal). An incinerator facility was constructed and operated after closure of the burial site. The facility was subsequently dismantled and removed, leaving only a concrete pad.

2.1.5.2 Hinkson Creek Waste Site

The Hinkson Creek Waste Site is a 95' x 65' area up to 8' deep containing radioactive waste buried from about 1964 to 1969 under 10 CFR 10.304. Existing records indicate very low levels of relatively short-lived isotopic activity were buried (P-32, Ca-45 and Se-75).

2.1.5.3 South Farm Site

The South Farm site, located approximately four miles southeast of the campus, was operated from 1967-1978 as an incineration and burial facility for chemical wastes from the university's laboratories. The original disposal area of 100' x 50' was expanded to 200' x 75' in 1974. Wastes also included pesticides and herbicides, organic solvents, acids, bases, explosives, and metals. Wastes included 772 gallons of scintillation fluids, containing a total of 47 mCi of predominantly H-3 and C-14. The site was closed in 1978. Closure included implementation of various erosion control measures, including construction of surface-water diversion structures and the establishment of vegetation on the surface of the disposal area.

Additionally, a study was performed in the early 1970s involving moles tagged with 100 μCi Co-60 pellets. All but one of the pellets were recovered in 1971. The lost pellet was reported missing in July 1971 (nearly eight half-lives ago). After an exhaustive search for the pellet over a five acre area, it was assumed the mole was either taken by a predator, or burrowed deep enough to avoid detection of the source from the surface. Considering the quantity and half-life of the pellet, this area is considered non-impacted for decommissioning and no level of effort is captured in this cost estimate.

2.1.5.4 Bradford Farm

The Bradford Research and Extension Center (BREC) is a 591-acre research farm located eleven miles from the campus. AmBe soil density gauges were placed into 20' deep tubes for soil density measurements. In 1973, there was also a C-14 plant uptake study performed at the site inside a portable 72 cubic foot plastic enclosure. Plants were exposed to 1 mCi of C-14 as CO_2 gas on four occasions. After the study, the plants were removed and disposed as radioactive waste. Because there was no history of leakage from the AmBe sources and the limited scope of the plant uptake study, this area is considered non-impacted for decommissioning.

2.1.5.5 Sanborn Field

Sanborn Field is located on campus and bounded on three sides by Rollins Street, College Avenue and Bouchelle Avenue. C-14 was used for studies involving wheat. The wheat was grown in two gallon containers in a greenhouse and then planted in a 25 square foot area in plot number 10. The study was limited to a soil depth of seven inches and all impacted soils were removed and disposed after the experiment. Due to the limited scope of the study, it is assumed that the area meets the unrestricted release criteria and the level of effort for decommissioning is assumed to consist of collection and analysis of soil samples.

2.1.5.6 Tucker Prairie

Tucker Prairie is a 160 acre research facility located about 16 miles east of Columbia alongside Interstate 70 in Callaway County. In 1976, an experiment was performed to study the carbon cycle in strip mines involving 2 μCi packets of C-14. After the study, all materials were removed and disposed as radioactive waste. Due to the limited scope of the study, Tucker Prairie is considered non-impacted for decommissioning.

2.2 License History

Facilities operate under NRC Type A broad scope medical use license No. 24-00513-32, Issued to the Curators of the University of Missouri, amendment 108 dated February 4, 2011 with an expiration date of January 31, 2014. Licensed material is authorized for usage at the following addresses:

- The University of Missouri-Columbia, Columbia, MO campus, Columbia, MO
- Ellis Fischel Cancer Center, 115 Business Loop 70 West, Columbia, MO
- Missouri's Women's and Children's Hospital, 404 Keene Street, Columbia, MO
- Portable moisture density gauges may be used at temporary job sites anywhere in the US under NRC regulatory jurisdiction

Licensed materials are used in the following general ways:

- Medical procedures permitted by 10 CFR 35.100, 10 CFR 35.200, 10 CFR 35.300, 10 CFR 35.400
- Diagnostic and medical use of sealed sources permitted by 10 CFR 35.500
- Research and development as defined in 10 CFR 30.4
- Instrument calibration
- Student instruction
- Sample analysis
- Sealed sources for calibration and moisture/ density measurements
- Sealed sources for medical and veterinary medical brachytherapy
- Depleted uranium for shielding

- Waste storage, decay and processing; including wastes from other licenses issued to the Curators of the University of Missouri
- Sealed sources for medical radiography in humans
- Ra-226 possession incidental to decommissioning activities
- Disposal by incineration
- Transport of licensed material

A copy of the current radioactive materials license is provided as Appendix A.

2.3 Previous Decommissioning

The NRC concurred with release of the Sinclair Farm Waste Site and Hinkson Creek Waste Site for unrestricted use in a letter dated August 7, 1997 to Susan Langhorst (RSO). Therefore, no level of effort for decommissioning is captured in this cost estimate.

2.4 Radiological Status of Facilities

During operation, accessible building surfaces are maintained less than 200 dpm/100cm^2 removable surface activity. All radioactive materials entering and exiting the site are packaged for shipment according to DOT and IATA requirements. Personnel that enter areas containing dispersible radioactive materials are required to wear appropriate personal protective equipment and monitor themselves for skin/clothing contamination upon exit. Facility personnel conduct routine periodic surveys, which are performed by researchers and radiation safety personnel. Laboratory closeout procedures are used when authorized users cease possession and use of radioactive materials. Uncontained radioactivity in volatile forms is confined to ventilated hoods.

There are several locations with known residual radioactivity that must be remediated in order to achieve unrestricted release. The radiological status of each type of facility is described below.

MU is continuing to make progress accomplishing thorough characterization of indoor and outdoor facilities in a phased approach. For example, MU is currently collecting radiological information at Sinclair Farm buildings, Schweitzer Hall attic, Sinclair Farm lagoons, and outside grounds around the MURR Barn.

2.4.1 Research and Medical Laboratories

Research and medical laboratories are assumed to contain low levels of residual radioactivity with removable contamination less than 200 dpm/100cm^2 as demonstrated by routine survey results. Small, discreet areas of elevated activity on building structural surfaces and in building ventilation, vacuum and drain systems are expected to exist, but at levels less than the NRC Default Screening Values (DSVs). Laboratories are authorized and closed-out with Radiation Safety Committee authorization as needed to support research activities. Estimated decommissioning costs are mainly for planning, surveying, and reporting. Minor amounts of remediation are assumed for ALARA purposes.

2.4.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Two buildings have known residual radioactivity above NRC DSVs from historical work involving the separation of alpha-emitting radionuclides from ores containing uranium and thorium, Pickard Hall and Schweitzer Hall.

<u>Pickard Hall</u>
Pickard Hall was characterized for residual radioactivity to the extent possible due to its use as a museum. Characterization results indicate that the nuclides of concern are U-238, Th-232 and their progeny (particularly Ra-226) and that low levels of residual radioactivity exists in the following locations:

- On basement concrete floor surfaces that are covered with vinyl tiles.
- On concrete floor surfaces in basement mechanical rooms. These surfaces were subsequently encapsulated with epoxy paint.
- In the steam tunnel feeder adjacent to Mechanical Room 15. The top foot of soil in the steam tunnel feeder was removed and then geotextile and pavers were placed in the feeder.
- In buried drain lines under the basement floor.
- In a small inaccessible area under the stage in Room 106 – this area is also detectable in the basement ceiling in Room 1B.
- In a small area inside a wall in Room 213.
- In the attic on one small location on the floor and in open joist areas.
- Inside two brick ducts (assumed to be fume hood exhaust ducts) that are open in the attic and likely extend to the basement.
- In soils immediately outside the northwest corner of the building.

Characterization results are available in the Pickard Hall Characterization Survey Report dated July 16, 2010.

<u>Schweitzer Hall</u>
Areas of Schweitzer Hall are known to have or suspected of having elevated residual radioactivity from operations similar to those at Pickard Hall in the following locations:

- On attic concrete floor surfaces
- On roof surfaces
- Inside brick ducts and chimneys
- Inside roof drains

Accessible roof surfaces of Schweitzer Hall were characterized in 2010. The results are available in the Schweitzer Hall Roof Survey Report dated March 3, 2010. MU plans to replace Schweitzer Hall's roof. As part of the preparation for roof replacement, the University has initiated radiological characterization of attic surfaces and currently inaccessible layers of roofing material. Costs for removal and disposal of the roofing materials are captured in this Plan.

2.4.3 Sealed Source Use and Storage Areas

Sealed source usage areas are not expected to contain residual radioactivity because sources are periodically leak checked and have never indicated leakage. Decommissioning costs are captured for removal and disposal of sources and verification/administration of leak test data.

2.4.4 Waste Facilities

Waste and Incinerator facilities are assumed to meet the NRC DSVs based on routine survey results. Decommissioning costs are mainly for disposal of existing waste as well as planning, surveying, and reporting. Minor amounts of remediation are assumed for ALARA purposes.

2.4.5 Outdoor Facilities

Outdoor areas have not been fully characterized, but are assumed to meet NRC release criteria using a site-specific dose model. Minor amounts of remediation are assumed for ALARA purposes. The level of effort for dose modeling assessments is captured in this estimate. MU will continue to collect radiological information in outdoor facilities in a phased approach and update this DFP as appropriate. Inactive disposal sites and lagoons are also impacted for chemical contaminants and regulated by Missouri Department of Natural resources (MDNR).

2.5 Radiological Release Criteria

Facility release criteria for unrestricted use are those of NRC 10CFR20 Subpart E. Specifically, the facility will be surveyed in accordance with the guidance contained in MARSSIM to demonstrate compliance with the criteria of 10CFR20.1402, "Radiological Criteria for Unrestricted Use." The criteria are that residual radioactivity results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem per year, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

2.6 Decommissioning Groups

All indoor facilities, except Pickard Hall and Schweitzer Hall, are expected to be decommissioned using the screening approach because it is expected that residual radioactivity will be surficial (up to a 1 cm depth). These facilities are expected to be decommissioned as Group 2 under NUREG 1757: "Unrestricted Release Using Screening Criteria; No Decommissioning Plan Required." From NUREG 1757: "Group 2 facilities may have residual radiological contamination present in building surfaces and soils. However, licensees are able to demonstrate that their facilities meet the provisions of 10

CFR 20.1402 ("Radiological Criteria for Unrestricted Use") by applying the screening approach dose analysis described in Chapter 6. Additionally, licensees in Group 2 typically possess historical records of material receipt, use, and disposal, such that quantifying past radiological material possession and use may be developed with a high degree of confidence. Furthermore, these licensees have radiological survey records that characterize the residual radiological contamination levels present within the facilities and at their sites. That is, they are able to demonstrate residual radiological contamination levels without more sophisticated survey procedures (greater than those used for operational surveys) or dose modeling. These licensees do not need to use site-specific parameters or establish site-specific DCGLs in order to demonstrate acceptability for release of their sites. For Group 2 facilities, a DP is not required, but licensees will have to demonstrate that the site meets the screening criteria assumptions described in Chapter 6. A DP is not required because worker cleanup activities and procedures are consistent with those approved for routine operations, and no dose analysis is required."

Pickard Hall, Schweitzer Hall, and outdoor areas are assumed to require site-specific DCGLs and/or a dose model and will be decommissioned under a formal decommissioning plan. This will require long (~ 1-2 yr) planning and regulatory review times. These facilities are expected to be decommissioned as Group 4 under NUREG 1757: "Unrestricted Release with Site-Specific Dose Analysis and No Ground Water Contamination; Decommissioning Plan Required." From NUREG 1757: "Group 4 facilities have residual radiological contamination present in building surfaces and soils, but the licensee cannot meet, or chooses not to use, screening criteria, and the ground water is demonstrably not contaminated. The licensees are able to demonstrate that residual radioactive material may remain at their site but within the levels specified in NRC criteria for unrestricted use (10 CFR 20.1402, "Radiological Criteria for Unrestricted Use") by applying site-specific criteria in a comprehensive dose analysis. A site DP is required and should characterize the location and extent of radiological contamination. The DP should also identify the land use, exposure pathways, and critical group for the dose analysis."

2.7 Nuclides of Concern

2.7.1 Research and Medical Laboratories

Research and medical laboratories use tracers and short-lived imaging nuclides. After considering quantities, locations of usage, and the impact of radioactive decay, the nuclides of concern for these types of facilities are typically C-14 and H-3 that have very high DSVs. However, survey design for this cost estimate assumes detection sensitivities of 5,000 dpm/100cm^2 gross total beta activity and 200 dpm/100cm^2 gross removable beta activity to ensure adequate costs are captured for beta-gamma emitting nuclides of concern with more restrictive DSVs. Removable contamination analysis is assumed to be performed by liquid scintillation counting.

2.7.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

The nuclides of concern in Pickard Hall and Schweitzer Hall are natural uranium, natural thorium, and their progeny, particularly Ra-226. Solid samples at Pickard Hall indicate a nuclide distribution of approximately 80% Ra-226 and 20% Th-232, and solid samples of Schweitzer roof materials indicate a distribution almost entirely due to Ra-226 (>90%).

2.7.3 Sealed Source Use and Storage Areas

Nuclides of concern for sealed source areas are Cs-137, Co-60, and Am-241. It may be possible to decommission these areas after removal of sources without performing surveys for residual activity. However, this cost estimate assumes that surface contamination surveys are performed in these areas, but assumes no remediation is required.

2.7.4 Waste Facilities

Radioactive waste facilities could contain any of the nuclides used at any of the facilities. Therefore it is assumed that facilities will be surveyed to demonstrate compliance with the most limiting alpha and beta nuclides possessed on site (assumed to be Th-232 and Co-60).

2.7.5 Outdoor Facilities

The nuclides of concern for impacted outdoor areas are primarily C-14 and H-3. Facilities that have been historically released with NRC concurrence are classified as non-impacted. The area around the MURR Barn is also impacted for fission and activation products.

2.8 Derived Concentration Guideline Levels

The Derived Concentration Guideline Level (DCGL) is the radionuclide-specific surface contamination or volumetric concentration that could result in a dose equal to the release criterion. $DCGL_W$ is the concentration limit if the residual activity is essentially evenly distributed over a large area.

2.8.1 Research and Medical Facilities

DCGLs for research and medical facilities are assumed to be the Default Screening Value (DSV) for the most limiting nuclide for a particular area. The NRC has published default screening values in NUREG 1757 for commonly used radionuclides. The DSV for unlisted nuclides can be calculated using NRC-approved DandD software under default conditions of the building occupancy scenario. Research and medical laboratories are assumed to use the C-14 DSV of 3.7E6 dpm/100cm^2. However, survey design for this plan assumes detection sensitivities of 5,000 dpm/100cm^2 gross total beta activity and 200 dpm/100cm^2 removable activity to ensure adequate costs are captured for beta-gamma emitting nuclides of concern with more restrictive DSVs than C-14.

2.8.2 Areas with Historical Usage of Alpha-Emitting Radionuclides

Areas with a history of using alpha emitting nuclides are assumed to have site-specific DCGLs for surfaces and soils of outside grounds.

2.8.3 Sealed Source Use and Storage Areas

Sealed source areas are assumed to use a gross beta-gamma DCGL equal to the Co-60 DSV of 7.1E3 dpm/100cm^2 and an alpha DCGL based on the Am-241 DSV of 27 dpm/100cm^2.

2.8.4 Waste Facilities

The radioactive waste facility is assumed to use a gross beta-gamma DCGL equal to the Co-60 DSV of 7.1E3 dpm/100cm^2 and a gross alpha DCGL based on the Th-232 DSV of 7.3 dpm/100cm^2.

2.8.5 Outdoor Areas

The nuclides of concern for impacted outdoor areas are primarily C-14 (DSV=12 pCi/g) and H-3 (DSV=110 pCi/g). The area around the MURR Barn will also be impacted for fission and activation products, so other beta-gamma emitter screening values will be used as well. Site-specific DCGLs are assumed to be developed for outdoor areas.

2.9 Equipment and Materials Release Limits

The release criteria specified in FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses" is assumed to be used for release of loose equipment and materials.

2.10 Area Classifications

For the purpose of decommissioning cost estimation, the guidance in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), was used to divide the facility into areas with similar contamination potential based on results of radiological surveys, radionuclides used, activities conducted and the potential for tracking residual radioactivity:

- Non-impacted areas (not surveyed) – medical and research laboratory building structural surfaces above a two meter height, outside grounds, and building exteriors.

- Class 1 – areas with historical usage of alpha emitters, areas of known contamination, and lagoon/disposal sites

- Class 2 – medical and research laboratories with a history of radioactive materials usage

- Class 3 (buffer areas) - areas with no history of radioactive materials usage, but bordering Class 1 and Class 2 areas, and sealed source storage areas with no history of leakage.

- Building systems (ventilation, vacuum and drain systems) are not within the scope of MARSSIM, but are assumed to be surveyed at each accessible inlet and inside equipment.

2.11 Cost Estimate Procedure

Because of significant design, regulatory and operational differences, common assumptions and thumb rules cannot be applied to all facilities in the same way. Therefore, facilities have been grouped into three independent projects and separate cost estimates are provided for clarity of presentation. The three separate cost estimates are summed to obtain the required level of financial assurance estimated for the license. Facilities were divided into three categories in order to estimate costs:

- Group 2 facilities (research and medical labs, sealed source areas, radioactive waste storage areas, and incinerator facilities)
- Facilities with residual alpha radioactivity
- Outdoor facilities – disposal sites and farms

To estimate facility decommissioning costs, a bottom-up approach was used consistent with the guidance provided in NUREG 1757. Specifically, a typical layout for each type of facility was obtained and the principal features and equipment identified. The work scope and activity sequence necessary to support unrestricted release of the facility was then developed. A project schedule was created from the activity sequence and expected duration of each task. Cost estimates are based on anticipated time-and-materials rates for goods, labor and services necessary to complete the project.

Overall, conservative assumptions were made concerning the likely extent and duration of necessary remediation activities. Remediation to unrestricted levels (i.e., the facility could be released for any future use without restrictions) was assumed. This assumption means there are no long term costs associated with site surveillance and monitoring following decommissioning.

Contamination present in each building was assumed to be limited to the portions of the building posted and controlled as "radioactive materials" areas. In particular, contamination was presumed not to be present beneath the concrete floors or walls or on the roof or other external surfaces (except for Pickard Hall and Schweitzer Hall). Facility restoration of Group 2 facilities is limited to patching a few openings on roof surfaces as a result of removal of ventilation ducts and fans. Restoration of Group 4 facilities includes only the restoration necessary to place the site in a safe condition (make buildings weather-tight and back-fill excavations).

Schedules of equipment, features and characteristics were developed for each category of facility. The schedules systematically capture the size of each area and key features relevant to estimating decommissioning costs. The schedules for all facility categories were then summed to a total facility schedule.

Labor estimates were derived from the expected work scope and a conceptual project plan. A project plan was developed that detailed the sequence of tasks required to decommission the facilities and terminate the radioactive material license. Crew sizes were developed based on the numbers and locations of tasks to be performed. In addition to the actual facility decontamination and decommissioning, labor estimates were made for pre-planning activities and performing the final radiation survey. Since the assumed endpoint of the decontamination effort was unrestricted release of the facility, there was no labor or other costs associated with long term site surveillance and maintenance.

Labor estimates for planning and preparation include time for document preparation, decommissioning plan submittal to regulatory agencies, work plan development, equipment procurement, staff training and mobilization. Pre-planning labor estimates assume straightforward internal and external document, plan, and procedure reviews and approvals.

The duration of field activities for decontaminating and/or dismantling facilities was estimated based on the task sequence and project schedule. Crew sizes and number of workers were limited to those that could be efficiently utilized in the field.

Radioactive waste estimates were based upon the volume and weight of equipment and of material in the laboratories, storage areas, and supporting systems as well as waste generated as a result of remediation of building structures and soils. The site is assumed to have a waste storage inventory similar to that which would be on-site immediately prior to a routine waste shipment. For decommissioning purposes, installed equipment with contamination levels expected to be in excess of release criteria was assumed to be disposed of as radioactive waste rather than being decontaminated and released. This is due to the cost of labor required to decontaminate and survey equipment typically exceeding the cost of disposal. However, costs are captured for decontamination of equipment and surfaces that are below release criteria for ALARA purposes. ALARA is assumed to mean removable contamination on surfaces is remediated (NUREG-1757, Volume 2, Appendix N).

Estimates for the level of effort required for the final radiation survey were based on previous experience with facilities of comparable complexity. As noted above, the assumed endpoint for the facility is license termination and unrestricted release. This implies that removal of all radioactive materials from the facility has been confirmed.

Marketplace rates (including overhead and contractor profit) were obtained for each element of the project including labor, materials, supplies, sampling, construction activities, waste packaging, waste processing and disposal. The unit rates were extended through the estimated quantities to determine total cost for each line item. Costs were summed by each element of the project to determine subtotals by element. Element subtotals were summed to total project cost.

Annual labor rates were estimated for the Project Manager, Health Physics Supervisor, Foreman, Health Physicist, Shipper, Draftsman, Health Physics Technicians, Equipment Operators, Laborers, and Administrative Assistant. Labor rates include base salary and fringe benefits (e.g., vacation, health insurance, etc.). A rate of 50% was applied for overhead costs, consisting of 18% for labor overhead, 15% for general and administrative costs and 10% profit. The base annual labor rate plus the overhead expenses was divided by the number of workdays per year (taken as 260) to determine a daily cost for each category of employee.

Living expenses were taken from current allowable government per diem rates. For the Columbia area, this is $129 per day. Project management and technical staff are paid the daily living allowance since they are assumed to be from outside the local area. Administrative and support staff are not paid a living allowance. The daily living expenses were multiplied by 7 days per week then divided by 5 workdays per week to correctly incorporate living expenses into the daily rate. This is a variation from the NUREG 1757 methodology in that NUREG 1757 format does not explicitly account for living expenses.

The completed cost estimate schedules for Group 2 facilities are included in Appendix B. The completed cost estimate schedules for alpha emitter facilities are included in Appendix C. The completed cost estimate schedules for outdoor facilities are included in Appendix D. The cost estimate summary tables are summed and presented in Section 2.15.

2.12 Project Overviews

Facilities are expected to be decommissioned as three separate projects. Each project is assumed to be performed by a third party, non-local decommissioning contractor that will provide the qualified staff, on-site and off-site labor, materials and equipment needed to complete the project. The projects are assumed to be performed using the contractor's Agreement State license under a reciprocal agreement with the NRC in order to capture costs associated with reciprocity. The projects will be conducted according to the phases described below. A detailed description of each phase follows.

- Historical Site Assessment (HSA) and Scoping Surveys
- Characterization
- Decommissioning Plan and Supporting Documents

- Equipment and Material Removal / Decontamination
- Remediation of Building Structures and Soils of Outside Grounds
- Waste Disposal
- Final Status Surveys and Report

Each of these project elements are described below.

