APPENDIX A

Film Badge Application

Radioactive Material Package Receipt Log

Radioactive Material Package Receipt Form (Off-Campus Locations)

Radiation / Contamination Survey Form

PERSONNEL MONITORING DEVICE APPLICATION

University of Florida
Division of Environmental Health & Safety
Department of Radiation Control & Radiological Services
P.O. Box 118340, 212 Nuclear Sciences Center, Gainesville, FL 32611
Telephone: (352) 392-7359 or (352) 392-8700
Fax: (352) 846-0489

THIS REQUEST IS TO:
_____Reactivate an old badge
_____Apply for a new badge

_____whole body, collar
_____whole body, waist
_____whole body, fetal*
_____extremity, rt hand
_____extremity, lt hand
_____extremity, rt wrist
_____extremity, lt wrist

*A request for a fetal monitor must be accompanied by a copy of the letter to the employee's supervisor declaring pregnancy and approximate date of conception.

PRINT NAME:_____
(LAST, FIRST, MIDDLE INITIAL)

UFID: _____ - _____

DATE OF BIRTH: _ _/ _ _/ _ _
mo day yr

SEX: MALE FEMALE (circle one)

PRINCIPAL INVESTIGATOR/SUPERVISOR: _____

FILM BADGE COORDINATOR: _____

DEPARTMENT: _____

FACILITY: _____ BLDG: _____ ROOM: _____

MAILING ADDRESS: _____ PHONE NUMBER: (_ _ _) _ _ _ - _ _ _ _

DO YOU WORK WITH: _____ radiation producing device (x-ray machine, accelerator, irradiator)
_____ radioactive material; list radionuclide(s) _____

If you directly work with radioactive material or radiation producing devices, a completed *Statement of Training and Experience* form must be attached for approval.

If you do not work with radioactive material or a radiation producing device, list the reason for this badge request:

_____

_____

(Based on this reason, the badge may/may not be issued at the discretion of the Radiation Control Officer.)

COMPLETE REVERSE SIDE OF FORM

OFFICE USE ONLY	
RCO Approval	Part ID#
Binary #	Series Code
	Date Issued

OCCUPATIONAL RADIATION EXPOSURE HISTORY IDENTIFICATION

Have you **EVER** received a personal monitoring device or participated in a bioassay program somewhere other than UF/Shands Health Care Systems and Clinics: ☐ YES ☐ NO

IF YES, COMPLETE THE FOLLOWING:

OCCUPATIONAL EXPOSURE – PREVIOUS HISTORY			
Previous employment involving occupational exposure List name and address of employer	Date of Employment (From – To)	Period of Exposure (From – To)	Estimated Radiation Exposure (mrem)

Certification: I certify that the exposure history information listed above is correct and complete to the best of my knowledge. I authorize the release of my radiation exposure records to the University of Florida.

Employee Signature: _____ Name (Print) _____

UFID: _____ - _____ Date: _____

RADIOACTIVE MATERIAL PACKAGE RECEIPT FORM

RECEIVING DATA

Principal Investigator		Dept.
Facility	Building	Lab Room
Radionuclide	Activity (mCi)	
Date Received ____/____/____	Received By	
RC Number	PO Number	
Supplier		

RADIATION SURVEY DATA

Surface of Container	mR/hr
Packing Material	mR/hr

CONTAMINATION SURVEY

Surface of Container	dpm/100 sqcm

RADIATION CONTROL OFFICE

Review Date ____/____/____	Approval

Complete form upon package receipt and return or FAX to:

University of Florida
Radiation Control and Radiological Services
PO Box 118340
212 Nuclear Sciences Center
Gainesville FL 32611

FAX: 352-846-0489

APPENDIX B

Suggested Format for New Proposals to Use Radioactive Material to Radiation Control Committee

In order to achieve uniformity and to cover the pertinent items required by the Radiation Control Committee, the following outline should be followed as closely as possible in order to save time in getting your proposal approved by the Radiation Control Committee:

Date: _____

TO: Radiation Control Committee
Attention: D. L. Munroe
Radiation Control Officer
Box 118340

FROM: Principal Investigator, (Signature required)
Department
Name of other users (technicians, students)

SUBJECT: Proposal to Use _____

Items that should be covered:

1. Brief description of the project.

2. Amount and chemical/physical form of radioactive material to be used.

3. Proposed use locations.

4. Proposed dates that this project will be carried out.

5. Protective clothing to be worn.

6. Whether or not work will be done in a hood.

7. Precautions to be taken to: (1) prevent the spread of contamination from unsealed sources, and (2) prevent external radiation exposure from penetrating radiation (x and gamma rays) by using proper shielding devices.

8. Radiation detection equipment that will be used for laboratory and personnel monitoring and frequency of use.

9. Disposal of radioactive waste.

Attach to proposal:

1. Statement of Training forms (RC-1) shall be attached for all individuals involved in the study. (Appendix B)

2. Proposal Summary Sheet (Appendix B)

UNIVERSITY OF FLORIDA
STATEMENT OF TRAINING AND EXPERIENCE

(*To be completed by ALL personnel who will be working with radioactive material at the University of Florida*)

NAME:_____ DEPARTMENT:_____ PHONE: _____

UFID: _____CLASSIFICATION (*Faculty, Technician, Student,* _____

RADIOACTIVE MATERIAL TO BE USED:_____ PRINCIPAL INVESTIGATOR:_____

RADIATION SAFETY TRAINING

SUBJECT	*WHERE TRAINED*	*DATES AND DURATION OF TRAINING*	*PRECEPTOR/ ON THE JOB (Circle Answer)*	*FORMAL COURSE (Circle Answer)*
A. *Principles and practices of radiation protection*			*Yes No*	*Yes No*
B. *Radioactivity Measurement, standardization, monitoring techniques, and instruments*			*Yes No*	*Yes No*
C. *Mathematics and calculations basic to use and measurement of radioactivity*			*Yes No*	*Yes No*
D. *Biological effects of radiation exposure*			*Yes No*	*Yes No*
E. *Transportation of radioactive material*			*Yes No*	*Yes No*
F. *Operating and Emergency procedures*			*Yes No*	*Yes No*

RADIOACTIVE MATERIAL HANDLING EXPERIENCE

RADIONUCLIDE USED	*MAXIMUM AMOUNT*	*WHERE EXPERIENCE WAS GAINED*	*DATES AND DURATION OF EXPERIENCE*	*TYPE OF USE*

Have radiation exposure records been maintained for you at another institution? Yes No

I have read and will abide by the University regulations as set forth in the RADIATION CONTROL GUIDE.

*SIGNATURE:*_____*DATE:*_____

If additional space is needed, use the back of this sheet. Keep a copy and return original to:
R*ADIATION CONTROL DEPARTMENT - 212 Nuclear Sciences Center - Box 118340*

SUMMARY SHEET
PROPOSAL TO USE RADIOACTIVE MATERIAL

1. Title of Proposal: _____

   _____

2. Radioactive material users:

Name	Position	UF Approved User	Relation to Project

3. Proposed Project Starting Date: _____

4. Radionuclides to be used:

Radio-nuclide	Form	Half-life	Principal Radiation	Activity Inventory Amount	Activity Used Per Experiment	Activity Total Project

5. Where are radioactive materials to be used (include building and room)? _____

   _____

6. What physical facilities are available (i.e. fumehood)? _____

   _____

7. How will lab surveys be done? How often? What equipment? _____

   _____

8. Describe any problems associated with final disposal of radioactivity: _____

   _____

EH&S RC-RADPROMSM rev 9/93

DOCUMENTATION OF TRAINING FORM:

NAME _____ DEPARTMENT_____ EXT._____

CLASSIFICATION (*Faculty, Technician, Student, etc.*) _____

RADIOACTIVE MATERIAL TO BE USED:_____ PRINCIPAL INVESTIGATOR_____

Check appropriate response:

_____Option 1: Radiation Safety Training Provided by Principal Investigator.

TYPE OF TRAINING	*WHERE TRAINED*	*DATES AND DURATION OF TRAINING*	*TRAINING PROVIDER*
A. *Principles and practices of radiation protection*			
B. *Radioactivity Measurement, standardization, monitoring techniques, and instruments*			
C. *Mathematics and calculations basic to use and measurement of radioactivity*			
D. *Biological effects of radiation exposure*			
E. *Transportation of radioactive material*			
F. *Operating and Emergency procedures*			

_____Option 2: Radiation Safety Training provided by Radiation Control Department.

I have contacted the Radiation Control Office Secretary and have enrolled the above individual in the next available Radiation Safety Short Course.

