APPENDIX C

PUBLIC DOSE LIMITS COMPLIANCE STUDY

Introduction

Florida State University uses sealed and unsealed sources of radioactive material (RAM) in its research and educational activities. The University's radiation sources are strictly regulated by the Florida Dept. of Health's Bureau of Radiation Control (BRC). That agency's regulatory program is overseen and audited by the U.S. Nuclear Regulatory Commission (NRC). The state's radiation control regulations are found in Chapter 64E-5, Florida Administrative Code (FAC), which is available on the BRC website.

Section 64E-5.312 of the Florida regulations requires FSU activities using RAM to be conducted in compliance with two public dose limits:

- Radiation doses in unrestricted areas cannot exceed **2 millirem* in any one hour**; and
- Doses to members of the public cannot exceed **100 millirem in a year**.

Section 64E-5.313, FAC requires FSU to demonstrate that its RAM activities comply with the public dose limits, and to maintain records demonstrating compliance. The regulations state that compliance can be demonstrated using direct measurements, calculations and/or environmental monitoring.

This document describes how FSU complies with the state's public dose limits (which are the same in every state in the U.S.). Its contents have been reviewed and accepted by the Florida BRC. The Bureau's RAM Section staff may be contacted at (850) 245-4545 (Tallahassee).

Demonstration of Compliance

Low Activity RAM Sources

The radioactive materials used at FSU have low activities – ranging from background environmental levels up to microcuries (uCi) and millicuries*, which significantly limits the potential for exposures.

The source's radiation emission types and energies vary due to the diverse radioisotopes in use (listed below), with applications ranging from development of new crystalline structures with unique properties, to neurobiology and phosphogypsum research.

Am-241	Cm-244	Depleted uranium (DU)	Np-237	Rb-86	Tc-99	Th-232
C-14	Cm-248	H-3 (tritium)	P-32	S-35	Th-229	U-238
Ca-45	Co-57	I-125	Pb-210	Sm-151	Th-230	
Cf-249	Co-60	Na-22	Ra-226	Sr-90		

* A millirem (mrem) is a thousandth of a rem – the special unit of radiation dose that accounts for the biological effects of different types of ionizing radiation. Rem is an acronym for "Roentgen equivalent man." One mrem represents a very small dose. The average person receives about 1 mrem each day from exposure to background radiation; a chest x-ray gives a dose of ~10 mrem. The metric dose unit is the Sievert (Sv); 1 mrem = 0.01 mSv.

** The Curie (Ci) is a special unit used to describe the intensity of radioactivity (disintegration rate) of radioactive material. One Ci represents a large amount; it is defined as the radioactivity of any material decaying at a rate of 37 billion atoms/second. A microcurie is a millionth of curie. The equivalent metric unit is the Becquerel (Bq); one Bq is equal to 1 disintegration/sec (0.000027 uCi).

Demonstration of Compliance (continued)

RAM Security Measures

Areas where radioactive materials are used and stored are equipped with various security measures to prevent access by members of the public. RAM labs are key-locked or require security badge activation for entry. Visitors are escorted by authorized users and in some cases (e.g. the Mag Lab) are issued security badges which identify their visitor status. Additional security barriers such as locked cabinets, further restrict access to authorized personnel. These security measures greatly limit the potential for members of the public to receive exposures from FSU radiation sources.

RAM Hazard Communication

Areas where radioactive materials are used and stored are properly posted with warning signs or labels to communicate the presence of a radiation hazard. equipped with various security measures to prevent access by members of the public. Entry doors to RAM labs are posted with signage identifying the presence of RAM sources. These hazard communication tools ensure that members of the public are alerted to the presence of RAM, enabling them to avoid receiving unnecessary exposures.

RAM Radiation Safety Training

Individuals working with RAM are required to complete basic radiation safety awareness-level training, followed by function-specific and lab-specific training. This approach ensures that personnel understand radiation hazards and are familiar with the proper equipment and procedures needed to work safely. The training ensures that anyone at FSU working with RAM has the knowledge needed to minimize exposures to themselves and to members of the public.

RAM Radiation Safety Equipment and Procedures

The FSU Radiation Safety Office maintains an large collection of radiation detection instruments, counting equipment and accessories, along with a comprehensive set of procedures and forms that ensure proper radiation monitoring and record-keeping. Proper equipment and procedures ensure that anyone at FSU working with RAM has the knowledge needed to minimize exposures to themselves and to members of the public, and that FSU is adequately equipped to monitor RAM use on campus.

RAM Monitoring & Surveys

Area surveys, area monitoring, and personnel monitoring are conducted to track radiation levels and exposures associated with the University's RAM activities. FSU researchers perform regular surveys and tests to limit contamination in their labs, while Radiation Safety Office staff perform confirmatory lab surveys and contamination tests while verifying that lab protocols are being followed.

Decades of tracking occupational doses of badged FSU researchers and Radiation Safety Office staff show that the majority receive doses below the 100 millirem annual public dose limit. Simple extrapolation means that public doses are also below the annual limit, because badged workers spend more time and are in closer proximity to the RAM on campus.

Demonstration of Compliance (continued)

RAM Radiation Safety Audits and Inspections

The FSU Radiation Safety Officer conducts annual comprehensive audits of the University's RAM activities, with a focus on the effectiveness of efforts to keep doses as low as reasonably achievable (ALARA). FSU has also employed contract consultants to perform objective safety audits of the program. Finally, the FDOH BRC conducts annual on-site inspections to verify the University's compliance with the public dose limits.

Summary

Detailed procedures, appropriate safety equipment, and trained, tested and audited personnel are the measures in place to comply with the public dose limits specified in 64E-5.312, FAC. The RAM sources at FSU are controlled to prevent unauthorized access or removal. Areas of RAM use and storage are posted with radiation warning signage to signal their presence and deter the public. Handling of RAM is restricted to authorized personnel trained to follow safety procedures and monitor their workstations. Oversight by the Radiation Safety Section and state inspectors are in place to ensure compliance with the 100 millirem/yr and 2 millirem/hour public dose limits.