2.12.1 Historical Site Assessment

The purpose of the HSA is to determine the current status of the site including potential, likely, or known sources of radioactive contamination by gathering data from various sources. This data includes physical characteristics of the site as well as information found in site operating records, including radiological surveys. A records review will include: radioactive materials licenses, license applications, amendment requests, Radiation Safety Committee meeting minutes, radiological surveys, radionuclide receipt and distribution records, radioactive waste records, incident reports, decommissioning records, facility renovation records, blueprints, plans and design specifications. Personnel interviews will include radiation safety, maintenance, operations, and facilities personnel. Limited scoping surveys and sampling are assumed to be performed to augment the HSA and help plan characterization.

2.12.2 Characterization

Characterization surveys will be designed to identify areas of elevated activity that require remediation. Building characterization consists primarily of surface scans and smears of building structural surfaces and systems internal surfaces. Outside grounds characterization consists of gamma scans and soil sampling.

2.12.2.1 Group 2 Facilities

Facility survey records are assumed to be sufficient to plan decommissioning for Group 2 facilities.

2.12.2.2 Alpha Emitter Facilities

Existing characterization data and facility routine surveys will be used to plan decommissioning activities, but additional information regarding the activity in soils is required. Additional characterization data will be collected of soils of outside grounds of Pickard and Schweitzer Halls and under the basement slab of Pickard Hall. A track-mounted geoprobe core sampler will be used to collect samples at depths up to two feet below the Pickard Hall basement floor slab and up to twelve feet in the soils of outside grounds around Pickard Hall and Schweitzer Hall. Samples will be analyzed by gamma spectroscopy and/or alpha spectroscopy.

2.12.2.3 Outdoor Areas

Characterization of outdoor areas will be conducted by performing surface gamma scans and collecting soil samples for laboratory analysis. A track-mounted geoprobe core sampler or hand auger will be used to collect soil and sediment samples at depths up to six inches in surface soils, up to two feet in lagoon sediments, and up to twelve feet in burial grounds. Samples will be analyzed by gamma spectroscopy, C-14 and H-3.

2.12.3 Decommissioning Plan and Supporting Documents

The information gained from the HSA and Characterization will be used to develop a Decommissioning Plan (DP) for each project. While a Group 2 decommissioning project does not require a formal DP, a comprehensive plan is assumed to be developed. A formal NRC-approved Decommissioning Plan is required for Group 4 decommissioning projects. The checklists provided in NUREG 1757 Appendix D are used to develop the DPs. Project plans and procedures supporting the DP will also be developed in this phase. Costs have been captured in the planning phases for regulatory discussions, particularly in regards to development of decommissioning plans and site-specific DCGLs for Group 4 facilities.

2.12.4 Equipment and Material Removal / Decontamination

The decommissioning contractor will remove all loose equipment and materials from the facilities such that only permanent fixtures remain (fixtures attached to structural components of the facilities). Loose equipment and materials will be surveyed for release using the release limits of FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses." Items not meeting FC 83-23 limits are assumed to be disposed as radioactive waste.

2.12.5 Remediation

2.12.5.1 Group 2 Facilities

Remediation of laboratory surfaces is expected to consist of wiping, scrubbing and scouring or removal of surfaces, such as vinyl floor coverings. A small amount of equipment, drains and ventilation systems are assumed to be removed for ALARA purposes. Several small areas of persistent contamination are assumed to be remediated in waste storage areas by removing a thin layer of the concrete floor surface. An average of 150 lb of waste for each of 400 labs, and each of 25 farm buildings is assumed. Additionally, six drums of liquid scintillation vial waste are assumed to be generated from decommissioning activities.

2.12.5.2 Alpha Emitter Facilities

Pickard Hall is assumed to require the following remediation:

- Remove and dispose all insulation and loose materials in the attic.
- Remove attic wooden decking.
- Power plane contaminated wooden structural supports in attic – joists and rafters. Assume up to 1/8" of materials must be removed over 50% of area.
- Remove two contaminated brick ducts from the attic to the basement. The walls will be demolished on each elevation to provide access.
- Demolish small wall area on 2nd floor (room 213).
- Demolish stage area on the 1st floor (room 106).
- Demolish several wall areas in the basement.
- Remove an average of 1/8" of the basement floor surface over an area of 4200 ft^2.
- Remove basement floor slab over an area of 4200 ft^2 to access underlying soils – concrete assumed to be releasable for unrestricted use.
- Remove buried drain lines.
- Remove average of 1 ft depth of soils over an area of 4200 ft^2.
- Remove an additional 1,000 ft^3 of soil in outside grounds.

Schweitzer Hall is assumed to require the following remediation:

- Remove and dispose all insulation and loose materials in the attic (currently being performed, but costs captured in this estimate).
- Remove slate roof and wooden plank roof surfaces.
- Power plane contaminated wooden structural supports – joists and rafters. Assume up to 1/8" of materials must be removed over 50% of area.
- Remove 2400 ft^2 of six inch thick concrete attic floor.
- Remove an additional 1,000 ft^3 of soil in outside grounds.

2.12.5.3 Outdoor Areas

Outdoor areas are assumed to meet release criteria as demonstrated using a site-specific dose model. However, removal and disposal of 40 cubic yards of soils is assumed in order to capture additional costs to offset uncertainty associated with lack of characterization data.

2.12.6 Waste Disposal

Radioactive waste packaging, shipping, processing and disposal costs were determined based upon the expected volume generation and disposal facility waste acceptance criteria. Waste processing activities for soils, slate, and rubble from Pickard Hall and Schweitzer Hall are assumed to take place in Richland, WA. Other waste processing activities are assumed to take place in Oak Ridge, TN to ensure adequate transportation costs are captured for a number of available processors.

In addition to wastes generated during decommissioning, costs are captured for disposal of sealed sources and existing waste on site at the time of cessation of licensed activities. Disposal cost estimates for sealed sources is based on the assumption that there is no leakage from the sealed sources and no external contamination. Sealed sources will be shipped to a facility for recycling of the sources. The majority of the cost associated with disposal of the sources will be for transportation and disposal. The sources will be placed in a cask and loaded onto a conveyance for transportation to the disposal facility. Transportation and disposal costs for sealed sources are presented in Table 2-3.

Table 2-3 Sealed Source Transportation and Disposal Estimates

Item	Cost Basis	Unit Cost	Qty.	Total
Transportation and Permits	$/mile	$3.80	2850	$10,830
Cask Rental	$/day	$1,800.00	7	$12,600
Recycling Charges	$/item	$8,000.00	1	$8,000
Labor (Engineers)	$/day	$3,667.00	3	$11,001
Labor (Cask Operators)	$/day	$2,250.00	2	$4,500
Labor (Riggers)	$/day	$4,500.00	2	$9,000
			Total:	**$55,931**

The cost for disposal of operational waste at the time of cessation of operations is assumed from a typical annual waste inventory based on average data from waste disposal shipments over the past three years. A breakdown of waste assumed to be on site at cessation of operations is presented in Table 2-4.

Table 2-4 Operational Waste at Cessation of Licensed Activities

Item	Quantity	Unit Rate	Total
Incinerator Ash	7.5 ft^3	$200/$ft^3$	$1,500
Non-Hazardous Liquid Scintillation Vials	7.5 ft^3	$180/$ft^3$	$1,350
Dry Active Waste	500 lb	$6/lb	$3,000
Animal Carcasses	30 lb	$20/lb	$600
Liquids	400 lb	$6/lb	$2,400
		Total:	**$8,850**

2.12.7 Final Status Surveys and Report

Final status surveys are performed to demonstrate that residual radioactivity in each survey unit satisfies the predetermined criteria for release for unrestricted use. Final status surveys will be conducted by performing the appropriate combination of scan surveys, total activity measurements, dose rate measurements, soil samples and removable contamination measurements.

2.12.7.1 Group 2 Facilities

Final status survey will consist of surface scans, static measurements and smears for all areas. Scan percentages are assumed to be: 100% for Class 1 areas, 50% for Class 2 areas, and 10% for Class 3 areas. Fifteen sample locations per survey unit are assumed in medical and research laboratories. For conservatism, each Class 1 and Class 2 room is assumed to be an individual survey unit.

Survey design for building systems is out of the scope of MARSSIM. For the purpose of identifying potential residual contamination within these systems, the following survey protocol is assumed: Surveys of building ventilation and fume hood ventilation consist of scan surveys, total activity measurements, and removable contamination measurements of accessible ventilation exhaust points and at locations of potential collection/buildup. Removable contamination surveys will be taken in sink drains, sink drain traps, floor drains and vacuum pumps/nozzles.

2.12.7.2 Alpha Emitter Facilities

Final status surveys will consist of surface scans, static measurements and smears for all areas. Additionally, soil samples are assumed to be performed for impacted soils. Scan percentages are assumed to be: 100% for Class 1, 50% for Class 2 areas, and 10% for Class 3 areas. 20 sample locations per survey unit are assumed in structure and soil survey units.

2.12.7.3 Outdoor Areas

Final status surveys will consist of surface scans, and soil samples for all areas. Scan percentages are assumed to be: 100% for Class 1 areas, 50% for Class 2 areas, and 10% for Class 3 areas. 20 sample locations per survey unit are assumed in soil survey units.

2.12.8 Schedules

A breakdown of the estimated schedule for each project is presented in Table 2-5.

Table 2-5 Schedule Breakdown[2]

Project Element	Cost Estimate Table[3]	Group 2 Facilities (Weeks)	Alpha Facilities (Weeks)	Outdoor Facilities (Weeks)
Decommissioning Planning	Table 3.6	3	7	7
Characterization Surveys	Table 3.6	1	1	1
Equipment Removal, Remediation, Waste Disposal	Table 3.7 Table 3.14	12	18	1
Final Status Surveys	Table 3.9	13	3	4
Final Status Report	Table 3.9	3	3	2
Restoration	Table 3.8	0.5	2.5	0.5
	Total	**32.5**	**34.5**	**15.5**

2.13 Staffing and Labor

2.13.1 Group 2 Facilities

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), six Health Physics Technicians (HPT), and two Laborers. Part time on-site and off-site support is provided by a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The PM is responsible for the overall management of the project and provides the daily interface with MU management, vendors and subcontractors. The PM is also responsible for coordination of decommissioning activities and for arranging any needed support items as well as ensuring that the project is completed within required parameters with respect to cost, timeliness, safety, quality, and compliance. The Health Physics Supervisor provides day-to-day supervision of field operations. Health Physics Technicians provide labor for radiological surveys, remediation, waste packaging, and final status surveys. Laborers are radiation workers that provide labor for decontamination, dismantlement and waste handling activities. The Health Physicist is responsible for developing appropriate techniques, controls, and monitoring for the work being performed. This position is also responsible for ensuring that appropriate instrumentation and procedures are utilized for performing remedial support and final status surveys. The Shipper is responsible for packaging, classifying and shipping all radioactive materials from the project as well as scheduling shipments and ordering shipping containers as necessary. The Draftsman creates, documents and indexes facility drawings and radiation surveys. The administrative assistant provides support to the Project Manager for cost-tracking, timekeeping, procurement and recordkeeping functions.

[2] Project elements are not contiguous and do not include regulatory review periods.
[3] The cost estimate table numbers refer to the tables contained in Appendices B, C and D.

2.13.2 Alpha Emitter Facilities

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), six Health Physics Technicians (HPT), a Foreman, an Equipment Operator and six Laborers. Part time on-site and off-site support is provided by a Structural Engineer, a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The functions and responsibilities are the same as above for common positions. The Structural Engineer is a part-time position responsible for evaluating the effect of remediation on the structural integrity of the buildings and stability of outside grounds. The Structural Engineer also designs and inspects shoring of building structures. The Equipment Operator operates heavy equipment required for movement, excavation, and loading of remediation wastes. The Foreman provides day-to-day supervision of the laborer crew. Laborers are radiation workers that provide labor for decontamination, dismantlement, lifting, rigging and waste handling activities.

2.13.3 Outdoor Areas

Full time, on-site staffing is assumed to consist of a Project Manager (PM), a Health Physics Supervisor (HPS), two Health Physics Technicians (HPT), a Foreman, two Equipment Operators and two Laborers. Part time on-site and off-site support is provided by a Structural Engineer, a Health Physicist, a Shipper, a Draftsman and an Administrative Assistant. The functions and responsibilities are the same as above.

2.14 Additional Assumptions

- All labor estimates are expressed in workdays. Workdays are actual days on the job excluding weekends, holidays, etc. Project schedules were based on 5-day workweeks consisting of 8 hours per day.
- No credit is taken in these estimates for any salvage value of any material or equipment.
- It is assumed that all facilities are decontaminated for unrestricted use and are not demolished.
- Inventories of materials and wastes at the time of decommissioning will be in amounts consistent with routine facility conditions over time.
- Decommissioning activities take place immediately on cessation of operations without multiyear storage-for-decay periods.
- Work will be performed by an independent third-party contractor. All labor, services, equipment and supply costs are based on third party costs.
- Activities will be conducted under the contractor's Agreement State license utilizing a reciprocal agreement with the NRC.

- Group 4 activities will be conducted under the contractor's Agreement State license over a period of two years (long development and regulatory review periods are assumed) such that two annual reciprocity fees are captured.

- Group 2 activities will be conducted under the contractor's Agreement State license and can be completed in a single year.

- The licensee operated the facility according to all license conditions and industry standard radiological practices.

- There is no contamination on the external surfaces of Group 2 buildings, including the roof.

- There is no contamination of building structural surfaces in laboratories above a two-meter height.

- There are no subsurface drain lines in Group 2 facilities that must be remediated.

- Radioactive wastes from consumables used in the decommissioning process are captured in waste estimates under Dry Active Waste (DAW).

- Building footers will not be impacted to a degree that would require building demolition.

- No structural engineering or shoring is required during demolition work. However, costs are captured for a Structural Engineer's evaluation.

- Groundwater is not impacted.

- No costs are captured for removing museum items or protection of museum artifacts.

- Museum artifacts are assumed to have no salvage value used to offset decommissioning costs.

2.15 Cost Estimate Results

The overall estimated cost to achieve unrestricted release of the facility is $9,046,453 including a contingency of 25%. Table A.3.18 data from each of the independent cost estimates were summed and presented in Table 2-6 below.

Table 2-6 Total Decommissioning Cost Breakdown

Task/Component	Cost	Percentage
Planning and Preparation	$359,380	5.0%
Decontamination and/or Dismantling of Radioactive Facility	$1,723,199	23.8%
Restoration of Contaminated Areas on Facility Grounds	$84,420	1.2%
Final Radiation Survey	$806,180	11.1%
Packing Material Costs	$29,080	0.4%
Shipping Costs	$179,831	2.5%
Waste Disposal Costs	$3,337,920	46.1%
Equipment/Supply Costs	$416,152	5.8%
Laboratory Costs	$291,000	4.0%
Miscellaneous Costs	$10,000	0.1%
SUBTOTAL	**$7,237,162**	**100.0%**
25% Contingency	$1,809,291	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	**$9,046,453**	**125.0%**

3.0 Periodic Adjustment of Decommissioning Cost Estimate and Funding Levels

The decommissioning cost estimate will be updated with the current prices of goods and services at least every three years, and the decommissioning funding will be adjusted as needed at that time. Additionally, annually, as part of the annual program review, the Radiation Safety Committee will review the need for updating based on operational changes such as adding or deleting facilities as well as significant changes in quantities, usage, and/or radiological conditions.

4.0 Certification of Financial Assurance and Financial Instrument

A copy of the Statement of Intent that provides financial assurance for decommissioning is attached as Appendix E.

5.0 References

- 10 CFR 20, Standards For Protection Against Radiation
- NUREG-1757, Volume 1, Rev. 2 "Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees," September, 2006
- NUREG-1757, Volume 2, Rev. 1 "Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria," September, 2006

- NUREG-1757, Volume 3 "Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness," September, 2003
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
- NUREG/CR-6477, "Revised Analyses of Decommissioning Reference, Non-Fuel-Cycle Facilities," December 2002
- NUREG-1505, Revision 1, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys," June 1998
- NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998
- NUREG/CR-5512, "Residual Radioactivity from Decommissioning: Parameter Analysis," August 1999.
- NUREG-1549, "Decision Methods for Dose Assessment to Comply with Radiological Criteria for License Termination," July 1998
- ANL/EAD/03-1 "User's Manual for RESRAD-BUILD Version 3," June 2003
- "Decommissioning Health Physics, A Handbook for MARSSIM Users," Abelquist, 2001
- "Handbook of Health Physics and Radiological Health", 3rd Edition, 1998
- FC 83-23, "Guidelines for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses."
- Pickard Hall Characterization Survey Report, July 16, 2010 (ML102800311, ML102800322, ML102800330, ML102800336, ML102800398, ML102800412, ML102800427, ML102800430, ML102800436, ML102800441, ML102800450, ML102800452, ML102800455, ML102800458, ML102800463, ML102800467, and ML102800563)
- Schweitzer Hall Roof Survey Report, March 3, 2010

NRC FORM 374

U.S. NUCLEAR REGULATORY COMMISSION

Amendment No. 108

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. The Curators of the University of Missouri	In accordance with letter dated **November 1, 2010**
2. 311 Jesse Hall Columbia, MO 65211	3. License number 24-00513-32 is amended in its entirety to read as follows:
	4. Expiration date January 31, 2014
	5. Docket No. 030-02278 Reference No.

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Any byproduct material permitted by 10 CFR 35.100	A. Any	A. As needed
B. Any byproduct material permitted by 10 CFR 35.200	B. Any	B. As needed
C. Any byproduct material permitted by 10 CFR 35.300	C. Any	(b)(7)(F)
D. Any byproduct material permitted by 10 CFR 35.400	D. Any	
E. Any byproduct material permitted by 10 CFR 35.500	E. Any	
F. Any byproduct material with Atomic Numbers between 3 through 92, inclusive; except as specified below:	F. Any	
G. Hydrogen-3	G. Any	G. 15 curies
H. Molybdenum-99	H. Mo-99/Tc99m Generator	H. 12 curies
I. Technetium-99m	I. Any	I. 6 curies

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
24-00513-32

Docket or Reference Number
030-02278

Amendment No. 108

J. Gold-198	J. Any	J. 1 curie
K. Polonium-210	K. Any	K. 5 millicuries
L. Neptunium-237	L. Any	L. 2 millicuries
M. Americium-241	M. Any	(b)(7)(F)
N. Phosphorus-32	N. Any	N. 5 curies
O. Cesium-137	O. Sealed source (registered pursuant to 10 CFR 32.210 or an Agreement State)	(b)(7)(F)
P. Americium-241	P. Sealed source	(b)(7)(F)
Q. Americium-241	Q. Sealed source	(b)(7)(F)
R. Americium-241/Cesium-137	R. Sealed source	(b)(7)(F)
S. Americium-241	S. Sealed source	(b)(7)(F)
T. Curium-244	T. Calibration sources	T. Not to exceed 0.001 millicuries per source; total possession not to exceed 0.005 millicuries
U. Americium-241	U. Sealed source	(b)(7)(F)

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 24-00513-32

Docket or Reference Number: 030-02278

Amendment No. 108

V. Americium-241	V. Sealed source	(b)(7)(F)
W. Americium-241	W. Sealed source	(b)(7)(F)
X. Americium-241	X. Sealed source	(b)(7)(F)
Y. Americium-241	Y. Sealed source	(b)(7)(F)
Z. Uranium (depleted in uranium-235)	Z. Stainless steel covered metal	Z. 4 shields not to exceed 12 kilograms each
AA. Uranium (Natural)	AA. Any	AA. 250 kilograms
BB. Thorium (Natural)	BB. Any	BB. 250 kilograms
CC. Plutonium-239	CC. Sealed source (Mound Laboratory)	(b)(7)(F)
DD. Uranium (Depleted)	DD. Any	DD. 250 kilograms
EE. Californium-252	EE. Sealed source	EE. Total not to exceed 19.0 micrograms
FF. Strontium-90	FF. Sealed source	FF. 500 millicuries
GG. Hydrogen-3	GG. Waste Storage/Processing	GG. 3 curies
HH. Any byproduct material with Atomic Numbers between 3 through 83, inclusive	HH. Waste Storage/Processing	(b)(7)(F)
II. Gadolinium-153	II. Sealed sources (North American Scientific, Inc. Model MED 3601)	II. 12 sources not to exceed 250 millicuries each; total possession not to exceed 3 curies.
JJ. Cesium-137	JJ. Sealed sources (Isotope Products Model HEG-137)	JJ. 8 sources not to exceed 30 millicuries each; not to exceed 240 millicuries total

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

KK. Any byproduct material with a half-life less than or equal to 6 hours	KK. Any	KK. Total possession not to exceed 10 curies
LL. Americium-241	LL. Sealed source (ICN Model 400)	(b)(7)(F)
MM. Radium-226	MM. Any	MM.100 millicuries

9. Authorized use:

A. Any uptake, dilution and excretion procedure permitted by 10 CFR 35.100.

B. Any imaging and localization procedure permitted by 10 CFR 35.200.

C. Any diagnostic or therapy procedure permitted by 10 CFR 35.300.

D. Any manual brachytherapy procedure permitted by 10 CFR 35.400.

E. Diagnostic medical use of sealed sources permitted by 10 CFR 35.500 in compatible devices registered pursuant to 10 CFR 30.32(g).

F. through N., AA., BB., DD., EE., KK and LL. Research and development as defined in Section 30.4 of 10 CFR Part 30, instrument calibration, student instruction and sample analysis as described in application dated June 18, 2003.

O. Sealed sources to be used in J.L. Shepherd 28-6A 5071; Amersham X2016 40666F; EON Corp. 64-761 177 for calibration and density measurements and for medical and veterinary medical brachytherapy use.

P. To be used in Troxler Electronics Labs, Inc., Model 1257 soil moisture/density gauge.

Q. To be used in Troxler Electronics Labs, Inc., Model 1257 soil moisture/density gauge.

R. To be used in Troxler Electronics Labs, Inc., Model 1403 and Model 3411B soil moisture/density gauges.

S. To be used for laboratory moisture/density measurement of soil samples Amersham/Searle in a type X-92 capsule.

License Number
24-00513-32

Docket or Reference Number
030-02278

Amendment No. 108

MATERIALS LICENSE
SUPPLEMENTARY SHEET

T. Electroplated calibration sources to be used in an E G & G Model Let -SE 1/2 counter and a Far West Technologies Tissue Equivalent Proportional Counter (TEPC), Model Number LET-SW5.

U. To be used in Campbell Pacific Nuclear Model 500 Series moisture gauges (CPN-131).

V. To be used in Troxler electronics 3220 series moisture gauges, Troxler Drawing No. A-102700.

W. To be used in a Siemens Model SS10244 anatomical marker, Amersham Model AMC24, also for calibration and research.

X. To be used in a Siemens Model 035-423000 dual Isotopic Motion Correction Point Source Holder, Amersham Model AMC24, also for calibration and research.

Y. To be used for research and development, as defined in Section 30.4 of 10 CFR Part 30, and for student instruction; Amersham/Searle in a Type X-92 capsule, AMC-26X108-3675LV.

Z. Shielding in ADAC Laboratories MCD-AC attenuation correction system.

CC. To be used for laboratory research, student instruction and instrument calibration.

FF. To be used in Tracer Lab model 772 for veterinary medical therapy.