_____Option 3: Radiation Safety Training provided by credit course.

I will assure that the above individual will enroll in and attend the following credit course:

_____

PI Signature Date

Return original to the:

RADIATION CONTROL DEPARTMENT - 212 Nuclear Sciences Center
Box 118340

Renewal of Radioactive Material Use Authorization

Proposal Title: _____

_____

Description of Project: _____

_____

_____

Participants in Project:

Name	Position	Radioactive Material User Yes	No

Radionuclides to be Used:

Radionuclides	Chemical Form(s)	Inventory Amount (mCi)	Activity per Experiment	Activity per Year (mCi)

Locations (buildings/rooms) where radioactive materials are used and stored: _____

_____

Physical facilities and equipment	Yes	No	Location
fumehood			
ultra centrifuge			
centrifuge			
cold room			
other			

	Yes	No	Location	Make	Model
liquid scintillation counter (LSC)					
LSC with external standard					
gamma counter					
laser system					
GC with ECD					
portable radiation meter					
x-ray equipment					
other					

Describe any anticipated problems associated with radioactive waste disposal: _____

_____

Will you be generating radioactive mixed waste?_____

_____ _____

(Signature) Firstname Lastname, Title Date

APPENDIX C

PROCEDURE FOR OPENING PACKAGES CONTAINING RADIONUCLIDES

Laboratory personnel should open and inspect packages immediately upon receipt. Claims for damaged or incorrect material must be submitted as soon as possible to the vendor. Return of radioactive material to the vendor must be coordinated with the Radiation Control Office.

Procedure:

1. Place package in a hood on absorbent paper. Wear gloves.

2. Open package and verify that contents agree in name and quantity with packing slip and with what was ordered.

3. If the package contains a gamma emitting radionuclide or more that 500 μCi of P-32, place the contents behind suitable shielding.

4. Check for breakage of seals or containers, loss of liquid or change in color of absorbing material.

5. The inner packaging which includes the liner, shield, and absorbent materials may be contaminated; they are to be discarded in the radioactive waste container unless shown to be uncontaminated by suitable monitoring techniques. NOTE: Any material placed in regular trash must be checked to be free of contamination and must have all radioactive labels removed or defaced.

6. Record radionuclides, quantity and date of receipt on the Radionuclide Utilization Form.

7. Follow any special handling or opening procedures that are supplied by the vendor when opening the vial.

8. Use extreme caution when opening the inner vial containing the radioactive material. Monitor yourself and hood area after completion of procedure.

9. Store radioactive material in a secure location.

10. Report any problems to the Radiation Control Officer.

NOTE: These procedures are general guidelines for opening packages containing millicurie quantities of radioactive material. The precautions which must be taken will depend on the quantities involved. Consult with Radiation Control before opening any non-routine package or if you have any questions.

APPENDIX D

The annual occupational dose limits as specified in the Code of Federal Regulations, Title 10, Part 20, "Standards for Protection Against Ionizing Radiation," and in the Florida Department of Health, Chapter 64E-5 (July 1997), "Control of Radiation Hazards Regulations" are listed below.

The annual occupational dose limits for adults are:

1. A total effective dose equivalent equal to 5 rem (0.05 Sv); or
2. The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye equal to 50 rem (0.5 Sv).

The annual dose limits to the lens of the eye, to the skin, and to the extremities are:

1. An eye dose equivalent of 15 rem (0.15 Sv).
2. A shallow dose equivalent of 50 rem (0.5 Sv) to the skin or to any extremity.

The annual occupational dose limits for minors (less than 18 years old) are:

1. 10 percent of the annual occupational dose limits for adults.

The dose to an embryo or fetus for women who have declared pregnancy:

1. The dose to an embryo or fetus during the entire pregnancy shall not exceed 0.5 rem (5 mSv).
2. It is recommended that no more than 0.05 rem (0.5 mSv) be received by the embryo or fetus in any one month.

Whole body includes head, trunk, including male gonads, arms above the elbow, or legs above the knee. Extremity includes hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

APPENDIX E

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

A. INTRODUCTION

Section 64E-5.902 of Chapter 64E-5, FAC, requires that all individuals whose work may involve exposure to radiation be instructed in the health protection problems associated with exposure to radioactive material or radiation, in precautions or procedures to minimize exposure and in the regulations that they are expected to observe. This appendix describes the instructions that should be provided concerning biological risks to the embryo/fetus exposed to radiation, a dose limit for the embryo/fetus, and suggestions for reducing radiation exposure.

B. DISCUSSION

It has been known since 1906 that cells that are dividing very rapidly and are undifferentiated in their structure and function are generally more sensitive to radiation. In the embryo stage, cells meet both these criteria and thus would be expected to be highly sensitive to radiation. Furthermore, there is direct evidence that the embryo/fetus is radiosensitive. There is also evidence that it is especially sensitive to certain radiation effects during certain periods after conception, particularly during the first 2 to 3 months after conception when a woman may not be aware that she is pregnant.

It is important to note that the mother assumes all risk until she specifically declares her pregnancy, in a written and signed statement, to her Principal Investigator and copies the statement to the Radiation Control Officer. Upon receipt of the statement by the Radiation Control Office, the University and Principal Investigator is responsible for assuring that the female worker's exposure will not result in 500 millirem to the fetus. After a female occupational worker voluntarily notifies her Principal Investigator and the Radiation Control Officer in writing that she is pregnant and the estimated date of conception, for the purposes of fetal/embryo dose protection, she is considered a declared pregnant worker. Section 64E-5.311, FAC, places different radiation dose limits on declared pregnant workers than on adult workers. Specifically, for a declared pregnant worker who chooses to continue working as an occupational worker, the dose limit for the embryo/fetus from conception to birth (entire gestation period) is 500 mrem. Further, efforts should be made to avoid exceeding 50 mrem per month to the pregnant worker. It is the responsibility of the pregnant worker to decide when or whether to formally declare her condition. If a woman chooses not to declare her pregnancy, she will continue to be governed by guidelines for adult occupational exposure.

Because of the sensitivity of the unborn fetus, the National Council on Radiation Protection and Measurements (NCRP) has recommended that substantial variations in the rate of exposure be avoided to the unborn fetus from occupational exposure of the expectant mother and that special precautions be taken to limit the exposure of pregnant or potentially pregnant women. If the dose to the fetus is determined to have already exceeded 500 mrem when a worker notifies her Principal Investigator and the Radiation Control Officer of her pregnancy, the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the gestation period.

C. REGULATORY POSITION

Instructions on radiation risks should be provided to workers, including supervisors, in accordance with 64E-5.902 before they are allowed to work with radioactive materials and/or radiation producing devices or access to such areas. In providing instructions on radiation risks, employers should include specific instructions about the risks of radiation exposure to the embryo/fetus. The instructions should be presented both orally and in printed form, and the instructions should include, as a minimum, the information provided in the Attachments to this Appendix. Individuals should be given the opportunity to ask questions and in turn should be questioned to determine whether they understand these instructions.

ATTACHMENT 1

EFFECTS ON THE EMBRYO/FETUS OF EXPOSURE TO RADIATION AND OTHER ENVIRONMENTAL HAZARDS

For the NRC and State position to be effective, it is important that both the employee and the Principal Investigator understand the risk to the unborn fetus from radiation received as a result of the occupational exposure of the mother. This guide tries to explain the risk and to compare it with other, more familiar, risks to the unborn fetus during pregnancy. This will hopefully help pregnant employees evaluate the risk to the unborn fetus against the benefits of employment. In order to decide whether to continue working while exposed to ionizing radiation during her pregnancy, a woman should understand the potential effects on an embryo/fetus, including those that may be produced by various environmental risks such as smoking and drinking. This will allow her to compare these risks with those produced by exposure to ionizing radiation.

Table 1 provides information on the potential effects resulting from exposure of an embryo/fetus to radiation and nonradiation risks. The second column gives the rate at which the effect is produced by natural causes in terms of the number per thousand cases. The fourth column gives the number of additional effects per thousand cases believed to be produced by exposure to the specified amount of the risk factor.

The following section discusses the studies from which the information in Table 1 was derived. The results of exposure of the embryo/fetus to the risk factors and the dependence on the amount of the exposure are explained.