GG. and HH. Short term waste inventory for including waste materials transferred from other licenses issued to the Curators of the University of Missouri.

II. Six sources to be used in ADAC Laboratories Transmission Line Source Housing VANTAGE devices for medical radiography in humans. Six sources in shipping containers for replacement of the sources.

JJ. Four sources to used in ADAC Laboratories MCD-AC attenuation correction system for medical radiography in humans. Four sources in shipping containers for replacement of the sources.

MM. For possession only, incident to decommissioning activities.

CONDITIONS

10. Licensed material may be used at the licensee's facilities located at **The University of Missouri, Columbia Missouri campus, Columbia, Missouri**; Ellis Fischel Cancer Center, 115 Business Loop 70 West, Columbia, Missouri; and at **Women's and Children's Hospital**, 404 Keene Street, Columbia, Missouri. Portable moisture density gauges may be used at temporary job sites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

11. The Radiation Safety Officer for this license is Willie (Jack) M. Crawford, M.S.

NRC FORM 374A	U.S. NUCLEAR REGULATORY COMMISSION	PAGE 6 of 11 PAGES
	MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

12. A. The use of licensed material in or on humans shall be by an authorized user as defined in 10 CFR 35.2.

    B. Individuals designated to work as authorized users, authorized nuclear pharmacists, or authorized medical physicists, as defined in 10 CFR 35.2, shall meet the training, experience and recentness of training criteria established in 10 CFR 35, and shall be designated, in writing, by the licensee's Radiation Safety Committee.

    C. Licensed material for other than human use shall be used by, or under the supervision of, individuals designated by the Radiation Safety Committee. The licensee shall maintain records of individuals designated as users for three years after the individual's last use of licensed material.

13. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the limits specified in 10 CFR 30.72 which require consideration of the need for an emergency plan for responding to a release of licensed material.

14. For sealed sources not associated with 10 CFR Part 35 use, the following conditions apply:

    A. Sealed sources shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State.

    B. Notwithstanding Paragraph A of this Condition, sealed sources designed to primarily emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.

    C. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

    D. In the absence of a certificate from a transferor indicating that a leak test has been made within the intervals specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State, prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested and the test results received.

    E. Sealed sources need not be leak tested if they contain only hydrogen-3; or they contain only a radioactive gas; or the half-life of the isotope is 30 days or less; or they contain not more than 100 microcuries of beta- and/or gamma-emitting material or not more than 10 microcuries of alpha-emitting material.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

F. Sealed sources need not be tested if they are in storage and are not being used; however, when they are removed from storage for use or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

G. The leak test shall be capable of detecting the presence of 0.005 microcurie (185 becquerels) of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie (185 becquerels) or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(c)(2), and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations.

H. Tests for leakage and/or contamination, including leak test sample collection and analysis, shall be performed by the licensee or by other persons specifically licensed by the U. S. Nuclear Regulatory Commission or an Agreement State to perform such services.

I. Records of leak test results shall be kept in units of microcuries and shall be maintained for 3 years.

15. Pursuant to 10 CFR Part 40, "Domestic Licensing of Source Material," the licensee is authorized to possess, use, transfer, and import up to 999 kilograms of depleted uranium contained as shielding material.

16. The licensee shall conduct a physical inventory every six months, or at other intervals approved by the U.S. Nuclear Regulatory Commission, to account for all sources and/or devices received and possessed under the license

17. A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperature from exceeding that specified by the manufacturer and approved by U.S. Nuclear Regulatory Commission.

B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

18. Notwithstanding the requirements of License Condition No. 32, the licensee is authorized to make program changes and changes to procedures specifically identified in the application June 18, 2003, which were previously approved by the Commission and incorporated into the license without prior Commission approval as long as:

    A. the proposed revision is documented, reviewed, and approved by the licensee's Radiation Safety Committee, in accordance with established procedures prior to implementation;

    B. the revised program is in accordance with regulatory requirements, will not change the license conditions, and will not decrease the effectiveness of the Radiation Safety Program;

    C. the licensee's staff is trained in the revised procedures prior to implementation; and,

    D. the licensee's audit program evaluates the effectiveness of the change and its implementation.

19. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee except as authorized by the Radiation Safety Committee and as described in the facsimile dated May 30, 2007, transmitted May 31, 2007, to permit the removal of sealed sources from liquid scintillation counting devices, or other similar types of equipment, for disposal pursuant to 10 CFR 30.41, 10 CFR 30.51, Subpart K in 10 CFR 20, and the conditions of this license.

20. The licensee is authorized to hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash provided:

    A. Before disposal as ordinary trash, byproduct material shall be surveyed at the container surface with the appropriate meter set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

    B. Generator columns shall be segregated so that they may be monitored separately to ensure decay to background levels prior to disposal.

    C. A record of each disposal permitted under this License Condition shall be retained for 3 years. The record must include the date of disposal, the date on which the byproduct material was placed in storage, the radionuclides disposed, the survey instrument used, the background dose rate, the dose rate measured at the surface of each waste container, and the name of the individual who performed the disposal.

    D. Radioactive waste being held for decay shall not be stored for a period greater than 4 years.

21. Radioactive waste other than that specified in Condition 20. shall not be stored for a period greater than 2 years.

22. Notwithstanding Conditions 20. and 21., radioactive waste transferred from other University of Missouri Licenses shall be disposed of within one year of receipt.

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

23. A. Pursuant to 10 CFR 20.1302(c), and 10 CFR 20.2002, the licensee is authorized to dispose of licensed material by incineration provided the gaseous effluent from incineration does not exceed the limits specified for air in Appendix B, Table I, Column I, 10 CFR Part 20.

    B. Pursuant to 10 CFR 20.2002, the licensee may dispose of incinerator ash containing radioactive materials with Atomic Nos. 1-83, other than those isotopes listed below, as ordinary waste in a landfill, provided the concentrations of the isotopes, expressed in microcurie (μCi) per gram of ash, at the time of disposal, do not exceed the numerical values listed in Table II, Column 2, 10 CFR 20, Appendix B. Isotopes not included are hydrogen-3, carbon-14, aluminum-26, chlorine-36, silver-108m, niobium-94, iodine-129, technetium-99, and thallium-204, for which the concentrations must not exceed 10 percent of the values listed in Table II, Column 2, 10 CFR Part 20, Appendix B.

    C. Pursuant to 10 CFR 20.2002, the licensee may incinerate tritium waste without the requirement for removing any ash previous to or following tritium waste incineration, provided the ash is not used for the dilution of subsequently incinerated waste containing other licensed materials.

24. The licensee shall not use licensed material in or on human beings except as provided otherwise by specific condition of this license.

25. Experimental animals, or the products from experimental animals, that have been administered licensed materials shall not be used for human consumption.

26. The licensee shall not acquire licensed material in a sealed source or device that contains a sealed source unless the source or device has been registered with the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or with an Agreement State.

27. The licensee is authorized to transport licensed material only in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

28. The licensee shall maintain records of information related to decommissioning at the EHS Main Offices, 1306 Research Park Drive, Columbia, Missouri as specified in 10 CFR 30.35(g) until this license is terminated by the Commission.

29. Each portable nuclear gauge shall have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The gauge or its container must be locked when in transport. A minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal whenever the portable gauge is not under the control and constant surveillance of the licensee are required.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32
	Docket or Reference Number 030-02278
	Amendment No. 108

30. A. If the licensee uses unshielded sealed sources extended more than 3 feet below the surface, the licensee shall use surface casing that extends from the lowest depth to 12 inches above the surface and other appropriate procedures to reduce the probability of the source or probe becoming lodged below the surface. If it is not feasible to extend the casing 12 inches above the surface, the licensee shall implement procedures to ensure that the cased hole is free of obstruction before making measurements.

B. If a sealed source or a probe containing sealed sources becomes lodged below the surface and it becomes apparent that efforts to recover the sealed source or probe may not be successful, the licensee shall notify the U. S. Nuclear Regulatory Commission and submit the report required by 10 CFR 30.50(b)(2) and (c). The licensee shall not abandon the sealed source or probe without obtaining the Commission's prior written consent.

31. (b)(7)(F)

NRC FORM 374A	U.S. NUCLEAR REGULATORY COMMISSION	PAGE 11 of 11 PAGES
	MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number 24-00513-32 Docket or Reference Number 030-02278 Amendment No. 108

32. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below, except for minor changes in the medical use radiation safety procedures as provided in 10 CFR 35.31. The U.S. Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Application June 18, 2003;

B. Letters dated October 23, 2003, November 25, 2003, and October 25, 2010; and,

C. Facsimiles dated April 12, 2007 (excluding items 1, 2, 3, 5 and 10), April 25, 2007, and May 30, 2007, transmitted on May 31, 2007.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

ate FEB 04 2011

By Colleen Carol Casey

Colleen Carol Casey
Materials Licensing Branch
Region III

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.				
Name of room, laboratory, or area:	Area 1: Research and Medical Laboratories (400 Laboratories)			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods	400	144	57,600	ft^3
Lab Benches	400	270	108,000	ft^3
Sinks	800	8	6,400	ft^3
Drains	800	3.75	3,000	ft^3
Floors	400	256	102,400	ft^2
Walls	400	640	256,000	ft^2
Ceiling	400	256	102,400	ft^2
Ventilation/Ductwork	400	30	12,000	ft^3
Hot Cells				ft^3
Equipment/Materials	400	7.5	3,000	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: Farm Buildings (25 Buildings)			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks	50	8	400	ft^3
Drains	250	3.75	937.5	ft^3
Floors	25	5,000	125,000	ft^2
Walls	25	6,000	150,000	ft^2
Ceiling	25	5,000	125,000	ft^2
Ventilation/Ductwork	100	30	3,000	ft^3
Hot Cells				ft^3
Equipment/Materials	25	7.5	187.5	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 3: Radioactive Waste Areas (satellite collection areas included with labs)			
Level of Contamination:	MARSSIM Class 1			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods	2	144	288	ft^3
Lab Benches	2	270	540	ft^3
Sinks	6	8	48	ft^3
Drains	10	3.75	38	ft^3
Floors	2	256	512	ft^2
Walls	2	640	1,280	ft^2
Ceiling	2	256	512	ft^2
Ventilation/Ductwork	6	30	180	ft^3
Hot Cells				ft^3
Equipment/Materials	2	96	192	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify)				ft^3
Other (specify)				ft^3

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan						
Development of Work Plans	10	5	1	0	0	5
Procurement of Special Equipment	1	1	0	0	0	1
Staff Training	1	1	1	6	2	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	20	13	4	24	2	7

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS
(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of

Name of room, laboratory, or area:	Research and Medical Labs, Radwaste Areas, Farm Buildings
Level of Contamination:	From background levels to DCGLs

Component	Decon Method	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Glove Boxes							
Fume Hoods/ Hot Cells	Decon				120	20	
Lab Benches	Decon				60	10	
Sinks	Decon						
Drains	Remove/Disp				120	20	
Floors	Decon				60	10	
Walls	Decon				60	10	
Ceilings							
Ventilation/Ductwork	Remove/Disp				120	20	
Hot Cells							
Equipment/Materials	Sur/Rem/Disp				102	34	
Soil Plots							
Storage Tanks							
Storage Areas							
Radwaste Areas							
Scrap Recovery Areas							
Maintenance Shop							
Equipment Decon Areas							
Other (specify) Shipping				10			
Other (specify) Supervision		62	62				
TOTALS		62	62	10	642	124	

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.

Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Restore Roof Penetrations	2	2			4	
TOTALS	2	2	0	0	4	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.

Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
FSS Setup	10	5		10		5
Survey Packages	10	5		10		5
Class 2 Research Labs	40	40		240		40
Class 2 Farm Buildings	10	10		60		10
Class 1 Waste Storage Area	5	5		30		5
Class 3 Buffer Areas	10	10		60		10
Report	15		3	3		3
TOTALS	100	75	3	413	0	78

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.						
Activity	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10).						
Task	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	20	13	4	24	2	7
Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7)	62	62	10	642	124	0
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	2	2	0	0	4	0
Final Radiation Survey (TOTALS from Table A.3.9)	100	75	3	413	0	78
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.						
Labor Cost Component	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,046	$959	$786	$375	$260

[1] Per Diem Rate: $129 per day.
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr	(1) HPS	(1) Health Physicist/ (1) Shipper	(6) HPT's / (1) Draftsman	(2) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$23,804	$13,598	$3,838	$18,873	$750	$1,817	$62,680
Decontamination or Dismantling of Radioactive Facility Components	$73,793	$64,851	$9,594	$504,849	$46,500	$0	$699,588
Restoration of Contaminated Areas on Facility Grounds	$2,380	$2,092	$0	$0	$1,500	$0	$5,972
Final Radiation Survey	$119,022	$78,449	$2,878	$324,770	$0	$20,250	$545,369
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES
(Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE from Decomm.	3188	119	1 m^3 Sacks	$80	$9,520
LSC Vials	45	6	Drum	$70	$420
All DAW/PPE/LSC Vials	2,560	2	Rented Seavan	$2,000	$4,000
TOTAL					$13,940

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE from Decomm.	1.5	$3.50	0	0	600	$3,150
LSC Vials	0.25	$3.50	0	0	600	$525
Annual Waste Inventory	0.25	$3.50	0	0	600	$525
Self-Shielded Irradiator	1					$55,931
TOTAL	3					$60,131

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/$ft^3$ or $/container)	Total Disposal Costs
DAW/PPE from Decomm.	3,188	20	63,750	6.00	0	$382,500
LSC Vials	45	40	1,800	5.00	0	$9,000
Annual Waste Inventory	885	10	8,850	6.00	0	$53,100
TOTAL	3,233					$444,600

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	144	$8	$1,152
Instrumentation Rental (per week)	15	$2,000	$30,000
Misc Tools (per week)	15	$1,000	$15,000
LSC Supplies (per sample)	15,000	$1	$15,000
Consumables (per week)	15	$1,000	$15,000
TOTAL			$76,152

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.			
Activity	Quantity	Unit Cost	Total Item Cost
Sampling			
Transport of Samples			
Testing and Analysis			
Other (specify)			
TOTAL			

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (reciprocity)	$2,000
Insurance (included in unit rates)	
Taxes (included in unit rates)	
Other (specify)	
TOTAL	$2,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in		
Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$62,680	3.3%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$699,588	36.6%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$5,972	0.3%
Final Radiation Survey (From Table A.3.13)	$545,369	28.5%
Packing Material Costs (TOTAL from Table A.3.14(a))	$13,940	0.7%
Shipping Costs (TOTAL from Table A.3.14(b))	$60,131	3.1%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$444,600	23.3%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$76,152	4.0%
Laboratory Costs (TOTAL from Table A.3.16)	$0	0.0%
Miscellaneous Costs (TOTAL from Table A.3.17)	$2,000	0.1%
SUBTOTAL	$1,910,432	100.0%
25% Contingency	$477,608	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$2,388,040	125.0%

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.

Name of room, laboratory, or area:	Area 1: Pickard Hall
Level of Contamination:	MARSSIM Class 1

Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains	10	3.75	38	ft^3
Floors	1	33,600	33,600	ft^2
Walls	1	134,400	134,400	ft^2
Ceiling	1	33,600	33,600	ft^2
Ventilation/Ductwork	7	60	420	ft^3
Hot Cells				ft^3
Equipment/Materials	1	96	96	ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Roof	1	12,600	12,600	ft^2
Other (specify)				ft^3

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: Schweitzer Hall			
Level of Contamination:	MARSSIM Class 1			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft³
Fume Hoods				ft³
Lab Benches				ft³
Sinks				ft³
Drains	2	3.75	8	ft³
Floors	1	9,900	9,900	ft²
Walls	1	4,950	4,950	ft²
Ceiling	1	9,900	9,900	ft²
Ventilation/Ductwork	2	60	120	ft³
Hot Cells				ft³
Equipment/Materials	1	96	96	ft³
Soil Plots				ft²
Storage Tanks				ft³
Storage Areas				ft³
Radwaste Areas				ft³
Scrap Recovery Areas				ft³
Maintenance Shop				ft³
Equipment Decon Areas				ft³
Other (specify) Roof	1	14,850	14,850	ft²
Other (specify)				ft³

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan	20	10	10	20	0	10
Development of Work Plans	10	5	5	10	0	5
Procurement of Special Equipment	4	4	0	0	0	1
Staff Training	1	2	2	8	6	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	43	27	19	56	6	17

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS
(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of

Name of room, laboratory, or area: Pickard Hall and Schweitzer Hall

Level of Contamination: From background levels to above DCGLs

Component	Decon Method	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Pickard Hall							
Drains	Remove/Disp				40	30	
Floors	Scabble/Rem				80	60	
Walls	Remove/Disp				20	15	
Ceilings	Plane Attic				60	45	
Ventilation/Ductwork	Remove/Disp				60	45	
Equipment/Materials	Sur/Rem/Disp				8	6	
Soil Plots	Rem Soil				60	45	
Schweitzer Hall							
Drains	Remove/Disp				16	12	
Floors	Scabble/Rem				40	30	
Walls	Remove/Disp				8	6	
Ceilings	Plane Attic				60	45	
Roof	Remove/Disp						
Ventilation/Ductwork	Remove/Disp				60	45	
Equipment/Materials	Sur/Rem/Disp				8	6	
Soil Plots	Rem Soil				20	15	
Other (specify) Shipping				90			
Other (specify) Supervision		90	180				90
TOTALS		90	180	90	540	405	90

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Restore Roof	10	10		10	60	
Backfill Excavations	3	3		6	18	
TOTALS	13	13	0	16	78	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical	
FSS Setup	5	2		2		2	
Survey Packages	5	2		2		2	
Structures	10	10		60		10	10 days
Soils	5	5		30		5	5 Days
Report	15		3	3		3	
TOTALS	40	19	3	97	0	22	

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE (Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10).

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	43	27	19	56	6	17
Decontamination and/or Dismantling of Radioactive *Facility Components* (Sum of TOTALS from all copies of Table A.3.7)	90	180	90	540	405	90
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	13	13	0	16	78	0
Final Radiation Survey (TOTALS from Table A.3.9)	40	19	3	97	0	22
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Labor Cost Component	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,046	$959	$786	$375	$260

[1] Per Diem Rate: $129 per day.
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(6) HPT's or (1) Draftsman or (2) Equipment Operators	(6) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$51,179	$28,242	$18,229	$44,037	$2,250	$4,413	$148,350
Decontamination or Dismantling of Radioactive Facility Components	$107,119	$188,277	$86,350	$424,639	$151,875	$23,365	$981,627
Restoration of Contaminated Areas on Facility Grounds	$15,473	$13,598	$0	$12,582	$29,250	$0	$70,903
Final Radiation Survey	$47,609	$19,874	$2,878	$76,278	$0	$5,712	$152,350
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES (Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE	162	6	1 m^3 Sacks	$80	$480
Wood Floor, Roof	7680	3	Rented Seavan	$2,000	$6,000
Soil, Slate and Rubble	8100	15	Rented Roll-Off	$500	$7,500
TOTAL					$13,980

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE	1	$3.50	0	0	600	$2,100
Wood Floor, Roof	3	$3.50	0	0	600	$6,300
Soil, Slate and Rubble	15	$3.50	0	0	2000	$105,000
TOTAL	19					$113,400

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/ft^3 or $/container)	Total Disposal Costs
DAW/PPE	162	20	3,240	6.00	0	$19,440
Wood Floor, Roof	1960	60	117,600	6.00	0	$705,600
Soil, Slate and Rubble	7980	105	837,900	2.00	0	$1,675,800
TOTAL	2,122					$2,400,840

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.			
Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	3600	$8	$28,800
Instrumentation Rental (per week)	22	$2,000	$44,000
Misc Tools (per week)	22	$1,000	$22,000
Heavy Equipment Rental	18	$10,000	$180,000
Consumables (per week)	22	$1,000	$22,000
TOTAL			$296,800

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.

Activity	Quantity	Unit Cost	Total Item Cost
Sampling			Labor captured in remediation / FSS
Transport of Samples	10	$500	$5,000
Testing and Analysis (gamma)	200	$150	$30,000
Testing and Analysis (alpha)	20	$300	$6,000
Other (specify)			
TOTAL			$41,000

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (2 yrs reciprocity)	$4,000
Insurance (included in unit rates)	
Taxes (included in unit rates)	
Other (specify)	
TOTAL	$4,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in		
Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$148,350	3.5%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$981,627	23.2%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$70,903	1.7%
Final Radiation Survey (From Table A.3.13)	$152,350	3.6%
Packing Material Costs (TOTAL from Table A.3.14(a))	$13,980	0.3%
Shipping Costs (TOTAL from Table A.3.14(b))	$113,400	2.7%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$2,400,840	56.8%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$296,800	7.0%
Laboratory Costs (TOTAL from Table A.3.16)	$41,000	1.0%
Miscellaneous Costs (TOTAL from Table A.3.17)	$4,000	0.1%
SUBTOTAL	$4,223,250	100.0%
25% Contingency	$1,055,813	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$5,279,063	125.0%

A.3.4 FACILITY DESCRIPTION SUMMARY

Radioactive Material license numbers and types (i.e., Byproduct, Source):
See DFP text.
Types and quantities of materials authorized under the licenses listed above:
See DFP text.
Description of how licensed materials are used:
See DFP text.
Description of facility, including buildings, rooms, grounds, and description of where particular types of materials are used:
See DFP text.
Quantities of materials or waste accumulated before shipping or disposal
See DFP text.

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS

Use this table to summarize relevant features of the facility. Copy and complete the table as necessary for each room, laboratory, or area.				
Name of room, laboratory, or area:	Area 1: Sinclair Farm			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains				ft^3
Floors				ft^2
Walls				ft^2
Ceiling				ft^2
Ventilation/Ductwork				ft^3
Hot Cells				ft^3
Equipment/Materials				ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Lagoons	2	2	4	acre
Other (specify) Impacted Grounds	1	100	100	acre

A.3.5 NUMBER AND DIMENSIONS OF FACILITY COMPONENTS (Cont'd)

Name of room, laboratory, or area:	Area 2: South Farm			
Level of Contamination:	MARSSIM Class 2			
Component	Number of Components	Dimensions of Component (specify units)	Total Dimensions (specify units)	
Glove Boxes				ft^3
Fume Hoods				ft^3
Lab Benches				ft^3
Sinks				ft^3
Drains				ft^3
Floors				ft^2
Walls				ft^2
Ceiling				ft^2
Ventilation/Ductwork				ft^3
Hot Cells				ft^3
Equipment/Materials				ft^3
Soil Plots				ft^2
Storage Tanks				ft^3
Storage Areas				ft^3
Radwaste Areas				ft^3
Scrap Recovery Areas				ft^3
Maintenance Shop				ft^3
Equipment Decon Areas				ft^3
Other (specify) Burial Site	1	0.34	0.34	acre
Other (specify) Impacted Grounds	1	5	5	acre

A.3.6 PLANNING AND PREPARATION

(Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete planning and preparation activities. Include all labor categories, including Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Preparation of Documentation for Regulatory Agencies	2	0	1	2	0	1
Submittal of Decommissioning Plan	20	10	10	20	0	10
Development of Work Plans	10	5	5	10	0	5
Procurement of Special Equipment	4	4	0	0	0	1
Staff Training	1	2	2	8	6	0
Characterization of Radiological Condition (including sampling, soil and tailings analysis, or groundwater analysis, if applicable)	5	5	0	10	0	0
Other (specify) Mobilization	1	1	1	6	0	0
TOTALS	43	27	19	56	6	17

A.3.7 DECONTAMINATION OR DISMANTLING OF RADIOACTIVE FACILITY COMPONENTS (Work Days)

Estimate the number of workdays, by specific labor category, that will be required to complete decontamination and/or dismantling activities for each facility component. Copy and complete this table as necessary for each room, laboratory, or area. Rooms, laboratories, or areas with similar levels of

Name of room, laboratory, or area:		Outdoor Areas					
Level of Contamination:		From background levels to DCGLs					
Component	Decon Method	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Glove Boxes							
Fume Hoods/ Hot Cells							
Lab Benches							
Sinks							
Drains							
Floors							
Walls							
Ceilings							
Ventilation/Ductwork							
Hot Cells							
Equipment/Materials							
Soil Plots	Rem/Dispose				20	10	
Storage Tanks							
Storage Areas							
Radwaste Areas							
Scrap Recovery Areas							
Maintenance Shop							
Equipment Decon Areas							
Other (specify) Shipping				5			
Other (specify) Supervision		5	10				5
TOTALS		5	10	5	20	10	5

A.3.8 RESTORATION OF CONTAMINATED AREAS ON FACILITY GROUNDS
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to restore contaminated areas on the facility grounds.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Grade Excavations	2	2		2	4	
TOTALS	2	2	0	2	4	0

A.3.9 FINAL RADIATION SURVEY

(Work Days)

Estimate the number of work days, by specific labor category, that will be required to conduct a final radiation survey.

Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
FSS Setup	5	2		2		2
Survey Packages	5	2		2		2
Soils Surveys/Sampling	15	15		30	30	15
Report	10		2	2		2
TOTALS	35	19	2	36	30	21

A.3.10 SITE STABILIZATION AND LONG-TERM SURVEILLANCE
(Work Days)

Estimate the number of work days, by specific labor category, that will be required to complete site stabilization and long-term surveillance activities.						
Activity	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
None - Unrestricted Release						
TOTALS	0	0	0	0	0	0

A.3.11 TOTAL WORK DAYS BY LABOR CATEGORY

Enter the total work days for each specific labor category from the applicable table above (i.e., from the bottom rows of Tables A.3.6 through A.3.10).

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Planning and Preparation (TOTALS from Table A.3.6)	43	27	19	56	6	17
Decontamination and/or Dismantling of Radioactive Facility Components (Sum of TOTALS from all copies of Table A.3.7)	5	10	5	20	10	5
Restoration of Contaminated Areas on Facility Grounds (TOTALS from Table A.3.8)	2	2	0	2	4	0
Final Radiation Survey (TOTALS from Table A.3.9)	35	19	2	36	30	21
Site Stabilization and Long-Term Surveillance (TOTALS from Table A.3.10)	0	0	0	0	0	0

A.3.12 WORKER UNIT COST SCHEDULE

Estimate labor costs (including salary, fringe benefits, and corporate overhead). Include all appropriate labor categories, including *Supervisor, Foreman, Craftsman, Technician, Health Physicist, Laborer, Clerical, and others as needed.*

Labor Cost Component	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical
Salary & Fringe ($/year)	$175,000	$150,000	$135,000	$105,000	$65,000	$45,000
Overhead Rate (%)	50%	50%	50%	50%	50%	50%
Total Cost Per Year	$262,500	$225,000	$202,500	$157,500	$97,500	$67,500
Living Expenses (PD*7/5)[1]	$181	$181	$181	$181	0	0
Total Cost Per Work Day[2]	$1,190	$1,048	$959	$786	$375	$260

[1] Per Diem Rate: $129 per day.
[2] Based on 260 work days per year (e.g., 260).

A.3.13 TOTAL LABOR COSTS BY MAJOR DECOMMISSIONING TASK

Multiply the estimated work days for each specific labor category (from Table A.3.11) by the total cost per work day for the corresponding labor category (from Table A.3.12), and enter the results in the table below. Then, add across all labor categories to determine the total labor costs for each

Task	(1) Project Mgr or (1) Structural Engineer	(1) HPS or (1) Foreman	(1) Health Physicist or (1) Shipper	(2) HPT's or (1) Draftsman or (2) Equipment Operators	(2) Laborer	Clerical	Total Labor Cost
Planning and Preparation	$51,179	$28,242	$18,229	$44,037	$2,250	$4,413	$148,350
Decontamination or Dismantling of Radioactive Facility Components	$5,951	$10,460	$4,797	$15,727	$3,750	$1,298	$41,984
Restoration of Contaminated Areas on Facility Grounds	$2,380	$2,092	$0	$1,573	$1,500	$0	$7,545
Final Radiation Survey	$41,658	$19,874	$1,919	$28,309	$11,250	$5,452	$108,461
Site Stabilization and Long-Term Surveillance	$0	$0	$0	$0	$0	$0	$0

A.3.14 PACKAGING, SHIPPING, AND DISPOSAL OF RADIOACTIVE WASTES (Excluding Labor Costs)

(a) Packing Material Costs

Estimate the types and volumes of waste expected to be generated, along with the number and types of containers required for packaging the waste. Multiply the number of containers required by the unit cost per container.

Waste Type	Volume (ft^3)	Number of Containers	Type of Containers	Unit Cost of Container	Total Packaging Costs
DAW/PPE	54	2	1 m^3 Sacks	$80	$160
Soil	1080	2	Rented Roll-Off	$500	$1,000
TOTAL					$1,160

(b) Shipping Costs

Estimate the number of truckloads of waste expected to be shipped. Multiply shipping costs per mile (including truckload costs, surcharges, and overweight charges) by the total distance shipped.

Waste Type	Number of Truckloads	Unit Cost ($/mile/truckload)	Surcharges ($/mile)	Overweight Charges($/mile)	Distance Shipped (miles)	Total Shipping Costs
DAW/PPE	1	$3.50	0	0	600	$2,100
Soil	2	$3.50	0	0	600	$4,200
TOTAL	3					$6,300

(c) Waste Disposal Costs

Estimate the volume of waste to be disposed. Multiply the volume of waste disposed by the unit disposal cost (including any volume-based surcharges). Add any surcharges that are based on the number of containers of waste.

Waste Type	Disposal Volume (ft3)	Density (lb/ft3)	Disposal Mass (lbs)	Unit Cost ($/lb)	Surcharges ($/$ft^3$ or $/container)	Total Disposal Costs
DAW/PPE	54	20	1,080	6.00	0	$6,480
Soil	1080	90	97,200	5.00	0	$486,000
TOTAL	54					$492,480

A.3.15 EQUIPMENT/SUPPLY COSTS (Excluding Containers)

Estimate the quantity of equipment and supplies required for decommissioning and multiply that quantity by the appropriate unit costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/Supply Cost
Protective Clothing (per dress-out)	400	$8	$3,200
Instrumentation Rental (per week)	5	$2,000	$10,000
Misc Tools (per week)	5	$1,000	$5,000
Heavy Equipment Rental	2	$10,000	$20,000
Consumables (per week)	5	$1,000	$5,000
TOTAL			$43,200

A.3.16 LABORATORY COSTS

If applicable, estimate costs for analyses to be performed by an independent third-party laboratory.

Activity	Quantity	Unit Cost	Total Item Cost
Sampling			Labor captured in remediation / FSS
Transport of Samples	20	$500	$10,000
Testing and Analysis (gamma)	600	$150	$90,000
Testing and Analysis (C-14/H-3)	600	$250	$150,000
Other (specify)			
TOTAL			$250,000

A.3.17 MISCELLANEOUS COSTS

Estimate any other applicable costs.	
Activity	Total Cost
License Fees (2 yrs reciprocity)	$4,000
Insurance (included in unit rates)	
Taxes (included in unit rates)	
Other (specify)	
TOTAL	$4,000

A.3.18 TOTAL DECOMMISSIONING COSTS

Enter the total costs reported in Tables A.3.13, A.3.14(a)-(c), A.3.15, A.3.16, and A.3.17 into the appropriate cells below, and add then to obtain a subtotal. Add to the subtotal a contingency allowance in

Task/Component	Cost	Percentage
Planning and Preparation (from Table A.3.13)	$148,350	13.4%
Decontamination and/or Dismantling of Radioactive Facility (From Table A.3.13)	$41,984	3.8%
Restoration of Contaminated Areas on Facility Grounds (From Table A.3.13)	$7,545	0.7%
Final Radiation Survey (From Table A.3.13)	$108,461	9.8%
Packing Material Costs (TOTAL from Table A.3.14(a))	$1,160	0.1%
Shipping Costs (TOTAL from Table A.3.14(b))	$6,300	0.6%
Waste Disposal Costs (TOTAL from Table A.3.14(c))	$492,480	44.6%
Equipment/Supply Costs (TOTAL from Table A.3.15)	$43,200	3.9%
Laboratory Costs (TOTAL from Table A.3.16)	$250,000	22.7%
Miscellaneous Costs (TOTAL from Table A.3.17)	$4,000	0.4%
SUBTOTAL	$1,103,480	100.0%
25% Contingency	$275,870	25.0%
TOTAL DECOMMISSIONING COST ESTIMATE	$1,379,350	125.0%

Office of the Vice Chancellor
for Administrative Services

University of Missouri-Columbia

319 Jesse Hall
Columbia, MO 65211-1250

PHONE (573) 882-4097
FAX (573) 884-4847

June 1, 2011

TO: U.S. Nuclear Regulatory Commission
U.S. NRC Region III
801 Warrenville Road
Lisle, Illinois 60532

STATEMENT OF INTENT

As Vice Chancellor of Administrative Services of the University of Missouri, I exercise express authority and responsibility to request from the Board of Curators of the University of Missouri funds for decommissioning activities associated with operations authorized by U.S. Nuclear Regulatory Commission Material License No. 24-00513-32. This authority is established by the Collected Rules and Regulations of the University of Missouri. Within this authority I intend to request that funds be made available when necessary in the amount of $9,046,453.00 (Nine Million Forty-Six Thousand Four Hundred Fifty-Three Dollars) to decommission the properties owned by the University of Missouri. I intend to request and obtain these funds sufficiently in advance of decommissioning to prevent delay of required activities.

A copy of the University's Collected Rules and Regulations Section 70.010 is attached as evidence that I am authorized to represent the University of Missouri in this transaction.

Sincerely,

Jacquelyn K. Jones
Vice Chancellor for Administrative Services

Attachment: As Stated

University of Missouri System
COLUMBIA | KANSAS CITY | ROLLA | ST. LOUIS

Chapter 70: Execution of Instruments

70.010 General Execution of Corporate or Board Instruments

172.390; R.S.Mo. 1959; Bd. Min. 4-11-58, p. 12,512; Amended 5-20-77, p. 37,690 and 3-28-80, p. 38,100; Revised Bd. Min. 6-14-85; 1-21-98, Revised Bd. Min. 5-5-06.

A. **All Instruments**—All instruments affecting The Curators of the University of Missouri, the Board of Curators of the University of Missouri, or the University generally shall be executed on behalf thereof as provided in this section unless execution thereof shall have otherwise been specifically provided for and directed by the Board.

B. **Real Estate**

   1. Any of the lands donated by the Atlantic & Pacific Railroad Company to the State of Missouri by deed dated the sixteenth day of February, 1871, and all other lands conveyed by corporations or individuals to the State of Missouri for sale in aid of the state university, may be sold and conveyed by the board of curators, and deeds of conveyance to same shall be executed by the president of the board, signed by him, with the seal of the corporation attached thereto, and attested by the secretary of the board; and provided further, that any conveyances of such lands heretofore made by said board in accordance with the provisions of this section shall divest the State of Missouri of all title to the same and vest said title in the grantees, their heirs and assigns forever.
   2. Instruments conveying title to real estate owned by The Curators of the University of Missouri shall, upon approval of same by the Board of Curators or University President as delegated by the Board, be executed in the name of The Curators of the University of Missouri and signed by the President of the University or his/her designee, with the corporate seal affixed, attested by the Secretary.

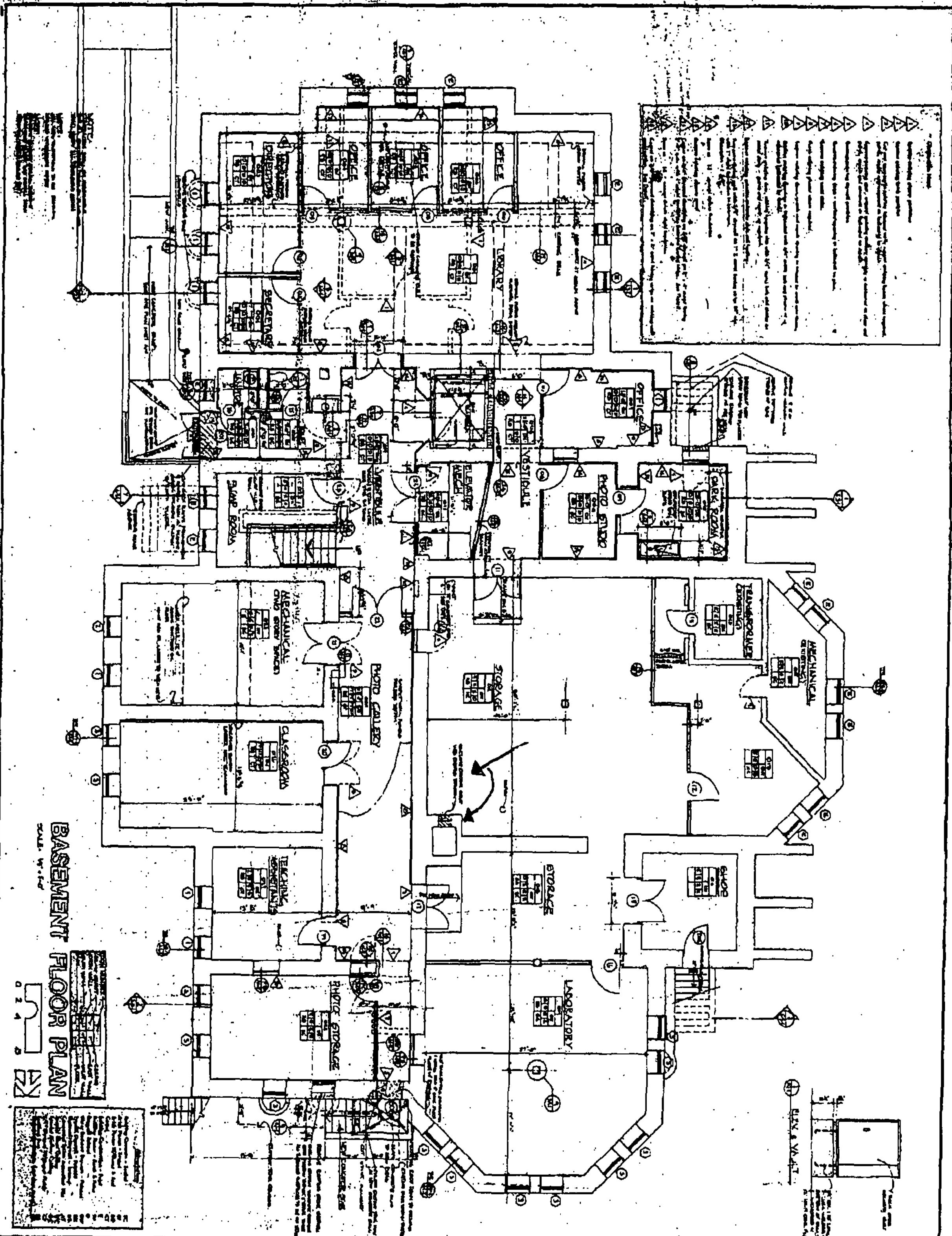
C. **All Contracts, Other Instruments and Agreements**—All contracts and other instruments and agreements of The Curators of the University of Missouri shall be executed in the name of The Curators of the University of Missouri and signed by the President thereof, the President of the University, the Vice President for Finance and Administration, or such other officer as may be specifically designated by the Board, and the corporate seal may be affixed, attested by the Secretary. The named officers

Attachment 2 – Various Schematics of Ductwork for Pickard Hall (7 pages)


CIRCA 1895

CIRCA
1995

RC 020 A-2-1 74 00



HS/A HOFFMANN/SAUR AND ASSOCIATES, INC. ARCHITECTS/ENGINEERS/PLANNERS

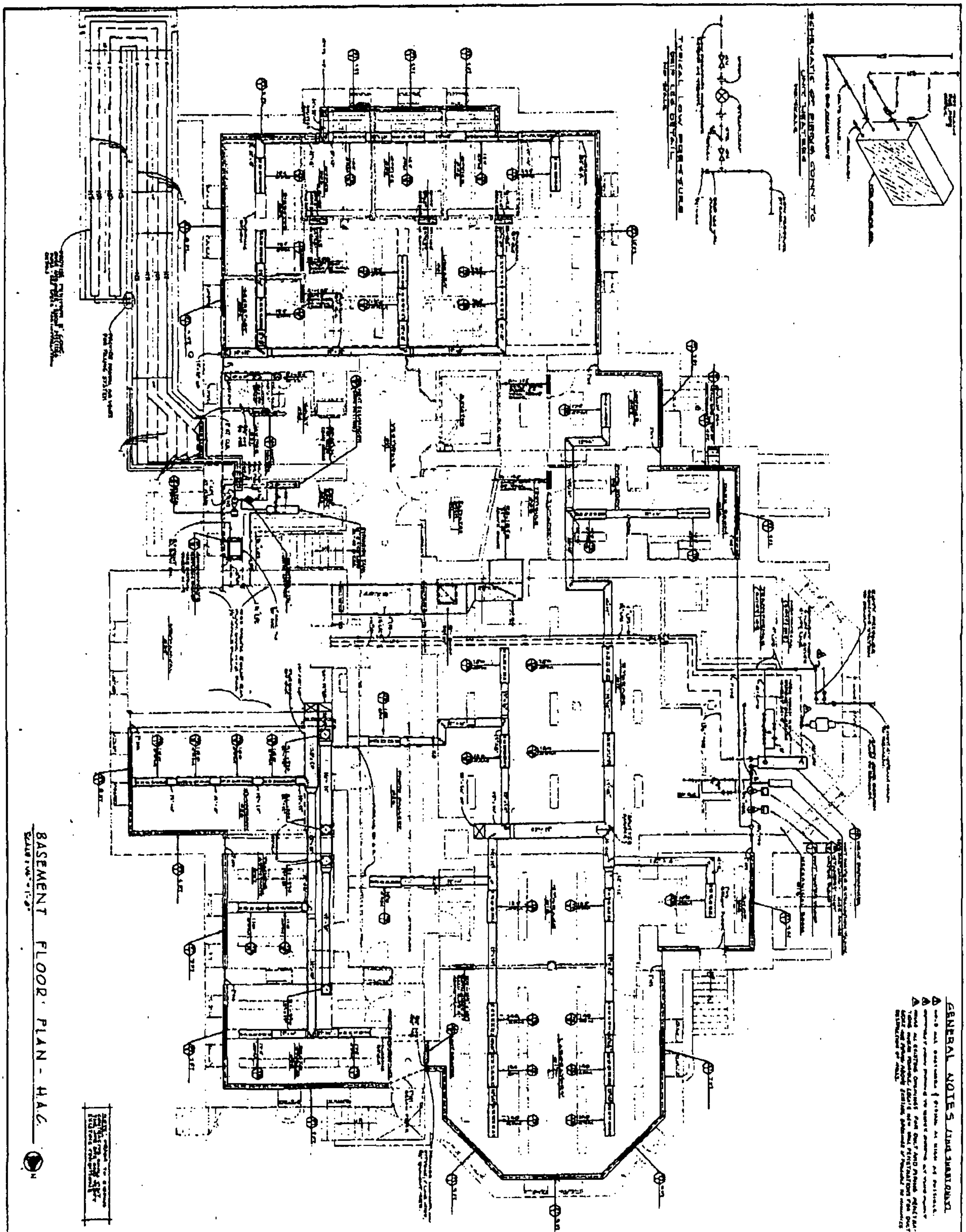
ST. LOUIS, MISSOURI

A-2-1

OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA
COLUMBIA, MISSOURI

HS/A NO 722

RC 020 H02 74 00



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OLD CHEMISTRY BUILDING RENOVATION

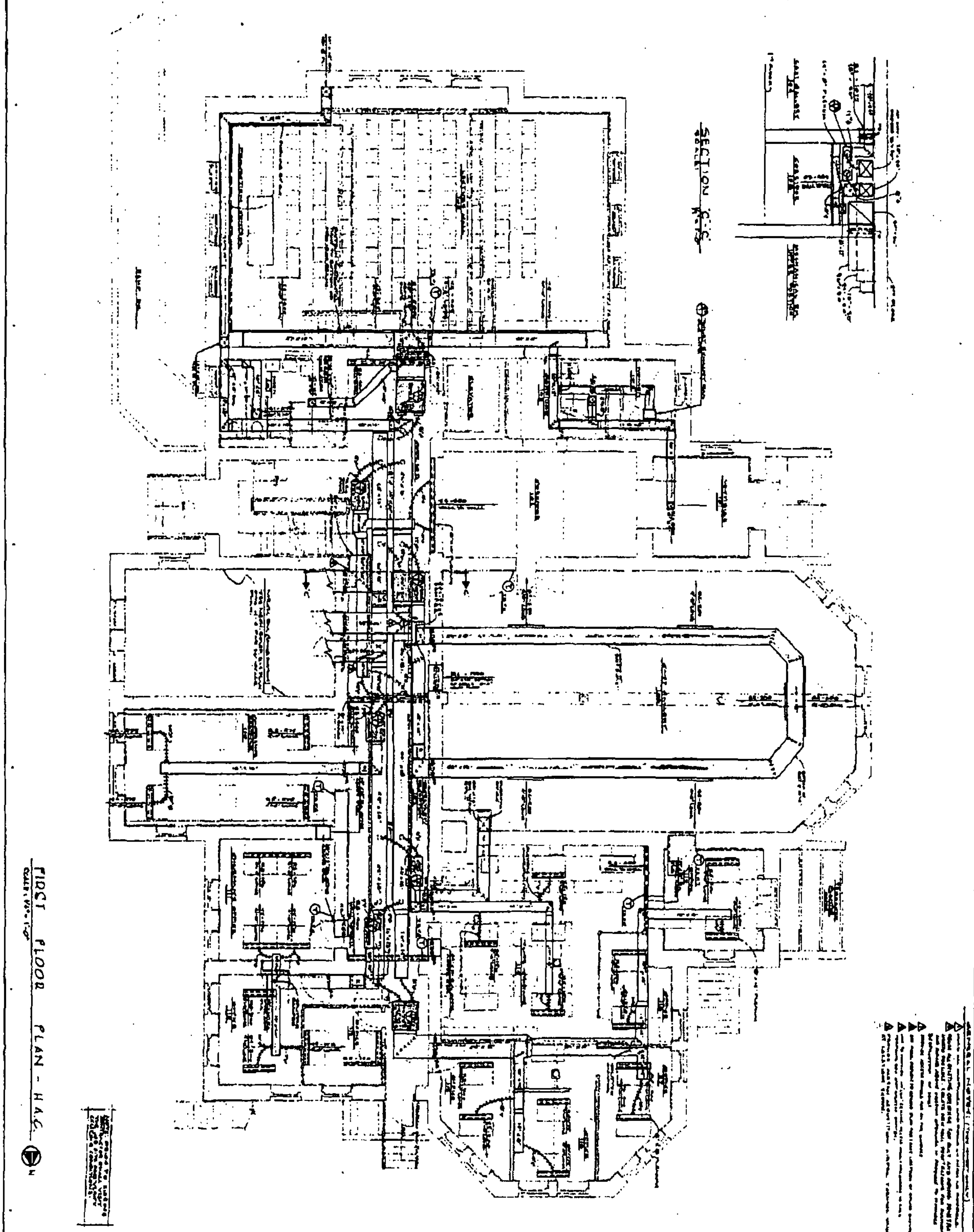
UNIVERSITY OF MISSOURI - COLUMBIA

COLUMBIA, MISSOURI HS/A Nº 722

JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER - BANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