A. RADIATION RISKS

1. Childhood Cancer

   Numerous studies of radiation-induced childhood cancer have been performed, but a number of them are controversial. The National Academy of Science (NAS) BEIR report reevaluated the data from these studies and even reanalyzed the results. Some of the strongest support for a causal relationship is provided by twin data from the Oxford survey (Ref. 4). For maternal radiation doses of 1,000 millirem, the excess number of deaths (above those occurring from natural causes) was found to be 0.6 deaths per thousand children (Ref. 4).

2. Mental Retardation and Abnormal Smallness of the Head (Microcephaly)

   Studies of Japanese children who were exposed while in the womb to the atomic bomb radiation at Hiroshima and Nagasaki have shown evidence of both small head size and mental retardation. Most of the children were exposed to radiation doses in the range of 1 to 50 rad. The importance of the most recent study lies in the fact that investigators were able to show that the gestational age (age of the embryo/fetus after conception) at the time the children were exposed was a critical factor (Ref. 7). The approximate risk of small head size as a function of gestational age is shown in Table 1. For a radiation dose of 1,000 millirem at 4 to 7 weeks after conception, the excess cases of small head size was 5 per thousand; at 8 to 11 weeks, it was 9 per thousand (Ref. 7).

In another study, the highest risk of mental retardation occurred during the 8 to 15 week period after conception (Ref. 8). A recent EPA study (Ref. 16) has calculated that excess cases of mental retardation per live birth lie between 0.5 and 4 per thousand per rad.

3. Genetic Effects

Radiation-induced genetic effects have not been observed to date in humans. The largest source of material for genetic studies involves the survivors of Hiroshima and Nagasaki, but the 77,000 births that occurred among the survivors showed no evidence of genetic effects. For doses received by the pregnant worker in the course of employment considered in this guide, the dose received by the embryo/fetus apparently would have a negligible effect on descendants (Refs. 17 and 18).

B. NONRADIATION RISKS

1. Occupation

A recent study (Ref. 9) involving the birth records of 130,000 children in the State of Washington indicates that the risk of death to the unborn fetus is related to the occupation of the mother. Workers in the metal industry, the chemical industry, medical technology, the wood industry, the textile industry, and farms exhibited stillbirths or spontaneous abortions at a rate of 90 per thousand above that of workers in the control group, which consisted of workers in several other industries.

2. Alcohol

It has been recognized since ancient times that alcohol consumption had an effect on the unborn fetus. Carthaginian law forbade the consumption of wine on the wedding night so that a defective fetus might not be conceived. Recent studies have indicated that small amounts of alcohol consumption have only the minor effect of reducing the birth weight slightly, but when consumption increases to 2 to 4 drinks per day, a pattern of abnormalities called the fetal alcohol syndrome (FAS) begins to appear (Ref. 11). This syndrome consists of reduced growth in the unborn fetus, faulty brain function, and abnormal facial features. There is a syndrome that has the same symptoms as full-blown FAS that occurs in children born to mothers who have not consumed alcohol. This naturally occurring syndrome occurs in about 1 to 2 cases per thousand (Ref. 10).

For mothers who consume 2 to 4 drinks per day, the excess occurrences number about 100 per thousand; and for those who consume more than 4 drinks per day, excess occurrences number 200 per thousand. The most sensitive period for this effect of alcohol appears to be the first few weeks after conception, before the mother-to-be realizes that she is pregnant (Refs. 10 and 11). Also, 17% or 170 per thousand of the embryo/fetuses of chronic alcoholics develop FAS and die before birth (Ref. 15). FAS was first identified in 1973 in the United States where less than full-blown effects of the syndrome are now referred to as fetal alcohol effects (FAE) (Ref. 12).

3. Smoking

Smoking during pregnancy causes reduced birth weights in babies amounting to 5 to 9 ounces on the average. In addition, there is an increased risk of 5 infant deaths per thousand for mothers who smoke less than one pack per day and 10 infant deaths per thousand for mothers who smoke one or more packs per day (Ref. 13).

4. Miscellaneous

Numerous other risks affect the embryo/fetus, only a few of which are touched upon here. Most people are familiar with the drug thalidomide (a sedative given to some pregnant women), which caused children to be born with missing limbs, and the more recent use of the drug diethylstilbestrol (DES), a synthetic estrogen given to some women to treat menstrual disorders, which produced vaginal cancers in the daughters born to women who took the drug. Living in high altitudes also gives rise to an increase in the number of low-birth-weight children born, while an increase in Down's Syndrome (Mongolism) occurs in children born to mothers who are over 35 years of age. The rapid growth in the use of ultrasound in recent years has sparked an ongoing investigation into the risks of using ultrasound for diagnostic procedures (Ref. 19).

EFFECTS OF RISK FACTORS ON PREGNANCY OUTCOME

Effect	Number Occurring from Natural Causes	Risk Factor	Excess Occurrence from Risk Factor
		RADIATION RISKS	
		Childhood Cancer	
Cancer death in children	1.4 per thousand (Ref. 5)	Radiation dose of 1000 millirem received before birth	0.6 per thousand (Ref. 4)
		Abnormalities	
		Radiation dose of 1000 millirad received during specific periods after conception:	
Small head size	40 per thousand (Ref. 6)	4-7 weeks after conception	5 per thousand (Ref. 7)
Small head size	40 per thousand (Ref. 6)	8-11 weeks after conception	9 per thousand (Ref. 7)
Mental retardation	4 per thousand (Ref. 8)	Radiation dose of 1000 millirad received 8 to 15 weeks after conception	0.5-4 per thousand (Ref. 8)
		NONRADIATION RISK	
		Occupation	
Stillbirth or spontaneous abortion	200 per thousand (Ref. 9)	Work in high-risk occupations (see text)	90 per thousand (Ref. 9)
		Alcohol Consumption (see text)	
Fetal Alcohol Syndrome	1 to 2 per thousand (Ref. 10)	2-4 drinks per day	100 per thousand (Ref. 11)
Fetal Alcohol Syndrome	1 to 2 per thousand (Ref. 10)	More than 4 drinks per day	200 per thousand (Ref. 11)
Fetal Alcohol Syndrome	1 to 2 per thousand (Ref. 10)	Chronic alcoholic (more than 10 drinks per day)	350 per thousand (Ref. 12)
Prenatal infant death (around the time of birth)	23 per thousand (Refs. 13, 14)	Chronic alcoholic (more than 10 drinks per day)	170 per thousand (Ref. 15)
		Smoking	
Perinatal infant death	23 per thousand (Refs. 13, 14)	Less than 1 pack per day	5 per thousand (Ref. 13)
Perinatal infant death	23 per thousand (Refs. 13, 14)	One pack or more per day	10 per thousand (Ref. 13)

ATTACHMENT 2
PREGNANT WORKER'S GUIDE

POSSIBLE HEALTH RISKS TO THE FETUS OF WOMEN WHO ARE EXPOSED TO RADIATION DURING PREGNANCY

During pregnancy, you should be aware of things in your surroundings or in your style of life that could affect your unborn fetus. For those of you who work with radioactive materials and/or radiation producing devices or who have access to such areas, it is desirable that you understand the biological risks of radiation to your unborn fetus.

Everyone is exposed daily to various kinds of radiation: heat, light, ultraviolet, microwave, ionizing, and so on. For the purposes of this guide, only ionizing radiation (such as x-rays, gamma rays, neutrons, and other high-speed atomic particles) is considered. Actually, all human activities involve exposure to radiation. People are exposed to different amounts of natural "background" ionizing radiation depending on where they live. Radon gas in homes is a problem of growing concern. Background radiation comes from the four following sources:

	Average Annual Dose
Terrestrial: radiation from soil and rocks	28 millirem (0.28 mSv)
Cosmic: radiation from outer space	27 millirem (0.27 mSv)
Radioactivity normally found within the human body	39 millirem (0.39 mSv)
Radon	200 millirem (2.00 mSv)
	294 millirem (2.94 mSv)[1]
Dosage range (geographic and other factors)	75 to 5,000 millirem (0.75 mSv to 50.00 mSv)

The first two of these sources expose the body from the outside, and the last two exposes it from the inside. The average person is thus exposed to a total dose of about 294 millirem per year from natural background radiation.

[1] Radiation dose in this document is described in three different units. The rad is a measure of the amount of energy absorbed in a certain amount of material (100 ergs per gram). Equal amounts of energy absorbed from different types of radiation may lead to different biological effects. The rem is a unit that reflects the different biological effects done to the body by different types of radiation. The millirad and millirem refer to 1/1000 of a rad and rem, respectively. The Sievert (Sv) is the System Internationale unit that equivalent to 100 rem; the millisievert (mSv) refers to 1/1000 of a Sievert.