H-2

RC 020 H03 74 00



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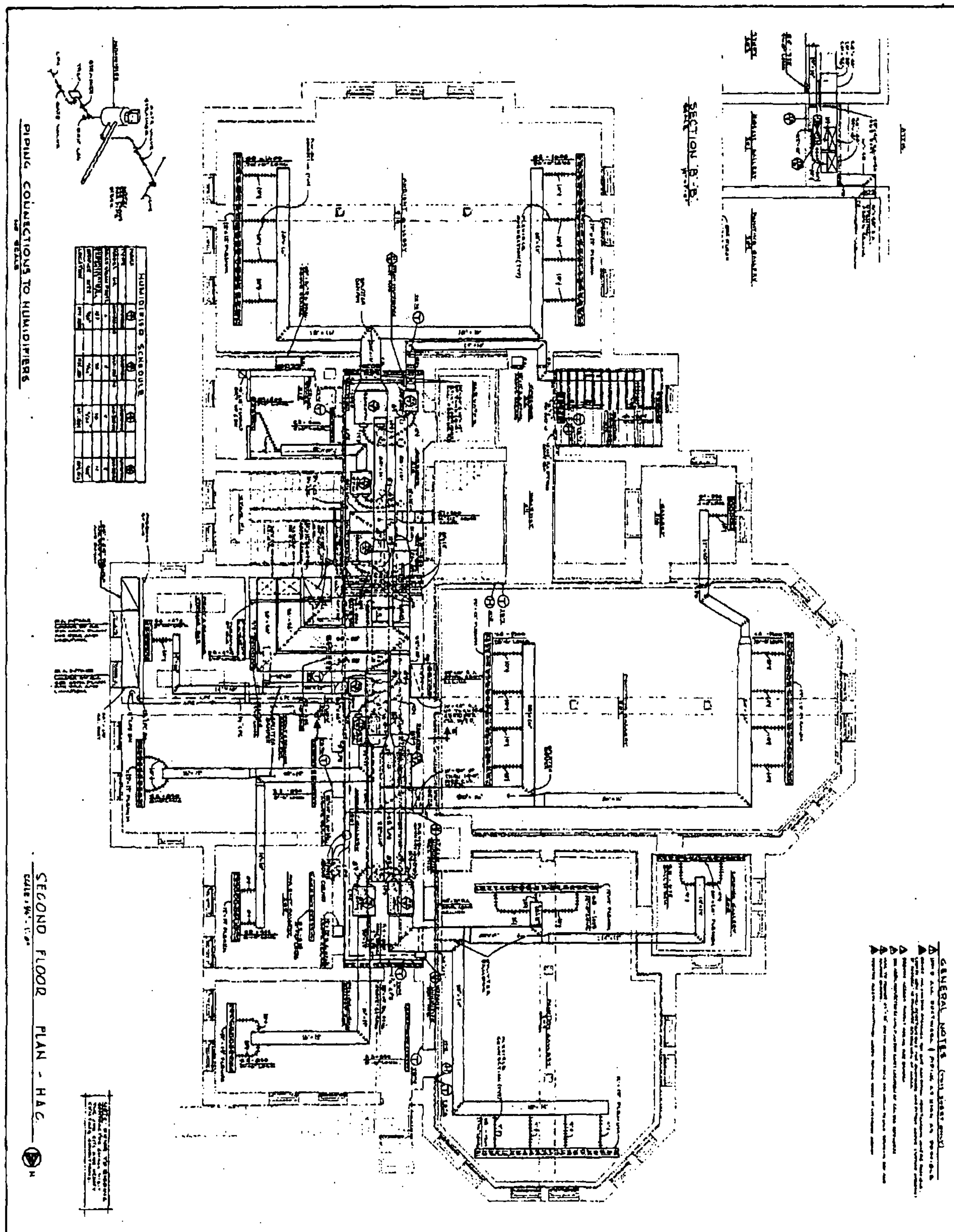
H-3

RC 020 H04 74 00



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7777 BONHOMME AVENUE/SUITE 2000 ST. LOUIS, MISSOURI

OLD CHEMISTRY BUILDING RENOVATION
UNIVERSITY OF MISSOURI - COLUMBIA

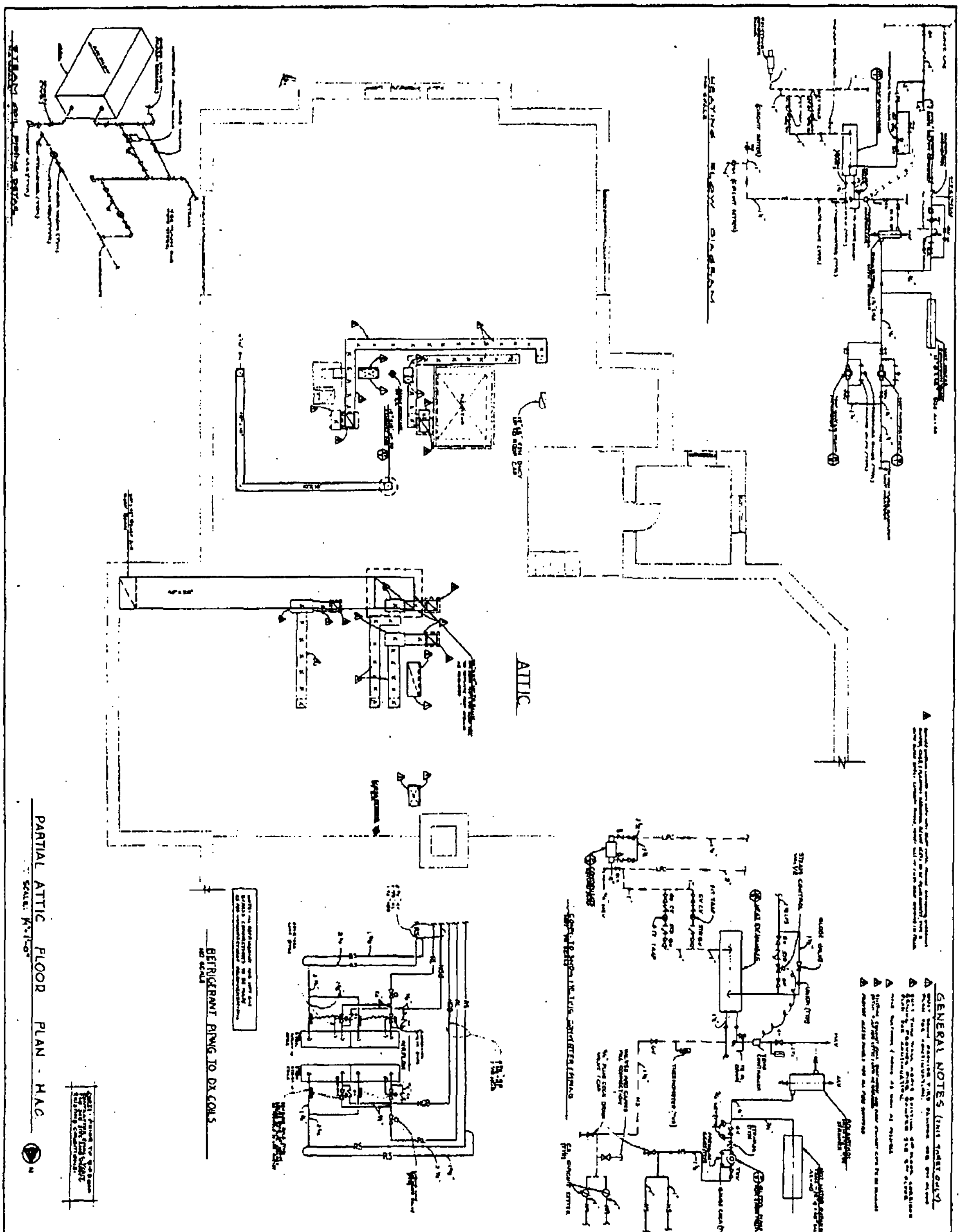
COLUMBIA, MISSOURI HS/A Nº 722

JACK A. SONTAG, CONSULTING ENGINEERS, STRUCTURAL ENGINEER — BANASHEK AND ASSOCIATES, ELECTRICAL AND MECHANICAL ENGINEERS

H-4

722

RC 020 H05 74 00



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ST. LOUIS, MISSOURI

OLD CHEMISTRY BUILDING RENOVATION

UNIVERSITY OF MISSOURI - COLUMBIA

COLUMBIA, MISSOURI

HS/A Nº 722

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H-5

Attachment 3a – Radiation Worker Training Status report for Pickard Hall 55555 (1 page)

ORIGINAL TRAIN DATE

Name	Start	Last Training	Training Date	Training Due
Alex Barker	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Amanda Maloney	09/12/11	INTRO. TO RAD SAFETY AT MU	09/08/11	09/08/14
Anne Stanton	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Antone Pierucci	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Barbara Smith	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Brandy Tumnire	09/19/12	INTRO. TO RAD SAFETY AT MU	09/18/12	09/18/15
Bruce Cox	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Carol Geisler	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Cathy Asbury	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Cathy Callaway	12/15/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Christina Schappe	07/11/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Christopher Ruff	10/04/11	INTRO. TO RAD SAFETY AT MU	10/01/11	10/01/14
Danielle Gibbons	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Devyn Hunter	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Donna Dare	09/19/12	INTRO. TO RAD SAFETY AT MU	09/18/12	09/18/15
Emani Castro	09/24/12	INTRO. TO RAD SAFETY AT MU	09/20/12	09/20/15
George Szabo	12/15/09	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
James Van Dyke	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Jeffrey Wilcox	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Jillian Hartke	02/07/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
JosephKidd	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
June Davis	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Katharine Mascari	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Katherine Iselin	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Kathleen Slane	11/04/11	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Kenyon Reed	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Kristen Harris	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Kristie Lee	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Kristin Schwain	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Linda Garrison	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Lorenz Lepper	02/07/11	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Lorinda Roorda	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Lucas Gabel	07/11/11	INTRO. TO RAD SAFETY AT MU	07/05/11	07/05/14
Marcus Rautman	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Mary Conley	11/04/11	INTRO. TO RAD SAFETY AT MU	10/25/11	10/25/14
Michael Yonan	12/20/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Nancy Alexander	11/14/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Norman Land	12/14/09	INTRO. TO RAD SAFETY AT MU	09/12/11	09/12/14
Paul Stebbing	12/14/09	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Rebecca Pursley	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Ryan Johnson	09/12/11	INTRO. TO RAD SAFETY AT MU	09/08/11	09/08/14
Sarah Jones	11/04/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Sarah Williams	08/28/12	INTRO. TO RAD SAFETY AT MU	08/22/12	08/22/15
Shelby Wolfe	09/12/11	RAD SAFETY AT MU - REFRESHER	11/03/11	11/03/14
Susan Langdon	05/25/11	INTRO. TO RAD SAFETY AT MU	11/03/11	11/03/14
Susan Lowrey	12/27/11	INTRO. TO RAD SAFETY AT MU	12/20/11	12/20/14
Wayne Mehrhoff	12/14/09	INTRO. TO RAD SAFETY AT MU	08/19/11	08/19/14

Attachment 3b – Radiation Safety for new Radiation Workers at MU (25 pages)

Radiation Safety Manual

published by the

MU Radiation Safety Committee

in cooperation with

Environmental Health and Safety

of the

University of Missouri – Columbia

Fourth Edition 2005

http://ehs.missouri.edu/rad

NRC

Nuclear Regulatory Commission

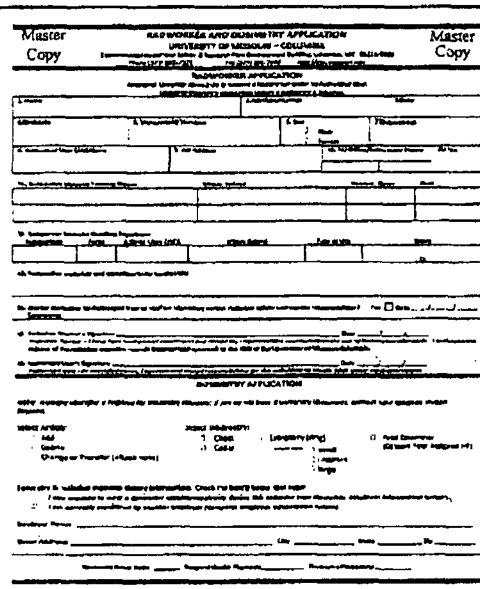
BECOMING

A

RADIATION

WORKER

R A D I A T I O N



W O R K E R

Safety Responsibilities

Radiation Safety Committee

- **Comprised of members representing departments where radiation or radioactivity is used**
- **Shall approve all use of radioactive materials and radiation producing equipment within the university**
- **Establish and review an effective, safe Radioactive Protection plan in compliance with MU's NRC license and the Radiation Safety Manual**
- **Review the activities of the Radiation Safety Office**

Safety Responsibilities

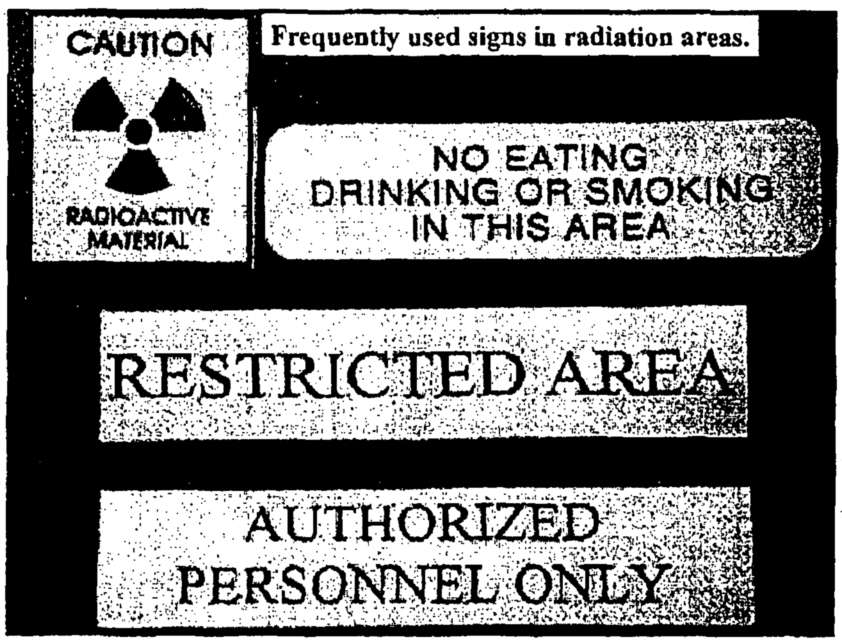
Radiation Safety Officer

- Has been delegated authority to ensure the implementation of the Radiation Protection Program and is responsible for the day to day conduct of the program
- Is a member of the RSC, and brings issues of compliance, efficiency and safety to the committee for resolution
- Provides technical assistance and guidance to all users of radioactive material or radiation producing equipment

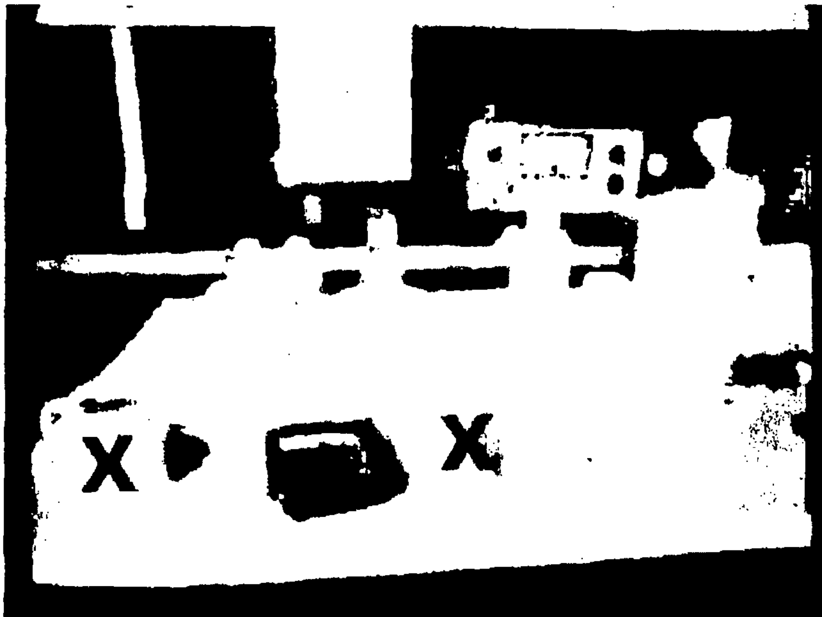
Safety Responsibilities

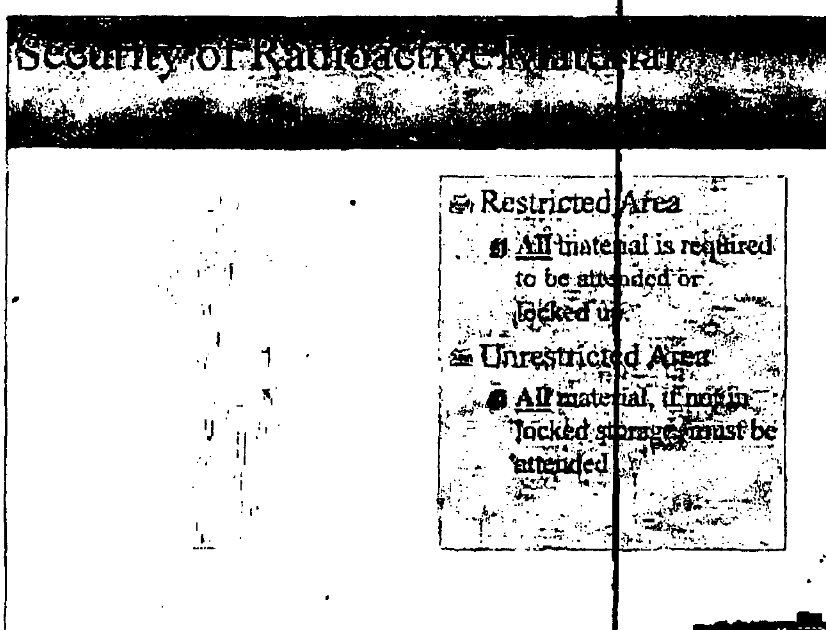
Authorized User

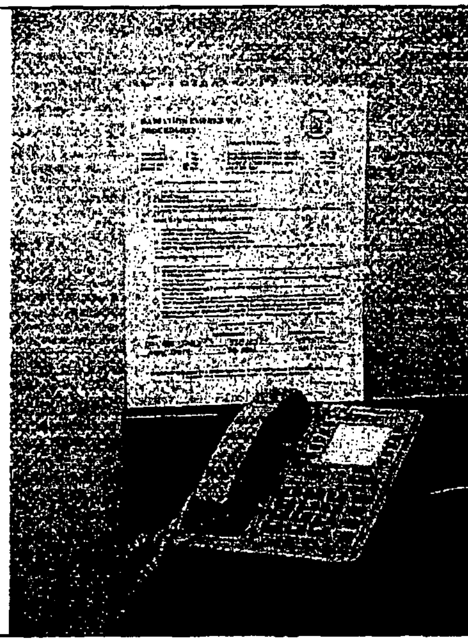
- Individuals authorized by the RSC to use radiation producing equipment or possess radioactive material, and supervise their use
- Responsible for compliance with all guidelines, policies, and safety procedures set forth in MU's Radiation Safety Manual and Broad scope License
- Supervisory person directly responsible for training and safety in the lab



Frequently used signs in radiation areas.