In addition to exposure from normal background radiation, radiation exposure can result from man-made materials and devices. Some consumer products such as smoke detectors, static eliminators and building materials contain radioactive material. The following lists the average annual dose from man-made radiation.

	Average Annual Dose
Fallout	< 1 millirem (< 0.01 mSv)
Nuclear Power Fuel Cycle	< 1 millirem (< 0.01 mSv)
Consumer Products	13 millirem (0.13 mSv)
Medical	54 millirem (0.54 mSv)

Medical procedures may also contribute to the dose people receive. The following table lists the average doses received by the bone marrow (the blood-forming cells) from different medical applications.

X-Ray Procedure	Average Dose[2]
Normal chest examination	10 millirem (0.1 mSv)
Normal dental examination	10 millirem (0.1 mSv)
Rib cage examination	140 millirem (1.4 mSv)
Gall bladder examination	170 millirem (1.7 mSv)
Barium enema examination	500 millirem (5.0 mSv)
Pelvic examination	600 millirem (6.0 mSv)

In summary, the average person is exposed to radiation daily, receiving a radiation dose of approximately 360 mrem/year (3.6 mSv/year). A dose of about 294 millirem/year (2.94 mSv/year) is from natural background radiation, while medical radiation exposure and consumer products contribute the rest (Refs 4, 19, 20).

NUCLEAR REGULATORY COMMISSION POSITION

NRC and State regulations and guidance are based on the conservative assumption that any amount of radiation, no matter how small, can have a harmful effect on an adult, child, or unborn fetus. This assumption is said to be conservative because there are no data showing ill effects from small doses; the National Academy of Sciences has expressed "uncertainty as to whether a dose of, say, 1 rad would have any effect at all." As it is known that the unborn fetus is more sensitive to radiation than adults, particularly during certain stages of development, the NRC and State has established a special dose limit for protection of the unborn fetus. However, such a limit could result in job discrimination for women of child-bearing potential. The NRC has taken the position that special protection of the unborn fetus should be voluntary and should be based on decisions made by workers and employers who are well informed about the risks involved.

For the NRC position to be effective, it is important that both the employee and the employer understand the risk to the unborn fetus from radiation received as a result of

[2] Variations by a factor of 2 (above and below) are not unusual.

the occupational exposure of the mother. This document tries to explain the risk as clearly as possible and to compare it with other risks to the unborn fetus during pregnancy. It is hoped this will help pregnant employees balance the risk to the unborn fetus against the benefits of employment to decide if the risk is worth taking. This document also discusses methods of keeping the dose, and therefore the risk, to the unborn fetus As Low As Is Reasonably Achievable (ALARA).

RADIATION EXPOSURE LIMITS

Since 1906, it has been known that rapidly dividing, undifferentiated cells are more sensitive to radiation. The embryo/fetus[3] is composed of cells that meet these criteria and are more sensitive to radiation. In addition, scientific studies have shown that the embryo/fetus is more sensitive to radiation than the adult (particularly during the first 2-3 months after conception when a woman may not be aware that she is pregnant). Because of the sensitivity of the unborn fetus, the exposure to the unborn fetus of a "declared pregnant worker" shall be limited to 500 millirem (5 mSv) for the entire pregnancy (Refs 20, 25, 26); the guidance also recommends that substantial variations in the rate of exposure be avoided and efforts should be made to avoid exceeding 50 mrem per month to the pregnant worker.

ADVICE FOR EMPLOYEE

Although the risks to the unborn fetus are small under normal working conditions, it is still advisable to limit the radiation dose from occupational exposure to be ALARA, not to exceed 500 millirem (5 mSv) for the total pregnancy. The employee, Principle Investigator and Radiation Control Office should work together to decide the best method for minimizing exposure and accomplishing this goal. Some methods include reducing the time spent in radiation areas, wearing some shielding over the abdominal area, and maximizing the distance from radiation sources. The medical/health physicist will be able to estimate the probable dose to the unborn fetus during the normal nine month pregnancy period and to inform the employee of the amount. If the predicted dose exceeds 50 millirem (0.5 mSv) per month, work schedules or procedures shall be modified to limit the dose to the 500 millirem recommended limit. It is important that the employee inform her Principal Investigator and the Radiation Control Officer of her condition as soon as she realizes she is pregnant, so that the exposure to the unborn fetus can be minimized.

INTERNAL HAZARDS

This guidance has been directed primarily toward a discussion of radiation doses received from external sources. Workers must also be aware of the risk of radioactive

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[3] In conformity with 10CFR20 and 64E-5, the term "embryo/fetus" is used throughout this document to represent all stages of pregnancy. The definitions are taken from Stedman's Medical dictionary, 21st edition, The Williams and Wilkins Company, Baltimore, MD 1966 and read as follows:

Embryo: An organism in the early stages of development; in man, from conception until approximately the end of the second month. Developmental stages from this time are commonly designated as fetal.

Fetus: The unborn young of a viviparous animal after it has taken form in the uterus; in man, the product of conception from the end of the eighth week to the moment of birth.

Undifferentiated Cells: Those cells in early development which have not progressed to a mature and specialized state, such as muscle or nerve cells.

material entering the body in working places where unsealed radioactive material is used. Nuclear medicine clinics, research laboratories, and certain manufacturers use radioactive material in bulk form, often as a liquid or a gas. General precautions[4] include the following:

1. Do not smoke, eat, drink or apply cosmetics around radioactive material.

2. Do not pipette solutions by mouth.

3. Use disposable gloves while handling radioactive material.

4. Wash hands after working around radioactive material.

5. Wear lab coats or other protective clothing whenever there is a possibility of spills.

Remember that the Principal Investigator is required to have demonstrated that he/she will have safe procedures and practices before the Radiation Control Office will authorize their approval to use radioactive material under one of the University's radioactive material licenses. Workers are urged to follow established procedures and consult the Radiation Control Office or medical/health physicist whenever problems or questions arise.

RADIONUCLIDE CHARACTERISTICS

Biological data has been collected for a set of radionuclides which are expected to be of greatest significance for prenatal exposure in the work environment. These materials are: tritium, as gas and water; tritium and carbon in three typical organic forms--glucose, amino acid, and thymidine; and iodine.

TRITIUM

Trace amounts of inorganic tritium in gaseous form or when incorporated into water are readily absorbed from the lung or gastrointestinal (GI) tract. In air most tritium will form water, as will some small amount of that which is absorbed, so that little tritium actually enters the body as a gas. Physiologic studies demonstrate that water crosses the placenta in both directions. The percentage water content of the embryo and fetal tissues generally is measurable greater than that of the corresponding tissues in adults, so that their relative tritium concentrations may be slightly greater. For practical purposes, it may be assumed that the concentration of tritium in the conceptus is the same as that of the pregnant woman, and that it would be readily excreted in parallel with its loss from her body.

Tritium in the form of tritiated water is assumed to be uniformly distributed throughout the maternal and embryo/fetal soft tissues. It is assumed that tritiated water has a biological half-life of 10 days (Ref. 23).

[4] Specific precautions are made on a case-by-case basis for specific radionuclide of interest.

ORGANICALLY BOUND TRITIUM AND CARBON

1. Glucose

Glucose is actively transported from maternal to fetal blood across the placental layers and uterine blood. Fetal brain, liver, kidney and skeletal muscle are the major organs that utilize glucose, and the overall glucose utilization rate is higher in the fetus than in the pregnant female.

Glycolysis of tritium-labeled glucose produces tritiated water, which then can exchange and distribute throughout the intracellular and extracellular water pools in both maternal and fetal compartments. A limited fraction of the tritiated water may subsequently become incorporated into lipid via lipogenesis, but this is sufficiently small that it can be ignored for dosimetry purposes. Catabolism of ^{14}C-labeled glucose results in $^{14}CO_2$ production in the fetus, but this does not accumulate in the fetus, rather it is randomly excreted to the mother via the placenta, and then exhaled. There are essentially no available concentration data for ^{3}H-glucose or ^{14}C-glucose applicable to radiation dosimetry (Ref. 23).

2. Amino Acids

In general, the concentrations of free amino acids in fetal tissues are similar to those in maternal tissues. Significant amounts of labeled amino acids are incorporated in protein during organogenesis or the growth phases of gestation. Concentration concurrently would be reduced through dilution by further incorporation of amino acids during progressive growth, so that consistently major deviations from maternal concentration would not be expected (Ref. 23).

3. Thymidine

Biological behavior of radiolabeled thymidine under conditions of accidental or environmental exposure is not clear. There does not appear to be any major differences between the metabolic behavior of ^{3}H- or ^{14}C-labeled thymidine and both precursors are incorporated into the DNA of proliferating cells. Only a fraction (10%) of that which enters the adult is incorporated; most of the remainder is catabolized rapidly and excreted. There is long-term retention of incorporated thymidine; it remains in the DNA until the cell divides, where it is partitioned between the daughter cells, and some may be re-utilized when the cell dies. The processes by which thymidine crosses the placenta have not been established (Ref. 23).

IODINE

The fetal thyroid begins to concentrate iodine at about 90 days of age and continues to accumulate iodine throughout gestation. Inorganic iodine in the blood readily crosses the placenta and is accessible to the embryo or fetus. Depending on which iodine radionuclides are involved, their decay schemes and half-lives, and whether exposure is chronic or acute, the thyroid concentration in the last months of pregnancy has been estimated to be as much as three to ninefold greater in the human fetus than in the adult.

The thyroid begins to secrete iodine shortly after it starts to concentrate iodine, and this secretion continues throughout gestation resulting in an organic iodine concentration of about 75% that in maternal blood. The concentrations of individual species of organic iodine (in particular triiodothyronine (T_3) and thyroxine (T_4) in fetal and maternal blood are not well correlated, which suggests that there is little, if any, placental transfer of organic iodine. Concentrations of T_3 and T_4 change abruptly at birth, and within about a week, reach values comparable to adults (Ref. 23, 24).

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APPENDIX F

APPLICATION OF BIOASSAY FOR TRITIUM

A. CONDITIONS UNDER WHICH BIOASSAY IS NECESSARY

1. Routine bioassay is necessary when quantities of tritium processed by an individual at any one time or the total amount processed per month exceed those for the forms of tritium shown in Table 1.

Table 1.

ACTIVITY LEVELS ABOVE WHICH TRITIUM BIOASSAY IS REQUIRED

Types of Operation	HTO and Other Tritiated Compounds (Including Nucleotide Precursors)
Processes in open room or bench with possible escape of tritium from process vessels	25 mCi (925 MBq)
Processes with possible escape of tritium carried out within a fume hood of adequate design, face velocity and performance reliability	25 mCi (925 MBq)
Processes carried out with gloveboxes that are ordinarily closed but with possible release of tritium from process vessels and occasional exposure to contaminated box and box leakage	250 mCi (9250 MBq)

2. Bioassay is not required, when process quantities handled by an individual are less than those in Table 1.

B. PARTICIPATION

All individuals involved in the processing of tritium under conditions specified in Section 1 or in the immediate area of the process should participate in the bioassay program.

C. TYPES OF BIOASSAY THAT SHOULD BE PERFORMED

1. Baseline (preemployment or preoperational)

   A baseline bioassay should be conducted not more than one month prior to the individual beginning work with tritium in amounts that would require participation in the bioassay program.

2. Routine Urinalysis

   Regular bioassays should be conducted to monitor routine operations at frequencies specified in Section D.

3. Emergency

If the initial sample or other data indicates a possible exposure high enough to warrant immediate medical attention, a complete and immediate follow-up should be conducted as described in Section E.1.b.

4. Post-Operational and Termination of Usage

A bioassay should be performed within one month after the last possible exposure to tritium such as when operations are being discontinued, or when the individual is terminating activities with potential exposure.

5. Diagnostic

Follow-up bioassay should be performed as soon as possible but within one week of any sample exceeding levels given as action points in Section E, in order to confirm the initial results and in the case of a single intake, to allow an estimate of the effective half-life of the tritium in the body.

D. FREQUENCY OF SAMPLING

Initial Routine

A bioassay sample of at least 50 ml of urine should be taken within 72 hours following entry of an individual into an area where operations require bioassay according to Section A and then every month or more frequently thereafter, as long as the individual is working with tritium. When work with tritium is on an infrequent basis (less frequently than every month), bioassay should be performed within 10 days of the end of the work period during which tritium was handled.

E. ACTION POINTS AND CORRESPONDING ACTIONS

1. Monthly and Other Sampling

a. If urinary excretion rates exceed 5 μCi/L (0.18 MBq/L), but are less than 50 μCi/L (1.8 MBq/L), the following course of action should be taken:

(1) A survey of the operations involved, including air and surface contamination monitoring, should be carried out to determine the causes of the exposure and evaluate the potential for further exposures or for the possible involvement of other individuals.

(2) Any reasonable corrective actions that the survey indicates may lower the potential for further exposures should be implemented.

(3) A repeat urine sample should be taken within one week of the previous sample and should be evaluated within a week after collection. Internal dose commitments should be estimated using at least these two urine sample evaluations and other survey data, including the probable times of the intake of tritium.

(4) Any evidence indicating that further work in the area might result in an individual receiving a dose commitment in excess of the limits established in 64E-5.304, should serve as cause to remove the individual from work in this operation until the sources of exposure is discovered and corrected.

(5) Reports or notification must be provided as required by 64E-5.344 and 64E-5.345 of Chapter 64E-5 or as required by conditions of the license.

b. If urinary excretion rates exceed 50 μCi/L (1.8 MBq/L), the following course of action should be taken:

(1) Carry out all steps in item a of Section E.1.

(2) If the projected dose commitment exceeds levels for whole body as provided in 64E-5.304 of Chapter 64E-5, provide appropriate notification to DOH.

(3) Refer the case to appropriate medical/health physics consultation for recommendations regarding immediate therapeutic procedures that may be carried out to accelerate removal of tritium from the body and reduce the dose to as low as is reasonably achievable.

(4) Carry out repeated sampling (24 hr urine collections) at approximately one week intervals at least until samples show an excretion rate less than 5 μCi/L (0.18 MBq/L). If there is a possibility of long term organic compartments of tritium that require evaluation (reference NUREG-0938), continue sampling as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected and to provide estimates of total dose commitments.

APPENDIX G

APPLICATION OF BIOASSAY FOR I-125 AND I-131

A. CONDITIONS UNDER WHICH BIOASSAY IS NECESSARY

1. Routine bioassay is necessary when an individual handles in open form, unsealed quantities of radioactive iodine that exceed those shown in Table 1. The quantities shown in Table 1 apply to both the quantity handled at any one time or integrated as the total amount of activity handled by an individual over a one month period.

2. Bioassay is not required, but recommended, when process quantities handled by an individual are less than those in Table 1.

B. PARTICIPATION

All individuals handling radioactive iodine or sufficiently close to the process so that intake is possible (i.e., within a few meters and in the same room as the individual handling the material), should participate in bioassay programs.

C. TYPES OF BIOASSAY THAT SHOULD BE PERFORMED

1. Baseline

   A baseline bioassay should be conducted prior to beginning work with radioactive iodine in amounts that would require participation in the bioassay program.

2. Routine

   Regular bioassay should be conducted to monitor routine operations at the frequency specified in Section D.

3. Emergency

   A bioassay should be performed as soon as possible after any incident that might cause thyroid uptakes to exceed burdens given in Section E.1.b so that actions recommended in Section E.1.b.(3) can be most effective.

4. Post-Operational and Termination of Usage

   A bioassay should be performed within 2 weeks of the last possible exposure to I-125 or I-131, when operations are being discontinued or when the individual is terminating activities with potential exposure to these radionuclides.

5. Diagnostic

   Follow-up bioassay should be performed within 2 weeks of any measurements exceeding levels given as action points in Section E. in order to confirm the initial results and in the case of a single intake, to allow an estimate of the effective half-life of radioiodine in the thyroid.

D. FREQUENCY

Initial Routine

A bioassay sample or measurement should be obtained within 72 hours following entry of an individual into an area where bioassay is performed in accordance with Sections A and B and every 4 weeks or more frequently thereafter, as long as the conditions described in Sections A and B exist. When work with radioactive iodine is on an infrequent basis, (less frequently than every 4 weeks), bioassay should be performed within 10 days of the end of the work period during which radioactive iodine was handled, unless emergency action is appropriate.