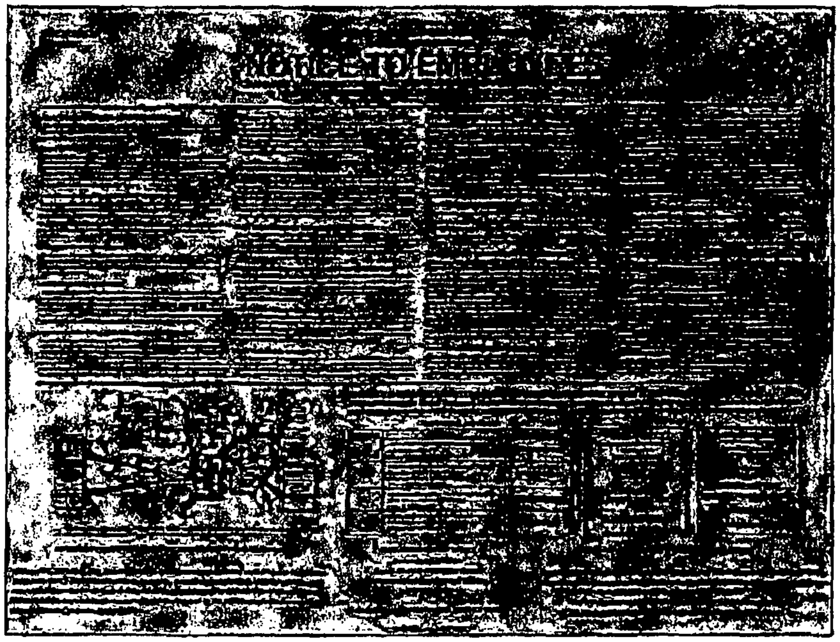

X
X

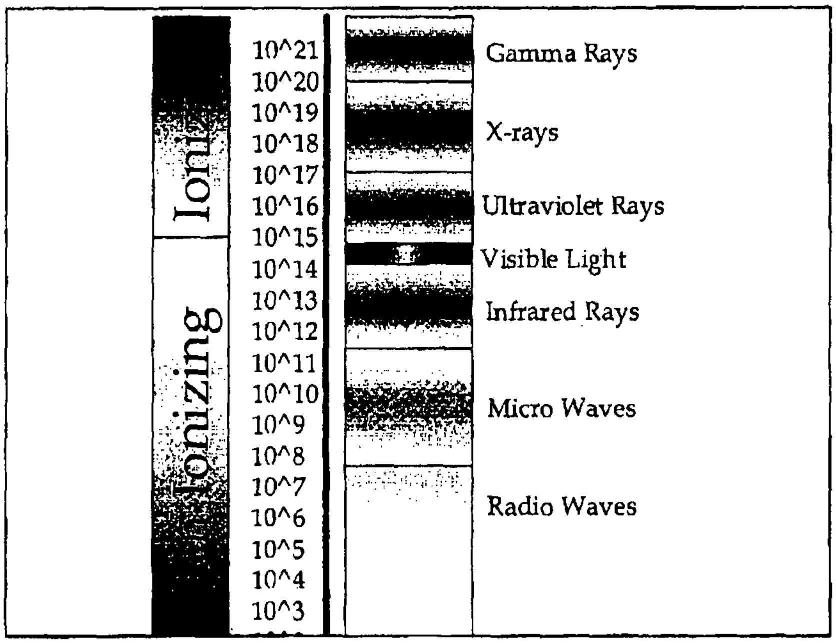

Security of Radioactive Material
Restricted Area
All material is required to be attended or locked up
Unrestricted Area
All material, if not in locked storage, must be attended

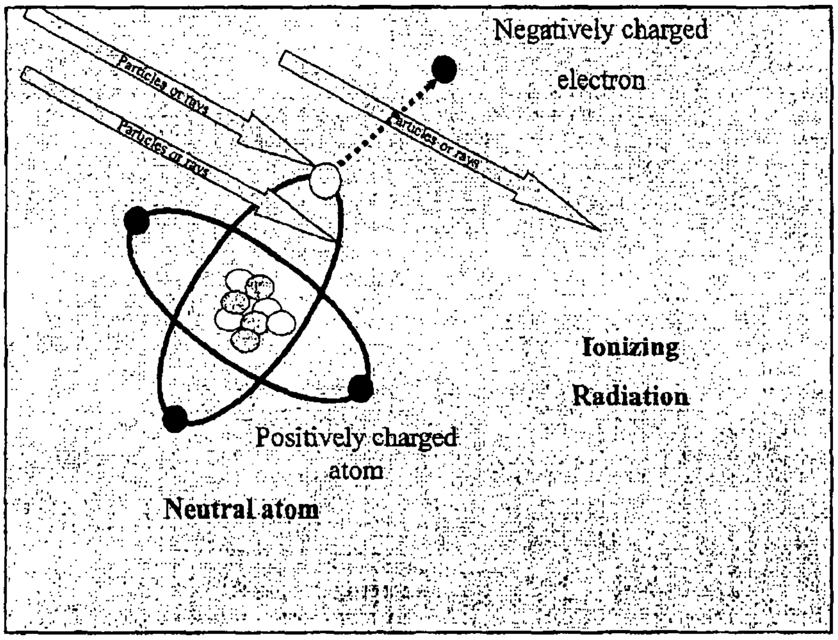


Emergency Procedures

- Fire emergencies with radiation
- Medical emergencies with radiation
- Radiation only
- Laboratory contact personnel
- During business hours call Radiation Safety at 882-7221
- After hours call MU Police at 882-7201


NOTICE TO EMPLOYEES


Ioni
Ionizing
10^21
10^20
10^19
10^18
10^17
10^16
10^15
10^14
10^13
10^12
10^11
10^10
10^9
10^8
10^7
10^6
10^5
10^4
10^3
Gamma Rays
X-rays
Ultraviolet Rays
Visible Light
Infrared Rays
Micro Waves
Radio Waves


Negatively charged
electron
Particles or rays
Particles or rays
Particles or rays
Ionizing
Radiation
Positively charged
atom
Neutral atom

Definitions

Radioactivity

- That property of certain unstable material where ionizing radiation is spontaneously emitted

Contamination

- Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence may be harmful

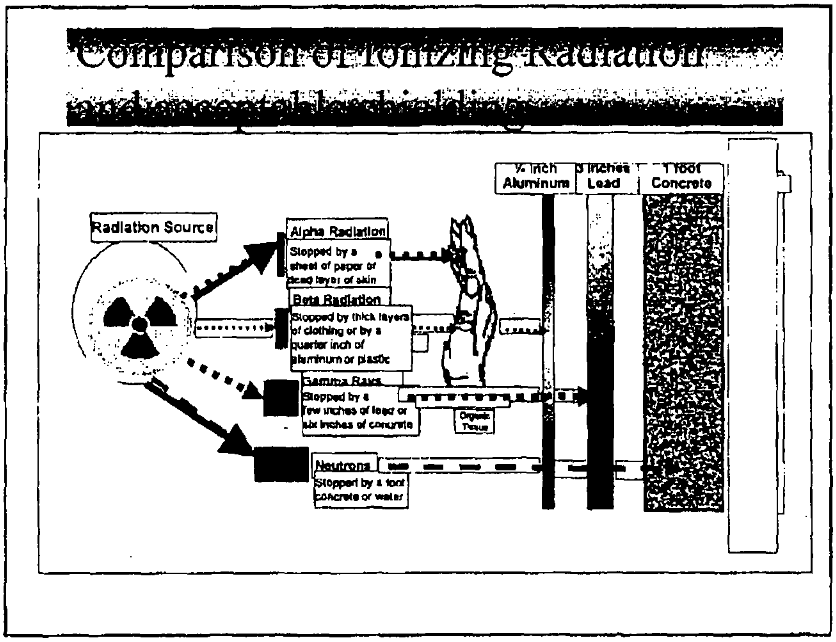
Radioactivity Basics

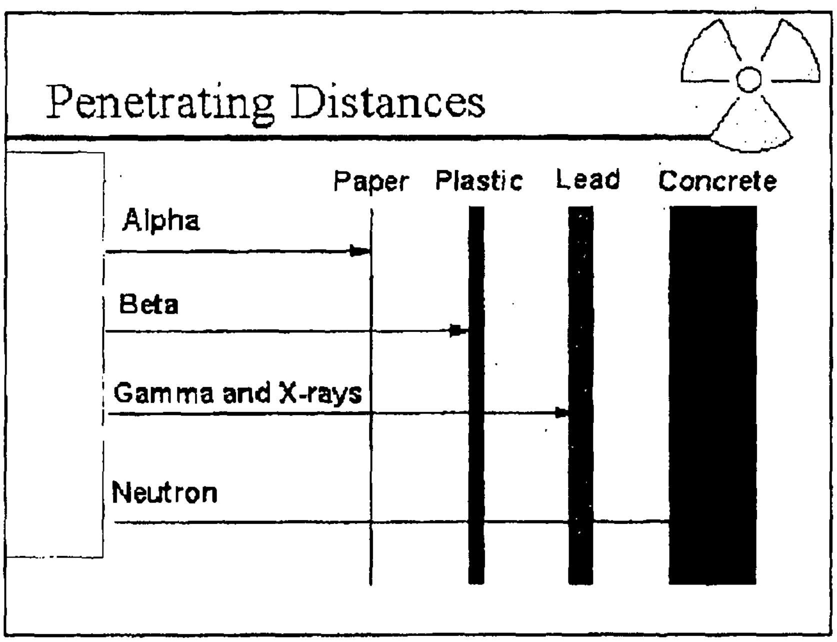
Radioactivity – The spontaneous nuclear transformation of an unstable atom that often results in the release of radiation, also referred to as disintegration or decay.

Units

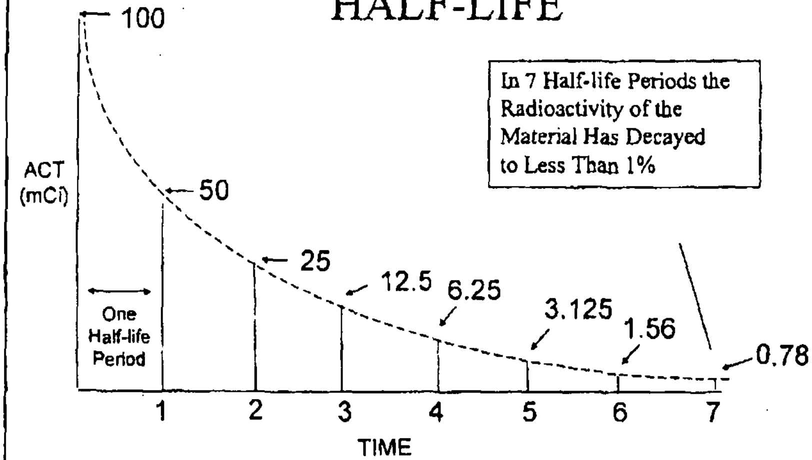
Curie (Ci) the activity in one standard gram of Radium = 3.7×10^{10} disintegrations per second

Becquerel (Bq) 1 disintegration per second – International Units (SI)


Comparison of Ionizing Radiation
Radiation Source
Alpha Radiation
Stopped by a sheet of paper or dead layer of skin
Beta Radiation
Stopped by thick layers of clothing or by a quarter inch of aluminum or plastic
Gamma Rays
Stopped by a few inches of lead or six inches of concrete
Organic Tissue
Neutrons
Stoppert by a foot concrete or water
¼ inch Aluminum
3 inches Lead
1 foot Concrete


Penetrating Distances
Paper
Plastic
Lead
Concrete
Alpha
Beta
Gamma and X-rays
Neutron

HALF-LIFE



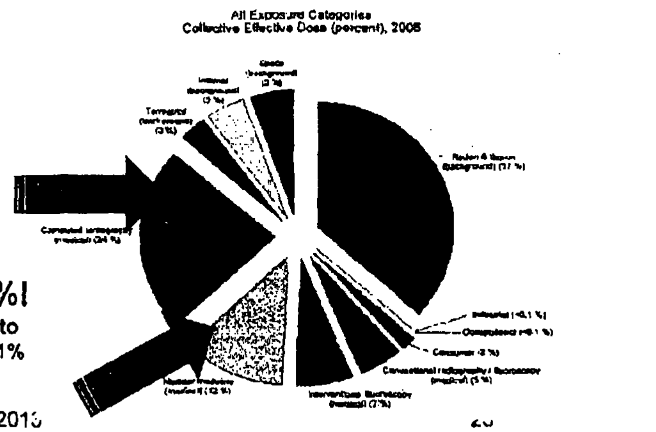
DEFINITION: TIME FOR 1/2 THE ATOMS TO DECAY AWAY

Average Annual Radiation Exposure in the U.S. (Approximate)

Man Made Sources		Combined Total (Old - 1980) = *360 mRem*
X-Rays	39	
Medical Studies (CT/Nuc)	~(275)	
Consumer Products	10	
Other	2	
TOTAL Man Made	*326*	
Natural Sources		
Radon	~200	
Own Body	40	
Sun	26	
Earth	28	
TOTAL Natural	*~294*	

Average Annual Radiation Exposure in the U.S. (NEW)

(Approximate)

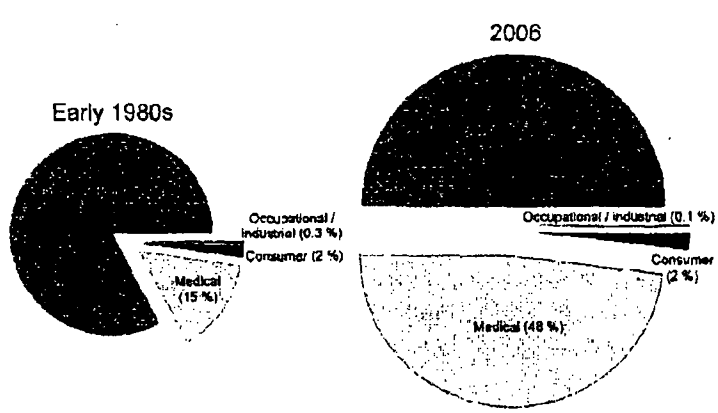


36%!
Use to
be 11%

2/4/2013

2006 NCRP Annual Report and the Press Release for NCRP Report No. 160 on *Ionizing Radiation Exposure of the Population of the United States.*

NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States*



	Early 1980s	2006
Collective effective dose (person-Sv)	835,000	1,870,000
Effective dose per individual in the U.S. population (mSv)	3.6	6.2

Radiation effects on the Cell

- **Indirect Effect** - radiation that interacts with the water of the cytoplasm of the cell, not the nucleus, and breaks the bonds holding the molecules together forming hydrogen ions and hydroxyls. These molecular fragments may recombine and form water or may form to make other substances like hydrogen peroxide.

Direct effect

- Direct effect can cause immediate damage to the most important part of the cell, the genetic material.
- Damage to genetic material can cause immediate problems to the cell and to the daughter cells it creates.
- Damage to genetic material is highly dependent on the cell cycle.

Radiation Exposure Limits (PART 19)

For Occupationally Exposed Individuals

GENERAL RADIATION EXPOSURE GUIDES †

Type of Exposure	Annual Limit*
Whole body (head & trunk), active blood forming organs, gonads	5 rem/year, total effective dose equivalent
Lens of eye	15 rem/year
Extremities	50 rem/year
Skin	50 rem/year

† Based on USNRC Regulations, Title 10, Part 20, Code of Federal Regulations and adopted by many states. Limits on declared pregnant workers and minors will differ; see 10CFR20 for details. Certain states and other regulatory agencies may adhere to different limits.

* Note: 1 rem = 1,000 mrem

10%

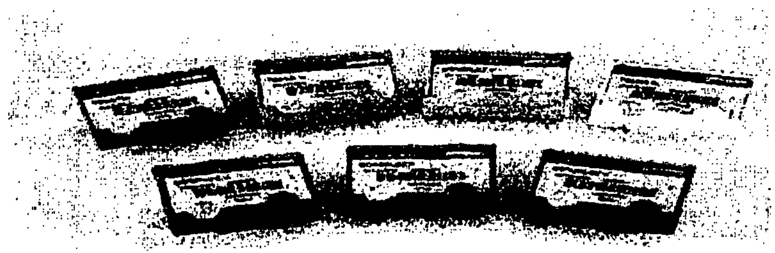
Whole Body = 5,000 mrem
Lens of Eye = 15,000 mrem
Skin of WB = 50,000 mrem
Extremity = 50,000 mrem

AT MU we have new Dosimetry

New Dosimetry by Mirion

MIRION TECHNOLOGIES

TLD – Thermoluminescent Dosimetry

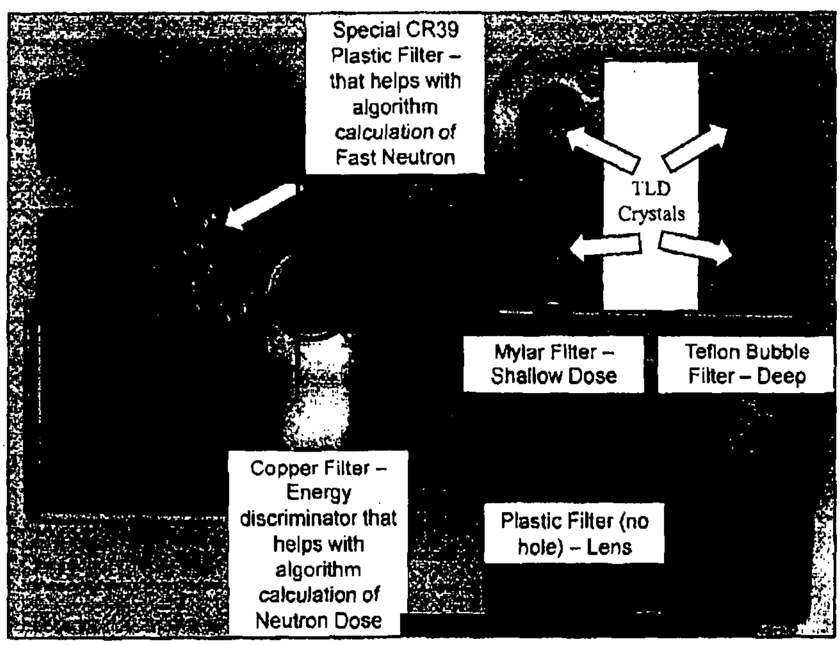


Requirement of Dosimetry

- Adult Workers
  - 10% of any applicable limit
- Declared Pregnant Workers
  - 100 mrem over course of pregnancy
- Minors
  - DDE of 100 mrem
  - LDE of 150 mrem
  - SDE of 500 mrem
- High Radiation Area (>100 mR/hr)

To Assure Accurate Dosimeter Readings:

- wear badge at sternum level
- keep badge away from heat sources
- store badge away from radiation sources
- do not wear your badge when having personal medical or dental x-rays
- notify the Radiation Safety Staff if anything unusual happens to your dosimeter
- only wear the dosimetry assigned to you
- assigned dosimetry should be worn at only one institution



Dosimetry Continued

- If you are assigned dosimtery from the university which is used to monitor your work related occupational exposure to ionizing radiation, and you plan to receive a diagnostic or therapeutic treatment with RAM (radiopharmaceuticals) then you MUST inform the RS Office PRIOR to the treatment so we can advise you on the particulars associated with how we are going to continue to monitor your occupational exposure without it being affected by the radiation from your treatment or scan.
- Dosimetry issued by the RS Office of the University of Missouri should also not to be worn home, to the store, to lunch etc but rather kept at work to be donned and doffed when you are working around sources of ionizing radiation unless prior arrangements have been made with RS.

35

Dosimetry Continued

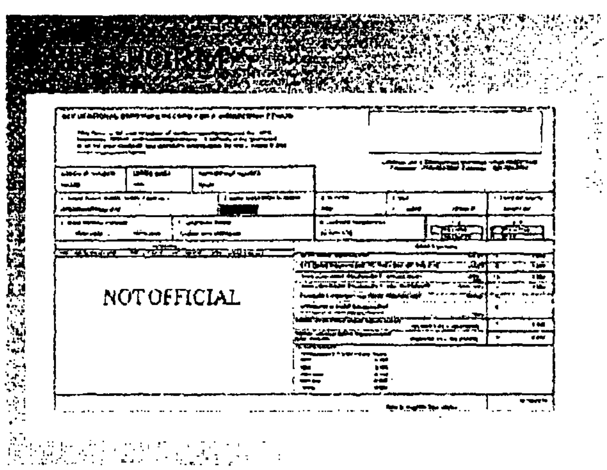
- Do not store your personal dosimeter close to sources of radiation. If you leave them on your lab coat or desk drawer as an example make for sure they are reasonably away from sources of ionizing radiation. In other words don't store you dosimeter near the Radioactive Waste storage containers.
- Ensure that you are wearing YOUR assigned dosimeter, wearing it correctly as identified on the dosimeter itself, "Chest", "Collar", and wearing the correct color and date on dosimeter associated with wear period. If you questions concerning this call EHS RS at 882-7018.

36

Measure Your Radiation Dose -Dosimeters-

Used to measure the occupational dose equivalent from x-ray, gamma, and high energy beta emitters. Dosimeters cannot detect radiation from low energy beta emitters.

	Global Whole Body	Ring Dosimeter	Fetal Dosimeter
Measures...	Whole body exposure	Extremity exposure	Exposure to a fetus
Is worn...	On the torso between the neck and waist	On either hand under the gloves with the name facing the radiation source	At the waist line
Can detect...	X-rays & gamma rays	X-rays & gamma rays	
	High energy beta emitters	High energy beta emitters	


NOT OFFICIAL

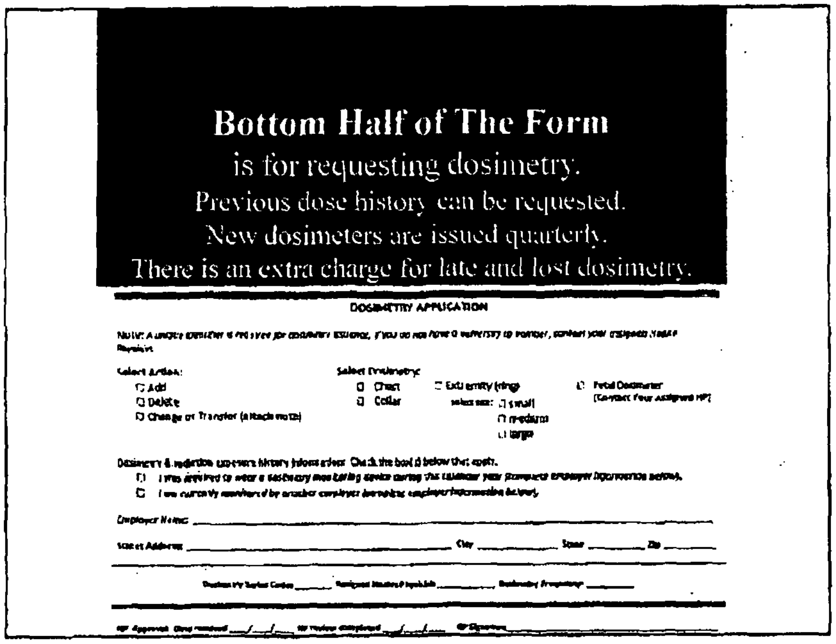
Your official dose report is provided IAW the law at least once a year if you receive greater than 100 mRem as part of your occupational dose. You can request it more often if you want it. But we HAVE to provide it at least annually.