E. ACTION POINTS AND CORRESPONDING ACTIONS

1. Monthly and Other Measurements

   a. Whenever the thyroid burden at the time of measurement exceeds 0.12 μCi (4.4 kBq) of I-125 or 0.04 μCi (1.5 kBq) of I-131, the following actions will be taken:

      (1) An investigation of the operations involved, including air and other in-house surveys, will be carried out to determine the causes of exposure and to evaluate the potential for further exposures or for the possible involvement of other individuals.

      (2) Any evidence indicating that further work in the area might result in an individual receiving a dose commitment in excess of the limits established in 64E-5.304, should serve as cause to remove the individual from work in this operation until the sources of exposure is discovered and corrected.

      (3) Reports or notification must be provided as required by 64E-5.344 and 64E-5.345 of Chapter 64E-5 or as required by conditions of the license.

      (4) Corrective actions that will eliminate or lower the potential for further exposures should be implemented.

      (5) A repeat bioassay should be taken within 2 weeks of the previous measurement and should be evaluated within 24 hours after measurement in order to confirm the presence of internal radioiodine and to obtain an estimate of effective half-life for use in estimating dose commitment.

   b. If the thyroid burden at any time exceeds 0.5 μCi (18.5 kBq) of I-125 or 0.14 μCi (5.2 kBq) of I-131, the following actions will be taken:

      (1) Carry out all steps in item a of this regulatory position.

      (2) If the projected dose commitment exceeds levels for whole body as provided in 64E-5.304 of Chapter 64E-5, provide appropriate notification to DOH.

(3) As soon as possible, the case will be referred to appropriate medical consultation for recommendations regarding therapeutic procedures that may be carried out to accelerate removal of radioiodine from the body. This should be done within 2-3 hours after exposure when the time of exposure is known so that any prescribed thyroid blocking agent would be effective.

(4) Carry out repeated measurements at approximately 1 week intervals at least until the thyroid burden is less than 0.12 μCi (4.4 kBq) of I-125 or 0.04 μCi (1.5 kBq) of I-131.

TABLE 1

ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR I-125 OR I-131 IS REQUIRED

	Activity Handled in Unsealed Form Making Bioassay Necessary*	
Type of Operation	Volatile or Dispersible*	Bound to Nonvolatile Agent
Processes in open room or bench, with possible escape of iodine from process vessels	1.0 mCi (37 MBq)	1.0 mCi (37 MBq)
Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	1.0 mCi (37 MBq)	10.0 mCi (370 MBq)
Processed carried out within gloveboxes, ordinarily closed, but with possible release of iodine from process and occasional exposure to contaminated box and box leakage	10.0 mCi (370 MBq)	100.0 mCi (3700 MBq)

*Quantities may be considered the cumulative amount in process handled by a individual during a 1-month period; e.g., the total quantity introduced into a chemical or physical process over a 1 month period, or on one or more occasions in that period, by opening stock reagent containers from which radioactive iodine may escape. Quantities in the right-hand column may be used when it can be shown that activity in process is always chemically bound and processed in such a manner that I-125 and I-131 will remain in nonvolatile form and diluted to concentrations less than 0.1 mCi/mg (3.7 MBq/mg) of nonvolatile agent. Capsules (such as gelatin capsules given to patients for diagnostic test), may be considered to contain the radioiodine in non-free form, and bioassay would not be necessary unless a capsule were inadvertently opened (e.g., dropped and crushed). However, certain compounds where radioiodine is normally bound are known to release radioiodine when the material is in process, and the left-hand column may then be applicable. In those laboratories working only with I-125 in radioimmunassay (RIA) kits, the quantities of I-125 are very small and in less volatile forms; thus, bioassay requirements may be judged from the right-hand column. In field operations, where reagent containers are opened outdoors for simple operations such as pouring liquid solutions, the above table does not apply; bioassay should be performed whenever an individual handles in open form (e.g., an open bottle or container) more than 50 mCi (1850 MBq) at any one time.

Operations involving the routine use of I-125 or I-131 in an open room or bench are discouraged. Whenever practicable, sealed bottles or containers holding more than 0.1 mCi (3.7 MBq) of I-125 or I-131 should be opened at least initially within hoods having adequate face velocities of 150 lf/min or more.

APPENDIX H
INVENTORY REPORTING INSTRUCTIONS

A CONDITION of our radioactive material license requires Principal Investigators submit quarterly inventory reports of radioactive materials to the Radiation Control Officer (RCO). To insure compliance with this license condition, the Radiation Control Committee has agreed that Principal Investigators who are delinquent or neglect submitting their inventory reports are subject to enforcement actions.

"Quarterly Radioactive Materials Inventory" forms are provided for use when reporting. These inventory forms are for reporting the amount of activity "On Hand" at the end of the reporting quarter. Maintenance of the laboratory's utilization forms will facilitate the completion of the quarterly inventory form.

See "QUARTERLY RADIOACTIVE MATERIAL INVENTORY" form. The following is an explanation of each column.

Radionuclide	Radionuclide listed (self-explanatory). List radionuclides not already listed.
Present Inventory (mCi)	List in this column, beside the listed radionuclides, the amount of activity in stock solutions or vials that are on hand at the end of the reporting quarter.
Location	Use this column to record the room location of the listed activity.
Remarks	Any additional pertinent information we need to know (i.e. waste material)

UTILIZATION FORM INSTRUCTIONS

Accountability of radioactive material is of great importance in maintaining compliance with license requirements. See Radionuclide Utilization Form.

1. A Utilization Form must be initiated and maintained for each separate shipment of radioactive material received.

2. An entry must be made on this form each time there is radionuclide usage by the receiving Principal Investigator in his lab.

3. An entry must be made on this form each time radioactive materials are transferred to another Principal Investigator.

4. Each Principal Investigator who receives radioactive material via on-campus transfers must keep and maintain a Radionuclide Utilization Form. All Transfers must be approved by the Radiation Control Department prior to the Transfer.

5. An entry must be made on this form when radioactive materials are received via transfer or shipment and each time those radioactive materials are used.

6. Accurate and regular use of the Utilization Forms facilitate the completion of the Quarterly Radioactive Material Inventory Form.

University of Florida
Radiation Control and Radiological Services Department
Quarterly Radioactive Material Inventory

PI:
_____ Date:_____
(signature)
Department:_____ Building:_____Room:_____

Inventory Date:

Radionuclide	Present Inventory (mCi)	Location	Remarks
^{3}H			
^{14}C			
^{125}I			
^{32}P			
^{33}P			
^{35}S			
^{51}Cr			
^{45}Ca			
^{60}Co			
^{137}Cs			
^{65}Zn			
^{22}Na			
^{36}Cl			
^{63}Ni			
^{192}Ir			
^{90}Sr			

Equipment Containing Radioactive Material.

	Manufacturer	Location
Liquid Scintillation Counter	_____	_____
Gamma Counter	_____	_____
Portable Survey Meter	_____	_____
Gas Chromatograph w/ECD	_____	_____
Nuclear Gauge	_____	_____

μ **NO RADIOACTIVE MATERIAL IN MY POSSESSION**

RETURN FORM TO:
Johnny Weaver
Box 118340
212 Nuclear Sciences Center

RADIONUCLIDE UTILIZATION FORM

PRINCIPAL INVESTIGATOR:_____ROOM NO.:_____

RADIONUCLIDE:_____CHEMICAL/PHYSICAL FORM:_____

INITIAL ACTIVITY RECEIVED (μCi or mCi):_____DATE RECEIVED: ____/____/____

Transferred from PI:_____Transfer Approval Date: ____/____/____

(USE A SEPARATE FORM FOR EACH SHIPMENT OF EACH RADIONUCLIDE RECEIVED)

Date	Activity Removed μCi-mCi	Activity Remaining μCi-mCi	Use	Final Disposal	Users Initials

NOTE: When this particular shipment of radioactive material has been completely utilized, decayed or disposed, maintain this form in laboratory files for review by State and University Radiation Control inspectors.

EHS-RC-7 UTILFORM rev 1/96

APPENDIX I

UNIVERSITY OF FLORIDA

Program for Maintaining Occupational Radiation Exposure for Non-Medical Licensed Activities at the University of Florida, As Low As Reasonably Achievable (ALARA)

I. Management Commitment

A. The University of Florida is committed to the program described in this document for keeping radiation exposures (individual and collective) as low as reasonably achievable (ALARA). In accordance with this commitment, we hereby establish an administrative organization for radiation safety and will develop the necessary written policies, procedures, and instructions to foster the ALARA concept within our institution. The organization includes a Radiation Control Committee (RCC) and a Radiation Control Officer (RCO).