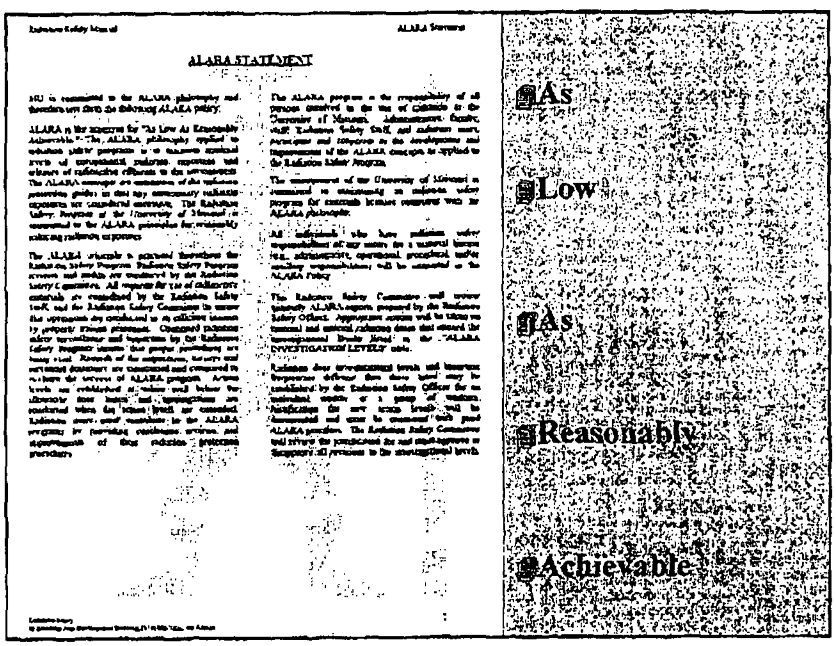
MU Radiation Safety Program
2009 Annual Dose Data

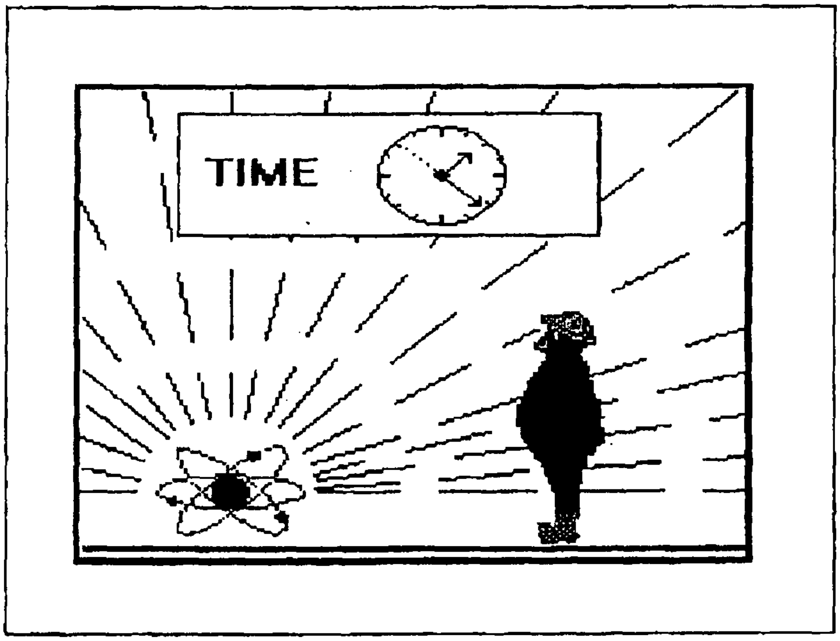
10%	**5,000mrem**
Dose mrem	Whole Body
Minimal	169
1-100	102
101-200	2
201-500	3
501-1000	1
1001-2000	0
2001-3000	0

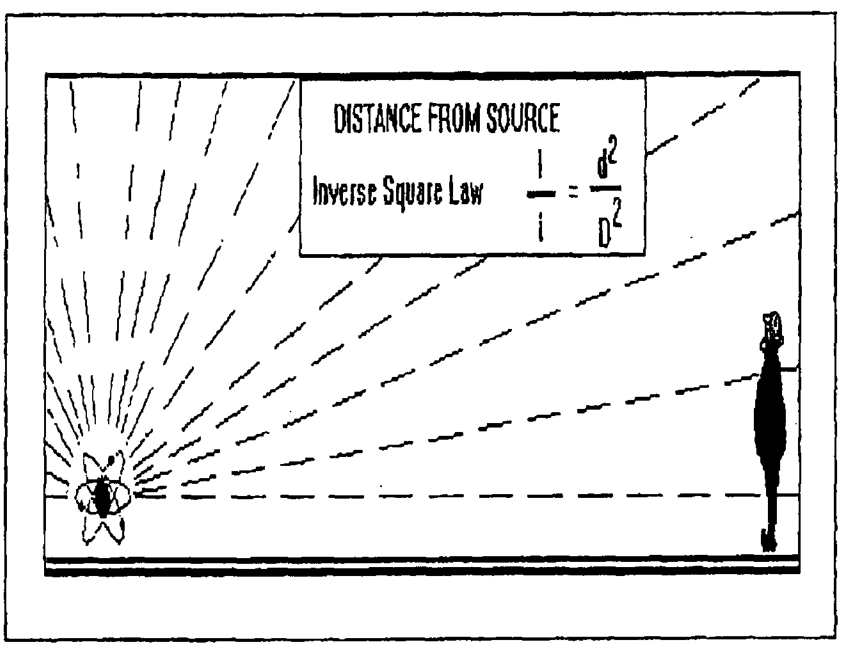
Risk in Focus

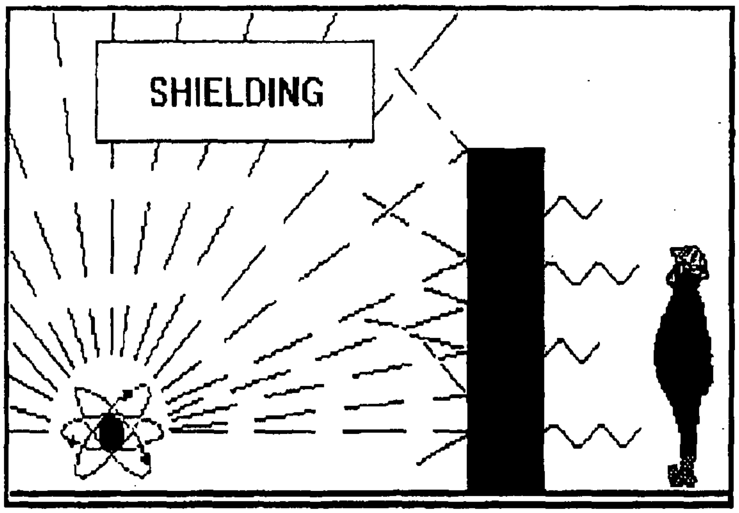
CAUSE	DAYS
SMOKING 1 PACK OR MORE OF CIGARETTES/DAY (MALE)	2409
DRIVING A SMALL CAR	290
DRIVING A LARGE CAR	145
AVERAGE EXPOSURE FROM NATURAL RADIATION	**39**
PARACHUTING	25
CONTINUOUS EXPOSURE TO 100 MREM/YR/ LIFE	**10**
SMOKE DETECTORS	-9
SEAT BELTS	-69


Bottom Half of The Form
is for requesting dosimetry.
Previous dose history can be requested.
New dosimeters are issued quarterly.
There is an extra charge for late and lost dosimetry.
DOSIMETRY APPLICATION
Select Action:
Add
Delete
Change or Transfer (attach note)
Select Dosimetry:
Chest
Collar
Extremity (ring)
small
medium
large
Fetal Dosimeter
Employer Name:
Street Address:
City
State
Zip


ALARA Statement
ALARA STATEMENT
As
Low
As
Reasonably
Achievable


TIME

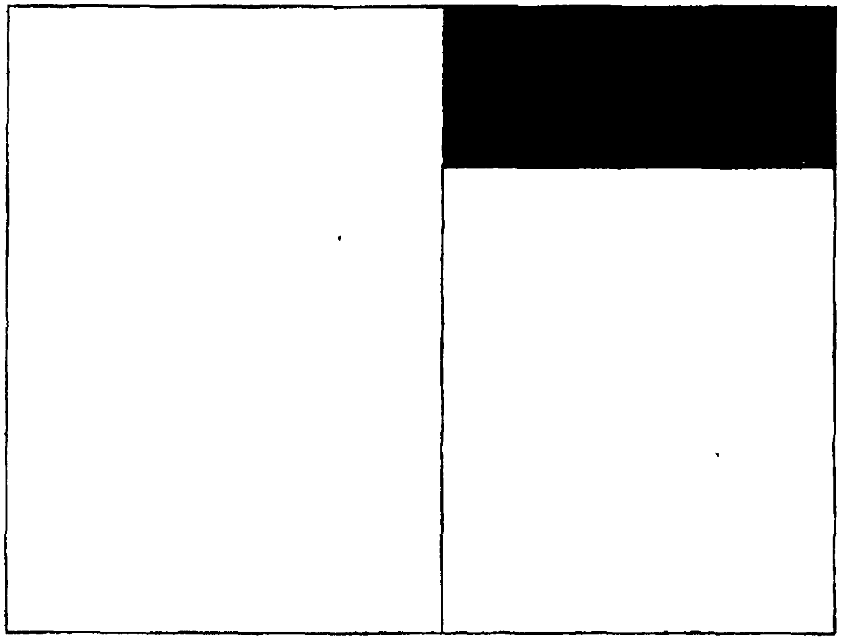

DISTANCE FROM SOURCE
Inverse Square Law
$\frac{I}{i} = \frac{d^2}{D^2}$



ALARA LEVELS

Monthly and Quarterly

- DDE - 100 mrem * Whole Body
- LDE - 300 mrem * Lens of Eye
- SDE - 400 mrem * Skin Whole Body
- SDE-ME - 400 * Extremity



Radiation Safety Manual

DECLAR

10 CFR 20.1003 DEFINITIONS – DEFINES A D

Declared pregnant woman means a wom
[illegible] estimated date of conception. The
[illegible] declaration in writing or is no longer p

10 CFR 20.1208 DOSE TO AN EMBRYO/FETU

(a) The licensee shall ensure that the
occupational exposure of a decla

(b) The licensee shall make efforts t
declared pregnant woman so as t

(c) The dose to the embryo/fetus sha
(1) The deep-dose equivale

Working in Pickard – things to know

- Do not disturb surfaces
- Call EHS if CF needs to make a repair or amendment that will disturb a surface
- For entry into artifact storage 12 - Staff without dosimetry must be escorted
- Posted areas (room17, 27, 12) are no eating drinking areas
- Postings are on the rise
- Call EHS with questions
- Direct questions form the public to EHS or Christian Basi 2-4430
- Security
  - Security guards in the galleries
  - Physical barriers in place
  - Prevent disturbance, removal, or access to contamination.

EHS: Contact 573-529-2385
Jack Crawford, Radiation Safety Officer
Mary Aldrich, Health Physicist
David Burgess, Health Physicist

Attachment 4 – Pickard Hall 55555 Jan 2013 inspection/survey report (7 pages)

Attachment 4 – Pickard Hall 55555 Jan 2013 inspection/survey report (7 pages)

UNIVERSITY OF MISSOURI - COLUMBIA
AUTHORIZATION INSPECTION REPORT

This is a summary of the authorization inspection conducted on the date indicated below. The status of the numbered items below indicates your authorization's compliance with the MU Campus Radiation Safety Program: an S - Satisfactoryl a U = Unsatisfactory; or an N = Not applicable or not checked. For unsatisfactory items a re-inspection date may be listed below; for those unsatisfactory items which also require a response by the authorized user, the response guidelines and a response due date will also be listed.

AUTHORIZED USER: Willie M Crawford
AU NUMBER: 55555
EXPIRATION DATE: 01/12/2013
INSPECTION DATE: 01/07/2013
RISK CATEGORY: I

ROOM(S) AND BUILDING:
INSPECTION CONTACT(S): Donna Dare

106 stage PICKARD HALL
12 PICKARD HALL
12A PICKARD HALL
13 PICKARD HALL
15 PICKARD HALL
17 PICKARD HALL
17A PICKARD HALL
1B PICKARD HALL
1st floor PICKARD HALL
205 PICKARD HALL
206 PICKARD HALL
213 PICKARD HALL
23 PICKARD HALL
25 PICKARD HALL
27 PICKARD HALL
2nd floor PICKARD HALL
Attic PICKARD HALL
C000C hall PICKARD HALL
C101-Ciel PICKARD HALL
Feeder ST PICKARD HALL

* Inactive Room

A. [S] **Records of Receipts, Inventory, and Transfers**
B. [S] **Survey Documentation**
C. [S] **Radionuclide Waste Disposal**
D. [S] **Posting and Labeling**
E. [S] **Radionuclide Use and Storage**
F. [S] **Safety and Prudent Practice**
G. [S] **Training**
H. [N] **Other Inspection Items:**
I. [S] **Performance Based Evaluations(s)**

J. [S] **Radiation Survey Results- See Attached EHS/RSO Survey Form(s)**
All survey results were within limits for removable contamination; radiation levels were largely consistent with previous surveys.

Overall Inspection Results: Satisfactory

Deficiencies Found:
None.

UNIVERSITY OF MISSOURI - COLUMBIA
AUTHORIZATION INSPECTION REPORT

This is a summary of the authorization inspection conducted on the date indicated below. The status of the numbered items below indicates your authorization's compliance with the MU Campus Radiation Safety Program: an S - Satisfactoryl a U = Unsatisfactory; or an N = Not applicable or not checked. For unsatisfactory items a re-inspection date may be listed below; for those unsatisfactory items which also require a response by the authorized user, the response guidelines and a response due date will also be listed.

Comments and Recommendations:

This inspection is conducted to ensure the radiation safety group regularly reviews Pickard Hall for radiation safety program issues and conducts a regular survey. The inspection shall review the controls that have been put into place and shall evaluate whether they are still functional and useful; changes over time may be required and should be brought to the RSO for consideration.

General statements:

Maintenance or other work in the museum that might disturb surfaces (nailing/drilling into walls, floors etc.) must be coordinated with Museum and EHS staff. Maintenance workers must be escorted into restricted areas by Radiation Safety staff.

Staff in Pickard Hall are trained as radiation workers and staff with office or primary duties on the basement level are provided with dosimetry.

During this inspection it appeared that all work projects with the potential to disturb building surfaces are being routed through EHS for evaluation.

Surveys were limited to the first and second floors during this month's inspection.

EHS attempted to select survey points that would allow for better reproducibility and therefore better trending.

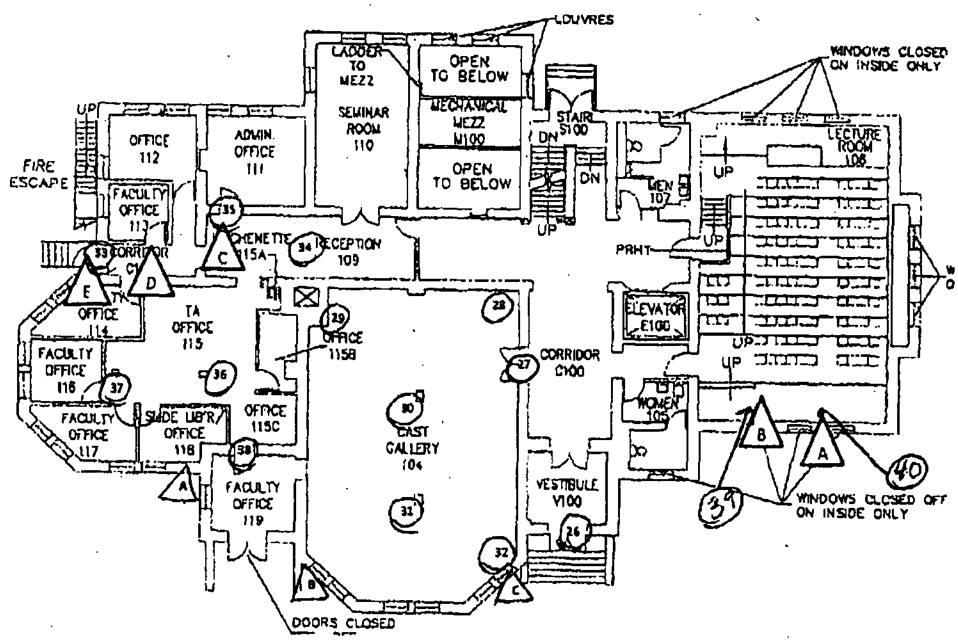
CC:
Alex Barker, Museum Director, Co-authorization #01041
Bruce Cox, Assistant Director, Museum Operations.
Susan Langdon, PhD. Chair Department of Art History & Archeology

Assigned HP Review Comments(optional):

Report Date: 01/10/2013 Inspected By: Mary Aldrich Assigned HP: Mary Aldrich

UNIVERSITY OF MISSOURI
RADIATION AND AREA CONTAMINATION SURVEY

Room & Building: Pickard Floor 1 Authorized User: RSO Authorization #: 55555



Not To Scale

Radiation Survey	Denotes Location

☐ Dose rates less than 0.03 mR/hr, except:

Surveys performed with GM and MN 192.

	uR/hr	cpm		uR/hr	cpm		uR/hr	cpm	
26	12	40	36	9	40	A	12	40	*
27	22	40	37	5	40	B	13	40	*
28	20	4	38	11	40	C	12	40	*
29	25	40	39	10	40				
30	18	40	40	10	40				
31	18	40							
32	15	40							
33	10	40							
34	11	40							
35	15	40							

Instrument: Ludlum MN: 14C; SN: 92302 Cal. Date: 10/8/12; MN: 192. SN: 294944 Cal. Date: 10/3/12

Contamination Survey	Denotes Location

☐ Removable activity less than:

200 dpm/100cm2 beta/gamma

20 dpm/100cm2 alpha

POSTINGS ARE LOCATED AT:

A	wall 106	C	ceiling access
B	lecturn base 106	D	ceiling access
		E	ceiling access

Instrument: Gamma 5000

NOTES: locations are generally in corners, dead center doorways for reproducability. Classes in session, therefore several areas were not attempted.

* Dose rate measurements only at this location, no wipe test conducted in outdoor areas.

Date 1/7/13 By [signature] Assigned HP or Radiation Safety Officer

4/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2 **Group Date/Time**2013/01/07 13:01:33.00
USER ID: RSO **System Serial #:** 2000-120399

Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	1	1.00	26	26.0	207	207.0
2	wipe test	tamination_E	1 Min 0 Sec	0	0.0	33	52.239	215	50.0
3	wipe test	tamination_E	1 Min 0 Sec	0	0.0	20	0.0	203	0.0
4	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	197	0.0
5	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	199	0.0
6	wipe test	tamination_E	1 Min 0 Sec	1	0.0	22	0.0	207	0.0
7	wipe test	tamination_E	1 Min 0 Sec	0	0.0	26	0.0	224	106.25
8	wipe test	tamination_E	1 Min 0 Sec	0	0.0	25	0.0	207	0.0
9	wipe test	tamination_E	1 Min 0 Sec	2	4.034	33	52.239	199	0.0
10	wipe test	tamination_E	1 Min 0 Sec	1	0.0	19	0.0	240	206.25 SA
11	wipe test	tamination_E	1 Min 0 Sec	0	0.0	20	0.0	206	0.0
12	wipe test	tamination_E	1 Min 0 Sec	0	0.0	30	29.851	212	31.25
13	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	214	43.75
14	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	189	0.0
15	wipe test	tamination_E	1 Min 0 Sec	0	0.0	32	44.776	213	37.5
16	wipe test	tamination_E	1 Min 0 Sec	1	0.0	23	0.0	185	0.0

Collected By: MRa **Date:** 1/7/13

Approved BY: ____________ **Date:** ________

5/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2
USER ID: RSO

Group Date/Time 2013/01/07 16:31:08.00
System Serial #: 2000-120399

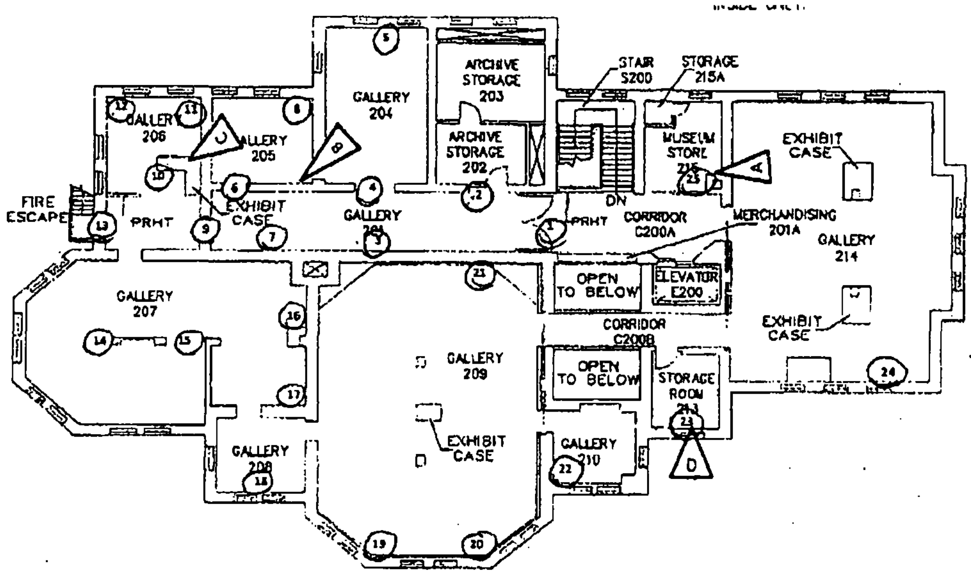
Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	0	0.0	22	22.0	218	218.0
10	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	228	62.5

Collected By: [signature] **Date:** 1/7/13

Approved BY: ______ **Date:** ______

UNIVERSITY OF MISSOURI
RADIATION AND AREA CONTAMINATION SURVEY

Room & Building: Pickard Floor 2 | Authorized User: RSO | Authorization #: 55555



Not To Scale

Radiation Survey — Denotes Location

☐ Dose rates less than 0.03 mR/hr, except: 8, 23

Surveys performed with GM and MN 192.

	uR/hr	cpm		uR/hr	cpm		uR/hr	cpm
1	15	40	11	22	40	21	20	40
2	18	40	12	20	40	22	21	40
3	20	40	13	12	40	23	120*	350
4	18	40	14	17	40	24	13	40
5	18	30	15	12	40	25	15	40
6	28	60	16	15	40			
7	20	40	17	19	40			
8	34	60	18	18	40			
9	16	40	19	19	40			
10	15	40	20	17	40			

Instrument: Ludlum MN: 14C; SN: 92302 Cal. Date: 10/8/12; MN: 192, SN: 204944 Cal. Date: 10/3/12

Contamination Survey — Denotes Location

☐ Removable activity less than:

200 dpm/100cm2 beta/gamma

20 dpm/100cm2 alpha

POSTINGS ARE LOCATED AT:

A ladder to attic

B wall 205

C wall 206

D wall 213

Instrument: Gamma 5000

NOTES: locations are generally in corners, dead center doorways for reproducability. 18 is dead center of the walls, 23 is on a marked area of wall. 25 is at ladder

* survey point moved lower on wall below sign for higher reading, confirmed 90 mR/hr reading in November 2012 (closer to sign)

Date 1/8/13 By [signature] Assigned HP or Radiation Safety Officer

7/7

University of Missouri-Columbia
G-5000W Standard Four Activity Analysis Report

Machine Name: PEPPER MILL 2 **Group Date/Time** 2013/01/09 08:25:38.00
USER ID: RSO **System Serial #:** 2000-120399

Sample Position	Sample Ident	Sample Type	Elapsed Count Time	Alpha Counts	Alpha DPM	Beta Counts	Beta DPM	Gamma Counts	Gamma DPM
1	BKG	AutoBkg ABG	1 Min 0 Sec	5	5.0	35	35.0	211	211.0
2	wipe test	tamination_E	1 Min 0 Sec	2	0.0	20	0.0	223	75.0
3	wipe test	tamination_E	1 Min 0 Sec	0	0.0	33	0.0	209	0.0
4	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	184	0.0
5	wipe test	tamination_E	1 Min 0 Sec	0	0.0	26	0.0	220	56.25
6	wipe test	tamination_E	1 Min 0 Sec	0	0.0	31	0.0	224	61.25
7	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	219	50.0
8	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	228	106.25
9	wipe test	tamination_E	1 Min 0 Sec	0	0.0	22	0.0	216	31.25
10	wipe test	tamination_E	1 Min 0 Sec	0	0.0	24	0.0	242	193.75
11	wipe test	tamination_E	1 Min 0 Sec	1	0.0	24	0.0	212	6.25
12	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	206	0.0
13	wipe test	tamination_E	1 Min 0 Sec	1	0.0	24	0.0	229	112.5
14	wipe test	tamination_E	1 Min 0 Sec	0	0.0	31	0.0	215	25.0
15	wipe test	tamination_E	1 Min 0 Sec	0	0.0	25	0.0	194	0.0
16	wipe test	tamination_E	1 Min 0 Sec	0	0.0	17	0.0	218	43.75
17	wipe test	tamination_E	1 Min 0 Sec	1	0.0	16	0.0	218	43.75
18	wipe test	tamination_E	1 Min 0 Sec	0	0.0	15	0.0	212	6.25
19	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	196	0.0
20	wipe test	tamination_E	1 Min 0 Sec	0	0.0	30	0.0	230	118.75
21	wipe test	tamination_E	1 Min 0 Sec	0	0.0	21	0.0	212	6.25
22	wipe test	tamination_E	1 Min 0 Sec	1	0.0	19	0.0	195	0.0
23	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	209	0.0
24	wipe test	tamination_E	1 Min 0 Sec	0	0.0	19	0.0	212	6.25
25	wipe test	tamination_E	1 Min 0 Sec	0	0.0	18	0.0	222	68.75
26	wipe test	tamination_E	1 Min 0 Sec	0	0.0	15	0.0	212	6.25

Collected By: [signature] **Date:** 1/9/13

Approved BY: ______________________ **Date:** __________

University of Missouri - Columbia Environmental Health & Safety Radiation Safety Office

Authorization Inspection Check List

(Heading Boxes: S - Satisfactory, U - Unsatisfactory, N - Not Applicable. Numbered Items: Check deficient items)

Authorized User: Crawford **AU#** 55555 **Individual Contacted:** Donna Dare / L. Loepper

Building: Pickard **Rooms:** see auth/insp report

[N] Receipt, Inventory and Transfer
____1. Radionuclide Shipment Receipt Log Incomplete
____2. Use of radionuclides inadequately recorded
____3. Inventory records incorrect / incomplete
____4. Transfer(s) performed improperly

[N] Survey Meter and Survey Documentation
____5. Survey Meter Functional Checks
____A. Battery Check
____B. Response Check
____C. Past calibration date.
____6. Survey frequency not adequate (see Table 1)
____7. Area survey map inadequate
____8. Meter survey inadequate
____A. Meter survey not performed
____B. Meter results not in mR/hr
____9. Contamination survey(s) inadequate
____A. Swipe survey not performed / documented
____B. Results not in dpm and not converted.
____C. LSC past calibration date.
____D. Swipe locations not indicated.
____10. Corrective Action(s) not taken Table 2 / Table 3

[N] Radionuclide Waste Disposal
____11. Waste disposal records not kept
____12. Solid Waste not stored properly
____13. Liquid Waste not stored properly
____A. No secondary containment
____B. Not capped
____C. Funnels not stored properly
____14. Improper disposal of waste
____A. Sink disposal
____B. In Bio/regular trash
____15. No RML label or improperly filled out
____16. Waste not picked up or request not submitted within 6 months of start date.