B. The RCO will perform a review to determine methods by which exposures might be lowered. This review shall include reviews of operating procedures and past exposure records, inspections and consultations with the radiation control staff. A brief summary of the audit will be prepared covering the scope of the review and the conclusions reached, and lessons learned, if any.

C. A representative of administration shall be an active member of the RCC. The University of Florida will consider any modifications or changes as recommended by the Committee including those resulting from the annual review of the radiation safety program performed by the RCO.

D. Modifications to operating and maintenance procedures and to equipment and facilities will be made when they will reduce exposures at reasonable costs. We will be able to demonstrate that improvements have been sought, that modifications have been considered, and that they have been implemented where reasonably achievable. Where modifications have been considered but not implemented, we will be prepared to describe the reasons for not implementing them.

E. In addition to maintaining doses to individuals as far below the limits as reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level.

II. Radiation Control Committee

A. Review of Proposed Users and Uses

1. The RCC will review the qualifications of each potential Principal Investigator (PI) and approved user of radioactive material and radiation producing devices with respect to the types and quantities of materials and uses for which he/she has applied to assure that the user will be able to take appropriate measures to maintain exposure ALARA.

2. When considering a new use of radioactive material, the RCC will review the efforts of the PI to maintain exposure ALARA. The user shall have systematic procedures to ensure ALARA and must consider the use of special radiation safety equipment, such as rubber or disposable gloves, fume hoods, remote handling tools, and appropriate shielding in his/her proposed use, when appropriate.

B. Delegation of Authority

1. The RCC will delegate authority to the RCO for enforcement of the ALARA policy.

2. The RCC will support the RCO in those instances where it is necessary for the RCO to assert his authority. Where the RCO has been overruled by the RCC, the RCC will record the basis for its action.

C. Review of the ALARA Program

1. In association with the RCO, the RCC will perform an annual review of all current radiation safety procedures and the development of new procedures as appropriate to implement the ALARA concept.

2. The RCC will review all instances of deviations from the ALARA philosophy. Information in support of the review will be supplied by the RCO.

3. The RCC will evaluate the institution's overall effort for maintaining exposures ALARA. This annual review will include the efforts of the RCO, approved users and workers as well as those of Administration.

4. The RCC will perform a periodic review of occupational radiation exposure with particular attention to instances in which the Investigational Levels in Section VI are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when Investigational Levels are exceeded.

III. Radiation Control Officer (RCO)

A. Annual and Quarterly Review

1. The RCO will perform an annual review of the radiation control program for adherence to ALARA concepts. Reviews of specific procedures may be conducted on a more frequent basis.

2. The RCO will review, at least quarterly, the external radiation exposures of approved users and workers to determine that their exposures are ALARA in accordance with the provisions of Section VI of this program.

3. The RCO will review, at least quarterly, the records of radiation level surveys in unrestricted and restricted areas to determine that radiation levels were ALARA during the previous quarter.

B. Education Responsibilities for ALARA Program

1. The RCO will inform PIs, approved users, workers, and ancillary personnel of ALARA program efforts.

2. The RCO will ensure that PIs, approved users, workers and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that the administration, the RCC, and the RCO are committed to implementing the ALARA concept.

C. Cooperative Efforts for Development of ALARA Procedures

PIs, approved users, workers and ancillary personnel will be given opportunities to participate in formulation of the procedures that they will be required to follow.

1. The RCO will be in close contact with all users and workers in order to develop ALARA procedures for using radioactive materials and radiation producing devices.

2. The RCO will establish procedures for receiving and evaluating suggestions for improving ALARA procedures and will encourage the use of these procedures.

D. Reviewing Instances of Deviation from Good ALARA Practices

The RCO will investigate all known instances of deviation from good ALARA practices and will determine the causes. The RCO may require changes in working procedures to maintain exposures ALARA.

IV. Principal Investigators

A. New Procedures Involving Potential Radiation Exposures

1. The PI will consult with and receive the advance approval of the RCO during the planning stage before using radioactive material for a new procedure.

2. The PI will evaluate all procedures before using radioactive material to ensure that exposure will be kept ALARA. This may be implemented through the application of trial runs.

B. Responsibility of Principal Investigator to Persons Under His/Her Supervision

1. The PI will explain the ALARA concept and his/her commitment to maintain exposures ALARA to all persons under his/her supervision.

2. The PI will ensure that persons under his/her supervision who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

V. Persons Who Receive Occupational Radiation Exposure

A. The worker will be instructed in the ALARA concept and its relationship to working procedures and work conditions.

B. The worker will also be informed of recourses that are available if he/she feels that ALARA is not being promoted on the job.

VI. Establishment of Investigational Levels in Order to Monitor Individual Occupational External Radiation Exposures

The University hereby establishes Investigational Levels for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the RCO with subsequent review by the RCC. The Investigational Levels are listed in the table below. These levels apply to the exposure of individual workers. In cases where it is necessary for a worker's or a group of workers' doses to exceed these Investigational Levels; the RCC retains the right to establish new Investigational Levels on the basis that is consistent with good ALARA practices for that individual or group. Justification for new Investigational Levels will be documented.

A. The following actions will be taken at the Investigational Levels as stated in the table below.

1. Monthly exposure of individuals to less than Investigational Level I

Except when deemed appropriate by the RCO, no further action will be taken in those cases where an individual's exposure is less than values for the Investigational Level I.

2. Personnel exposures equal to or greater than Investigational Level I, but less than Investigational Level II.

The RCO will investigate the exposure of each individual whose monthly exposures equal or exceed Investigational Level I and will report the results of the investigation at the first RCC meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed Investigational Level II, no further action related specifically to the exposure is required unless deemed appropriate by the RCC. The RCC will, however, consider each such exposure in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the RCC minutes.

C. Personnel exposures equal to or greater than Investigational Level II

The RCO will investigate in a timely manner the cause(s) of all personnel exposures equaling or exceeding Investigational Level II and, if warranted, will take action. A report of the investigation and actions taken, if any will be presented to the RCC at the first meeting following completion of the investigation. The details of these reports will be recorded in the meeting minutes. A report of the investigation will also be made available to the Department of Health, Bureau of Radiation Control.

Investigation Levels
for Radiation Exposure

		Level I mrem per month	Level II mrem per quarter
Research Laboratories,	TEDE	40	375
	DDE+CDE	400	3750
	LDE	125	1125
	SDE	400	3750
Veterinary Medicine Radiology	TEDE	300	1250
	DDE+CDE	3300	12500
	LDE	1000	3750
	SDE	3300	12500

TEDE = Total Effective Dose Equivalent = DDE + CEDE = deep dose equivalent and the committed effective dose equivalent

DDE+CDE = Sum of the deep dose equivalent (DDE) and the committed dose equivalent (CDE) to any organ or tissue other than the lens of the eye

LDE = Lens of the eye (eye dose equivalent)

SDE = Skin (shallow dose equivalent) or to any extremity

NOTE: Bimonthly Investigation Levels are 2x monthly Investigation Levels

When annual doses exceed the levels specified in 64E-5.304 (1) (a) and (b), a report of the investigation will also be made available to the Department of Health, Bureau of Radiation Control.

VII. Signature of Certifying Official

I hereby certify that this institution has implemented the ALARA program set forth above.

By: _____ Date: _____

Ed Poppell
Vice President of Finance and Administration
University of Florida

APPENDIX J

APPLICATION FOR THE NON-HUMAN USE OF RADIATION PRODUCING DEVICES TO THE RADIATION CONTROL COMMITTEE

1. Principal Investigator: _____
   Department: _____
   Office Room Number: _____ Phone Number: _____
   Lab Technician: _____ Phone Number: _____

2: Authorized user(s): Job Title:

_____	_____
_____	_____
_____	_____
_____	_____

3. Information regarding the Principal Investigator and authorized user(s) basic training with the radiation producing device shall be forwarded to the Radiation Control Office at the time this proposal is submitted. Forms for submitting this information (RC-1X) are available from the Radiation Control Office, phone 392-7359.

4. Type of radiation producing device:

   ___a. Radioagraphic: max mA___ max kVp___

   ___b. Fluoroscopic: max mA___ max kVp___

   ___c. Cabinet

   ___d. Diffraction: max mA___ max kVp___

   ___e. Other (explain)

5. Use of radiation producing device:

   ___a. Veterinary medicine

   ___b. Research using animals

   ___c. Diffraction analysis

   ___d. Research other than above (explain)

6. Location of device:

   Bldg.: _____ Room(s)_____

7. Describe the procedures for which the device will be used. Submit any locally generated standard operating procedures and safety instructions and confirm that an operator's manual is available at the unit. If factory installed safety interlocks must be bypassed during any use of the equipment, submit justification for bypassing the interlock.

8. Describe the facility in which the device will be used. Include shielding design for radiographic and fluoroscopic units and type of enclosure or shielding design for diffraction units. State if warning sign/lights are installed in or outside the facility and any protective equipment such as lead aprons or portable shielding.

9. Briefly describe personnel monitoring available.

Return original to the: RADIATION CONTROL OFFICE
212 Nuclear Sciences Center / Box 118340

UNIVERSITY OF FLORIDA
RADIATION PRODUCING DEVICE OPERATOR
STATEMENT OF CERTIFICATION, TRAINING, AND EXPERIENCE

(To be completed by ALL personnel who will be working with x-ray machines at the University of Florida and Shands Hospital)

NAME:_____DEPARTMENT:_____
CLASSIFICATION *(Faculty, Technician, Student, etc.)*_____

SUPERVISOR:_____PHONE:_____

TYPE OF X-RAY MACHINE TO BE USED:

_____Medical - Fluoroscopic	_____Dental
_____Medical - Radiographic	_____Diffraction
_____Industrial	_____Analytical
_____Veterinary	_____X-Ray Irradiator
_____Other_____	

CERTIFICATION/LICENSURE (State of Florida):

_____Basic X-ray Machine Operator	_____Dental Hygienist
_____CRT-Radiographer	_____Dental Radiographer
_____CRT-Computed Tomography	_____CRT-Therapy
_____CRT-Nuclear Medicine	_____Other_____

Certificate/License Number:_____
Expiration Date:_____

NON-CERTIFIED/LICENSED INDIVIDUALS MUST COMPLETE THE REMAINDER OF THE FORM

RADIATION SAFETY AND X-RAY MACHINE OPERATION TRAINING			
SUBJECT	LOCATION	DATES	HOURS
Principles and Operation of X-ray machines _____ Preceptor _____ Formal			
Biological Effects of Radiation Exposure _____ Preceptor _____ Formal			
Radiation Safety _____ Preceptor _____ Formal			

X-RAY MACHINE OPERATING EXPERIENCE			
TYPE OF MACHINE	LOCATION	DATES	USAGE

Have radiation exposure records been maintained for you at another institution? YES NO

SIGNATURE _____DATE _____

Return original to the: RADIATION CONTROL OFFICE
212 Nuclear Sciences Center / Box 118340

DOCUMENTATION OF TRAINING FOR RADIATION PRODUCING DEVICE OPERATOR

NAME _____ DEPARTMENT_____

CLASSIFICATION (*Faculty, Technician, Student, etc.*) _____

TYPE OF X-RAY EQUIPMENT TO BE USED_____

PRINCIPAL INVESTIGATOR_____PHONE_____

Check appropriate response:

_____Option 1: Radiation Safety Training Provided by Principal Investigator.

TYPE OF TRAINING	*WHERE TRAINED*	*DATES AND DURATIO TRAINING*	*TRAINING PROVIDER*
A. *Principles and practices of radiation protection*			
B. *Significance of the radiation warning and safety devices incorporated into the equipment*			
C. *Operating and Emergency procedures*			
D. *Biological effects of radiation exposure*			
E. *Practical experience with the x-ray equipment to be used*			

_____Option 2: Radiation Safety Training provided by Radiation Control Department.

I have contacted the Radiation Control Office and have scheduled an in-service for the above individual.

_____Option 3: Radiation Safety Training provided by outside service.

I will assure that the above individual will enroll in and attend the following course:

_____ _____

PI Signature Date

Return original to the:

RADIATION CONTROL DEPARTMENT - 212 Nuclear Sciences Center
Box 118340

APPENDIX K

APPLICATION FOR THE NON-HUMAN USE OF LASERS TO THE RADIATION CONTROL COMMITTEE

1. Principal Investigator: _____

   Department: _____

   Office Room Number: _____ Phone Number: _____

   Lab Technician: _____ Phone Number: _____

2: Authorized user(s): Job Title:

   _____ _____

   _____ _____

   _____ _____

   _____ _____

3. Information regarding the Principal Investigator and authorized user(s) basic training with the laser shall be forwarded to the Radiation Control Office at the time this proposal is submitted. Forms for submitting this information (RC-1L) are available from the Radiation Control Office, phone 392-7359.

4. Inventory of Lasers: (use attached form)

5. Describe the procedures for which the laser will be used. Submit any locally generated standard operating procedures and safety instructions and confirm that an operator's manual is available at the unit. If factory installed safety interlocks must be bypassed during any use of the equipment, submit justification for bypassing the interlock.

8. Describe the facility in which the device will be used.

9. Briefly describe personnel safety equipment available.

Return original to the:

RADIATION CONTROL OFFICE
212 Nuclear Sciences Center / Box 118340

Inventory of Lasers

Mfgr	Model	Serial #	UF Decal Number	Type (CW, P)	Lasing Medium	Class (I, II, III, IV)	Max Power (W, J)	Wavelength(s) (nanometers)	Bldg	Room	Pulse Duration (seconds)	Beam Divergence (milliradians)

UNIVERSITY OF FLORIDA
LASER USER
STATEMENT OF TRAINING AND EXPERIENCE

(*To be completed by ALL personnel who will be working with Lasers at the University of Florida*)

NAME: _____ DEPARTMENT: _____ PHONE: _____

CLASSIFICATION (*Faculty, Technician, Student, etc.*): _____

PRINCIPAL INVESTIGATOR: _____

ALL INDIVIDUALS MUST COMPLETE THE REMAINDER OF THIS FORM

LASER SAFETY TRAINING

SUBJECT	*WHERE TRAINED*	*DATES AND DURATION OF TRAINING*	*PRECEPTOR/ ON THE JOB (Circle Answer)*	*FORMAL COURSE (Circle Answer)*
A. *Fundamentals of Laser Operation*			*Yes No*	*Yes No*
B. *Laser Classifications*			*Yes No*	*Yes No*
C. *Control Measures*			*Yes No*	*Yes No*
D. *Bioeffects of Laser Radiation Exposure*			*Yes No*	*Yes No*
E. *Non-Radiation Hazards Associated with Lasers*			*Yes No*	*Yes No*
F. *Investigator and User Responsibilities*			*Yes No*	*Yes No*

LASER USE EXPERIENCE

LASING MEDIUM	*LASER CLASS*	*MAX OUTPUT POWER*	*DATES AND DURATION OF EXPERIENCE*	*WHERE EXPERIENCE WAS GAINED*

*SIGNATURE:*_____*DATE:*_____

If additional space is needed, use the back of this sheet. Keep a copy and return original to:
RADIATION CONTROL DEPARTMENT - 212 Nuclear Sciences Center - Box 118340

DOCUMENTATION OF TRAINING FOR LASER USER

NAME _____ DEPARTMENT_____

CLASSIFICATION (*Faculty, Technician, Student, etc.*) _____

TYPE OF LASER(S) TO BE USED _____

PRINCIPAL INVESTIGATOR_____PHONE_____

Check appropriate response:

_____Option 1: Laser Safety Training Provided by Principal Investigator.

TYPE OF TRAINING	*WHERE TRAINED*	*DATES AND DURATION OF TRAINING*	*TRAINING PROVIDER*
A. *Fundamentals of Laser operations*			
B. *Laser Classifications*			
C. *Control measures*			
D. *Biological effects of laser radiation exposure*			
E. *Non-radiation hazards of lasers*			
F. *Operating and Emergency procedures*			

_____Option 2: Laser Safety Training provided by Radiation Control Department.

I have contacted the Radiation Control Office and have scheduled an in-service for the above individual.

_____Option 3: Laser Safety Training provided by outside service.

I will assure that the above individual will enroll in and attend the following course:

_____

PI Signature Date

Return original to the:

RADIATION CONTROL DEPARTMENT - 212 Nuclear Sciences Center
Box 118340

NRC/DOH INFORMATION NOTICES

Periodically, information notices pertaining to radiation safety are issued by the Florida Department of Health's Bureau of Radiation Control and the Radiation Control Office. Information Notices should be filed here for future reference.