[S] Posting and Labeling
____17. NRC Form 3 not posted
____18. Restricted area warning signs inadequate
____19. Food items for experimental use not labeled
____20. Emergency Procedures not posted / filled out
____21. Isotope equipment/containers/storage unlabeled

[S] Radionuclide Use and Storage
____22. Isotope improperly stored or shielded
____23. Radioactive Material unsecured or unattended
____24. Unlocked storage in unrestricted area

[S] Safety and Prudent Practices
____25. Fume Hood Flow Check performed within yearly periodicity
____26. Evidence of food or drink in restricted area
____27. Protective clothing not used
____28. Open toed shoes worn in lab
____29. Assigned dosimetry not properly worn

[S] Training
____30. AU, RW, AW training adequate and timely

[N] Other Inspection Items
____31. ____

[S] Initial Survey Results
____32. Exposure rate in excess of Table 3
____33. Removable contamination in excess of Table 2

[N] Performance-Based Evaluation

Comments / Communications:
insp started
1/7/13 @ Floor 1
1/8/13 @ Floor 2

(Put additional comments on the back of this form)

Initial Inspection Results: (CIRCLE ONE)

Excellent E

Satisfactory S

Deficiency level: A B C D

Donna Dare 1/8/13
Authorized User or Representative Date

MWard 1/8/13 mk
EH&S Inspector Date

Initial inspection results may be modified upwards or downwards by the Assigned Health Physicist.

Health Physicist final review:

HP ____ Compliance Level ____ Date: / /

Revision 02/2008

Attachment 5 – Calibrations sheets for most recent used Ludlum's used at Pickard Hall (4 pages)

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street, 325-235-5494, Sweetwater, TX 79556, U.S.A.
☐ 231 Sam Rayburn Parkway, 865-270-8962, Lenoir City, TN 37771, U.S.A.

CUSTOMER UNIV OF MISSOURI ENV HEALTH ORDER NO. 20208275

Ludlum Measurements, Inc. Model 192 Micro R Serial No. 294944

NA Model NA Serial No. NA

Cal. Date 3-Oct-12 Cal Due Date 3-Oct-13 Cal. Interval 1 Year Meterface 202-333

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 32 % Alt 704.8 mm Hg

☑ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC
☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 600 V Input Sens. 30 mV Det. Oper. NA V at NA mV Threshold Dial Ratio NA = NA mV

☐ HV Readout (2 points) Ref./Inst. NA / NA V Ref./Inst. NA / NA V

COMMENTS:
Alarm is range dependent. (alarm set to full scale).

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	4000 uR/hr	NA	4
x1000	1000 uR/hr		0.99
x100	400 uR/hr= 295000cpm		4
x100	100 uR/hr		1.1
x10	25900 cpm		4
x10	6480 cpm		1
x1	2590 cpm		4
x1	648 cpm		1
NA	NA		NA
NA	NA		NA

*Uncertainty within ± 10% C.F. within ± 20% X10,X1 Range(s) Calibrated Electronically

Digital Readout: REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale: REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
NA	NA	NA	NA	NA	NA

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☑ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

1 500 S/N 38120 ☐ Oscilloscope S/N ☑ Multimeter S/N 84260131

Calibrated By: [signature] Date 3-Oct-12

Reviewed By: Diana Ahrens Date 3 Oct 12

FORM C22A 06/12/2012 Page 1 of 1

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway
865-270-8982
Lenoir City, TN 37771, U.S.A.

CUSTOMER UNIV OF MISSOURI   ORDER NO. 20204392/380793

Ludlum Measurements, Inc.   Model 9DP   Serial No. 25003027

Mfg. ____   Model ____   Serial No. ____

Cal. Date 15-Sep-12   Cal Due Date 15-Sep-13   Cal. Interval 1 Year   Meterface R/hr

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec.   T. 76 °F   RH 44 %   Alt 698.8 mm Hg

☐ New Instrument   Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☑ Requiring Repair ☐ Other-See comments

☑ Mechanical ck.   ☐ Meter Zeroed   ☐ Background Subtract   ☐ Input Sens. Linearity
☐ F/S Resp. ck   ☑ Reset ck.   ☐ Window Operation   ☐ Geotropism
☑ Audio ck.   ☐ Alarm Setting ck.   ☑ Batt. ck. (Min. Volt) 7.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.   ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set ____ V   Input Sens. ____ mV   Det. Oper. ____ V at ____ mV   Threshold Dial Ratio ____ = ____ mV

☐ HV Readout (2 points)   Ref./Inst. ____ / ____ V   Ref./Inst. ____ / ____ V

COMMENTS:

```
Instrument is Auto-Ranging.
Peak Dose Rate & Integrated Dose are the available functions.
All undocumented features are currently set to off (0).
```

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
Auto	4 R/hr	N/A	4.00 R/hr
Auto	1 R/hr		0.95
	400 mR/hr		400 mR/hr
	100 mR/hr		99.7
	40 mR/hr		40.0
	10 mR/hr		9.99
	4 mR/hr		4.00
	1 mR/hr		1.01
	400 µR/hr		400 µR/hr
	100 µR/hr		94.0

*Uncertainty within ± 10%   C.F. within ± 20%   ____ Range(s) Calibrated Electronically

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978   State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☑ 059 ☑ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☑ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☑ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ____   ☐ Beta S/N ____   ☐ Other ____

☐ m 500 S/N ____   ☐ Oscilloscope S/N ____   ☑ Multimeter S/N 15060230

Calibrated By: James Abbott   Date 15SEP12

Reviewed By: [signature]   Date 17 Sep 12

FORM C22A 06/12/2012   Page 1 of 1

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed: ____

UNIVERSITY OF MISSOURI - COLUMBIA
RADIATION SAFETY OFFICE
SURVEY INSTRUMENT CALIBRATION SHEET

User: RSO

Building: 8 RPDB

Room: Mary

Instrument Background: 0.015 mR/Hr; 50 CPM

Manufacture: LUDLUM

Model: Model 14C

Serial No.: 92302

Shield: Fixed

Probe: 44-9 & Internal Window Facing Beam Port

Cs-137 Calibrator, Model: 28-6A, SN: 5071

EFFICIENCIES IN %

Measured
C-14 @ 1 cm: 1.47
IPL, # 1094-21
SI-32 @ 1 cm: 23.11
IPL,# 548-6

Interpolated
S-35 @ 1 cm: 2.1
P-32 @ 1 cm: 23.1
P-33 @ 1 cm: 5.7
Ca-45 @ 1cm: 6.0
Tc-99 @ 1cm: 7.2
Cl-36 @ 1cm: 15.2

GROSS CPM
C-14 @ 1 cm: 8500
SI-32 @ 1 cm: 24000

CALIBRATION POINTS mR/hr	ATTENUATOR	DISTANCE cm	SCALE X	INSTRUMENT RESPONSE mR/hr	POINT CORRECTION FACTORS	AVERAGE CORRECTION FACTORS
0.05	X2000	138	0.1	0.06	1.11	
0.15	X2000	80	0.1	0.16	1.03	1.07
0.5	X200	141	1	0.5	1.00	
1.5	X200	82	1	1.5	1.00	1.00
5	X20	142	10	5	1.00	
15	X20	82	10	15	1.00	1.00
50	X2	145	100	50	1.00	
150	X2	84	100	150	1.00	1.00
			1000	Not Calibrated for this range.		
			1000	Not Calibrated for this range.		

Check Source Response: 7.00 mR/hr Battery Check: OK

Comments: Do not use X1000 setting.

Signature of Calibrator: [signature] Date: 10/8/2012

SOURCE CK:	7.00 mR/hr
Calibrated:	10/8/2012

Do not use X1000 setting.

USER:	RSO	P-32 Eff (%):	23.1
INSTRUMENT:	LUDLUM MOD 3	C-14 Eff (%):	1.5
SERIAL # (sn):	92302	Cs-137 sn:	5071
WINDOW:	Fixed	GEOMETRY:	II
SOURCE CK:	7.00		
SCALE	**AVG CORR FAC**		
0.1	1.07	BATT:	OK
1	1.00		
10	1.00	CAL DATE:	10/8/2012
100	1.00		
INITIALS:	JA	DUE DATE:	10/8/2013

Attachment 6 – Original Attachment 1 - Pickard Hall Radon Monitoring Results (3 pages)

Attachment 1 – Pickard Hall Radon Monitoring Results

Radon Monitoring Report

EHS UNIVERSITY OF MISSOURI
ATTN: ROSE LEYKAMP
5 RESEARCH PARK DEV BUILDING
COLUMBIA MO 65211

LANDAUER

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425
Telephone (800) 528-8327 Facsimile (708) 755-70

Acct. No. 0410211

PROGRAM NAME: PICKARD

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l-days	Avg. Radon Conc pCi/l	
4741886	DRN	21-NOV-08	24-FEB-09	RM 3	55.0 ±5.18	0.6 ±0.05	
4741887	DRN	21-NOV-08	24-FEB-09	RM 26	104.5 ±8.3	1.1 ±0.09	
4741896	DRN	19-NOV-08	24-FEB-09	RM 17A	204.0 ±12.8	2.1 ±0.13	
4741904	DRN	21-NOV-08	24-FEB-09	RM 7	61.3 ±5.62	0.6 ±0.06	
4741918	DRN	19-NOV-08	24-FEB-09	RM 17	227.4 ±13.7	2.3 ±0.14	
4741929	DRN	19-NOV-08	24-FEB-09	RM 6	160.5 ±11.0	1.7 ±0.11	
4741959	DRN	21-NOV-08	24-FEB-09	RM 12	292.3 ±15.9	3.1 ±0.17	
4741974	DRN	19-NOV-08	24-FEB-09	RM 5	129.8 ±9.5	1.3 ±0.10	
4741977	DRN	19-NOV-08	24-FEB-09	RM 18, 18A, 16	215.7 ±13.2	2.2 ±0.14	
4741988	DRN	21-NOV-08	24-FEB-09	RM 27	380.1 ±18.6	4.0 ±0.20	
	②	③	④	⑤	⑥	⑦	⑧

RECEIVED MAR 17 2009 EHS

RELATED ONLY TO MONITORS
VED BY LANDAUER.

QC Release	Process No	Report Date	Date Received
DRB	AZ1617	12-MAR-09	27-FEB-09

PAGE 1 OF 1

Radon Monitoring Report

THE UNIVERSITY OF MISSOURI
ATTN: ROSE LEYKAMP
8 RESEARCH PARK DEV BUILDING
COLUMBIA, MO 65211

LANDAUER

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425
Telephone: (800) 528-8327 Facsimile: (708) 755-70

Acct. No. 0410211

PROGRAM NAME: PICKARD

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l-days	Avg. Radon Conc pCi/l	
4741991	DRN	21-NOV-08	24-FEB-09	RM 2	124.6 ±9.3	1.3 ±0.10	
4742006	DRN	19-NOV-08	24-FEB-09	RM 2B	246.5 ±14.4	2.5 ±0.15	
4742009	DRN	19-JAN-08	24-FEB-09	RM 1A	107.7 ±8.4	0.3 ±0.02	
4742019	DRN	21-NOV-08	24-FEB-09	RM 4	119.3 ±9.0	1.3 ±0.10	
4742030	DRN	21-NOV-08	24-FEB-09	RM 9	97.1 ±7.85	1.0 ±0.08	
①	②	③	④	⑤	⑥	⑦	⑧

RESULTS RELATED ONLY TO MONITORS
AS RECEIVED BY LANDAUER

Q C Release	Process No	Report Date	Date Received
DRB	AZ1617	12-MAR-09	27-FEB-09

PAGE 2 OF 1

Radon Monitoring Report

[illegible] UNIVERSITY OF MO
9 RESEARCH PA DEV BLDG
COLUMBIA, MO 65211

LANDAUER

Landauer Inc. 2 Science Road Glenwood Illinois 60425-1586
Telephone: (800) 528-8327 Facsimile: (708) 755-7048

Acct. No. [illegible]

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l-days	Avg. Radon Conc. pCi/l	
4741589	DRN	17 [illegible]	[illegible]-DEC-09	PICKARD 13 MBAS	1029.1 ±31.9	7.3 ±0.22	
4741900	DRN	21-NOV-08	[illegible] DEC 09	PICKARD 17 ONE YEAR	1127.4 ±33.4	3.0 ±0.09	
4741906	DRN	19 NOV 08	[illegible] DEC 09	PICKARD 25 ONE YEAR	901.5 ±29.5	2.4 ±0.08	
4741942	DRN	[illegible]	[illegible]	PICKARD 27 ONE YEAR	1193.[illegible] ±34.5	3.1 ±0.09	RECEIVED DEC 2 2 2009 EHS
①	②	③	④	⑤	⑥	⑦	

RESULTS RELATED ONLY TO MONITORS
AS RECEIVED BY LANDAUER.

Q.C. Release	Process No	Report Date	Date Received
DRB	A21795	15-DEC-09	09-DEC-09

PAGE 1 OF 1

Attachment 7 – Chase Environmental Group, Inc - QAP 8.2 Chain-of-Custody Procedure (3 pages)

CHAIN-OF-CUSTODY

1.0 PURPOSE

This Quality Assurance Procedure (QAP) establishes the methods, responsibilities and requirements for item identification and control.

2.0 APPLICABILITY

This QAP applies to items, such as samples, specimens or test materials used in experimentation or testing, when the validity of the corresponding data or results depends on maintaining accurate identification and traceability of the items.

3.0 INSTRUCTIONS

3.1 Periodic surveillances shall be performed by the Project Manager to ensure that item control and identification comply with the following requirements.

Sample Preservation

3.1.1 The Sampling Technician shall ensure that samples will be properly prepared for transportation to the laboratory by refrigeration and chemical preservation, if necessary. The Sample Technician shall verify that the laboratory providing sample containers has added any necessary chemical preservatives to the sealed containers provided.

Container Label

3.1.2 The Sampling Technician shall ensure that all sample container lids will be sealed with tape and a label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- Facility name;
- Monitor well and sample location number (if applicable);
- Sampling date;
- Sampling time; and
- Sample collector's initials.

Sample Shipment

3.1.3 The Sampling Technician shall ensure that the following packaging and labeling requirements for nonhazardous sample materials are appropriate for shipping:

- Package sample so that it does not leak, spill, or vaporize from its packaging;
- Label package with:
  - Sample collector's name, address, and telephone number;
  - Laboratory's name, address, and telephone number;

- Description of sample;
- Quantity of sample; and
- Date of shipment.

If the materials to be shipped are considered hazardous or if their nature is uncertain, the samples will be appropriately labeled and will be transported by sampling personnel directly to the analytical facility or will be shipped using a carrier licensed to transport hazardous materials.

Sampling Records

3.1.4 The Sampling Technician shall ensure that detailed records are maintained during sampling. These records will include the information listed below applicable:

- Sample location (facility name);
- Sample identification (location or boring number and sample number);
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observation of :
  - Sample appearance,
  - Sample odor,
- Weather conditions;
- Sampler's identification; and
- Any other significant information.

Chain-of-Custody

3.1.5 The Sampling Technician shall ensure that the chain-of custody measures are followed to establish a written record concerning sample custody during movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of-custody form (see example Exhibit 1) completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate and sealed in the container. One copy of this form will be maintained at the site, and the other two copies at the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses to Chase.

3.2 All completed sampling documentation (log books, etc.) and chain-of-custody records shall be processed as quality assurance records

4.0 EXHIBITS

1. Chain of Custody Form (Example)

CHAIN-OF-CUSTODY

Chain of Custody Record No.

Chase Environmental Group, Inc.

Project Name:	Project Number:	Analysis Requested	Page ____ of ____
Send Report To:	Sampler (Print Name):		
Address:	Sampler (Print Name):		Purchase Order #: ____________
	Shipment Method:		
	Airbill Number:		
Phone:	Laboratory Receiving:		
Fax:			

Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers												Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)

Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:

Sample Custodian Remarks (Completed By laboratory):

QA/QC level		Turnaround		Sample Receipt	
Level I	↑	Routine	↑	Total # Containers Received?	
Level II	↑	24 Hour	↑	COC Seals Present?	
Level III	↑	1 Week	↑	COC Seals Intact?	
Other	↑	Other ______		Received Containers Intact?	
				Temperature?	

R USE

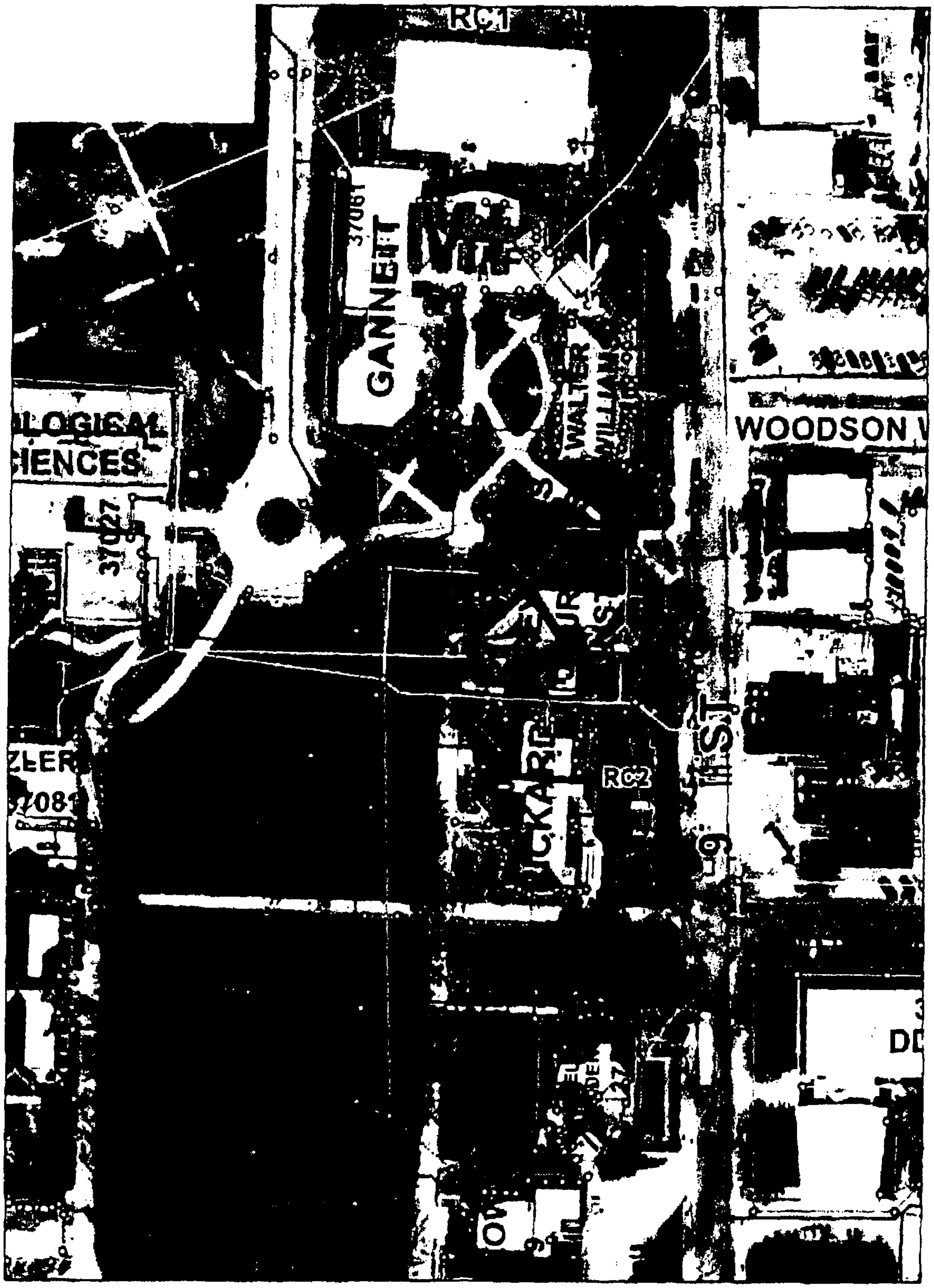
QUALITY ASSURANCE PROCEDURES MANUAL

QAP 8.2

CHAIN-OF-CUSTODY

Revision Number	Effective Date	Quality Assurance Approval	Management Approval

Attachment 8 – Sanitary and Storm Sewer line GIS Map for servicing Pickard (1 page)


RC1
37061
GANNETT
WALTER
WOODSON
SCIENCES
37027
RC2
ST